APPENDIX A-1

SNEC Calculation No. E900-04-027

FirstEnergy Corp.

SNEC CALCULATION COVER SHEET

Replacement for Lost Original

CALCULATION DESCRIPTION

Calculation Number	Revision Number	Effective Date	Page Number
E900-04-027	0	2/25/05	1 of

Subject

CV Yard Survey Design – Temporary Water Supply Trench in CV Yard

Question 1 - Is this calculation defined as "In QA Scope"? Refer to definition 3.5. Yes ☒ No ☐

Question 2 - Is this calculation defined as a "Design Calculation"? Refer to definitions 3.2 and 3.3. Yes ☒ No ☐

NOTES: If a "Yes" answer is obtained for Question 1, the calculation must meet the requirements of the SNEC Facility Decommissioning Quality Assurance Plan. If a "Yes" answer is obtained for Question 2, the Calculation Originator's immediate supervisor should not review the calculation as the Technical Reviewer.

DESCRIPTION OF REVISION

APPROVAL SIGNATURES

Calculation Originator	B. Brosey/ B. Brosey	Date	2/25/05
Technical Reviewer	R. Holmes/ R. Holmes	Date	3/10/05
Additional Review	A. Paynter/	Date	11 March 2005
Additional Review		Date	

1.0 PURPOSE

1.1 The purpose of this calculation is to develop a survey design for one (1) "Temporary Water Supply Trench" located in the CV Yard (OL1). This soil survey unit is shown on **Attachment 1-1** and in the **Attachment 1-2** photo. The trench is about 160 feet long, having an average width of about 46 inches and a mean depth of about forty (40) inches. It is a below grade Class 1 open land area and begins in site grid No. AS-127. This survey design is only valid for the section of trench depicted on **Attachment 1-1** (beginning in grid AS-127 and ending in grid AW-125).

1.2 This survey unit lies in site area ***OL1*** and is designated ***OL1-6***.

1.3 The total exposed soil surface area is ***~163 square meters*** which include the side walls.

2.0 SUMMARY OF RESULTS

The following information should be used to develop a survey request for this survey unit. The effective DCGLw values are listed below. The US NRC has reviewed and concurred with the methodology used to derive these values. See **Attachment 2-1** to **2-6**.

Volumetric DCGLw (pCi/g – Cs-137)
5.75 (4.31 A.L.)

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

2.1 Survey Design

2.1.1 Scanning of soil (and fill materials) shall be performed using a ***2" D by 2" L NaI detector*** with a Cs-137 window setting. The window will straddle the Cs-137 662 keV full energy peak width (see calibration information on **Attachment 3-1**).

Soil Scanning Parameters

MDCscan (pCi/g) – Cs-137	Scan Speed (cm/sec)	Maximum Distance from Surface	% Coverage
3.3	25	4" (gap between detector face & soil surface)	100%

2.1.2 The instrument conversion factor/efficiency shall be not less than the lowest value reported on **Attachment 3-1** (***205 cpm/uR/h – Cs-137***).

2.1.3 ***Class 1*** soil should be scanned using a serpentine pattern that is ~0.5 meters wide.

2.1.4 The MDCscan is determined using the MicroShield model of **Attachment 4-1**. MDCscan calculations are shown on **Attachments 4-2** and **4-3**.

2.1.5 Background has been measured in the OL1 area over similar materials, and ranges from about 100 cpm to about 400 cpm (see **Reference 3.1**). If a ***count rate*** of greater than ***300 gross cpm*** is encountered during the scanning process, the surveyor should stop and locate the boundary of the elevated area. The surveyor should then mark the elevated area with stakes or other appropriate marking methods. ***Sample the elevated areas(s)*** IAW SNEC procedure E900-IMP-4520.04 (**Reference 3.2**).

NOTE

This survey design must be revised if it is shown that the true background count rate (from natural occurring materials) is greater than ~550 counts per minute.

2.1.6 Sampling points are to be ***clearly marked, identified*** and ***documented***.

2.1.7 All survey personnel shall be trained to identify ***300 gross cpm*** based on the audible instrument response.

2.1.8 Other instruments of the type specified in Section 2.1.1 above may be used during the FSS, but they must demonstrate a detection efficiency at or above the value listed in Section 2.1.2.

2.1.9 The minimum number of sampling points indicated by the Compass computer program for this survey unit (**Reference 3.3**) is ***16*** (see Compass output on **Attachment 5-1** to **5-4**). Sampling depth should be the first 6 inches (15 cm) of soil.

2.1.10 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** for VSP sampling point locations)

2.1.11 The starting points for physically locating sample sites in the trench area are based on measurements from a local landmark (South end of trench well header and North end region – see diagram on **Attachment 6-1**). Soil sample points are positioned using coordinates developed from these landmarks.

2.1.12 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.

2.1.13 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.

3.0 REFERENCES

3.1 SNEC Calculation No. E900-03-018, "Optimize Window and Threshold Settings for the Detection of Cs-137 Using the Ludlum 2350-1 and a 44/10 NaI Detector", 8/7/03.

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 2.0 (or greater), Copyright 2002, Battelle Memorial Institute.

3.5 Plan SNEC Facility License Termination Plan.

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

3.7 GPU Nuclear, SNEC Facility, "Site Area Grid Map", SNECRM-020, Sheet 1, Rev 2, 1/29/03.

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

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

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

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

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 Post-remediation soil samples from this area are used as the initial estimate of variability for the OL1-6 area. These results are shown on **Attachment 7-1**.

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

4.4 The number of 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 The site area drawing used to determine the physical extent of this area is listed as **Reference 3.7**.

4.7 Remediation History

The Temporary Water Supply Trench in the OL1 area was installed to supply water to a trailer complex in the OL1 area. Clean materials were used to lay the water line (PVC pipe, etc.), but slightly contaminated soil was used to backfill the trench. SNEC site management decided to remediate these materials. The open trench area was selected to be surveyed IAW FSS methodology so that clean materials could be used to backfill the trench allowing closure. The open trench area is a safety hazard to site personnel. This final status survey

only addresses the trench area starting in grid AS-127 and ending in AW-125 as shown on **Attachment 1-1**.

A review of pre-remediation survey data pertaining to this area was conducted in support of this survey design. Analysis of soil samples showed Cs-137 concentrations ranging from ~0.1 pCi/g to ~43 pCi/g (see **Attachment 7-1**). After remediation to less than 2 pCi/g, post remediation samples show that the area has been reduced to an average concentration of 0.87 pCi/g (Cs-137) with a maximum value of 1.15 pCi/g (based on four (4) samples).

4.8 This survey design uses Cs-137 as a surrogate to bound the average concentration for all SNEC facility related radionuclides in the survey unit. The effective DCGLw is just the permitted Cs-137 concentration (6.6 pCi/g) 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 DCGLw for this radionuclide.

The impact of remediation must be considered in determining the effective Cs-137 DCGLw surrogate value. The initial remediation phase in the OL1 area was complete by about July of 2001. Most samples collected prior to this date have been disqualified. The final listing was decayed to December 15th, 2004. In all, twenty three (23) sample results were used to determine the best representative mix for OL1. Current remediation efforts in the trench area have been effective in lowering the average concentration of Cs-137 in the survey unit to less than 2 pCi/g (unprocessed) (see **Attachment 7-1**).

4.9 The sample database used to determine the effective radionuclide mix for the CV Yard area has been drawn from previous samples that were assayed at off-site laboratories. This list is shown on **Attachment 2-1** to **2-6**, and includes (23) analysis results. Review of the data shows several radionuclides have not been positively identified at any significant concentration. These radionuclides have been removed from the data set and will not be considered further. Radionuclides removed include Am-241, C-14, Eu-152, Ni-63, Pu-238, Pu-239 and Pu-41. Additionally, the data shows Cs-137 to be the predominant radioactive contaminant found in the area. Sr-90 on the other hand, was positively identified in only one (1) sample. H-3 was identified as a positive contaminant in six (6) samples, and Co-60 was identified in three (3) samples.

The decayed sample results were input to the spreadsheet titled "Effective DCGL Calculator for Cs-137" (**Reference 3-8**) to determine the effective volumetric DCGLw values for the OL1 area. The output of this spreadsheet is shown on **Attachment 2-6**.

The NaI scan MDC calculation is determined based on a 25 cm/sec scan rate, a 1.38 index of sensitivity (95% correct detection probability and 60% false positive) and a detector sensitivity of 205 cpm/uR/h for Cs-137. Additionally, the detection system incorporates a Cs-137 window that lowers sensitivity to background in the survey unit. The resulting range of background values varies from about 100 cpm to ~400 cpm, but for most locations in OL1 it lies between 100 and 200 cpm. The resulting MDCscan is ~3.3 pCi/g (see **Attachment 4-2** and **4-3**). This value is based on a nominal background value of 200 cpm.

4.10 The survey unit described in this survey design was inspected after remediation efforts were shown effective. A copy of portions of the SNEC facility post-remediation inspection report (**Reference 3.9**), is included as **Attachment 8-1**.

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) are not included in this survey design.

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.

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

4.17 Area factors are not applicable in subsurface soil volumes (below 1 meter). Therefore, the area factor input requirement for soil in the Compass computer program is 1 for both a 10,000 square meter area as well as for a 1 square meter area (see **Attachment 5-1**).

5.0 CALCULATIONS

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

6.0 APPENDICES

6.1 **Attachment 1-1**, is a diagram of survey unit OL1-6 in the OL1 area.

6.1.11 **Attachment 1-2**, is a photo of a section of the trench area.

6.2 **Attachment 2-1** to **2-6** is the sample results from the OL1 area in addition to the DCGL calculation sheets (decayed to December 15, 2004).

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

6.4 **Attachment 4-1**, is a MicroShield model of a soil volume used to determine the exposure rate from a 1 pCi/g Cs-137 source term in a cylindrical geometry of six (6) inches in depth for an assumed density of 1.6 g/cc.

6.5 **Attachment 4-2** and **4-3**, is the MDCscan calculation sheets.

6.6 **Attachment 5-1** to **5-4**, is the Compass output for the OL1-6 soil survey unit.

6.7 **Attachment 6-1**, is the sample point locations with dimensions.

6.8 **Attachment 7-1**, is the soil variability results for selected soil samples from the OL1-6 area.

6.9 **Attachment 8-1**, is the inspection report for the OL1-6 survey area.

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).

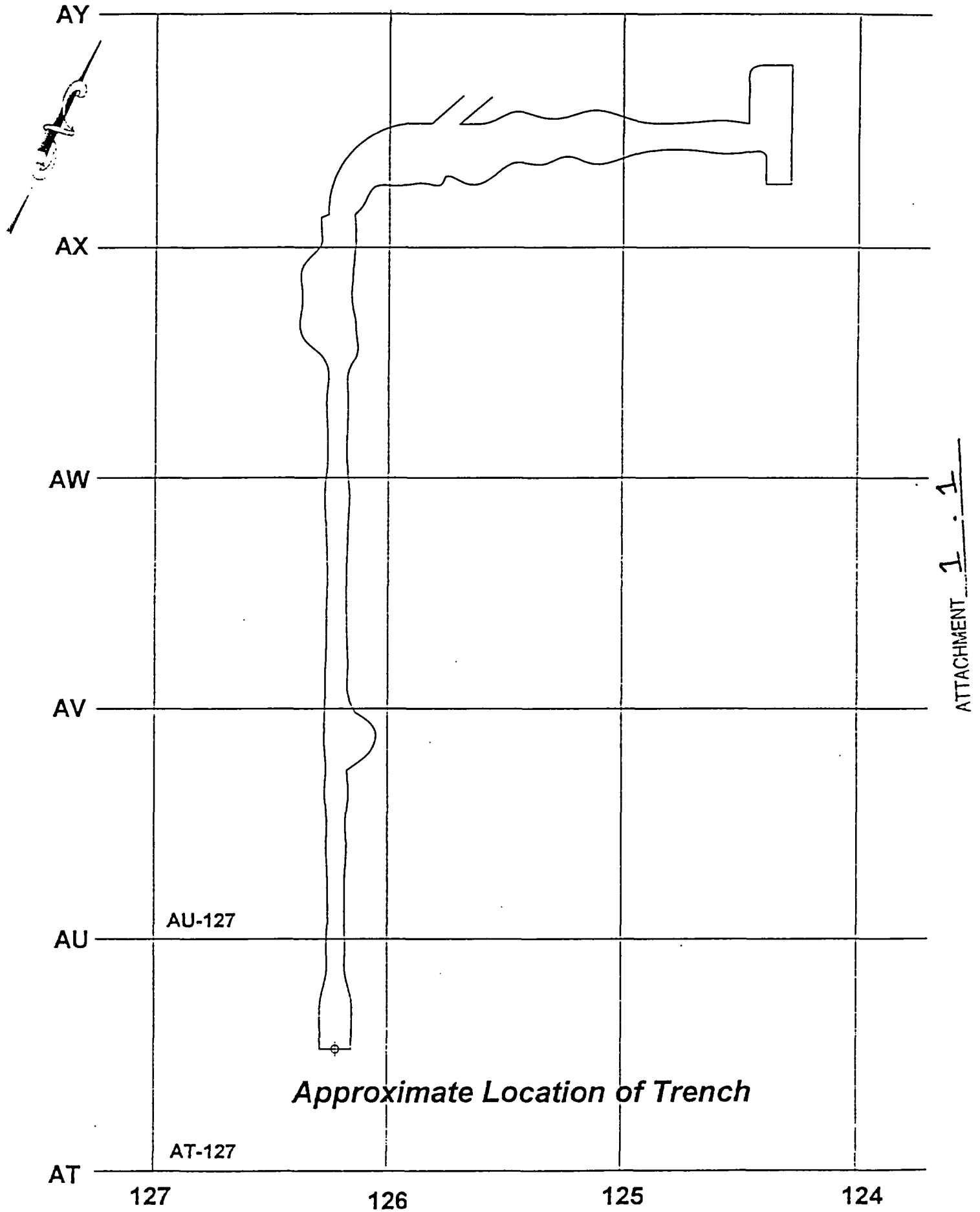
Exhibit 2

Survey Design Checklist

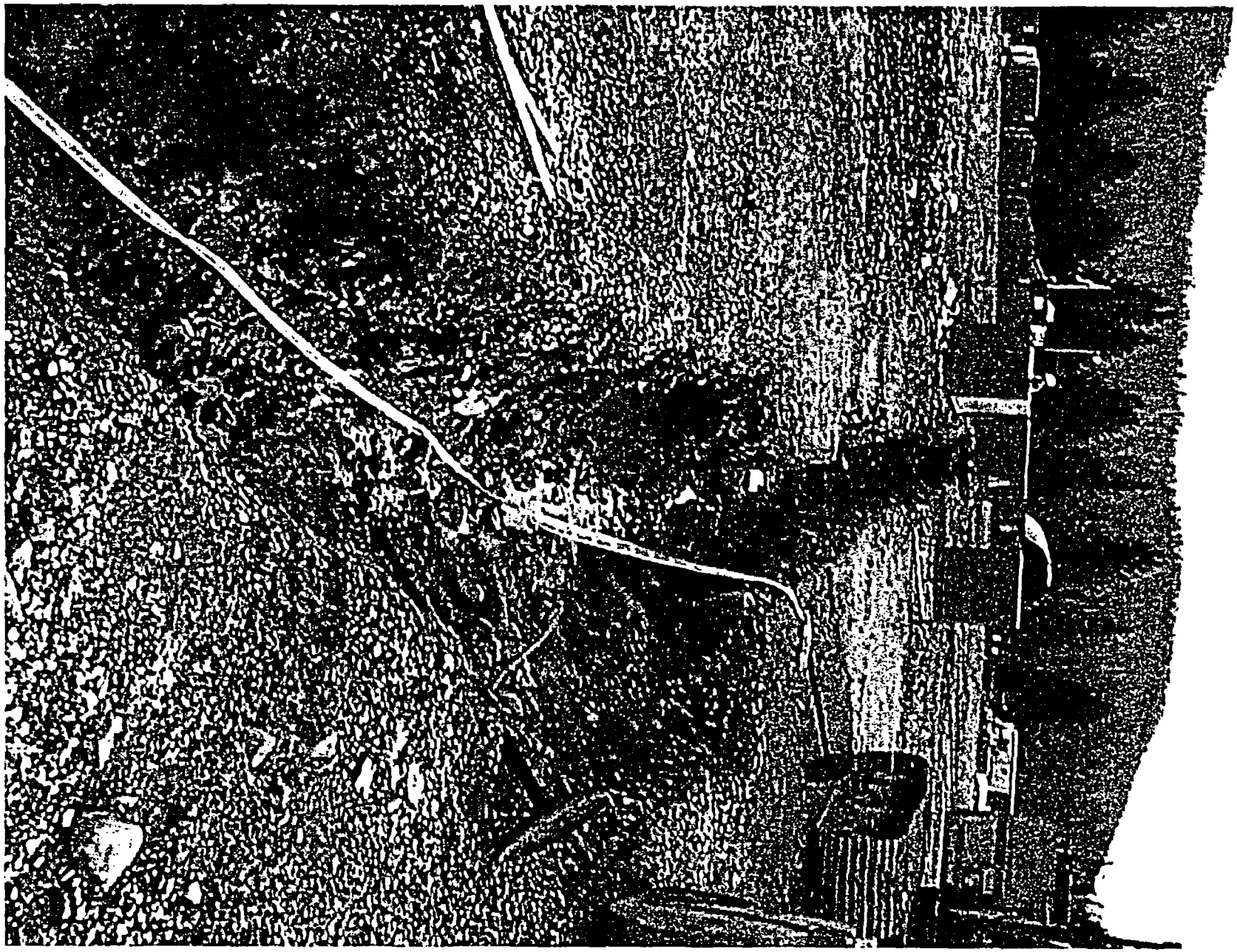
Calculation No. E900-04-027	Location Codes OL1-6 (Temporary Water Supply Trench)		
ITEM	REVIEW FOCUS	Status (Circle One)	Reviewer Initials & Date
1	Has a survey design calculation number been assigned and is a survey design summary description provided?	(Yes), N/A	3/7/05
2	Are drawings/diagrams adequate for the subject area (drawings should have compass headings)?	(Yes), N/A	3/7/05
3	Are boundaries properly identified and is the survey area classification clearly indicated?	(Yes), N/A	3/7/05
4	Has the survey area(s) been properly divided into survey units IAW EXHIBIT 10	(Yes), N/A	3/7/05
5	Are physical characteristics of the area/location or system documented?	(Yes), N/A	3/7/05
6	Is a remediation effectiveness discussion included?	(Yes), N/A	3/7/05
7	Have characterization survey and/or sampling results been converted to units that are comparable to applicable DCGL values?	(Yes), N/A	3/7/05
8	Is survey and/or sampling data that was used for determining survey unit variance included?	(Yes), N/A	3/7/05
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	3/7/05
10	Are applicable survey and/or sampling data that was used to determine variability included?	(Yes), N/A	3/7/05
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)	3/7/05
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)	3/7/05
13	Are all necessary supporting calculations and/or site procedures referenced or included?	(Yes), N/A	3/7/05
14	Has an effective DCGLw been identified for the survey unit(s)?	(Yes), N/A	3/7/05
15	Was the appropriate $DCGL_{EMC}$ included in the survey design calculation?	(Yes), N/A	3/7/05
16	Has the statistical tests that will be used to evaluate the data been identified?	(Yes), N/A	3/7/05
17	Has an elevated measurement comparison been performed (Class 1 Area)?	Yes, (N/A)	3/7/05
18	Has the decision error levels been identified and are the necessary justifications provided?	(Yes), N/A	3/7/05
19	Has scan instrumentation been identified along with the assigned scanning methodology?	(Yes), N/A	3/7/05
20	Has the scan rate been identified, and is the MDCscan adequate for the survey design?	(Yes), N/A	3/7/05
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)	3/7/05
22	Is survey instrumentation calibration data included and are detection sensitivities adequate?	(Yes), N/A	3/7/05
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	3/7/05
24	Are investigation levels and administrative limits adequate, and are any associated actions clearly indicated?	(Yes), N/A	3/7/05
25	For sample analysis, have the required MDA values been determined.?	Yes, (N/A)	3/7/05
26	Has any special sampling methodology been identified other than provided in Reference 6.3?	Yes, (N/A)	3/7/05

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

Trench in CV Yard



ATTACHMENT 1 : 1



ATTACHMENT 1 . 2

DCGL Calculation Logic-CV Yard Soil & Boulders

I. **Survey Unit:** SNEC Containment Vessel (CV) Yard Soil and Boulders

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

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

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

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

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

Table 4: Ratio to Cs-137 for Positive Nuclides – This table provides the calculation methodology for determining the surrogate ratio to Cs-137 for each radionuclide. From this information the mean, sigma, and mean % of total are calculated. The mean % of total values is used to calculate the volumetric $DCGL_w$ per MARSSIM equation I-14. See Table 5. Note that the mean percent values were averaged using only the positive sample results in each column. In some cases only a single nuclide value (e.g. Sr-90) had a positive result. This value is listed as the value in the mean result field. This results in higher "mean percent of total" values in the mix, which are conservative.

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

Table 5: Effective DCGL Calculator for Cs-137 (in pCi/g) – This table provides the surrogate volumetric modified Cs-137 $DCGL_w$ calculation results from data derived from Table 4.

IV. **Summary** – Since the CV Yard and Boulders are volumes of soil or rock material, existing in place or in a pile, the release limit is primarily based on the volumetric $DCGL_w$. Using the above data selection logic tables the calculated Cs-137 volumetric $DCGL_w$ is 5.73 pCi/g. This value will be reduced by 25% as part of SNEC's requirement to apply an administrative limit as discussed in the License Termination Plan (LTP).

ATTACHMENT 2.1

TABLE 1 - Data Listing (pCi/g)

	SNEC Sample No	Location/Description	H-3	Sr-90	Co-60	Cs-137	Am-241	Pu-238	Pu-239	Pu-241	C-14	Ni-63	Eu-152
1	CV Tunnel	CV Tunnel Sediment Composite, OL1	9.40E+00	9.67E+00	1.26E+00	1.25E+03	1.80E-01	5.50E-01	2.20E-01	4.47E+01	9.34E+00	4.02E+00	1.30E-01
2	SX9SL99219	Subsuface Sample #29 (0-5'), AY-128, OL1			7.00E-02	5.90E-01							
3	SXSL1083	North CV Yard Soil BA-127, 812' El, Sample # 5, OL2	4.58E+00	5.31E-02	1.92E-02	8.86E-01	9.61E-02	4.68E-02	3.27E-02	3.77E+00	2.10E-01	1.09E+01	5.25E-02
4	SXSL1089	North CV Yard Soil AY-127, 810' El, Sample # 3, OL1	3.03E+00	6.95E-02	3.32E-02	1.29E+00	9.93E-02	1.28E-01	5.00E-02	4.97E+00	2.10E-01	7.54E+00	8.28E-02
5	SXSL1115	North CV Yard Soil AY-128, 804' El, Sample # 2, OL1	4.88E+00	5.36E-02	2.43E-02	1.80E+00	2.40E-01	1.38E-01	4.07E-02	4.21E+00	2.10E-01	7.60E+00	5.71E-02
6	SXSL1122	North CV Yard Soil AY-129, 798' El, Sample # 2, OL1	3.44E+00	5.29E-02	2.79E-02	4.77E+00	1.83E-01	8.94E-02	4.00E-02	3.68E+00	2.06E-01	8.75E+00	8.62E-02
7	SXSL1130	North CV Yard Soil AX-129, 803' El, Sample # 4, OL1	4.99E+00	6.48E-02	2.98E-02	2.26E+01	1.49E-01	8.56E-02	1.21E-02	3.55E+00	2.31E-01	1.34E+01	9.89E-02
8	SXSL1132	North CV Yard Soil AZ-130, Sample # 5, OL1	2.98E+00	7.15E-02	3.50E-02	2.59E+00	1.64E-01	7.46E-02	6.46E-02	5.27E+00	2.15E-01	1.26E+01	7.34E-02
9	SXSL1270	AX-129, 3-3, Soil, CV SE Side 5' From CV, 800' El., OL1	1.13E+01	2.00E-02	1.00E-02	2.31E+01	3.70E-02	7.00E-03	7.00E-03	2.10E+00	3.93E+00	8.68E+00	7.00E-02
10	SXSL1281	AX-128, 3-1, Soil, CV Tunnel East 5' From CV, 800' El, OL1	1.15E+01	3.00E-02	1.00E-02	4.38E+00	3.10E-02	1.60E-02	7.00E-03	1.91E+00	4.00E+00	7.78E+00	4.00E-02
11	SXSL2649	Anulus Well, A-2, 5 to 10' Depth, OL1	2.00E+00	3.14E-02	1.00E-01	6.00E-01	9.78E-03	1.33E-02	1.10E-02	1.87E+00	1.83E-01	1.75E+00	
13	SXSL2871	CV Area - East Yard Dirt Pile - Middle, 1/2 Way Up, OL1		3.00E-02	7.00E-02	5.60E-01							
14	SXSL2872	CV Area - East Yard Dirt Pile - Bottom (also top center), OL1		3.00E-02	6.00E-02	1.00E-01							
15	SXSL3140	East CV Yard, Soil Pile @ 6' on West Side (6" Depth), OL1	1.89E+00	1.20E-02	1.40E-02	8.25E-01	7.00E-03	5.00E-03	5.00E-03	3.69E-01	8.60E-02	3.41E+00	3.00E-02
16	SXSL3142	Soil Pile, CV Yard, Three Feet on East Side, SR-37, OL1		2.95E-02	7.00E-02	6.00E-01							
17	SXSL3145	East CV Yard, Soil Pile @ 3' on East Side (6" Depth), OL1	1.90E+00	1.70E-02	1.30E-02	1.26E+00	4.00E-03	5.00E-03	5.00E-03	3.76E-01	8.30E-02	3.69E+00	3.80E-02
18	SXSL3149	Soil Pile, CV Yard, Six Feet on East Side, SR-37, OL1		2.97E-02	8.00E-02	3.00E-01							
19	SXSL3163	East CV Yard, Soil Pile @ Top (6" Depth), OL1	1.94E+00	4.30E-02	2.30E-02	3.00E-01	3.00E-03	5.00E-03	5.00E-03	3.43E-01	8.70E-02	4.18E+00	5.10E-02
21	SXSL4142	CV Yard Soil - West Side, AP1-7, OL1	2.22E+00	3.25E-02	5.00E-02	9.00E-01	1.76E-02	6.71E-02	2.02E-02				
22	SXSL4143	CV Yard Soil - West Side, AP1-7, OL1	2.23E+00	3.16E-02	5.00E-02	5.00E-01	2.21E-02	6.31E-02	3.64E-02				
23	SXSL4149	CV Yard Soil - West Side, AP1-7, OL1	2.24E+00	2.77E-02	7.00E-02	3.90E+00	2.77E-02	4.30E-02	3.04E-02				

TABLE 2 - Decayed Listing (pCi/g)

			T 1/2	T 1/2	T 1/2	T 1/2	T 1/2	T 1/2	T 1/2	T 1/2	T 1/2	T 1/2	T 1/2	Decay Date	
			4485.27	10446.15	1925.23275	11019.5925	157861.05	32050.6875	8813847.75	5259.6	2092682.5	36561.525	4967.4	January 15, 2004	
	SNEC Sample No	Location/Description	H-3	Sr-90	Co-60	Cs-137	Am-241	Pu-238	Pu-239	Pu-241	C-14	Ni-63	Eu-152	Analysis Date	ET (d)
1	CV Tunnel	CV Tunnel Sediment Composite, OL1	7.97E+00	9.01E+00	8.59E-01	1.17E+03	1.79E-01	5.37E-01	2.20E-01	3.88E+01	9.34E+00	3.94E+00	1.12E-01	February 14, 2001	1065
2	SX9SL99219	Subsuface Sample #29 (0-5'), AY-128, OL1			4.05E-02	5.36E-01								November 17, 1999	1520
3	SXSL1083	North CV Yard Soil BA-127, 812' El, Sample # 5, OL2	4.20E+00	5.11E-02	1.57E-02	8.55E-01	9.59E-02	4.62E-02	3.27E-02	3.50E+00	2.10E-01	1.08E+01	4.85E-02	June 27, 2002	567
4	SXSL1089	North CV Yard Soil AY-127, 810' El, Sample # 3, OL1	2.78E+00	6.69E-02	2.71E-02	1.24E+00	9.91E-02	1.26E-01	5.00E-02	4.61E+00	2.10E-01	7.46E+00	7.65E-02	June 28, 2002	566
5	SXSL1115	North CV Yard Soil AY-128, 804' El, Sample # 2, OL1	4.47E+00	5.16E-02	1.98E-02	1.74E+00	2.39E-01	1.36E-01	4.07E-02	3.91E+00	2.10E-01	7.52E+00	5.28E-02	June 29, 2002	565
6	SXSL1122	North CV Yard Soil AY-129, 798' El, Sample # 2, OL1	3.15E+00	5.10E-02	2.28E-02	4.60E+00	1.83E-01	8.83E-02	4.00E-02	3.42E+00	2.06E-01	8.66E+00	7.97E-02	June 29, 2002	565
7	SXSL1130	North CV Yard Soil AX-129, 803' El, Sample # 4, OL1	4.58E+00	6.24E-02	2.44E-02	2.18E+01	1.49E-01	8.46E-02	1.21E-02	3.30E+00	2.31E-01	1.33E+01	9.15E-02	July 3, 2002	561
8	SXSL1132	North CV Yard Soil AZ-130, Sample # 5, OL1	2.73E+00	6.89E-02	2.86E-02	2.50E+00	1.64E-01	7.37E-02	6.46E-02	4.89E+00	2.15E-01	1.25E+01	6.79E-02	July 3, 2002	561
9	SXSL1270	AX-129, 3-3, Soil, CV SE Side 5' From CV, 800' El., OL1	9.84E+00	1.88E-02	7.22E-03	2.18E+01	3.69E-02	6.86E-03	7.00E-03	1.87E+00	3.93E+00	8.53E+00	6.17E-02	July 26, 2001	903
10	SXSL1281	AX-128, 3-1, Soil, CV Tunnel East 5' From CV, 800' El, OL1	1.00E+01	2.83E-02	7.22E-03	4.14E+00	3.09E-02	1.57E-02	7.00E-03	1.69E+00	4.00E+00	7.65E+00	3.53E-02	July 26, 2001	903
11	SXSL2649	Anulus Well, A-2, 5 to 10' Depth, OL1	1.79E+00	3.00E-02	7.77E-02	5.74E-01	9.75E-03	1.31E-02	1.10E-02	1.71E+00	1.83E-01	1.73E+00		February 13, 2002	701
13	SXSL2871	CV Area - East Yard Dirt Pile - Middle, 1/2 Way Up, OL1		2.87E-02	5.48E-02	5.37E-01								March 6, 2002	680
14	SXSL2872	CV Area - East Yard Dirt Pile - Bottom (also top center), OL1		2.87E-02	4.70E-02	9.58E-02								March 6, 2002	680
15	SXSL3140	East CV Yard, Soil Pile @ 6' on West Side (6" Depth), OL1	1.75E+00	1.16E-02	1.17E-02	7.99E-01	6.98E-03	4.95E-03	5.00E-03	3.45E-01	8.60E-02	3.37E+00	2.80E-02	August 30, 2002	503
16	SXSL3142	Soil Pile, CV Yard, Three Feet on East Side, SR-37, OL1		2.85E-02	5.81E-02	5.81E-01								August 13, 2002	520
17	SXSL3145	East CV Yard, Soil Pile @ 3' on East Side (6" Depth), OL1	1.76E+00	1.64E-02	1.08E-02	1.22E+00	3.99E-03	4.95E-03	5.00E-03	3.52E-01	8.30E-02	3.65E+00	3.54E-02	August 30, 2002	503
18	SXSL3149	Soil Pile, CV Yard, Six Feet on East Side, SR-37, OL1		2.87E-02	6.63E-02	2.90E-01								August 13, 2002	520
19	SXSL3163	East CV Yard, Soil Pile @ Top (6" Depth), OL1	1.79E+00	4.16E-02	1.92E-02	2.91E-01	2.99E-03	4.95E-03	5.00E-03	3.21E-01	8.70E-02	4.14E+00	4.75E-02	August 30, 2002	503
21	SXSL4142	CV Yard Soil - West Side, AP1-7, OL1	2.18E+00	3.23E-02	4.81E-02	8.94E-01	1.76E-02	6.69E-02	2.02E-02					October 2, 2003	105
22	SXSL4143	CV Yard Soil - West Side, AP1-7, OL1	2.19E+00	3.14E-02	4.81E-02	4.97E-01	2.21E-02	6.30E-02	3.64E-02					October 2, 2003	105
23	SXSL4149	CV Yard Soil - West Side, AP1-7, OL1	2.20E+00	2.75E-02	6.74E-02	3.87E+00	2.77E-02	4.29E-02	3.04E-02					October 2, 2003	105

KEY

	Yellow Shaded Background = Positive Result
	Gray Shaded Background = MDA

C01

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

	SNEC Sample No	Location/Description	H-3	Sr-90	Co-60	Cs-137	Total pCi/g
1	CV Tunnel	CV Tunnel Sediment Composite, OL1		9.01E+00	8.59E-01	1.17E+03	1178.89
2	SX9SL99219	Subsuface Sample #29 (0-5'), AY-128, OL1				5.36E-01	0.54
3	SXSL1063	North CV Yard Soil BA-127, 812' El, Sample # 5, OL2	4.20E+00			8.55E-01	5.05
4	SXSL1089	North CV Yard Soil AY-127, 810' El, Sample # 3, OL1	2.78E+00			1.24E+00	4.02
5	SXSL1115	North CV Yard Soil AY-128, 804' El, Sample # 2, OL1	4.47E+00			1.74E+00	6.21
6	SXSL1122	North CV Yard Soil AY-129, 798' El, Sample # 2, OL1	3.15E+00			4.60E+00	7.76
7	SXSL1130	North CV Yard Soil AX-129, 803' El, Sample # 4, OL1	4.58E+00		2.44E-02	2.18E+01	26.42
8	SXSL1132	North CV Yard Soil AZ-130, Sample # 5, OL1	2.73E+00			2.50E+00	5.23
9	SXSL1270	AX-129, 3-3, Soil, CV SE Side 5' From CV, 800' El., OL1				2.18E+01	21.82
10	SXSL1281	AX-128, 3-1, Soil, CV Tunnel East 5' From CV, 800' El, OL1				4.14E+00	4.14
11	SXSL2649	Anulus Well, A-2, 5 to 10' Depth, OL1				5.74E-01	0.57
13	SXSL2871	CV Area - East Yard Dirt Pile - Middle, 1/2 Way Up, OL1				5.37E-01	0.54
14	SXSL2872	CV Area - East Yard Dirt Pile - Bottom (also top center), OL1				9.58E-02	0.10
15	SXSL3140	East CV Yard, Soil Pile @ 6' on West Side (6" Depth), OL1				7.99E-01	0.80
16	SXSL3142	Soil Pile, CV Yard, Three Feet on East Side, SR-37, OL1				5.81E-01	0.58
17	SXSL3145	East CV Yard, Soil Pile @ 3' on East Side (6" Depth), OL1				1.22E+00	1.22
18	SXSL3149	Soil Pile, CV Yard, Six Feet on East Side, SR-37, OL1				2.90E-01	0.29
19	SXSL3153	East CV Yard, Soil Pile @ Top (6" Depth), OL1				2.91E-01	0.29
21	SXSL4142	CV Yard Soil - West Side, AP1-7, OL1				8.94E-01	0.89
22	SXSL4143	CV Yard Soil - West Side, AP1-7, OL1				4.97E-01	0.50
23	SXSL4149	CV Yard Soil - West Side, AP1-7, OL1			6.74E-02	3.87E+00	3.94

TABLE 4 - Ratio To Cs-137 for Positive Nuclides

	SNEC Sample No	Location/Description	H-3	Sr-90	Co-60	Cs-137	Total
1	CV Tunnel	CV Tunnel Sediment Composite, OL1		7.71E-03	7.35E-04	1.00E+00	1.01
2	SX9SL99219	Subsuface Sample #29 (0-5'), AY-128, OL1				1.00E+00	1.00
3	SXSL1063	North CV Yard Soil BA-127, 812' El, Sample # 5, OL2	4.91E+00			1.00E+00	5.91
4	SXSL1089	North CV Yard Soil AY-127, 810' El, Sample # 3, OL1	2.23E+00			1.00E+00	3.23
5	SXSL1115	North CV Yard Soil AY-128, 804' El, Sample # 2, OL1	2.57E+00			1.00E+00	3.57
6	SXSL1122	North CV Yard Soil AY-129, 798' El, Sample # 2, OL1	6.85E-01			1.00E+00	1.68
7	SXSL1130	North CV Yard Soil AX-129, 803' El, Sample # 4, OL1	2.10E-01		1.12E-03	1.00E+00	1.21
8	SXSL1132	North CV Yard Soil AZ-130, Sample # 5, OL1	1.09E+00			1.00E+00	2.09
9	SXSL1270	AX-129, 3-3, Soil, CV SE Side 5' From CV, 800' El., OL1				1.00E+00	1.00
10	SXSL1281	AX-128, 3-1, Soil, CV Tunnel East 5' From CV, 800' El, OL1				1.00E+00	1.00
11	SXSL2649	Anulus Well, A-2, 5 to 10' Depth, OL1				1.00E+00	1.00
13	SXSL2871	CV Area - East Yard Dirt Pile - Middle, 1/2 Way Up, OL1				1.00E+00	1.00
14	SXSL2872	CV Area - East Yard Dirt Pile - Bottom (also top center), OL1				1.00E+00	1.00
15	SXSL3140	East CV Yard, Soil Pile @ 6' on West Side (6" Depth), OL1				1.00E+00	1.00
16	SXSL3142	Soil Pile, CV Yard, Three Feet on East Side, SR-37, OL1				1.00E+00	1.00
17	SXSL3145	East CV Yard, Soil Pile @ 3' on East Side (6" Depth), OL1				1.00E+00	1.00
18	SXSL3149	Soil Pile, CV Yard, Six Feet on East Side, SR-37, OL1				1.00E+00	1.00
19	SXSL3153	East CV Yard, Soil Pile @ Top (6" Depth), OL1				1.00E+00	1.00
21	SXSL4142	CV Yard Soil - West Side, AP1-7, OL1				1.00E+00	1.00
22	SXSL4143	CV Yard Soil - West Side, AP1-7, OL1				1.00E+00	1.00
23	SXSL4149	CV Yard Soil - West Side, AP1-7, OL1			1.74E-02	1.00E+00	1.02
		Mean⇒	1.95E+00	7.71E-03	6.42E-03	1	2.96
		Sigma⇒	1.708		0.010	0.000	
		Mean % of Total⇒	65.79%	0.26%	0.22%	33.74%	100.00%

C02

Table 5

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

					SNEC AL	75%	Total Activity Limit DCGLw		Administrative Limit		
							16.98	pCi/g	12.74	pCi/g	
SAMPLE NUMBER(s)⇒		CV YARD SOIL & BOULDER SAMPLES									
							Cs-137 Limit		Cs-137 Administrative Limit		
17.45%	25.0	mrem/y TEDE Limit					5.73	pCi/g	4.30	pCi/g	
7.79%	4.0	mrem/y Drinking Water (DW) Limit			☑ Check for 25 mrem/y						
	Isotope	Sample Input (pCi/g, uCi, % of Total, etc.)	% of Total	25 mrem/y TEDE Limits (pCi/g)	4 mrem/y DW Limits (pCi/g)	A - Allowed pCi/g for 25 mrem/y TEDE	B - Allowed pCi/g for 4 mrem/y DW	Value Checked from Column A or B		This Sample mrem/y TEDE	This Sample mrem/y DW	
1	Am-241		0.000%	9.9	2.3	0.00	0.00	0.00		0.00	0.00	Am-241
2	C-14		0.000%	2.0	5.4	0.00	0.00	0.00		0.00	0.00	C-14
3	Co-60	0.0064	0.216%	3.5	67.0	0.04	0.08	0.04		0.05	0.00	Co-60
4	Cs-137	1.0000	33.738%	6.6	2.39	5.73	12.63	5.73		3.79	0.01	Cs-137
5	Eu-152		0.000%	10.1	1440	0.00	0.00	0.00		0.00	0.00	Eu-152
6	H-3	1.9499	65.786%	132	531	11.17	25.02	11.17		0.37	0.25	H-3
7	Ni-63		0.000%	747	19000	0.00	0.00	0.00		0.00	0.00	Ni-63
8	Pu-238		0.000%	1.8	0.41	0.00	0.00	0.00		0.00	0.00	Pu-238
9	Pu-239		0.000%	1.6	0.37	0.00	0.00	0.00		0.00	0.00	Pu-239
10	Pu-241		0.000%	86	19.8	0.00	0.00	0.00		0.00	0.00	Pu-241
11	Sr-90	0.0077	0.260%	1.2	0.61	0.04	0.10	0.04		0.16	0.05	Sr-90
		2.96E+00	100.000%			16.98	38.03	16.98		4.364	0.312	
						Maximum Permissible pCi/g (25 mrem/y)	Maximum Permissible pCi/g (4 mrem/y)			To Use This Information, Sample Input Units Must Be In pCi/g *not % of Total.*		

ATTACHMENT 2.4

TABLE 5 - RATIO TO Cs-137

	SNEC Sample No	LAB No	Location/Description	H-3	Sr-90	Co-60	Cs-137	Total
1	CV Tunnel	BWXT, 0102059-01	CV Tunnel Sediment Composite, Ot 1		7 70E-03	6 65E-04	1 00E+00	1 01
2	SXSI 99219	111074	Subsurface Sample #29 (0 5'), AY-128 Ot 1				1 00E+00	1 00
3	SXSI 1063	Teledyne 80018; L19184 1	North CV Yard Soil BA-127, 812' El, Sample # 5, Ot 2	4 76E+00			1 00E+00	5 76
4	SXSI 1089	Teledyne 80019; L19184 2	North CV Yard Soil AY-127, 810' El, Sample # 3 Ot 1	2 16E+00			1 00E+00	3 16
5	SXSI 1115	Teledyne 80020; L19184-3	North CV Yard Soil AY-128, 804' El, Sample # 2, Ot 1	2 50E+00			1 00E+00	3 50
6	SXSI 1122	Teledyne 80021; L19184-4	North CV Yard Soil AY-129 798' El, Sample # 2, Ot 1	6 64E-01			1 00E+00	1 66
7	SXSI 1130	Teledyne 80022; L19184 5	North CV Yard Soil AX-129 803' El Sample # 4, Ot 1	2 03E-01		1 01E-03	1 00E+00	1 20
8	SXSI 1132	Teledyne 80023; L19184 6	North CV Yard Soil AZ-130, Sample # 5, Ot 1	1 06E+00			1 00E+00	2 06
9	SXSI 1270	BWXT, 0108055-02	AX-129, 3 3, Soil, CV SE Side 5' From CV, 800' El, Ot 1				1 00E+00	1 00
10	SXSI 1281	BWXT, 0108055 01	AX-128, 3-1, Soil, CV Tunnel East 5' From CV, 800' El, Ot 1				1 00E+00	1 00
11	SXSI 2649	Teledyne-73220; L18077 2	Anulus Well, A-2, 5 to 10' Depth, Ot 1				1 00E+00	1 00
13	SXSI 2871	Teledyne-71949; L17838-11	CV Area - East Yard Dirt Pile - Middle, 1/2 Way Up, Ot 1				1 00E+00	1 00
14	SXSI 2872	Teledyne-71948; L17838-10	CV Area - East Yard Dirt Pile - Bottom (also top center), Ot 1				1 00E+00	1 00
15	SXSI 3140	BWXT,1030-003 10-01	East CV Yard Soil Pile @ 6' on West Side (6" Depth), Ot 1				1 00E+00	1 00
16	SXSI 3142	Teledyne; L 20328 3	Soil Pile, CV Yard, Three Feet on East Side SR 37, Ot 1				1 00E+00	1 00
17	SXSI 3145	BWXT,1030-003 10-01	East CV Yard, Soil Pile @ 3' on East Side (6" Depth), Ot 1				1 00E+00	1 00
18	SXSI 3149	Teledyne; L 20328 4	Soil Pile CV Yard, Six Feet on East Side SR 37, Ot 1				1 00E+00	1 00
19	SXSI 3153	BWXT,1030-003-10-01	East CV Yard, Soil Pile @ Top (6" Depth) Ot 1				1 00E+00	1 00
21	SXSI 4142	Teledyne; L 22187-2	CV Yard Soil - West Side, AP1-7, Ot 1				1 00E+00	1 00
22	SXSI 4143	Teledyne; L 22187-3	CV Yard Soil - West Side, AP1-7, Ot 1				1 00E+00	1 00
23	SXSI 4149	Teledyne; L 22187-4	CV Yard Soil - West Side AP1-7, Ot 1			1 57E-02	1 00E+00	1 02
			Mean=	1 890991	0 007699	0 005808	1	2 90
			Sigma=	1 656		0 009	0 000	
			Mean % of Total =	65 11%	0 27%	0 20%	34 43%	100 00%
			2 Sigma + Mean=	5 20E+00	7 70E-03	2 30E-02	1 00E+00	6 23
			% of Total=	83 47%	0 12%	0 37%	16 04%	100 00%

KEY

	Yellow Background = Positive Result
1	Sample Non-representative or Lacked any Positive Information

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

SNEC AL	75%	Total Activity Limit DCGLw		Administrative Limit	
		16.70	pCi/g	12.53	pCi/g

SAMPLE NUMBER(s)⇒ CV YARD SOIL & BOULDER SAMPLES - Decayed to 12/15/04

Cs-137 Limit		Cs-137 Administrative Limit	
5.75	pCi/g	4.31	pCi/g

17.39%	25.0	mrem/y TEDE Limit
7.60%	4.0	mrem/y Drinking Water (DW) Limit

☑ Check for 25 mrem/y

	Isotope	Sample Input (pCi/g, uCi, % of Total, etc.)	% of Total	25 mrem/y TEDE Limits (pCi/g)	4 mrem/y DW Limits (pCi/g)	A - Allowed pCi/g for 25 mrem/y TEDE	B - Allowed pCi/g for 4 mrem/y DW	Value Checked from Column A or B	This Sample mrem/y TEDE	This Sample mrem/y DW	
1	Am-241		0.000%	9.9	2.3	0.00	0.00	0.00	0.00	0.00	Am-241
2	C-14		0.000%	2.0	5.4	0.00	0.00	0.00	0.00	0.00	C-14
3	Co-60	0.0058	0.200%	3.5	67.0	0.03	0.08	0.03	0.04	0.00	Co-60
4	Cs-137	1.0000	34.429%	6.6	397	5.75	13.15	5.75	3.79	0.01	Cs-137
5	Eu-152		0.000%	10.1	1440	0.00	0.00	0.00	0.00	0.00	Eu-152
6	H-3	1.8910	65.106%	132	31.1	10.87	24.87	10.87	0.36	0.24	H-3
7	Ni-63		0.000%	747	19000	0.00	0.00	0.00	0.00	0.00	Ni-63
8	Pu-238		0.000%	1.8	0.41	0.00	0.00	0.00	0.00	0.00	Pu-238
9	Pu-239		0.000%	1.6	0.37	0.00	0.00	0.00	0.00	0.00	Pu-239
10	Pu-241		0.000%	86	19.8	0.00	0.00	0.00	0.00	0.00	Pu-241
11	Sr-90	0.0077	0.265%	1.2	0.61	0.04	0.10	0.04	0.16	0.05	Sr-90
		2.90E+00	100.000%			16.70	38.20	16.70	4.348	0.304	
						Maximum Permissible pCi/g (25 mrem/y)	Maximum Permissible pCi/g (4 mrem/y)		To Use This Information, Sample Input Units Must Be In pCi/g *not* % of Total.		

ATTACHMENT 2 - 6

2350 INSTRUMENT AND PROBE EFFICIENCY CHART
10/06/04 *TYPICAL VALUES*

Inst.#	Cal Due	AP #		Probe #	Cal Due	*cpm/mR/h*
95361	6/25/05	P & W		25686 Pk	6/28/05	211,799
98625	5/18/05	R & Y		211680 Pk	5/18/05	214,882
98642	9/28/04	B&W		185844	9/28/04	209,771
98647	5/18/05	G &Y		211667 Pk	5/18/05	218,807
117566	4/09/05	G&R		185852 Pk	4/13/05	209,862
117573	5/18/05	O &Y		211674 Pk	5/18/05	212,173
126172	6/07/05	G&W		196022 Pk	6/07/05	208,302
126198	11/03/04	R&W		196021Pk	5/25/05	209,194
129423	5/18/05	P &Y		211687 Pk	5/18/05	213,539
129440	4/09/05	O&W		210938 Pk	4/14/05	205,603

ATTACHMENT 3.1

2350 INSTRUMENT AND PROBE EFFICIENCY CHART
8/26/04

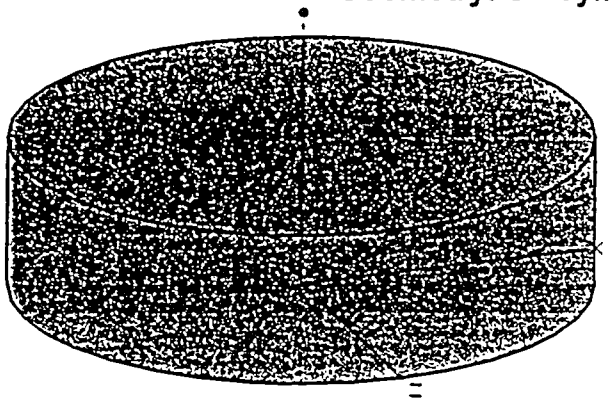
INST #	INST C/D	43-68 PROBE #	PROBE C/D			BETA EFF	ALPHA EFF
79037	04/06/05	122014	04/23/05			25.8%	N/A
126188	1/27/05	099186	1/27/05			28.2%	10.7%
126218	01/08/05	095080	01/09/05			27.9%	N/A

MicroShield v5.05 (5.05-00121)
GPU Nuclear

Page : 1
DOS File : SOIL.MS5
Run Date: October 20, 2004
Run Time: 12:54:38 PM
Duration : 00:00:01

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

Case Title: Soil
Description: Soil Density 1.6 g/cc, 6" Deep Cylinder @ 5" from Surface
Geometry: 8 - Cylinder Volume - End Shields



Source Dimensions

Height	15.24 cm	6.0 in
Radius	28.21 cm	11.1 in

Dose Points

	X	Y	Z
# 1	0 cm	27.94 cm	0 cm
	0.0 in	11.0 in	0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	3.81e+04 cm³	Concrete	1.6
Air Gap		Air	0.00122

Source Input
Grouping Method : Actual Photon Energies

Nuclide	curies	becquerels	µCi/cm³	Bq/cm³
Ba-137m	5.7670e-008	2.1338e+003	1.5136e-006	5.6003e-002
Cs-137	6.0962e-008	2.2556e+003	1.6000e-006	5.9200e-002

Buildup
The material reference is : Source

Integration Parameters

Radial	40
Circumferential	40
Y Direction (axial)	40

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0318	4.418e+01	6.794e-06	8.222e-06	5.659e-08	6.849e-08
0.0322	8.150e+01	1.306e-05	1.591e-05	1.051e-07	1.280e-07
0.0364	2.966e+01	7.236e-06	9.448e-06	4.111e-08	5.368e-08
0.6616	1.920e+03	6.179e-02	1.091e-01	1.198e-04	2.115e-04
TOTALS:	2.075e+03	6.182e-02	1.091e-01	1.200e-04	2.118e-04

ATTACHMENT 4 - 1

Nal Scan MDC Calculation

$b := 200$ $p := 0.5$ $HS_d := 56.42$ $SR := 25$ $d := 1.38$

$Conv := 205.603$ $MS_{output} := 2.115 \cdot 10^{-4}$

$\frac{HS_d}{SR} = 2.257$ *Observation Interval (seconds)*

$O_i := \frac{HS_d}{SR}$ *Observation Interval (seconds)*

$b_i := \frac{b \cdot O_i}{60}$

$MDCR_i := d \cdot \sqrt{b_i} \cdot \frac{60}{O_i}$

$MDCR_i = 100.629$ *net counts per minute*

$MDCR_{surveyor} := \frac{MDCR_i}{\sqrt{p}}$

$MDCR_{surveyor} = 142.311$ *net counts per minute*

$MDER := \frac{MDCR_{surveyor}}{Conv}$

$MDER = 0.692$ µR/h

$MDC_{scan} := \frac{MDER}{MS_{output} \cdot 1 \cdot 10^3}$

$MDC_{scan} = 3.273$ pCi/g

ATTACHMENT 4.2

where:

b = background in counts per minute

b_i = background counts in observation interval

Conv = NaI manufacturers reported response to energy of contaminant (cpm/uR/h)

d = index of sensitivity (Table 6.5 MARSSIM). 1.38 = 95% of correct detection's. 60% false positives

HS_d = hot spot diameter (in centimeters)

MDC_{scan} = Minimum Detectable Concentration for scanning (pCi/g)

$MDCR_i$ = Minimum Detectable Count Rate (ncpm)

$MDCR_{surveyor}$ = $MDCR_i$ corrected by human performance factor (ncpm)

MDER = Minimum Detectable Exposure Rate (uR/h)

MS_{output} = MicroShield output exposure rate for 1 pCi/g of contaminant (mR/h)

O_i = obervation Interval (seconds)

p = human performance factor

SR = scan rate in centimeters per second

NOTE

This is an example of an MDCscan calculation that is valid for a specific set of site conditions including the computer model used, soil density, soil moisture content, surveyor efficiency, ground cover, soil background and other variables that influence the calculated results. However, this and similar scan MDC's have been deemed valid for survey planning.

Site Report

Site Summary

Site Name: TRENCH OL1-6

Planner(s): BHB

Contaminant Summary

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

Contaminant	Type	DCGLw	Screening Value Used?	Area (m²)	Area Factor
Cs-137	Surface Soil	4.31	No	1	1
				10,000	1

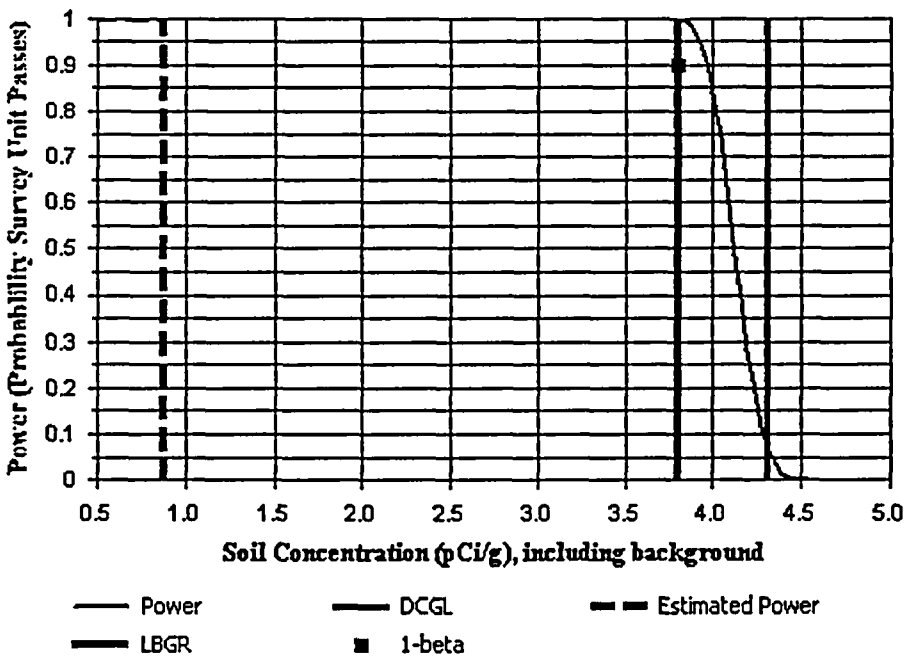
ATTACHMENT 5.1

Surface Soil Survey Plan

Survey Plan Summary

Site:	TRENCH OL1-6		
Planner(s):	BHB		
Survey Unit Name:	Temporary Water Supply Trench		
Comments:	AS-127 to AW-125		
Area (m^2):	163	Classification:	1
Selected Test:	Sign	Estimated Sigma (pCi/g):	0.39
DCGL (pCi/g):	4.31	Sample Size (N):	16
LBGR (pCi/g):	3.8	Estimated Conc. (pCi/g):	0.9
Alpha:	0.050	Estimated Power:	1
Beta:	0.100	EMC Sample Size (N):	16
Scanning Instrumentation:	2" by 2" NaI (Cs-137 w)		

Prospective Power Curve



ATTACHMENT 5.2

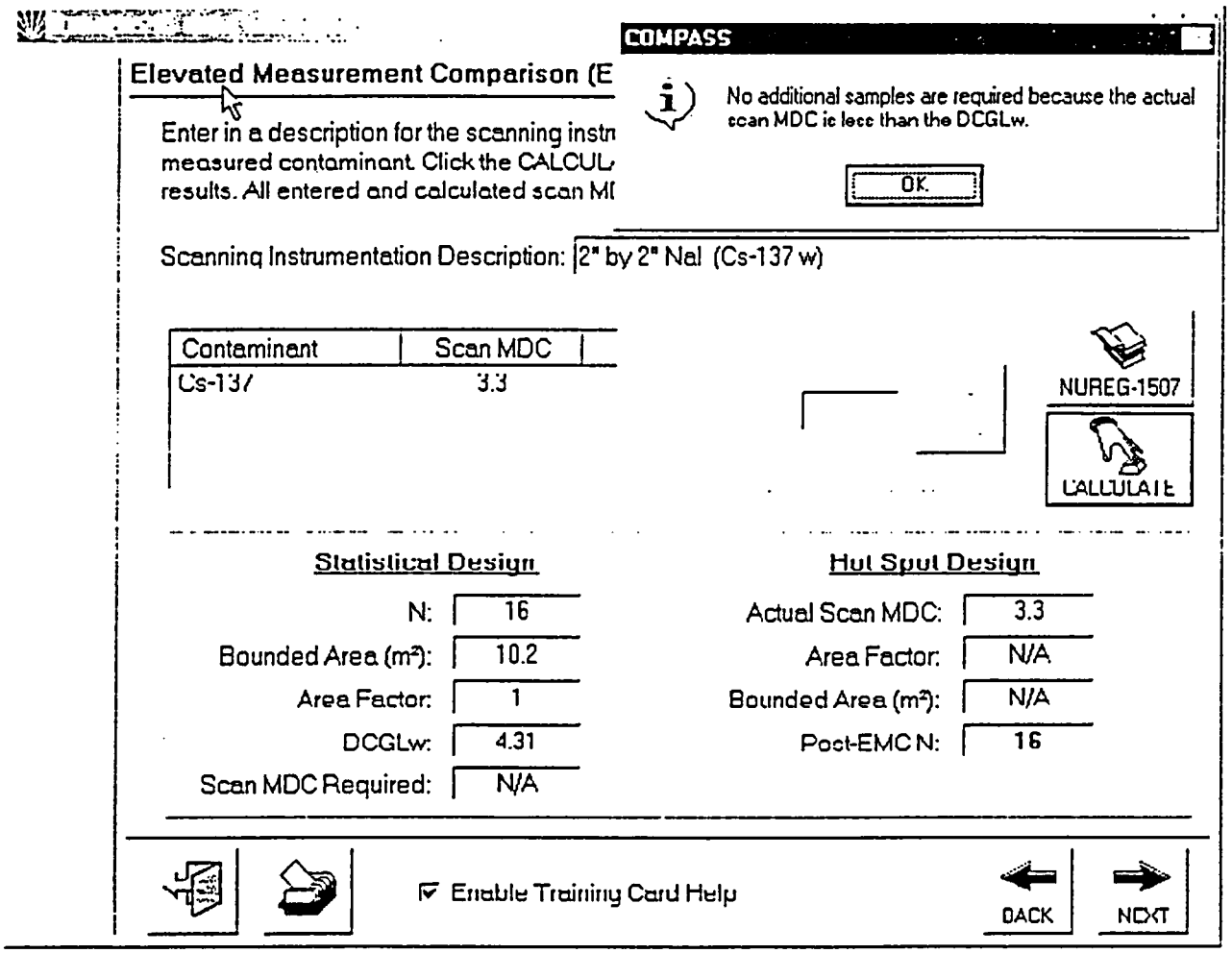
Surface Soil Survey Plan

Contaminant Summary

Contaminant	DCGLw (pCi/g)	Inferred Contaminant	Ratio	Modified DCGLw (pCi/g)	Scan MDC (pCi/g)
Cs-137	4.31	N/A	N/A	N/A	3.3

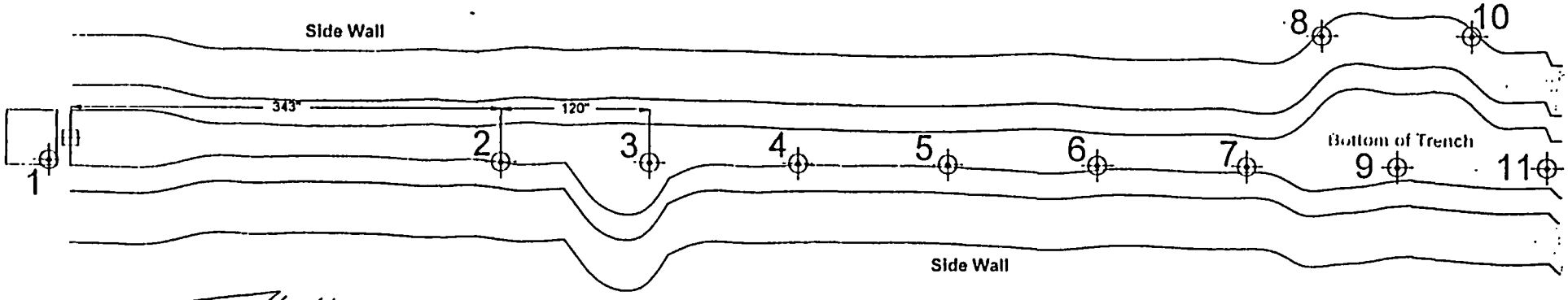
Contaminant	Survey Unit Estimate (Mean ± 1-Sigma) (pCi/g)	Reference Area Estimate (Mean ± 1-Sigma) (pCi/g)
Cs-137	0.87 ± 0.39	0.28 ± 0.39

ATTACHMENT 5.3

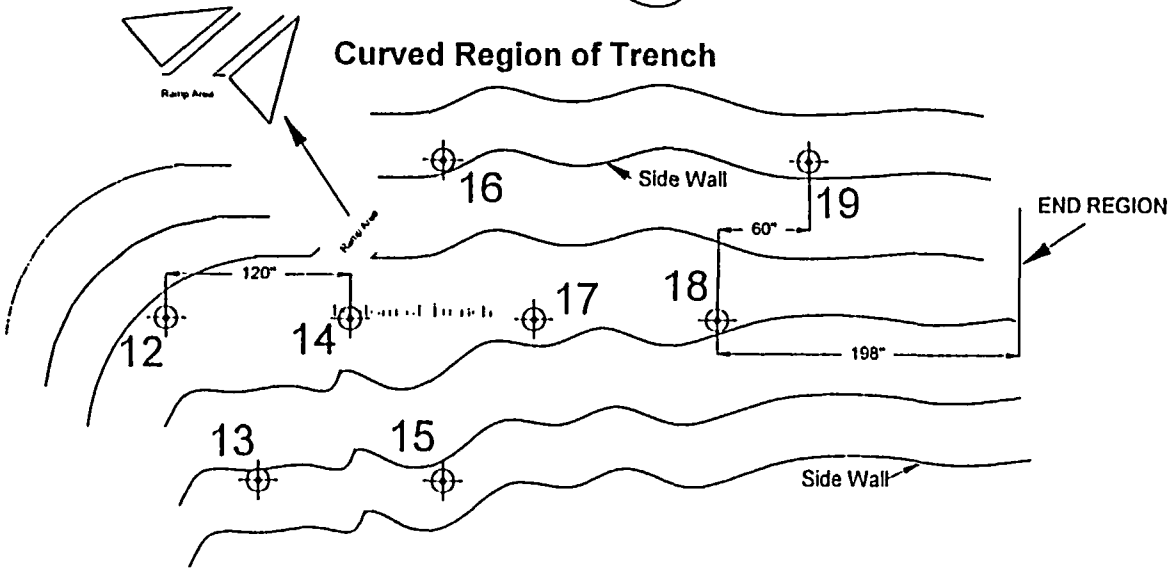


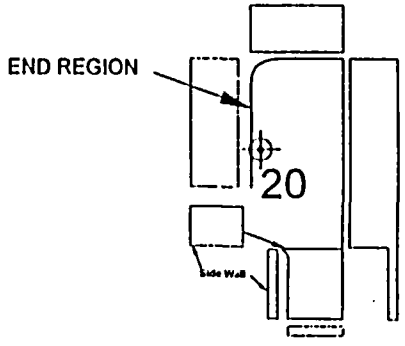
ATTACHMENT 5.4

Main Section of Trench



Curved Region of Trench





End Region of Trench

ATTACHMENT 6 - 1

PRE-REMEDIATION RESULTS

Samples of Soil from Trench Area		
Sample No.	Survey or Assay No.	pCi/g (Cs-137)
SP-1	306-04-1530	22.6
SP-2	306-04-1530	13.5
SP-3	306-04-1530	12
SP-11	306-04-1539	0.10
SP-12	306-04-1539	0.55
SP-4	306-04-1539	1.60
SP-5	306-04-1539	6.6
SP-6	306-04-1539	2.35
SP-7	306-04-1539	0.12
SP-4	306-04-1557	42.6
SP-5	306-04-1557	11.1
SP-1	306-04-1557	3.9
SP-2	306-04-1557	12.1
SP-3	306-04-1557	6.9
SP-4	306-04-1557	12.2
SP-5	306-04-1557	4.3
SP-6	306-04-1557	7.9
SP-7	306-04-1557	7.4
SP-8	306-04-1557	7.8
SP-1	306-04-1557	20.3
SP-6	306-04-1555	1.30
SP-7	306-04-1555	4
SP-8	306-04-1555	1.18
SP-8	306-04-1529	39.24
SP-9	306-04-1529	12.46
SP-10	306-04-1529	10.85
SP-1	306-04-1529	5.27
SP-2	306-04-1529	7.68
SP-3	306-04-1529	4.54

POST-REMEDIATION RESULTS

Samples of Soil from Trench Area		
Sample No.	Survey or Assay No.	pCi/g (Cs-137)
SP-1	1-21168	1.15
SP-1	1-21170	0.88
SP-1	2-21169	1.12
SP-1	2-21171	0.32
	Mean=>	0.87
	STDEV=>	0.39
	Max=>	1.15
	Min=>	0.32

ATTACHMENT 7.1

ORIGINAL

Exhibit 1
Survey Unit Inspection Check Sheet

SECTION 1 - SURVEY UNIT INSPECTION DESCRIPTION

Survey Unit #	CL1-6	Survey Unit Location	Temporary Water Line Trench
Date	12/13/04	Time	1100
Inspection Team Members	D.Sarge		

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 (1)		
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 fillings, 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:

Note to Question 1: The boundaries for the survey unit have not, at this time, been established. Barriers defining the trench area to be surveyed for FSS will have to be placed prior to setting PRI.

Response to Question 4: Miscellaneous material remains in trench. (cone, LSA Box gasket roll) Additionally a pipe section embedded in concrete pad approx. 8' in length should be removed prior to FSS. Notified L. Shamenek.

Response to Question 6: Water is present in low-lying areas throughout trench. Notified L. Shamenek.

Response to Question 10: Access assistance is required. Notified L. Shamenek.

Response to Question 12: Walls of trench are not stabilized and personnel in trench should be alert for collapse occurrence. Notified L. Shamenek.

Survey Unit Inspector (print/sign)	D. Sarge	Date 12/14/04
Survey Designer (print/sign)		Date 12/14/04

ATTACHMENT 8.1

APPENDIX A-2

SR-0189 (OL1-6)

SURVEY REQUEST CONTINUATION SHEET			
SR NUMBER	SR-0189	AREA/LOCATION	East Yard Trench (with surface area of 163 m^2)
SPECIFIC SAMPLING / SURVEY INSTRUCTIONS OR COMMENTS			

RESULTS SUMMARY FOR SR-0189

SR-0189 was issued to collect radiological survey and sample data (FSS) in the temporary water supply trench. The survey unit covered under this SR is OL1-6 (grids are listed in the SR). The SR required the following radiological measurements:

- Surface Scan Measurements Using a 2" x 2" Sodium Iodide Detector (set to identify Cs-137) – 100% surface scan is required of the grids at a rate not exceeding 10 inches/second at a distance within 4 inches. The action level is 300 gross cpm. If any areas indicate activity exceeding 550 gross cpm, contact the SR Coordinator before proceeding with survey.

- Surface Soil Sampling – Obtain samples in the locations indicated in the SR. (20 total). In addition, obtain samples of areas indicating activity exceeding the action level. If only rock media is available in a sample location, obtain a sample by chipping the rock.

- QC Repeat Measurements – A minimum of 5% of all surface scan measurements and sampling will be re-performed using identical methodology.

- Additional sampling/surveys may be performed at the request of the RSO.

1. Summary of Results

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

100% surface scan was performed on the trench walls and bottom.

Results: All areas indicated activity below action level with two exceptions. Static measurements were performed at these areas which indicated two areas exceeding the action level. The range of static measurement results was 312 to 362 gross cpm. Soil samples were obtained of these areas.

B. Surface Soil Sampling

Twenty (20) samples were obtained in the locations indicated in the SR. In addition, two samples were obtained in areas indicating activity above the action level and one sample obtained of the sump area.

Results: The highest result indicated 4.1 ± 0.4 pCi/g Cs-137, <0.08 pCi/g Co-60. This sample, SX-SL-9257 was obtained from Sample Point #10. Positive Cs-137 samples ranged from 0.09 to 4.1 pCi/g with a typical achieved Co-60 MDA of 0.1 pCi/g. The following table lists the samples and results:

SURVEY REQUEST CONTINUATION SHEET			
SR NUMBER	SR-0189	AREA/LOCATION	East Yard Trench (with surface area of 163 m^2)
SPECIFIC SAMPLING / SURVEY INSTRUCTIONS OR COMMENTS			

Sample Location	Cs-137 Activity (pCi/g)	Cs-137 Uncertainty (pCi/g)	Co-60 Activity (pCi/g)
SP-1	0.28	0.09	<0.14
SP-2	0.18	0.08	<0.12
SP-3	0.09	0.05	<0.07
SP-4	<0.1	N/A	<0.1
SP-5	<0.13	N/A	<0.14
SP-6	<0.1	N/A	<0.1
SP-7	<0.08	N/A	<0.08
SP-8	0.40	0.07	<0.08
SP-9	0.14	0.07	<0.13
SP-10	4.10	0.4	<0.08
SP-11	1.60	0.2	<0.07
SP-12	0.83	0.04	<0.09
SP-13	<0.1	N/A	<0.1
SP-14	<0.1	N/A	<0.1
SP-15	<0.1	N/A	<0.1
SP-16	0.16	0.06	<0.08
SP-17	<0.14	N/A	<0.1
SP-18	<0.14	N/A	<0.1
SP-19	2.7	0.29	<0.1
SP-20	0.37	0.08	<0.08
Trench Sump	0.40	0.1	<0.13
AP-1	<0.12	N/A	<0.1
AP-2	0.18	0.09	<0.14
Mean	0.79		
2 Standard Deviations	2.23		
Max	4.10		
Min	0.09		
Median	0.37		

2. Quality Control (QC) Measurements and Comparisons

- **Repeat Scan/Static measurements and Soil samples** were performed and met the applicable acceptance criteria established in Section 4.6 of E900-IMP-4520.04.

3. Exceptions and Discrepancies: Photographs of the surveying and sampling of the trench during FSS were not obtained. This was an oversight of the technicians and the GRCS. Photographs obtained prior to and after the FSS are included in this package as a substitute. Pre-FSS photographs indicate the types of soil and terrain and the post-FSS photographs indicate the sample points.

David Sarge (GRCS) _____ Date 5-26-05

SURVEY DATA VERIFICATION AND VALIDATION FORM

Survey Unit Number	OL1-6	SR Number	0189

Check the appropriate answer for each question below.	Yes	No	N/A
1. Was each radiological instrument capable of detecting the radiation of interest at or below the investigation level? If not, acceptable compensatory measures have been taken.	X		
2. Did each radiological instrument have a current calibration and were radioactive sources used for calibration traceable to recognized standards or calibration organizations?	X		
3. Was each radiological instrument source checked daily (before and, where required, after use)?	X		
4. Were survey team personnel properly trained in the applicable survey techniques, and was the training adequately documented?	X		
5. Were the MDCs and the assumptions used to develop them appropriate for the instruments and survey methods used to collect the data?	X		
6. Were the survey methods appropriate for the media and types of radiation being measured?	X		
7. If special measurement methods were used to collect data, were they properly documented in accordance with approved site procedures?	X		
8. Were the samples adequately tracked from their collection point (Field Sample Collection Sheet) and through the analysis process in accordance with the SNEC Sample Chain of Custody Program?	X		
9. Were the data collected in accordance with the Survey Design Package and Survey Request?	X		
10. Were the data representative of current site conditions?	X		
11. If Survey Request investigation levels were exceeded, was appropriate action taken?	X		
12. Were at least 5% of all survey and/or sample points randomly re-sampled and/or re-surveyed using identical methodology contained in the Survey Request per Section 4.6.2?	X		
13. Were the samples analyzed in accordance with requirements contained in the Survey Request Sample Analysis Sheet?	X		
14. Did all sample analyses meet the MDA requirements contained in the Survey Request Sample Analysis Sheet and Step 4.5.2 (10% of the applicable DCGLs)?	X		
15. Were at least 5% of FSS samples obtained under the Survey Request re-analyzed? Were replicate analysis calculations performed per Section 4.6.3?	X		
16. Were documented investigations performed for all survey and/or sample QA/QC non-agreements (Questions 12 & 15 above) and were corrective actions implemented as necessary?			X
17. Has the GRCS summary of surveying/sampling results been completed per Step 4.7.3?	X		

NOTES: If the question does not apply to the survey package, check the N/A (not applicable) box. If a "No" answer is obtained above, the GRCS should initiate corrective action in accordance with site procedures. Document actions taken and/or justifications in the "Comments" section below. Attach additional sheets as necessary.

GRCS (print/sign)	D. Sarge /	Date	01/19/05