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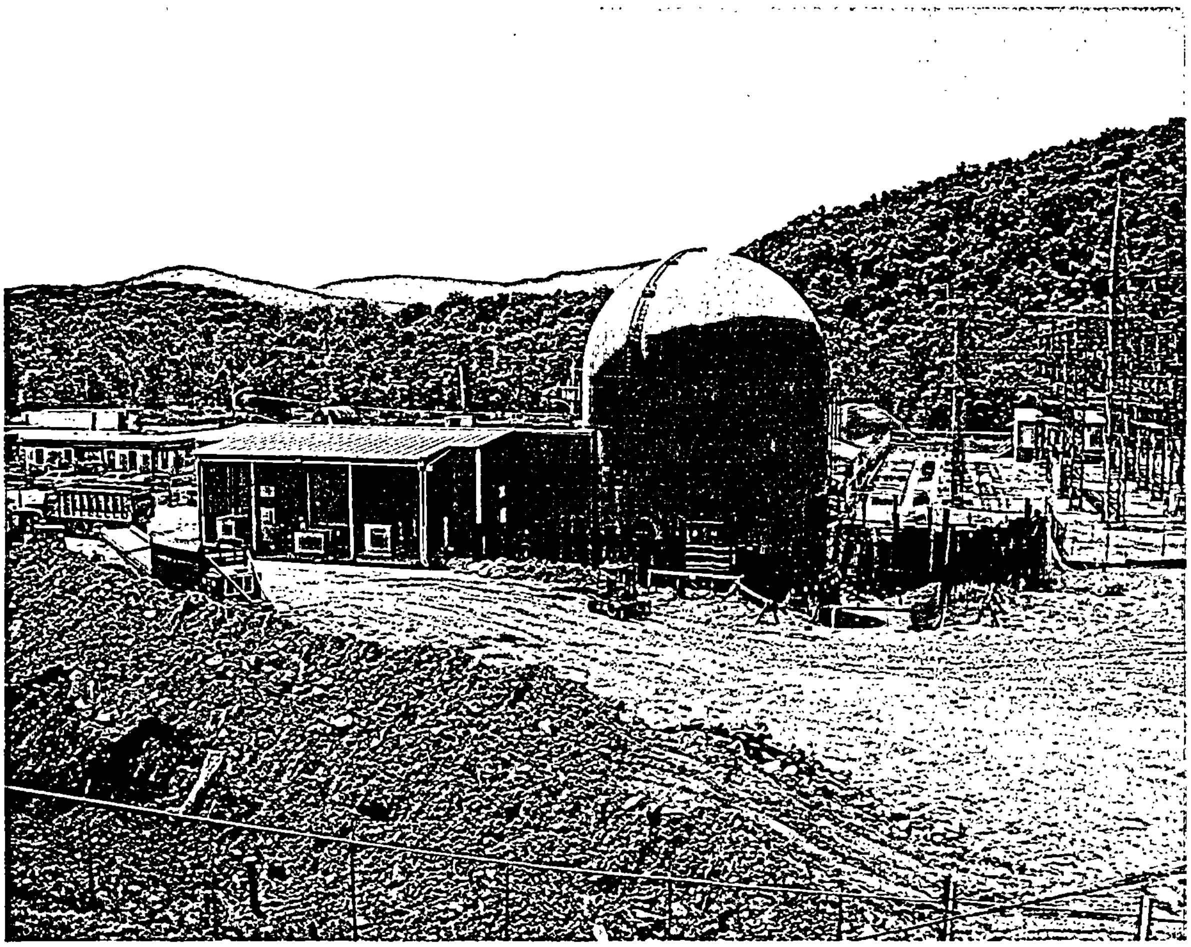
Final Status Survey Report

For

Saxton Nuclear Experimental Corporation

CV Interior Above 774' El. & Exterior



Prepared by GPU Nuclear, Inc.

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Executive Summary

This report presents the results and conclusions of the Final Status Survey (FSS) conducted by GPU Nuclear, Inc. on both the exterior and upper interior of the Saxton Nuclear Experimental Corporation (SNEC) Containment Vessel (CV). This FSS specifically provides the summary results of structure surface measurements taken in the CV interior above the 774' elevation (actually between the 775.2' and 805.4' elevations), areas outside the CV on the exterior shell, the associated excavation and soil/debris piles. The FSS for these areas was started in August 2003 and completed in October 2003. In addition, this report describes the results of surveys performed by Shonka Research Associates, Inc. (SRA) on Saxton related soil and debris piles. A portion of this material will be used to fill the excavation area surrounding the CV.

This FSS report provides a compliment to a previous FSS report (Reference 6.8) that described the FSS results for the CV interior below the 774' elevation (actual elevation was 775.2). Based on GPU Nuclear's review of the data the lower CV bowl (between the 765.7' and 775.2' elevations) was filled with clean crushed stone. In May 2003 approximately 967 tons of crushed limestone (804 tons of #3 and 163 tons of #2RC aggregate sizes) was added to the lower CV bowl.

This FSS was performed in accordance with Revision 2 of the SNEC License Termination Plan (LTP). The interior CV structure surfaces were divided into nine (9) survey units, three (3) survey units for the exterior shell and one survey unit for the excavated area. There is no survey unit designation for the debris and soil piles. Each survey unit was comprised of either metal building structure surfaces or excavated land areas, all varying in shape and size. Survey data was collected from each survey unit according to data collection requirements specified in the FSS design criteria. The following types of measurements were performed:

1. Scan measurements were performed on approximately 739 m^2 of CV interior and exterior shell areas.
2. Scan measurements were performed on approximately 350 m^2 of open land areas within the CV excavation.
3. Scan measurements were conducted by SRA on approximately 5000 tons of soil and 11,200 tons of debris consisting of crushed concrete, brick, tile and mortar.
4. Static measurements were performed at 208 locations.
5. In addition, 208 supplemental smear measurements were collected on metal surfaces to determine loose surface contamination. Although smear results are reported they are not used for determining compliance but for adherence to LTP section 6.2.1. Instead, they are used as a diagnostic tool to determine if the removable surface radioactivity is less than 10% of the surface area $DCGL_w$.

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

1.0 Purpose and Scope

This report presents the results and conclusions of the final status survey performed on the following areas:

1. CV interior shell above the 775.2' and up to approximately the 805.4' elevation.
2. Six (6) W-beams welded to the interior CV shell between elevations 778.25' and 803.5'.
3. CV exterior shell that encompasses the area from 804' to 796' elevation and approximately 280 degree circumference.
4. CV Yard area soil partially surrounding the CV, which slopes from the 796' to the 803' elevation.
5. Approximately 5,000 tons of soil and 11,200 tons of debris surveyed by the SRA Sub-surface Multi-spectral Contamination Monitor (SMCM).

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

This report describes the radiological data collected for the areas described above. This report does not address the final status survey previously performed on the interior CV shell below the 774' elevation. The FSS report for this area was previously submitted to the NRC on September 4, 2003 (Reference 6.8). Note in the Reference 6.8 report surveys were actually performed up to the 775.2' El. The format for both of these reports follow the guidance contained in Reference 6.1.

2.0 Final Status Survey Designs

2.1 Description of Survey Units

2.1.1 Interior CV Shell Above 774' El and Support Beams

There are nine (9) Class 1 survey units specified for inside the SNEC CV above the 774' El. (Actual start elevation is 775.2'.) The four (4) CV shell survey units (CV1-1, CV1-2, CV1-3 and CV1-4) are regions of the SNEC CV steel shell. Survey unit designation CV2-24 through CV2-28, are W14 x 74 W-beam support beams, which are welded to the CV shell.

W-beams were radiologically clean at the time of installation. W-beam survey units CV2-25 through CV2-28 extend 360 degrees around the inner circumference of the CV shell. Two short additional W-beams located at the 803.5' and 799.5' elevations are together, considered one survey unit (CV2-24).

The total area for the 9 survey units is ***693 m^2***. A short description of each survey unit is included below.

1. Survey unit ***CV1-1***, is composed of portions of 10 steel plates (G1 through G5 and F1 through F5), starting at ~805.4' El, and extending down to the ~798.1' El. This survey unit is approximately ***100 m^2*** in total area.
2. Survey unit ***CV1-2***, is composed of portions of 10 steel plates (F1 through F5 and E1 through E5), starting at ~798.1' El., and extending down to the ~790.4' El., This survey unit is approximately ***100 m^2*** in total area.
3. Survey unit ***CV1-3***, is composed of portions of 10 steel plates (E1 through E5 and D1 through D5), starting at ~790.4' El., and extending down to the ~783.3' El., This survey unit is approximately ***91.1 m^2*** in total area.
4. Survey unit ***CV1-4***, is composed of portions of 10 steel plates (D1 through D5), starting at ~783.3' El., and extending down to the ~775.2' El., This survey unit is approximately ***95.1 m^2*** in total area.
5. Survey unit ***CV2-24***, is two short W-beams at the ~803.5' and ~799.5' El. This survey unit is approximately ***33.7 m^2*** in total area.
6. Survey unit ***CV2-25***, is one W-beam at the ~792.5' El. This survey unit is approximately ***68.2 m^2*** in total area.
7. Survey unit ***CV2-26***, is one W-beam at the ~787' El. This survey unit is approximately ***68.2 m^2*** in total area.
8. Survey unit ***CV2-27***, is one W-beam at the ~782' El. This survey unit is approximately ***68.2 m^2*** in total area.
9. Survey unit ***CV2-28***, is one W-beam at the ~778.25' El. This survey unit is approximately ***68.2 m^2*** in total area.

Reference 6.8 describes the previous FSS submitted for the CV interior shell and support ring below the 774' EL. The actual elevation where this survey left off was above the support ring (survey unit CV2-23), which is the 775.2' El. CV1-4, described above, abuts this elevation and assures there is no gap between the respective survey areas.

An area behind each of the W-beams, described in items 6-9 above, was cleaned and surveyed prior to welding the beams in place on the CV shell. A summary of the survey designs and results is provided in Table 1.

Table 1

Survey Data for Areas Behind CV Rings (Support Beams)

Design Date	Design Number	Elevation of CV Rings Ext. (E) Int. (I)	Survey Request #	$DCGL_w$ (dpm/100 cm^2)	Scan $DCGL_w$ (ncpm)	Static $DCGL_w$ (ncpm)	Static Msmt. Points	Msmt. Results (dpm/100 cm^2)	Cs-137 Fraction
3/29/2002	6900-02-013	796'-804' (E)	38	1000	200	302	22	<1000	0.747
6/12/2002	6900-02-017	802' (I)	39	1000	220	290	13	<1000	1.000
6/24/2002	6900-02-019	792.5' (I)	41	2100	450	609	9	<2100	0.995
7/29/2002	6900-02-020	787' (I)	43	2100	450	635	9	<2100	0.995
8/19/2002	6900-02-022	782' (I)	44	2100	350	609	9	<2100	0.995
9/9/2002	6900-02-023	778.25' (I)	45	2100	250	580	9	<2100	0.995
9/26/2002	6900-02-024	774' (I)	46	2100	250	580	9	<2100	0.995

Notes: 1. Ludlum 2350-1 w/43-68 probe used to perform static and scan msmts. Average total efficiency = 23%
2. All areas Class 1, 100% scanned
3. Type I Decision Error (α) = 0.05; Type II Decision Error (β) = 0.10

Remediation of the SNEC CV began with gross decontamination and equipment removal e.g., piping, the steam generator, the pressurizer and the reactor vessel (fall of 1998). Extensive attempts at clean-up of the internal concrete structure indicated that the concrete had to be removed from the facility. In order to accomplish this, ground water abatement around the exterior of the CV was necessary and established. By the fall of 2002 the SNEC CV internal concrete structure was removed in total. However, several external and internal stiffener rings were necessary to maintain structural integrity. These assemblies were welded to the steel shell to add rigidity and produce a safe working environment for remediation crews and survey personnel. The internal surface of the CV steel shell was then cleaned to remove radiological contamination, paint, residual concrete dirt and weld and surface scale. Original weld areas between the sections of steel plate that make up the steel shell were vigorously decontaminated along with apparent surface defects. Remediation efforts of the interior CV steel surface included combinations of the following techniques:

- roto-peening
- liquid paint remover (MIRACHEM)
- surface grinding
- needle gun
- grit blasting
- wire brush
- vacuuming
- surface wipe-down

A decontamination effectiveness check was performed during the cleaning effort by means of biased and unbiased measurements on the surface of the cleaned steel shell using a gas flow proportional counter (GFPC). The criteria for determining when an area was acceptably decontaminated was established at < 3 times the local background count rate as determined by closed window readings in the area. Areas above this value were re-cleaned.

2.1.2 CV Exterior Shell Below Grade

There are three (3) survey units specified for the CV exterior shell below grade 804' elevation. Two (2) of these survey units are classified as Class 1. The third is classified as Class 2. These survey units are sections of the exterior CV shell wall that extend from about the 804' El down to about the 796' El, and along the circumference of the CV building approximately 280 degrees.

One (1) survey unit is part of CV6, which was previously surveyed in order to allow attachment of the exterior ring support assembly. The re-surveyed section of CV6 has been re-designated CV6-1.

The total area for the 3 survey units is **~46.4 m^2**. A short description of each survey unit is included below.

1. Survey unit ***CV4-1***, is ~ ***7.17 m^2*** and extends upward from the top edge of the upper installed support ring assembly to about the 804' El. This survey unit was surveyed IAW Class 1 survey criteria.
2. Survey unit designation ***CV6-1***, is composed of the center portion of the CV6 survey unit, and is ~ ***22.9 m^2***. This survey unit was re-surveyed IAW Class 1 survey criteria.
3. Survey unit designation ***CV5***, is ~ ***16.3 m^2*** and extends down from the bottom of the lower support ring assembly to about the 796' El. This survey unit was surveyed IAW Class 2 survey criteria.

An area behind each of the W-beams, described in items 1-3 above, was cleaned and surveyed prior to welding the beams in place on the CV exterior shell. A summary of the survey designs and results is provided in Table 1.

This exterior CV area supported the CV Stabilization system, which was to provide multiple and redundant methods to prevent flotation and/or deformation of the CV due to groundwater and soil pressure that could be expected during the CV concrete removal project. This was accomplished by anchoring the CV to bedrock, and by dewatering the ground in the vicinity of the CV. Forty (40) rock bolt anchors were installed in the immediate vicinity of the CV shell, encompassing approximately 300 degrees of the circumference. The immediate area of the tunnel beneath the Material Handling Building was maintained intact and thus was unavailable for anchoring space. Two (2) external annular I-beams with a vertical riser support bracket were installed to engage the rock anchor bolts. This system (I-beam and vertical support bracket) was designed for the radial extent of 300 degrees in order to complete installation of the 40 rock anchors. This system was supplemented on the interior by bridging approximately 60 degrees of the circumference with two internal annular I-beams. This system, with a total 360 degree annular complement (including both external and internal) was installed at elevations 802.72' and 798.72'.

2.1.3 CV Yard Soil (Excavation Area)

There is one (1) survey unit specified for the CV Yard Soil area. This survey unit is designated **OL1-1** and is classified as Class 1. This survey unit is part of the larger survey unit OL1. This is a below grade area that is adjacent to the SNEC CV structure. It extends upward from the 796' El (at the base of the exposed portion of the SNEC CV) to the 803' El. This survey unit is bounded on the south side by "wing walls" that have been added to isolate this survey unit from the remaining section of the CV Tunnel structure and excavation area.

The total area for **OL1-1** is approximately **350 m²**. The area estimate is an assessment of the exposed and sloped area within site grid markers AX-130, AX-128, AX-127, AY-130, AY-129, AY-128, AY-127, AZ-130, AZ-129, AZ-128, and AZ-127 (Reference 6.1, Figure 5-1).

In 2000 soil surrounding the CV exterior was excavated to support removal of contaminated structural and piping components. In 2001 additional soil was removed for installation of wells and rock anchors in support of the CV concrete removal project. Soil from this excavation was later staged and surveyed as per section 3.4.1 of this report. Radioactivity analyses of soil samples taken after remediation of the area shows the region between anchor bolt number 5 and proceeding clockwise to anchor bolt 40 (below the 803' El.), has been reduced to an average of 0.82 pCi/g (Cs-137) with a maximum value of 4.5 pCi/g). Other subsurface sample data collected in conjunction with installation of anchor bolts, grout curtain and wells indicate radioactivity concentrations are less than 1.5 pCi/g. Reference 6.1, Table 2-30 provides this data.

2.1.4 Debris and Soil Piles

Approximately 11,200 tons of building debris and 5,000 tons of soil was processed, batched and monitored for use as fill for excavations that will remain following site decommissioning. This material was classified as Class 1. It was determined that the concentration of man-made radionuclides in the materials would be measured prior to using the soil and debris for fill. Material with concentrations above a fraction (75%) of the $DCGL_w$ stated in the License Termination Plan (Reference 6.1) was separated from material to be used for fill. A system of conveyors and radiation monitors, along with sampling and laboratory analysis, was used to determine that the material was below the $DCGL_w$ values in the SNEC LTP.

Shonka Research Associates, Inc (SRA) was contracted to build, operate, and summarize data from the radiation monitors. SRA utilized a system called the Subsurface Multi-spectral Contamination Monitor (SMCM), which was developed with funding from the NRC (NRC-04-92-096. "Continued Development of a High Sensitivity Landfill Monitor: The Results of a Phase II SBIR Grant", December 1994). The SMCM combines into one instrument the capabilities of both scanning surveys with in-situ gamma spectrometry. The SMCM is a scanning spectrometer.

The scanned debris and soil were separated into approximately 250-ton piles called batches. Although there were a number of different types of materials present among the piles, each individual pile appeared to be a homogeneous mixture of the same type of material. Each batch was summarized in a Survey Request (SR) Report.

SR-55 (Reference 6.16) was issued to survey and sample backfill materials from the Saxton Steam Generating Station (SSGS) Footprint and the SNEC Yard. The material was consolidated near the SSGS Boiler Pad. SR-55, batches 1 through 38 consisted of building debris. The building debris had been crushed to less than 4 inches in diameter. SR-55 batches 1- 2 consisted of garage and warehouse demolition debris. This debris consisted mostly of brick and mortar. SR-55 batches 3 - 38 were the debris from the Saxton Steam Generating Station (SSGS) footprint, which was excavated to allow survey of below grade structure(s). This debris consisted mostly of brick and concrete with minor amounts of tile and grout.

SR-62 (Reference 6.17) was issued to survey and sample debris material consolidated into the East Soil Pile. This pile was comprised of soil/concrete/rocks from various excavations throughout the decommissioning project including remnants of the Control and Auxiliary Building unearthed during the Decommissioning Support Facility (DSF) excavation, the interceptor trench and the CV yard excavation. SR-62, batches 1 to 18 (except batch 3) consisted of soil excavated from areas around the CV and other impacted surface soils from the site. In SR-62 batch 3, the soil consisted of sediment pumped from the SSGS intake and discharge tunnels.

2.2 Site Release Criteria

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

Levels of residual radioactivity that correspond to the allowable dose to meet the site or survey unit release criteria were derived by analyses using either the building occupancy (surface area) or resident farmer (volumetric) scenarios. The dose modeling for these scenarios is explained in the SNEC LTP, Revision 2, Chapter 6. The derived concentration guideline levels (DCGLs) determined in the LTP form the basis for satisfying the site release criteria.

Residual radioactivity sample results for non-activated surfaces inside the CV were compared to calculate gross activity DCGLs. These gross activity DCGLs were developed using the methodology described in SNEC LTP Section 5.2.3.2.4, based on radionuclide specific DCGLs listed in Table 5-1 of the LTP.

As described in Chapter 6 of the SNEC LTP (Reference 6.1) a correction to the gross activity $DCGL_w$ was made to address de-listed radionuclides and to correct for activated steel in the SNEC CV. The SNEC facility has instituted an administrative limit of 75% for the allowable dose (DCGL) for all measurement results. The de-listed radionuclide dose is accounted for within the 75% administrative limit, but the activated steel dose correction is not. Based on Microshield calculations for activated metal inside the CV, an additional 28.8% reduction was also made for measurements taken in these regions.

2.3 Survey Designs

Survey unit designs are provided in Appendices A through D. Scan coverage measurements were set at 100% for Class 1 areas and, at least 50% for Class 2 areas. The number of static measurement points was determined using the COMPASS computer program (Reference 6.3). These points were located on survey maps for each survey unit using the VSP, Visual Sample Plan (Reference 6.4) computer code.

Survey designs use gross activity $DCGL_w$ values developed from results of samples taken in the respective areas. These samples consisted of scrapings, soil, sediment, debris or combinations of these media. The sample results were tabulated to determine the mean and standard deviations of each data set. Isotopic ratios were determined from the mean plus two standard deviations (2σ) and then used to determine the effective $DCGL_w$. This method produces the most representative effective $DCGL_w$ value that is used as input into the Compass computer program.

Nine of the SNEC eleven radionuclides were used in different combinations to determine mix ratios for the various survey units. These radionuclides are Am-241, C-14, Co-60, Cs-137, H-3, Ni-63, Pu-238, Pu-239 and Sr-90. Cs-137, H-3 and Ni-63 accounted for the majority of radionuclides, i.e. they were each greater than 1% of the mix. In all cases Cs-137 is the predominate radionuclide and provides the most detectable radionuclide in the various mixes.

Table 1A presents the data quality objectives (DQOs) and other relevant information, which went into the survey design package (Appendix A) for the Interior CV Shell Above 774' El. And Support Beams.

Table 1A

DQO/Design Parameter	CV1-1 & CV2-24	CV1-2 & CV2-25	CV1-3 & CV2-26	CV1-4, CV2-27 & CV2-28
SNEC Design Calc. No.	E900-03-020	E900-03-020	E900-03-020	E900-03-020
MARSSIM Classification	1	1	1	1
Area Size (m^2)	133.7	168.2	159.3	231.5
Statistical Test	WRS	WRS	WRS	WRS
Type I Decision Error (α)	0.05	0.05	0.05	0.05
Type II Decision Error (β)	0.10	0.10	0.10	0.10
LBGR (cpm)	335	340	345	345
Estimated σ (cpm)	21.5	19.3	17.7	17.7
Δ/σ	3.0	3.1	3.1	3.1
Minimum Number of Static Data Points (COMPASS)	16	16	16	24
$DCGL_w$ (dpm/100 cm^2)	2100	2100	2100	2100
$DCGL_w$ (ncpm)	400	400	400	400
Scan MDC (dpm/100 cm^2)	574	537	478	522
Static MDC (dpm/100 cm^2)	370	346	310	337
Sample #(s) used for nuclide mix	SXSD3164	SXSD3164	SXSD3164	SXSD3164
SNEC Survey Request No.	86 & 87	88	89	90
Survey Instrument Model	Ludlum 2350-1 w/43-68 probe	Ludlum 2350-1 w/43-68 probe	Ludlum 2350-1 w/43-68 probe	Ludlum 2350-1 w/43-68 probe
Instrument Total Efficiency	0.15	0.15	0.15	0.15
Measurement Type	Scan/static	Scan/static	Scan/static	Scan/static

Table 2 presents the data quality objectives (DQOs) and other relevant information, which went into the survey design packages (Appendices B-D) for the CV Exterior Shell, CV Yard Soil and Debris and Soil Piles.

Table 2

DQO/Design Parameter	CV4-1, CV6-1	CV5	OL1-1	Debris & Soil Piles (Shonka)
SNEC Design Calc. No.	E900-03-021	E900-03-021	E900-03-022	N/A
MARSSIM Classification	1	2	1	1
Area Size (m^2)	30.1	16.3	350	N/A
Statistical Test	WRS	WRS	WRS	N/A
Type I Decision Error (α)	0.05	0.05	0.05	N/A
Type II Decision Error (β)	0.10	0.10	0.10	N/A
LBGR (cpm) or pCi/g	2263 cpm	2263 cpm	3.4 pCi/g	N/A
Estimated σ (cpm) or pCi/g	18.4 cpm	18.4 cpm	1.06 pCi/g	N/A
Δ/σ	2.0	2.0	1.04	N/A
Minimum Number of Static Data Points (COMPASS)	16	8	23	N/A
$DCGL_w$ (dpm/100 cm^2)	8000	8000	N/A	N/A
$DCGL_w$ (ncpm) or pCi/g	2300	2300	4.5 pCi/g	4.2 pCi/g
Scan MDC (dpm/100 cm^2) or pCi/g	441	441	3.7 pCi/g	2.91 pCi/g
Static MDC (dpm/100 cm^2)	226	226	N/A	N/A
Sample #(s) used for nuclide mix	See Appendix B	See Appendix B	See Appendix C	Note 3
SNEC Survey Request No.	91 & 92	91 & 92	93	55 & 62
Survey Instrument Model	Ludlum 2350-1 w/43-68 probe	Ludlum 2350-1 w/43-68 probe	Ludlum 2350-1 2"x2" NaI w/44-10 probe	SMCM Note 1
Instrument Total Efficiency	0.23	0.23	0.106	2.195 Note 2
Measurement Type	Scan/static	Scan/static	Scan/Soil Samples	Scan/Soil Samples

Footnotes:
1. SMCM – Subsurface Multi-spectral Contamination Monitor - A radiation detection system that is a conveyor version of the SMCM that utilizes four-each, 5-inch (12.7 cm) diameter by 2-inch (5.1 cm) thick thallium-doped sodium iodide (NaI (Tl)) detectors.
2. SMCM calibration factor is in units of cps per pCi/g.
3. Sample median value determined from SNEC sample database (42 samples).

3.0 Final Status Survey Results

The following sections provide the survey summary results for each survey unit as required by the respective design. Summary data was taken from References 6.9 – 6.18 which are filed in the SNEC FSS history file.

3.1 Interior CV Shell Above 774' El and Support Beams

3.1.1 Survey Unit Results

Nine (9) survey units were developed. These survey units are designated as CV1-1, CV1-2, CV1-3, and CV1-4 for the CV shell portion and CV2-24, CV2-25, CV2-26, CV2-27, and CV2-28 for the beams. These survey units are described in section 2.1.1 of this report. The FSS design for these survey units is in Appendix A. DQOs are listed in Table 1A. Surveys were performed on the interior CV steel liner and associated beams at locations from approximately 775.2' to 805" elevation. Surveys were performed in accordance with References 6.9 – 6.13 (i.e. SRs 86–90). Surface scan and static measurements were performed using a Ludlum 2350-1 "datalogger" system with a 43-68 probe.

The Gross $DCGL_w$ for all areas was 2100 dpm/100 cm^2 or 400 cpm above background for a static measurement. A conservative mix of eight (8) radionuclides from a CV shell scraping was used to determine the gross $DCGL_w$. These radionuclides and mix percentages are as follows: Cs-137 (62%), Ni-63 (22.5%), H-3 (13.4%), Sr-90 (0.6%), C-14 (0.5%), Co-60 (0.4%), Am-241 (0.4%) and Pu-239 (0.2%).

Since these areas are Class 1 scan coverage was set at 100%. The scan speed was set at 2.2 cm/second (1 detector width per 4 seconds). The action level specified for scanning was **200 cpm above background**. If this level was reached, the surveyor would stop and perform at least a 1/2 minute static count to identify the actual count rate. NOTE: Static and Scan MDC values are listed in the Table 1A.

A smear survey was performed in each survey unit at each static measurement point location. These smears were obtained after static measurements were acquired. Smears were assayed for beta/gamma and alpha contamination. A gamma scan of each survey unit smear group was also performed.

No WRS statistical analysis is necessary for these survey units since all static measurements are below the assigned $DCGL_w$ (i.e. 400 ncpm or 2100 dpm/100 cm^2).

a. Surface Scan Measurements

100% of the surface areas for all nine (9) survey units were designed to be scanned. However, various obstructions made scanning 100% of all surfaces within ½ inch impossible. Table 3 provides information on how much of each survey unit that was not surveyed. All surfaces (97%) that were surveyed were less than the 200 ncpm action level.

Table 3

Survey Unit	Area Size (m^2)	Area Not Scanned (m^2)	% Not Scanned
CV1-1	100	1.10	1%
CV1-2	100	0.83	1%
CV1-3	91.1	0.83	1%
CV1-4	95.1	1.10	1%
CV2-24	33.7	1.20	4%
CV2-25	68.2	4.86	7%
CV2-26	68.2	0.92	1%
CV2-27	68.2	5.92	9%
CV2-28	68.2	6.08	9%
Total	692.7	22.84	3%

b. Static Measurements (Beta-gamma)

151 static measurements were obtained in the nine (9) survey units. Results of these measurements are listed in Table 4. These measurements are unshielded gross counts per minute (i.e. background not subtracted). The gross activity for all static measurements was less than the $DCGL_w$ (i.e. 400 ncpm or 2100 dpm/100 cm^2).

Table 4

Ludlum 2350 Static Measurements (CPM)

Points	CV1-1	CV1-2	CV1-3	CV1-4	CV2-24	CV2-25	CV2-26	CV2-27	CV2-28
1	159	155	201	135	230	119	164	119	118
2	178	168	225	149	268	132	152	129	108
3	162	205	184	146	235	124	154	123	115
4	172	169	224	142	230	124	143	132	141
5	169	168	213	137	304	123	188	141	135
6	205	185	189	141	314	135	129	134	126
7	211	167	231	151	253	134	145	137	143
8	186	132	193	159	240	133	137	177	106
9	158	187	208	150	250	126	147	174	106
10	162	159	237	140	253	143	129	191	124
11	206	156	258	132	227	174	136	167	139
12	154	162	172	156	250	166	124	180	161
13	176	158	220	150		208	109	160	170
14	211		223			197	133	195	159
15						176	136	168	130
16						172	129	156	110
17						151	143	145	109
18						134	166	135	119
19						101	157	119	111
20						132	162	105	117
21						142	140	138	
22							102	112	
MEAN	179	167	213	145	255	145	142	147	127
STD DEV	21	18	23	8	28	27	19	26	19
MIN	154	132	172	132	227	101	102	105	106
MAX	211	205	258	159	314	208	188	195	170
MEDIAN	174	167	217	146	250	134	142	140	122

c. Loose Surface Contamination (Smear Survey)

A smear was taken at each static measurement point for a total of 151 measurements. All results were less than minimum detectable concentration (MDC) for all beta-gamma and alpha measurements. Isotopic analysis was performed on each group of composited smears taken for each survey. Results are tabulated in Table 5.

Table 5

Loose Surface Contamination Results

Survey Unit	Smear Points	Beta-gamma (dpm/100 cm^2)	Alpha (dpm/100 cm^2)	Cs-137 uCi/group	Co-60 uci/group
CV1-1	14	< 169	<12.2	<7.4E-6	<1.1E-5
CV1-2	13	<172	<12.2	<1.1E-5	<8.7E-6
CV1-3	14	<166	<12.7	<1.2E-5	<9.0E-6
CV1-4	13	<169	<12.7	<1.1E-5	<1.3E-5
CV2-24	12	<155	<10.8	<1.1E-5	<1.2E-5
CV2-25	21	<169	<12.7	<1.0E-5	<1.0E-5
CV2-26	22	<162	<11.5	<1.5E-5	<1.4E-5
CV2-27	22	<172	<12.2	<1.2E-5	<1.1E-5
CV2-28	20	<159	<10.8	<1.3E-5	<1.1E-5

d. Exceptions

Due to structural obstructions and CV liner gouges scans could only be performed within ½ inch on 97% of the CV surfaces. Of the 3% not surveyed most of these surfaces were on radiologically clean beam supports, which were installed in 2002 for CV stabilization. CV liner surface gouges were caused during concrete removal in 2001. These gouges, and areas immediately surrounding them, were remediated in 2002. The results of the FSS for areas surrounding these gouges show no contamination above the $DCGL_w$. Therefore, there is strong justification that these areas as also less than the $DCGL_w$.

3.2 CV Exterior Shell Below Grade

3.2.1 Survey Unit Results

Three (3) survey units were developed. These survey units are designated as CV4-1, CV6-1 and CV5 for the CV exterior shell portion, which is below the 804' El. These survey units are described in section 2.1.2 of this report. The FSS design for these survey units is in Appendix B. DQOs are listed in Table 2. Surveys were performed on the exterior CV steel liner from approximately 796' to 804' El. and along a 280 degree circumference. Surveys were performed in accordance with Reference 6.14 (SR 91). Surface scan and static measurements were performed using a Ludlum 2350-1 "datalogger" system with a 43-68 probe.

The Gross $DCGL_w$ for all areas was 8000 dpm/100 cm^2 or 2300 cpm above background for a static measurement. A conservative mix of seven (7) radionuclides, determined from a soil sample data set, (mean + 2σ), representing the area along the CV exterior, was used to determine the gross $DCGL_w$. These radionuclides and mix percentages are as follows: Cs-137 (96.6%), H-3 (2.5%), Sr-90 (0.7%), Co-60 (0.07%), Am-241 (0.02%), Pu-238 (0.05%) and Pu-239 (0.02%).

Scan coverage was set at 100% for Class 1 areas, CV4-1 and CV6-1, and at 50% for Class 2 area, CV5. The scan speed was set at 2.2 cm/second (1 detector width per 4 seconds). The action level specified for scanning was **1000 cpm above background**. If this level was reached, the surveyor would stop and perform at least a 1/2 minute static count to identify the actual count rate. NOTE: Static and Scan MDC values are listed in the Table 2.

A smear survey was performed in each survey unit at each static measurement point location. These smears were obtained after static measurements were acquired. Smears were assayed for beta/gamma and alpha contamination. A gamma scan of each survey unit smear group was also performed.

No WRS statistical analysis is necessary for these survey units since all static measurements are below the assigned $DCGL_w$ (i.e. 2300 ncpm or 8000 dpm/100 cm^2).

a. Surface Scan Measurements

100% of the surface areas for CV4-1 and CV6-1 and 50% of CV5 were designed to be scanned. For the Class 1 areas various obstructions made surveying 100% of all surfaces impossible. 7.5% (0.54 m^2) of CV4-1 and 3.3% (0.75 m^2) of CV6-1 surface areas could not be surveyed as a result of obstructions. 55% of CV5 (Class 2 area) was scanned. Collectively 96% of Class 1 and 55% of Class 2 surfaces that were surveyed were less than the 1000 ncpm action level.

b. Static Measurements (Beta-gamma)

57 static measurements were obtained in the three (3) survey units. Results of these measurements are listed in Table 6. These measurements are unshielded gross counts per minute (i.e. background not subtracted). The gross activity for all static measurements was less than the $DCGL_w$ (i.e. 2300 ncpm or 8000 dpm/100 cm^2).

Table 6

Ludlum 2350 Static Measurements (CPM)			
Points	CV4-1	CV6-1	CV5
1	168	179	183
2	152	157	170
3	144	169	189
4	153	142	214
5	158	165	206
6	152	133	180
7	161	130	159
8	151	156	176
9	184	125	173
10	157	156	169
11		145	178
12		139	164
13		139	159
14		165	136
15		148	176
16		165	191
17		140	192
18		193	194
19		163	188
20		147	169
21		128	209
22			212
23			210
24			214
25			227
26			208
MEAN	158	152	186
STD DEV	11	18	22
MIN	144	125	136
MAX	184	193	227
MEDIAN	155	148	186

c. Loose Surface Contamination (Smear Survey)

A smear was taken at each static measurement point for a total of 57 measurements. All results were less than minimum detectable concentration (MDC) for all beta-gamma and alpha measurements. Isotopic analysis was performed on each group of composited smears taken for each survey. Results are tabulated in Table 7.

Table 7

Loose Surface Contamination Results

Survey Unit	Smear Points	Beta-gamma (dpm/100 cm^2)	Alpha (dpm/100 cm^2)	Cs-137 uCi/group	Co-60 uci/group
CV4-1	10	<169	<12.7	<6.6E-6	<7.8E-6
CV6-1	21	<169	<12.7	<1.0E-5	<9.5E-5
CV5	26	<169	<12.7	<9.5E-6	<1.1E-5

d. Exceptions

Due to structural obstructions from external ring installations, scans could only be performed within ½ inch on 96% of the external CV surfaces. Of the 4% not surveyed most of these surfaces were on radiologically clean beam supports, which were installed in 2002 for CV stabilization. For survey units CV4-1and CV6-1 there was a total of 140 obstructions resulting in a 1.3 m^2 area that could not be surveyed. In addition, 18 static measurement points had to be relocated due to these obstructions. The results of the FSS for areas surrounding these obstructions show no contamination above the $DCGL_W$. Therefore, there is strong justification for assessing these areas as less than the $DCGL_W$.

3.3 CV Yard Soil (Excavation Area)

3.3.1 Survey Unit Results

This survey unit is designated ***OL1-1*** and is a part of the larger survey unit designated OL1. This survey unit is described in section 2.1.3 of this report. The FSS design for this area is in Appendix C. DQOs are listed in Table 2. Surveys were performed in accordance with Reference 6.18 (i.e. SR 93). The total area for this Class 1 survey unit is ~350 square meters. This area estimate is an assessment of the exposed and sloped area within site grid markers AX-130, AX-128, AX-127, AY-130, AY-129, AY-128, AY-127, AZ-130, AZ-129, AZ-128 and AZ-127, up to the ~803' El.

The effective $DCGL_w$ for sampling work is 4.5 pCi/g (Cs-137). A conservative mix of seven (7) radionuclides, determined from a soil sample data set, (mean + 2σ), representing the CV yard area, was used to determine the effective $DCGL_W$. These radionuclides and mix percentages are as follows: Cs-137 (62.5%), H-3 (35.7%), Sr-90 (0.3%), Co-60 (0.4%), Am-241 (0.6%), Pu-238 (0.3%) and Pu-239 (0.2%).

Scanning was performed using a 2" diameter by 2" long NaI detector with a Cs-137 window setting. The window setting was ~100 keV wide and will straddled the Cs-137 662 keV full energy peak width. The instrument conversion factor/efficiency was ~221 cpm/uR/h.

The scan speed was set at a maximum of 25 cm/sec. Scan coverage was set at 100% for this Class 1 survey unit. The distance from the surface being scanned was no more than 4" in accordance with the MicroShield model used to develop this MDCscan (see Appendix C, Attachment 4-1).

Background was measured in the area and on similar background materials. Background ranged from about 100 cpm to approximately 400 cpm. If the net count rate was greater than the **200 ncpm (~3.7 pCi/g)** then soil sampling was conducted in the area of concern. Using a conservative background value of 100 cpm the action level was set at **300 gross cpm**.

A. Surface Scan Measurements

A 100% surface scan was performed in the grid areas listed above. Action level was 300 gross cpm.

Results: Most areas were below the action level with some exceptions. In these locations a 1-minute static measurement was performed and if >300 cpm a soil sample was obtained. These areas are described in the next section, i.e. static measurement results.

B. Static Measurement Results

Twenty-five static measurements were obtained in response to meeting or exceeding the scan action level. The highest reading was 454 cpm (action point #12 in Table 8). The average of these readings was 347 cpm. Additional soil samples were taken in elevated scan/static measurement locations. Results were all less than the $DCGL_W$. Table 8 lists the results.

Table 8

OL1-1 Static Measurement & Sampling Results

LOCATION	SAMPLE	Lab Results		Static Measurement Results (cpm)
		Cs-137(pCI/g)	Co-60 (pCI/g)	
AP1-1	SX-SL-4135	0.06 ± 0.03	<0.06	325
AP1-2	SX-SL-4136	0.1 ± 0.03	<0.05	413
AP1-3	SX-SL-4137	0.17 ± 0.04	<0.06	318
AP1-4	SX-SL-4138	0.16 ± 0.04	<0.05	370
AP1-5	SX-OT-4133	<0.06	<0.06	391
AP1-6	SX-OT-4134	<0.05	<0.06	407
AP1-7	SX-SL-4139	<0.06	<0.05	329
AP1-8	SX-OT-4140	<0.05	<0.06	349
AP1-9	SX-OT-4141	<0.06	<0.06	330
AP1-10	SX-OT-4142	0.9 ± 0.1	<0.05	317
AP1-11	SX-SL-4143	0.5 ± 0.07	<0.05	344
AP1-12	SX-SL-4149	3.9 ± 0.4	0.07 ± 0.02	454
AP1-13	SX-OT-4150	<0.05	<0.06	320
AP1-14	SX-OT-4152	<0.06	<0.07	359
AP1-15	SX-SL-4153	<0.05	<0.06	310
AP1-16	SX-OT-4154	<0.05	<0.06	324
AP1-17	SX-OT-4155	<0.06	<0.06	372
AP1-18	SX-SL-4156	0.14 ± 0.04	<0.05	358
AP1-19	SX-OT-4157	0.03 ± 0.02	<0.05	330
AP1-20	SX-OT-4160	<0.06	<0.05	320
AP1-21	SX-SL-4161	0.05 ± 0.03	<0.06	301
AP1-22	SX-SL-4162	0.04 ± 0.02	<0.06	304
AP1-23	SX-SL-4164	0.07 ± 0.03	<0.06	327
AP1-24	SX-OT-4165	<0.08	<0.07	395
AP2-1	SX-SL-4159	0.08 ± 0.03	<0.05	304
Sample #1	SX-SL-4170	0.09 ± 0.04	<0.07	
Sample #2	SX-SL-4173	<0.08	<0.08	
Sample #3	SX-SL-4171	0.09 ± 0.04	<0.06	
Sample #4	SX-SL-4172	<0.08	<0.07	
Sample #5	SX-SL-4174	<0.05	<0.05	
Sample #6	SX-SL-4175	<0.025	<0.036	
Sample #7	SX-SL-4176	0.046 ± 0.02	<0.04	
Sample #8	SX-SL-4177	<0.05	<0.05	
Sample #9	SX-SL-4178	<0.1	<0.09	
Sample #10	SX-SL-4179	<0.05	<0.08	
Sample #11	SX-SL-4180	<0.04	<0.06	
Sample #12	SX-SL-4181	0.09 ± 0.03	<0.07	
Sample #13	SX-SL-4182	0.12 ± 0.04	<0.06	
Sample #14	SX-SL-4183	<0.06	<0.06	
Sample #15	SX-SL-4184	0.1 ± 0.04	<0..07	
Sample #16	SX-SL-4185	<0.05	<0.07	
Sample #17	SX-SL-4186	0.1 ± 0.03	<0.09	
Sample #18	SX-SL-4187	<0.05	<0.06	
Sample #19	SX-SL-4188	0.09 ± 0.04	<0.06	
Sample #20	SX-SL-4189	0.09 ± 0.04	<0.06	
Sample #21	SX-SL-4190	<0.13	<0.06	
Sample #22	SX-SL-4191	0.08 ± 0.04	<0.08	
Sample #23	SX-SL-4192	0.19 ± 0.05	<0.05	
Sample #24	SX-SL-4193	0.08 ± 0.04	<0.05	
Sample #25	SX-SL-4194	<0.05	<0.04	
Sample #26	SX-SL-4195	<0.05	<0.05	
Sample #27	SX-SL-4196	0.28 ± 0.05	<0.06	
Sample #28	SX-SL-4197	<0.05	<0.06	
		STATIC MEASUREMENT SUMMARY	MEAN	347
			2 SIGMA	79
			MIN	301
			MAX	454
			MEDIAN	330

C. Soil Sample Results

Above Action Level Response Sampling - In response to alarms encountered during static measurement performance, twenty-five samples were obtained (reference Table 8). The highest result was 3.9 pCi/g Cs-137, 0.07 pCi/g Co-60. The range for positive results was 0.03 to 3.9 pCi/g for Cs-137. All results were less than the $DCGL_W$.

Soil Sampling - As required by the survey unit design, twenty-eight samples were obtained (reference Table 8). The highest result was 0.19 pCi/g Cs-137, <0.05 pCi/g, Co-60. The range for positive results was 0.05 to 0.19 pCi/g Cs-137; typical achieved MDA for Co-60 was <0.06 pCi/g.

Samples were sent to an off-site laboratory (Teledyne Brown Engineering, Inc.) for transuranic and hard to detect analyses (i.e. H-3, Sr-90, Am-241, Pu-238, and Pu-239/240). All analysis results were less than minimum detectable concentration (MDC). Results are listed in Table 9.

Table 9

CV Yard Soil Results (pCi/G)

Sample ID	Sr-90	H-3	Pu-238	Pu-239/240	Am-241
SX-SL-4139	<3.46E-2	<2.21	<4.16E-2	<1.86E-2	<2.78E-2
SX-SL-4142	<3.25E-2	<2.22	<6.71E-2	<2.02E-2	<1.76E-2
SX-SL-4143	<3.16E-2	<2.23	<6.31E-2	<3.64E-2	<2.21E-2
SX-SL-4149	<2.77E-2	<2.24	<4.30E-2	<3.04E-2	<2.77E-2

3.4 Debris and Soil Piles

3.4.1 Survey Results

A total of 16,195 tons of material consisting of backfill debris (11,183 tons) and soil (5,012 tons) was surveyed through a radiation detection system developed by Shonka Research Associates (SRA). This material is described in section 2.1.4 of this report. Appendix D provides specific information on the detector systems, survey methodology and survey results. DQOs are listed in Table 2. SR 55 and 62 (References 6.16 and 6.17 respectively) were referenced for survey summary results. A total of 56 batches of material, i.e. backfill debris (38 batches) and soil (18 batches), were surveyed. Each batch has its own survey record, which is provided on electronic medium (CD), provided as part of this report.

The effective volumetric $DCGL_W$ for the soil and debris material was calculated to be 4.2 pCi/g. A conservative mix of seven (7) radionuclides was used from SSGS debris samples to determine this $DCGL_W$. These radionuclides and mix percentages are as follows: Ni-63 (69.4%), Cs-137 (28.6%), Sr-90 (0.3%), Co-60 (1.0%), Am-241 (0.5%), Pu-238 (0.1%) and Pu-239 (0.1%). Table 10 provides the effective $DCGL_W$ calculation information.

Table 10

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

SNEC AL	75%	Total Activity Limit DCGLw		Administrative Limit	
		19.59	pCi/g	14.69	pCi/g
		Cs-137 Limit		Cs-137 Administrative Limit	
		5.61	pCi/g	4.21	pCi/g

SAMPLE NUMBER(s) ⇒ Median SSGS Area Sample Result Data

57.40%	25.0	mrem/y TEDE Limit
14.55%	4.0	mrem/y Drinking Water (DW) Limit

☑ Check for 25 mrem/y — TRUE

	Isotope	Sample Input (pCi/g, uCi, 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	0.053	0.470%	9.9	2.3	0.09	0.36	0.09	0.13	0.09	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	0.109	0.969%	3.5	67.0	0.19	0.75	0.19	0.78	0.01	Co-60
4	Cs-137	3.22	28.633%	6.6	397	5.61	22.13	5.61	12.20	0.03	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		0.000%	132	31.1	0.00	0.00	0.00	0.00	0.00	H-3
7	Ni-63	7.81	69.448%	747	19000	13.61	53.67	13.61	0.26	0.00	Ni-63
8	Pu-238	0.010	0.087%	1.8	0.41	0.02	0.07	0.02	0.14	0.10	Pu-238
9	Pu-239	0.015	0.133%	1.6	0.37	0.03	0.10	0.03	0.23	0.16	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	0.029	0.261%	1.2	0.61	0.05	0.20	0.05	0.61	0.19	Sr-90
		1.12E+01	100.000%			19.59	77.27	19.59	14.351	0.582	
						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		

The following sections provide a summary of survey results.

a. Surface Scan Measurements for Gamma Activity Using the SMCM

To assure material would not exceed the $DCGL_W$ an alarm set point was established equivalent to 2.91 pCi/g (Cs-137). This assumed 773 pounds of material with a uniform contamination distribution in a volume of 4 inches thick by 32 inches wide by 8.2 feet long. Results: All measurements on soil and debris material indicated levels below the DCGLw (4.2 pCi/g Cs-137).

b. Material Sample Results

Backfill Debris (SR 55) - Material was obtained from each truckload and composited into a total of 38 batches. Table 11 provides a comparison between SMCM and grab sample results. The positive Cs-137 samples ranged from 0.04 to 0.1 pCi/g. Non-positive samples achieved a Cs-137 MDA of typically 0.05 pCi/g. No Co-60 was indicated in the samples. Samples SX-SD-3389, 3390, 3399, 3416, 3418, 3427, 3444, 3475, 3498, and 3504 were analyzed at Teledyne Brown Engineering for Carbon-14 and Tritium. All samples indicated non-positive results. Typical MDAs were 0.15 and 1.7 pCi/g respectively. Two other samples SX-SD-3419 & 3496 were analyzed for all eleven radionuclides attributed to SNEC. Both samples indicated positive Cesium-137 and naturally-occurring isotopes, but all less than MDC results for all other radionuclides.

The SMCM and lab results agree within one standard deviation. For the case of the debris pile, the SMCM survey data agrees with the laboratory results such that the best estimate of the total pile is 0.069 ± 0.010 pCi/g. The SMCM did not alarm during the SR-55 survey. Therefore, there is no Cs-137 greater than 2.91 pCi/g.

Table 11

11,183 tons of Backfill Debris (Ref SR-55)

	SMCM Cs-137 (pCi/g)			Cs-137 (pCi/g)		
Batch	Mean	Max	1 Sigma StDev	Lab	2 sigma StDev	Sample ID
1	-0.04	0.18	0.1	0.067	0.063	513271
2	0.13	0.52	0.17	0.021	0.026	513274
3	-0.02	0.66	0.09	0.09	0.028	113280
4	0.01	0.19	0.07	0.052	0.026	513283
5	-0.07	0.17	0.06	0.061	0.027	513285
6	-0.06	0.11	0.05	0.047	0.025	113289
7	0	0.21	0.08	0.03	0.033	113293
8	0.1	0.31	0.08	0.081	0.03	113296
9	0.02	0.22	0.06	0.062	0.029	113300
10	0.02	0.21	0.06	0.081	0.031	113308
11	0.01	0.2	0.05	0.072	0.027	113331
12	0.05	0.43	0.11	0.057	0.031	513334
13	-0.01	0.24	0.13	0.052	0.028	113333
14	0.04	0.22	0.07	0.088	0.033	113342
15	0.11	0.4	0.07	0.104	0.034	513350
16	0.13	0.41	0.14	0.091	0.022	113354
17	-0.11	0.1	0.07	0.07	0.027	113357
18	0.08	0.35	0.06	0.101	0.04	513358
19	0	0.29	0.08	0.082	0.029	113365
20	0.07	0.24	0.06	0.068	0.019	113368
21	0.08	0.28	0.08	0.049	0.034	513371
22	0.12	0.35	0.06	0.056	0.026	113370
23	0.11	0.27	0.08	0.054	0.026	113373
24	0.19	0.53	0.08	0.062	0.029	113380
25	0.1	0.52	0.15	0.068	0.03	513386
26	-0.14	0.26	0.08	0.092	0.039	513389
27	-0.12	0.25	0.1	0.065	0.03	113400
28	-0.16	0.07	0.09	0.082	0.034	513413
29	-0.1	0.2	0.07	0.103	0.036	513428
30	-0.02	0.31	0.1	0.042	0.026	113459
31	-0.11	0.19	0.06	0.067	0.029	513456
32	-0.09	0.25	0.08	0.083	0.046	413477
33	-0.17	0.13	0.1	0.097	0.031	513496
34	-0.07	0.19	0.08	0.074	0.032	513510
35	-0.09	0.14	0.07	0.07	0.035	113547
36	-0.08	0.11	0.07	0.056	0.027	113585
37	-0.13	0.16	0.07	0.065	0.032	513584
38	-0.17	0.1	0.11	0.06	0.02	113603

Soil (SR 62) - 35 samples were obtained as composites from daily truckloads covering 18 batches, (typically 2 sample groups per batch). Table 12 provides a comparison between SMCM and grab sample results. All samples indicated positive Cs-137 with results ranging from 0.42 to 1.0 pCi/g. No Co-60 was indicated in the samples, (typical MDA was 0.08 pCi/g).

For the case of the soil pile, the SMCM survey data agrees with the laboratory results such that the best estimate of the total pile is 0.683 ± 0.085 pCi/g. When the SMCM did alarm during the SR-62 survey, the suspect material was removed. Therefore, there is no localized (hot-spot) volume of Cs-137 greater than 2.91 pCi/g.

Table 12

5,012 Tons of Soil (Ref SR 62)

	Cs-137 Results (pCi/g)								
Batch	Mean	Max	1 Sigma StDev	Lab Value	2 Sigma StDev	Sample Log Number	Value	2 Sigma StDev	Sample Log Number
1	1.73	2.08	0.12	0.699	0.118	513734	0.572	0.097	113752
2	1.76	2.32	0.24	1.005	0.124	513757	0.584	0.088	113774
3	1.36	1.67	0.09	0.418	0.081	413809	N/A	N/A	N/A
4	1.29	1.56	0.07	0.553	0.096	514128	0.463	0.081	514143
5	1.52	1.83	0.1	0.556	0.088	114165	0.607	0.098	114170
6	1.64	2.04	0.18	0.617	0.094	114177	0.657	0.082	114182
7	1.89	2.29	0.18	0.717	0.112	414197	0.855	0.131	414207
8	1.84	2.21	0.12	0.704	0.106	114218	0.733	0.099	514245
9	1.83	2.19	0.14	0.732	0.099	514245	0.749	0.129	414270
10	2	2.4	0.11	0.811	0.097	114269	0.718	0.117	414283
11	1.78	2.39	0.12	0.768	0.095	114302	0.906	0.115	514297
12	1.8	2.08	0.09	0.721	0.089	114305	1.002	0.111	114306
13	1.87	2.23	0.11	0.728	0.099	114317	0.712	0.099	514319
14	1.74	2.62	0.35	0.768	0.1	114318	0.817	0.104	114341
15	1.63	1.89	0.11	0.67	0.889	114363	0.79	0.101	514364
16	1.45	1.84	0.21	0.695	0.086	114370	0.624	0.084	514371
17	1.6	1.89	0.12	0.641	0.086	514413	0.661	0.089	514414
18	1.68	2.05	0.16	0.696	0.087	114417	0.623	0.08	514418

c. Survey Methodology

The radiation detection system is a conveyor version of the SMCM (Subsurface Multi-spectral Contamination Monitor) that utilizes four-each, 5-inch (12.7 cm) diameter by 2-inch (5.1 cm) thick thallium-doped sodium iodide (NaI (Tl)) detectors. The detectors are arranged in a line along the path of the conveyor, and are located one-half meter apart. Spectra in the energy range from 0.1 to 3 MeV are collected every five seconds via Ortec µAce Multi-Channel Analyzers (MCAs). The nominal conveyor speed was established at 4 inches per second (0.1 meters per second), with spectra collected every 19.7 inches (0.5 meters) of conveyor travel. The conveyor had material limited to 32 inches (0.8 m) wide and 4 inches (0.1 m) deep, with the face of the detectors located 13 inches (0.3 m) from the surface of the conveyed material. This height was chosen to provide a reasonable compromise between uniformity of response and sensitivity to localized sources.

The detectors were centered in 19.7 inch (0.5 meter) diameter barrels. The detectors have thermal shielding, heaters, thermocouples and controls for temperature stabilization, and are shielded with approximately 4 inches (10.2 cm) of sand to reduce the radiation background as well as reducing any variability from changes in background (due to radon in air, moving vehicles, or changes in nearby soil and building debris piles). The detector array is located in an enclosure above the conveyor that is also heated to provide a uniform thermal environment without diurnal variation. The sand shielding restricts the field of view of the detectors to a downward looking, nominal 90 degree angle cone. A 12-foot (3.6 m) by 5-foot (1.5 m) trailer served as a mobile command center (MCC). The SMCM process computer and post-processing computer were operated from within the MCC.

e. Survey Exceptions/Resolutions

Twenty-eight alarms occurred during the survey that included 5,258 (includes 5% re-surveyed) tons of soil. If an alarm occurred, the conveyor was stopped and the data was investigated. The SMCM operator would review the strip chart on the SMCM process software screen. The strip chart shows the four detectors and the diagonal mean of the 4 detectors. From the strip chart, the operator is able to determine if the alarm is a point source or a distributed source and where along the belt the suspect material is located. The best estimate of the source distribution was then described for investigation. Generally, large source distributions would motivate removing dirt from the entire survey conveyor. If the source were localized to a single acquisition, the affected acquisition and at a minimum the two adjoining acquisitions were removed.

Following an alarm from the SMCM, a scan survey was performed on the suspect material using a Ludlum 2350 (or equivalent) meter with a 2' by 2" sodium iodide detector. Any material indicating activity greater than or equal to 2000 NCPM was removed and contained. Fourteen static measurements were obtained when scans indicated >2000 cpm. Static measurements ranged from 467 to 38,312 ncpm.

f. Disposition of Suspect Material

Material causing low volume alarms was removed from conveyor belt and compiled into a suspect pile, which was rescanned and sampled and found to be below the alarm set points. Material causing point source alarms was removed and placed initially into a barrel and later placed into an LSA box for future disposal.

4.0 Data Assessment

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

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

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

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

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

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

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

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

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

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

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

The statistical test does not need to be performed for this final status survey since the data clearly show that the survey unit meets the site release criteria. The survey units clearly meet the criterion because of the following:

1. All measurements in the survey units are less than or equal to the $DCGL_W$, or

2. A background reference area was used and the difference between the maximum survey unit measurement and the minimum background reference area measurement is less than or equal to the DCGL.

5.0 Final Survey Conclusions

The FSS for the CV interior above the 774' elevation (actually between the 775.2' and 805.4' elevations), areas outside the CV on the exterior shell, the associated excavation and soil/debris piles was performed in accordance with Revision 2 of the SNEC LTP and site implementing procedures. Final status survey data was collected to meet and/or exceed the quantity and quality specified for each survey unit as prescribed by the applicable survey design. The survey data for each survey unit met the following conditions:

1. The average residual radioactivity inside and outside the respective CV areas was less than the assigned $DCGL_W$.

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

3. Remediation was performed to reduce the levels of residual radioactivity to below the concentrations necessary to meet the DCGLs.

These conditions satisfy the release criteria established in the SNEC LTP and the radiological criteria for unrestricted use given in 10 CFR 20.1402. Therefore, it is concluded that the SNEC CV Interior and Exterior Shell areas, CV Yard Soil and Debris and Soil Piles as described in this report, are suitable for unrestricted release.

6.0 References

6.1 SNEC License Termination Plan, Revision 2, December 2002.

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

6.3 Compass Computer Program, Version 1.0.0, Oak Ridge Institute for Science and Education.

6.4 Visual Sample Plan, Version 2.0 (or greater), Copyright 2002, Battelle Memorial Institute.

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

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

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

6.8 "Final Status Survey Report for Saxton Nuclear Experimental Corporation CV Interior, 774' El. And Below," Revision 1, August 2003.

6.9 SNEC Survey Request (SR) # 86 – Survey Unit CV1-1

6.10 SNEC Survey Request (SR) # 87 – Survey Unit CV2-24

6.11 SNEC Survey Request (SR) #88 – Survey Units CV1-2 & CV2-25

6.12 SNEC Survey Request (SR) # 89 – Survey Units CV1-3 & CV2-26

6.13 SNEC Survey Request (SR) # 90 – Survey Units CV1-4, CV2-27 & CV2-28

6.14 SNEC Survey Request (SR) # 91 – Survey Units CV4-1, CV6-1 & CV5

6.15 Deleted

6.16 SNEC Survey Request (SR) # 55 – Shonka Surveys on GPU Energy Yard (West Pile)/Backfill Materials from SSGS

6.17 SNEC Survey Request (SR) # 62 – Shonka Surveys on SNEC Yard (East Pile)/Backfill Materials from the SNEC Yard

6.18 SNEC Survey Request (SR) # 93 – Survey Unit OL1-1

7.0 Appendices

Appendix A - SNEC Calculation #E900-03-020, "CV Interior FSS Survey Design."

Appendix B - SNEC Calculation #E900-03-021, "CV Dome Exterior Below Grade Survey Design."

Appendix C - SNEC Calculation #E900-03-022, "CV Yard Soil – Survey Design to El 803'."

Appendix D - Shonka Research Associates, Inc. Report, "Final Report for Survey of Debris Pile," Revision 1, September 22, 2003.

FirstEnergy GPU

SNEC CALCULATION COVER SHEET

CALCULATION DESCRIPTION

Calculation Number	Revision Number	Effective Date	Page Number
E900-03-020	0	8-20-03	1 of 106

Subject

CV Interior FSS Survey Design

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

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

Question 3 - Does the calculation have the potential to affect an SSC as described in the USAR? Yes ☐ No ☒

NOTES: If a "Yes" answer is obtained for Question 1, the calculation must meet the requirements of the SNEC Facility Decommissioning Quality Assurance Plan. If a "Yes" answer is obtained for Question 2, the Calculation Originator's immediate supervisor should not review the calculation as the Technical Reviewer. If a "YES" answer is obtained for Question 3, SNEC Management approval is required to implement the calculation. Calculations that do not have the potential to affect SSC's may be implemented by the TR.

DESCRIPTION OF REVISION

APPROVAL SIGNATURES

Calculation Originator	B. Brosey/ [signature]	Date	8/20/03
Technical Reviewer	P. Donnachie/ [signature]	Date	8/20/03
Additional Review	A. Paynter/ [signature]	Date	8/20/03
Additional Review		Date	
SNEC Management Approval		Date	

1.0 PURPOSE

1.1 The purpose of this calculation is to develop a survey design for nine (9) Class 1 survey units located in the SNEC CV. Four (4) of these survey units have been aggressively decontaminated by SNEC personnel using methods described in Section 4.8 of this calculation. The remaining five (5) survey units (steel support rings), were installed new to the CV to add structural stability to the building during concrete remediation.

1.2 The four (4) CV shell survey units (CV1-1, CV1-2, CV1-3 and CV1-4) are regions of the SNEC CV steel shell. They are shown collectively on **Attachment 1-1**, and individually on **Attachments 1-2** through **1-5**.

1.3 Survey unit designation CV2-24 through CV2-28, are W14 x 74 W-beam support beams which are welded to the CV shell. These are also shown on **Attachment 1-1**, and individually on **Attachment 2-1** and **2-2**. **Attachment 2-3** is a diagram of the W-beam survey area. The area of the CV shell directly under W-beams has been surveyed IAW "at risk" survey designs (see FirstEnergy/GPU Calculation No.'s 6900-02-017, 019, 020, 022, 023 and 024, **Reference 3.1** through **3.6**).

1.4 W-beams were radiologically clean members at the time of installation. W-beam survey units CV2-25 through CV2-28 extend 360 degrees around the inner circumference of the CV shell. Two short additional W-beams located at the 803.5' and 799.5' elevations are together, considered one survey unit (CV2-24). The total area for all 9 survey units is ***693 square meters***. A short description of each survey unit is included below.

1.4.1 Survey unit designation ***CV1-1***, is composed of portions of 10 steel plates (G1 through G5 and F1 through F5), starting at ~805.4' El, and extending down to the ~798.1' El. This survey unit is approximately ***100 square meters*** in total area.

1.4.2 Survey unit designation ***CV1-2***, is composed of portions of 10 steel plates (F1 through F5 and E1 through E5), starting at ~798.1' El., and extending down to the ~790.4' El., This survey unit is approximately ***100 square meters*** in total area.

1.4.3 Survey unit designation ***CV1-3***, is composed of portions of 10 steel plates (E1 through E5 and D1 through D5), starting at ~790.4' El., and extending down to the ~783.3' El., This survey unit is approximately ***91.1 square meters*** in total area.

1.4.4 Survey unit designation ***CV1-4***, is composed of portions of 10 steel plates (D1 through D5), starting at ~783.3' El., and extending down to the ~775.2' El., This survey unit is approximately ***95.1 square meters*** in total area.

1.4.5 Survey unit designation ***CV2-24***, is two short W-beams at the ~803.5' and ~799.5' El. This survey unit is approximately ***33.7 square meters*** in total area.

1.4.6 Survey unit designation ***CV2-25***, is one W-beam at the ~792.5' El. This survey unit is approximately ***68.2 square meters*** in total area.

1.4.7 Survey unit designation ***CV2-26***, is one W-beam at the ~787' El. This survey unit is approximately ***68.2 square meters*** in total area.

1.4.8 Survey unit designation ***CV2-27***, is one W-beam at the ~782' El. This survey unit is approximately ***68.2 square meters*** in total area.

1.4.9 Survey unit designation ***CV2-28***, is one W-beam at the ~778.25' El. This survey unit is approximately ***68.2 square meters*** in total area.

1.5 A significant portion of this survey design has been adapted from **Reference 3-7**.

2.0 SUMMARY OF RESULTS

2.1 The following information should be used to develop a survey request for this survey design:

2.1.1 The number of required static measurement points indicated for each survey unit by Compass is listed below as 8 per survey unit. However, VSP adds additional points in cases where the diagram is odd shaped (edge effect) and/or because of the random starting point. Additionally, the bounded area dictates survey point spacing which also influences the actual number of survey points. For this design, the number of survey points ranges from 12 to 22 per survey unit (see **Attachment 11-1** to **11-9**).

2.1.2 The suggested starting point (0, 0) for physically locating each survey point is typically the lower left hand corner as one faces the survey unit (see **Attachment 11-1** to **11-9**).

2.1.3 The scan speed is set at ***2.2 cm/sec***. ***Scan coverage is set at 100%*** (Class 1 areas).

2.1.4 This survey design requires the detector be in ***contact with the surface*** during all measurement phases except in areas where this is not possible (debits, etc.).

2.1.5 Static measurement points are to be ***clearly marked/identified*** in each survey unit.

2.1.6 Scanning efforts shall be based on ***audible speaker output*** levels. Earphones are recommended.

2.1.7 The DCGLw is 2100 dpm/100 cm^2 or ***400 cpm above background*** for a static measurement.

2.1.8 The action level during first phase scanning is ***200 cpm above background***. If this level is reached, the surveyor should stop and perform ***a count of at least 1/2 minute*** duration to identify the actual count rate.

NOTE: Static and Scan MDC values are listed in the tables in Section 4.15 and 4.16.

2.1.9 ***Areas greater than the DCGLw (400 ncpm) must be identified, documented, marked, and bounded to include an area estimate***.

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

2.1.11 When an obstruction is encountered during the static measurement phase that will not allow placement of a static survey point, contact the cognizant SR coordinator for permission to delete that survey point. Document the reason for the deletion. Note that up to two survey points in any survey unit, may be deleted without reducing survey design effectiveness.

2.1.12 A smear survey shall be performed in each survey unit at static measurement point locations. These smears shall be obtained after static measurements are acquired. These smears shall be assayed for beta/gamma and alpha contamination. Report results in raw uncorrected counts per minute. A composite gamma scan of each survey units smear group shall also be performed and reported.

2.1.13 A gas flow proportional counter (GFPC) shall be used in the beta detection mode for this survey work (Ludlum 2350-1 with a 43-68B probe).

2.1.14 ***Other instruments of the type specified in 2.1.12 above may be used during the FSS but they must demonstrate an efficiency at or above the value listed in Attachment 5-1 (23.9%).***

3.0 REFERENCES

3.1 SNEC Calculation No. 6900-02-017, Interior CV Weld Ring Areas – Survey Plan.

3.2 SNEC Calculation No. 6900-02-019, Interior CV Weld Ring Areas @ 792.5 ft., El.– Survey Plan.

3.3 SNEC Calculation No. 6900-02-020, Interior CV Weld Ring Areas @ 787' El – Survey Plan.

3.4 SNEC Calculation No. 6900-02-022, Interior CV Weld Ring Areas @ 782' El – Survey Plan.

3.5 SNEC Calculation No. 6900-02-023, Interior CV Weld Ring Areas @ 778.25' El – Survey Plan.

3.6 SNEC Calculation No. 6900-02-024, Interior CV Weld Ring Areas @ 774' El – Survey Plan.

3.7 SNEC Calculation No. E900-03-003, CV Interior, 774' El., and Below, FSS Survey Design.

3.8 Plan SNEC Facility License Termination Plan.

3.9 Compass Computer Program, Version 1.0.0, Oak Ridge Institute for Science and Education.

3.10 Visual Sample Plan, Version 2.0 (or greater), Copyright 2002, Battelle Memorial Institute.

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

3.12 Westinghouse Electric Corporation, Gilbert Associates, Inc., Drawing No. D-37798, Saxton Reactor Project, "Containment Vessel Penetration Access", 7/21/60.

3.13 GPU Nuclear, SNEC Facility, "Containment Vessel Survey", SNECRM-019, Rev 1, 1/18/02.

3.14 Ryerson Structural Products Handbook, Joseph T. Ryerson & Son, Inc., 1972.

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

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

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

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

3.19 ISO 7503-1, Evaluation of Surface Contamination, Part 1: Beta-emitters (maximum beta energy greater than 0.15 MeV) and alpha-emitters, 1988.

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

3.21 SNEC Calculation No. 6900-02-028, GFPC Instrument Efficiency Loss Study.

4.0 ASSUMPTIONS AND BASIC DATA

4.1 A gas flow proportional counter (GFPC) will be used in the beta detection mode as the survey instrument (a Ludlum 2350-1 with a 43-68B probe).

4.2 The Compass computer program is used to develop the number of fixed point measurement locations to be taken within each Class 1 survey unit (**Reference 3.9**)

4.3 The WRS statistical testing criteria will be applicable for this survey design.

4.4 The number of points chosen by Compass is located on survey maps for each survey unit by the Visual Sample Plan (VSP) computer code (**Reference 3.10**).

4.5 VSP is used to plot random start systematically spaced fixed point survey locations on diagrams used in the field by survey personnel. The coordinates of the survey points are provided for each survey unit. Because of edge effects and a desire to error on the conservative side, additional measurement points have been forced by increasing the MARSSIM overage above the required 20%. This results in smaller bounded regions then that calculated by Compass.

In the case of the support rings, four quadrants were stacked graphically before plotting out the survey points. The triangular grid is spread over these four quadrants resulting in some differences in vertical point placements between quadrants.

4.6 **Reference 3.11** was used as guidance during the survey design development phase.

4.7 The construction/assembly drawings used to determine the physical extent of these areas are listed as **Reference 3.12** and **3.13**. In addition, **Reference 3.14** was used to establish the surface area of a steel W-beam (see **Attachment 2-3**):

- Flange thickness is 0.783" (4 areas of exposed thickness are considered). Then 4 x 0.783" = 3.132".
- Top width of Flange area is 10.072" wide.
- Bottom Flange area is welded to CV.
- Four areas of exposed Flange are located adjacent to the Web. Then 4 x 4.811" = 19.244".
- Height of Web is taken to be 14.19" – (2 x 0.783") = 12.624" x 2 = 25.248".
- Then the total vertical section is: 3.132" + 10.072" + 19.244" + 25.248" = ***57.7"***

The circumference of the CV is 50 ft x 12"/ft x π = ***1885"*** which is at the welded area of the W-beam (at the surface of the CV). However, since the W-beam is 14.19" in height, the exposed top Flange area of the W-beam is only [(50 ft x 12"/ft) – (2 x 14.19")] x π = ***1796"*** in circumference.

4.8 Remediation History

Remediation of the SNEC CV began with gross decontamination and equipment removal e.g., piping, the steam generator, the pressurizer and the reactor vessel (fall of 1998). Extensive attempts at clean-up of the internal concrete structure indicated that the concrete had to be removed from the facility. In order to accomplish this, ground water abatement around the exterior of the CV was necessary and established. By the fall of 2002 the SNEC CV internal concrete structure was removed in total. However, several external and internal stiffener rings were necessary to maintain structural integrity. These assemblies were welded to the steel shell to add rigidity and produce a safe working environment for remediation crews and survey personnel. The internal surface of the CV steel shell was then cleaned to remove radiological contamination, paint, residual concrete dirt and weld and surface scale. Original weld areas between the sections of steel plate that make up the steel shell were vigorously decontaminated along with apparent surface defects. Remediation efforts of the interior CV steel surface included combinations of the following techniques:

- roto-peening
- liquid paint remover (MIRACHEM)
- surface grinding
- needle gun
- grit blasting
- wire brush
- vacuuming
- surface wipe-down

A decontamination effectiveness check was performed during the cleaning effort by means of biased and unbiased measurements on the surface of the cleaned steel shell using a gas flow proportional counter (GFPC). The criteria for determining when an area was acceptably decontaminated was initially established at < 3 times the local background count rate as determined by closed window readings in the area. Areas above this value were re-cleaned.

A Post Remediation Survey (PRS) was conducted under the guidance of Survey Request (SR) SR-0070, SR-0075, SR-0076 and SR-0077 (**Reference 3.15**). The post remediation survey included both surface scans and static measurements. It also included a surface smear survey. Alpha radiation measurements were also taken at select locations. Smears were counted for both beta-gamma and alpha contamination. The results of the PRS survey effort were reviewed before the start of the Final Status Survey (FSS). The area was then inspected IAW criteria established in **Reference 3.16**, before being approved for FSS activities.

4.9 This survey design uses an effective gross activity DCGLw value developed for these survey units from analysis of scrape samples of the interior surface of the SNEC CV. These samples were taken at five (5) different elevations in the CV. SNEC sample No. SXSD3164 resulted in the lowest calculated gross activity DCGLw value (3880 dpm/100 cm^2), and was chosen to represent all survey units identified within this calculation (see **Attachment 3-1**, and **3-2**). This sample result was then used as input to the Compass computer program (see **Reference 3.7** for details regarding this sample result and the effective DCGLw value calculated for the CV shell area).

A further correction to the gross activity DCGLw is necessary to address de-listed radionuclides and to correct for activated steel in the SNEC CV. These correction factors are reported in the SNEC LTP (Chapter 6 – **Reference 3.8**). In addition, the SNEC facility has instituted an administrative limit of 75% of the allowable dose for the area. The de-listed radionuclide dose is accounted for within the 75% administrative limit, but the activated steel dose correction is not. Therefore, the 3880 dpm/100 cm^2 gross activity DCGLw is lowered by the fraction (25 mrem/y-7.2 mrem/y)/25 mrem/y, which results in 2763 dpm/100 cm^2 as the effective limit. The 75% administrative limit is then applied as follows: 0.75 x 2763 dpm/100 cm^2 = 2072 dpm/100 cm^2. This value is rounded to ***2100 dpm/100 cm^2***. See **Attachment 3-2** and **4-1**.

NOTE: Sample analysis result are decayed to 3/1/03.

4.10 Cs-137, H-3 and Ni-63 account for the majority of radionuclides in the above listed sample.

- SNEC Sample No. SXSD3164 (62.0% Cs-137 + 13.4% H-3 + 22.5% Ni-63) = 97.9%.

H-3 and Ni-63 provide no additional counting efficiency for this survey design. Cs-137 provides the only reasonably detectable radionuclide in this mix. Cs-137's detection efficiency has been checked by SNEC personnel using ISO standard 7503-1 methodology **(Reference 3.19)**. The SNEC facility uses only the lowest reported efficiency for any of the instruments available as input to the survey design process. **Attachment 5-1** indicates an ***instrument efficiency of 0.478***. The ***ISO value of 0.5*** is used as the source efficiency. The instrument S/N used to determine this value is 126218 and the probe S/N is 95080.

Other instruments may be used during the FSS but they must demonstrate an efficiency at or above 0.478 for the instrument efficiency.

4.11 The current version of Compass (version 1.0) does not perform correctly when using the gross activity option. Therefore, an alternative will be implemented for this survey design. The alternative approach involves several small changes that will not negatively impact the survey design process. These changes are:

4.11.1 For this survey design, the efficiency will be input as follows:

- $\varepsilon_i = 0.478$
- ε_s = [0.5 (ISO for Cs-137 energy betas)] x [the fraction of Cs-137 in the source area, which would be 1 for the Cs-137 calibration source or 0.62 for Cs-137 in the remaining CV survey units] x [any surface condition correction factor that impacts efficiency e.g., the impact from an increase in the average distance between the detector and source caused by a rough surface].

4.11.2 A radionuclide will be created in the library of Compass called "Gross Activity". This radionuclide will have the same nuclear parameters as Cs-137 (half-life, decay time, etc.). The effect will be (when called up) that "Gross Activity" will replace Cs-137 on the print-out from the Compass program (administrative impact only).

4.11.3 Only "Gross Activity" will be used in the Compass program for this survey design. However, the Area Factors (AF) input to Compass will be for Co-60, which is the more conservative of all the AF values for radionuclides present in the mix. Note that Co-60 AF values are very close to Cs-137 AF values.

4.12 The detectors physical probe area is 126 cm^2, and the instrument is calibrated to the same source area for Cs-137. The gross activity DCGLw is taken to be 2100 dpm/100 cm^2 x (126 cm^2 physical probe area/100 cm^2) = 2646 x (0.62 disintegrations Cs-137/disintegrations in mix) x ε_i (0.478) x ε_s (0.5) which yields ~392 net cpm above background which is then rounded to 400 ncpm (Compass calculates 397 ncpm as the gross beta DCGLw). The 0.148 count per disintegration counting efficiency considers only the Cs-137 contaminant present in the sample material matrix, and is calculated by: ε_i (0.478) x ε_s (0.5) x 0.62 disintegrations Cs-137/total disintegrations in mix = 0.148 cts/gamma.

4.13 No corrections for backscatter are made for the steel surfaces. Therefore, the source term will be overestimated in all areas where there is no loss in efficiency due to surface defects. Since all areas of the CV are rigorously decontaminated using the same technique(s), it is assumed that areas having significant surface defects (dents, weld buildup, etc.), are well represented by adjacent areas that do not have significant surface defects. Defect areas represent an extremely small fraction of the total surface area of these survey units. Therefore no additional efficiency correction factors will be applied to this survey design.

4.14 The survey units in the CV area are at different elevations below grade. Since below grade ambient background radiation levels (shielded measurements) are lower than grade level background levels, the Williamsburg background unshielded steel survey data will be adjusted downward to estimate this effect. **Attachment 6-1** presents these adjusted values along with the method for making these adjustments based on initial surface measurements in the CV area (see **Attachment 6-2** through **6-5**). Note that ring data is not used to develop survey unit variability. Instead, support ring variability will be assumed the same as the shell survey unit where the rings reside.

Attachment 6-6 through **6-9**, are the adjusted Williamsburg background data files for survey units CV1-1, CV1-2, CV1-3 and CV1-4.

4.15 The static beta-gamma MDC calculation result for the nine survey units is as shown in **Attachments 7-1** through **7-4** (using Williamsburg adjusted unshielded reading). The results are summarized below for a 1 minute count time. The results show an adequate static MDC for this survey work.

Survey Units	Estimated Background (cts/min)	MDC_{STATIC} (dpm/100 cm^2)
CV1-1 and CV2-24	201	370 (Compass = 365)
CV1-2 and CV2-25	176	346 (Compass = 342)
CV1-3 and CV2-26	139	310 (Compass = 306)
CV1-4 and CV2-27 and CV2-28	166	337 (Compass = 333)

4.16 The scan MDC calculation is determined based on a 2.2 cm/sec scan rate, a 1.38 index of sensitivity (95% correct detection probability and 60% false positive), 0.148 counts/disintegration and a 126 cm^2 probe area. This calculation is shown in **Attachment 8-1** through **8-5**. The worst case value calculated is ~574 dpm/100 cm^2 (Compass calculates a value of ~714 dpm/100 cm^2 since it does not use the 126 cm^2 probe correction factor in the equation). Since the scan MDC is less than the gross activity DCGLw in every case for every survey unit, there is no need to add additional survey points to these survey designs for purposes of meeting hot spot design criteria.

Survey Units	Estimated Background (cts/min)	MDC_{SCAN} (dpm/100 cm^2)
CV1-1 and CV2-24	201	574 (Compass = 714)
CV1-2 and CV2-25	176	537 (Compass = 668)
CV1-3 and CV2-26	139	478 (Compass = 594)
CV1-4 and CV2-27 and CV2-28	166	522 (Compass = 649)

4.17 The survey units described in this survey design were inspected after remediation efforts were shown effective. A copy of the SNEC facility post-remediation inspection report **(Reference 3.16)**, is included as **Attachment 9-1** to **9-27**.

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

4.19 The decision error for this survey design is 0.05 for the α value and 0.1 for the β value.

4.20 Special measurements including gamma-ray spectroscopy are not included in this survey design.

4.21 No additional sampling will be performed IAW this survey design.

4.22 The applicable SNEC site radionuclides and their associated DCGLw values are listed on **Exhibit 1** of this calculation.

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

4.24 The applicable Area Factors for these survey units are shown below (Co-60).

AREA (m^2)	AREA FACTOR
1	10.1
4	3.4
9	2
16	1.5
25	1.2
36	1

5.0 CALCULATIONS

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

5.2 See attached Compass output (**Attachment 10-1** to **Attachment 10-28**).

6.0 APPENDICES

6.1 **Attachment 1-1** to **1-5**, are diagrams of survey units on the SNEC CV interior shell showing steel plate designations and stiffener ring installation locations (CV1-1, CV1-2, CV1-3 and CV1-4).

6.2 **Attachment 2-1**, is a diagram of the upper short support rings at the 803.5' and 799.5' El (CV2-24).

6.3 **Attachment 2-2** and **2-3**, is a diagram of a full W-Beam support ring and the associated survey area (CV2-25 to CV2-28).

6.4 **Attachment 3-1**, is Teledyne Brown sample result for sample number SXSD3164.

6.5 **Attachment 3-2**, is the effective gross activity DCGLw calculation for sample SXSD3164. The sample was decayed to 3/1/03 before entry into this sheet.

6.6 **Attachment 4-1**, is the correction factor calculation for correcting the effective DCGLw value to compensate for other source terms in the survey area.

6.7 **Attachment 5-1**, is the SNEC site calibration sheet for the radiation measurement instrument with the lowest Cs-137 detection efficiency.

6.8 **Attachment 6-1**, is the estimated background count rate for the SNEC CV in different survey units based on corrected Williamsburg background measurement data.

6.9 **Attachment 6-2** to **6-5**, is GFPC measurement results from four survey units within the SNEC CV area (CV1-1, CV1-2, CV1-3 and CV1-4).

6.10 **Attachment 6-6** to **6-9**, is corrected Williamsburg unshielded measurement data, used to estimate elevation effects on ambient background in the SNEC CV.

6.11 **Attachment 7-1** to **7-4**, is calculated static MDC values (for CV1-1, CV1-2, CV1-3 and CV1-4) based on the corrected Williamsburg background data.

6.12 **Attachment 8-1** to **8-5**, is calculated scan measurement MDC values (for CV1-1, CV1-2, CV1-3 and CV1-4) based on corrected Williamsburg background data.

6.13 **Attachment 9-1** to **9-27**, is the CV inspection report results for these survey units.

6.14 **Attachment 10-1 to 10-28**, Compass output files for the nine (9) survey units previously described. These are further described by the following:

6.14.1 **Attachment 10-1**, Compass site summary.report listing applicable Area Factors.

6.14.2 **Attachment 10-2** to **10-4**, Compass output for CV1-1 survey unit.

6.14.3 **Attachment 10-5** to **10-7**, Compass output for CV2-24 survey unit.

6.14.4 **Attachment 10-8** to **10-10**, Compass output for CV1-2 survey unit.

6.14.5 **Attachment 10-11** to **10-13**, Compass output for CV2-25 survey unit.

6.14.6 **Attachment 10-14** to **10-16**, Compass output for CV1-3 survey unit.

6.14.7 **Attachment 10-17** to **10-19**, Compass output for CV2-26 survey unit.

6.14.8 **Attachment 10-20** to **10-22**, Compass output for CV1-4 survey unit.

6.14.9 **Attachment 10-23** to **10-25**, Compass output for CV2-27 survey unit.

6.14.10 **Attachment 10-26** to **10-28**, Compass output for CV2-28 survey unit.

6.15 **Attachment 11-1** to **11-9**, VSP located static survey locations plotted on survey unit diagrams.

Exhibit 1

SNEC Facility 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

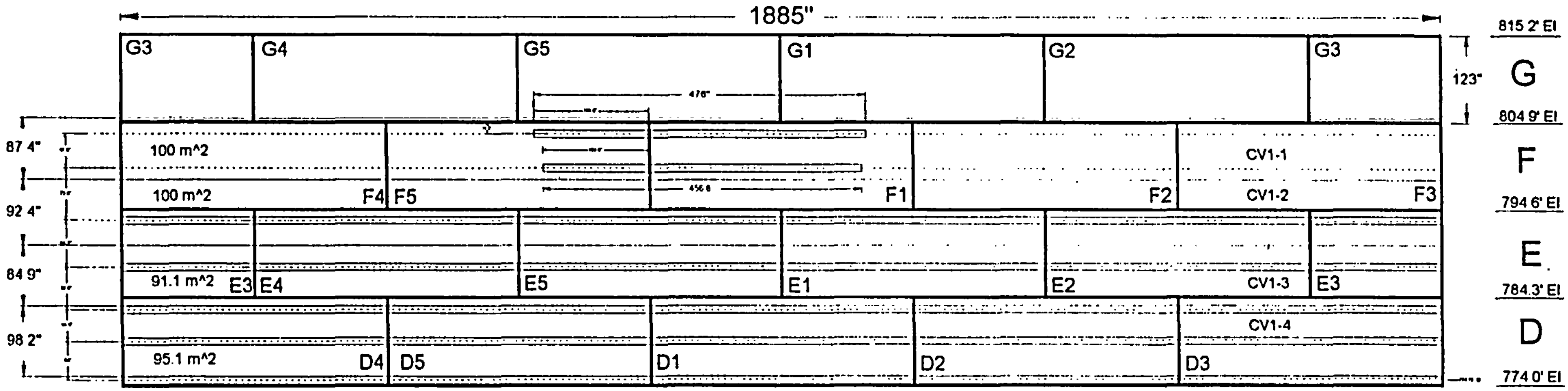
Calculation No. E900-03-020		Location Codes CV2-24, CV2-25, CV2-26, CV2-27, CV2-28, CV1-1, CV1-2 & CV1-3, & CV1-4	
ITEM	REVIEW FOCUS	Status (Circle One)	Reviewer Initials & Date
1	Has a survey design calculation number been assigned and is a survey design summary description provided?	(Yes), N/A	JD 8/20/03
2	Are drawings/diagrams adequate for the subject area (drawings should have compass headings)?	(Yes), N/A	
3	Are boundaries properly identified and is the survey area classification clearly indicated?	(Yes), N/A	
4	Has the survey area(s) been properly divided into survey units IAW EXHIBIT 10	(Yes) N/A	
5	Are physical characteristics of the area/location or system documented?	(Yes), N/A	
6	Is a remediation effectiveness discussion included?	(Yes), N/A	
7	Have characterization survey and/or sampling results been converted to units that are comparable to applicable DCGL values?	(Yes), N/A	
8	Is survey and/or sampling data that was used for determining survey unit variance included?	(Yes), N/A	
9	Is a description of the background reference areas (or materials) and their survey and/or sampling results included along with a justification for their selection?	(Yes), N/A	
10	Are applicable survey and/or sampling data that was used to determine variability included?	(Yes), N/A	
11	Will the condition of the survey area have an impact on the survey design, and has the probable impact been considered in the design?	(Yes), N/A	
12	Has any special area characteristic including any additional residual radioactivity (not previously noted during characterization) been identified along with its impact on survey design?	(Yes) N/A	
13	Are all necessary supporting calculations and/or site procedures referenced or included?	(Yes) N/A	
14	Has an effective DCGLw been identified for the survey unit(s)?	(Yes), N/A	
15	Was the appropriate $DCGL_{EMC}$ included in the survey design calculation?	(Yes), N/A	
16	Has the statistical tests that will be used to evaluate the data been identified?	(Yes), N/A	
17	Has an elevated measurement comparison been performed (Class 1 Area)?	Yes, (N/A)	
18	Has the decision error levels been identified and are the necessary justifications provided?	(Yes), N/A	
19	Has scan instrumentation been identified along with the assigned scanning methodology?	(Yes) N/A	
20	Has the scan rate been identified, and is the MDCscan adequate for the survey design?	(Yes), N/A	
21	Are special measurements e.g., in-situ gamma-ray spectroscopy required under this design, and is the survey methodology, and evaluation methods described?	Yes, (N/A)	
22	Is survey instrumentation calibration data included and are detection sensitivities adequate?	(Yes), N/A	
23	Have the assigned sample and/or measurement locations been clearly identified on a diagram or CAD drawing of the survey area(s) along with their coordinates?	(Yes) N/A	
24	Are investigation levels and administrative limits adequate, and are any associated actions clearly indicated?	(Yes) N/A	
25	For sample analysis, have the required MDA values been determined.?	Yes, (N/A)	
26	Has any special sampling methodology been identified other than provided in Reference 6.3?	Yes, (N/A)	JD 8/20/03

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

CV Wall Plates and Support Rings

Four (4) CV Wall Survey Units Starting 6" Above 804.9' El (Between Red Lines)

Five (5) Ring Survey Units (Top Two Short Rings are 1 Survey Unit)



ATTACHMENT 1 . 1

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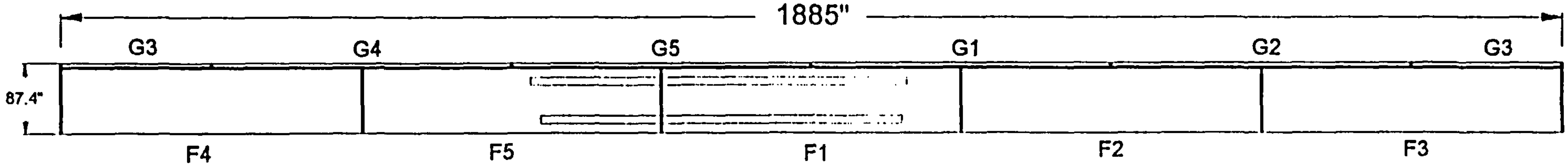
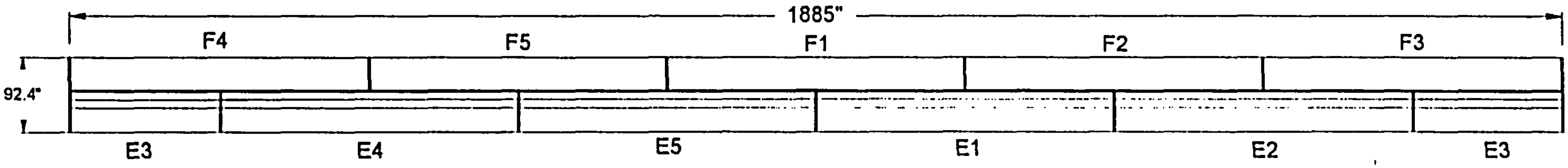
CV1-1 100 m^2, Starts 6" Above the 804.9' El



ATTACHMENT 1 . 2

CV1-2 100 m^2, Starts Bottom of CV1-1



ATTACHMENT 1 . 3

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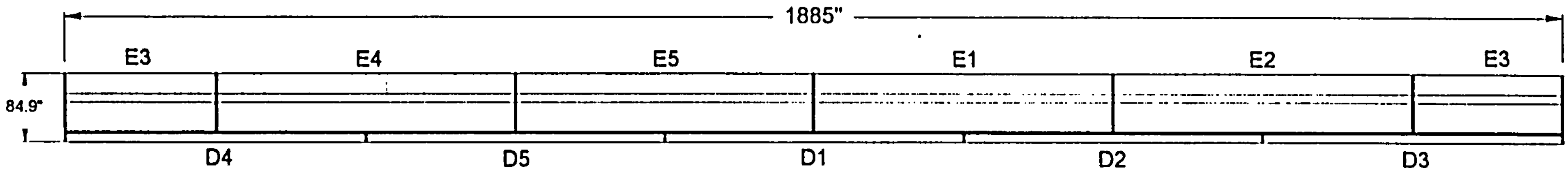
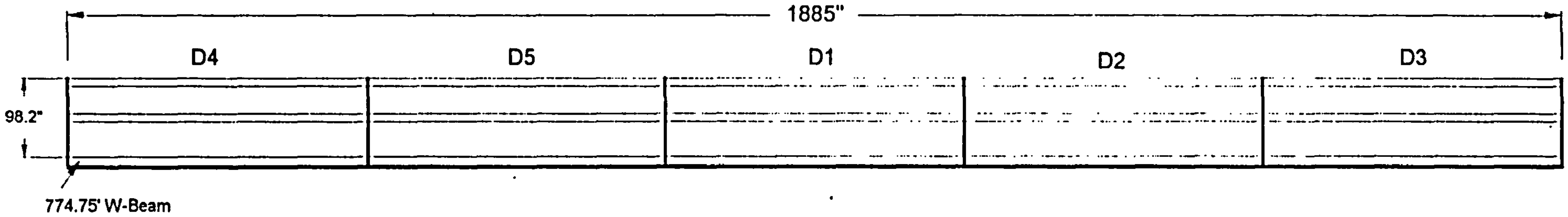
CV1-3 91.1 m^2, Starts Bottom of CV1-2



ATTACHMENT 1.4

CV1- 4 95.1 m^2, Starts Bottom of CV1-3



ATTACHMENT 1 - 5

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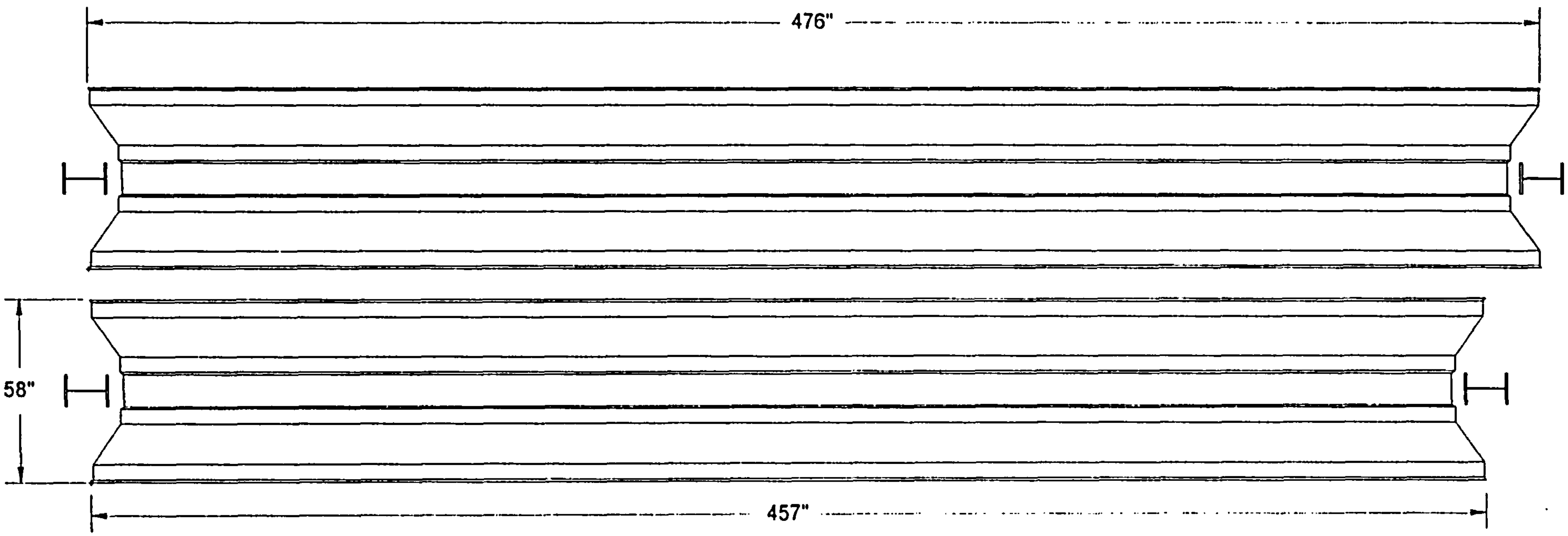
Upper 2 Support Rings - 803.5' & 799.5' El (CV2-24)

W-beam Sections are 17.22 Square Meters & 16.52 Square Meters



ATTACHMENT 2 . 1

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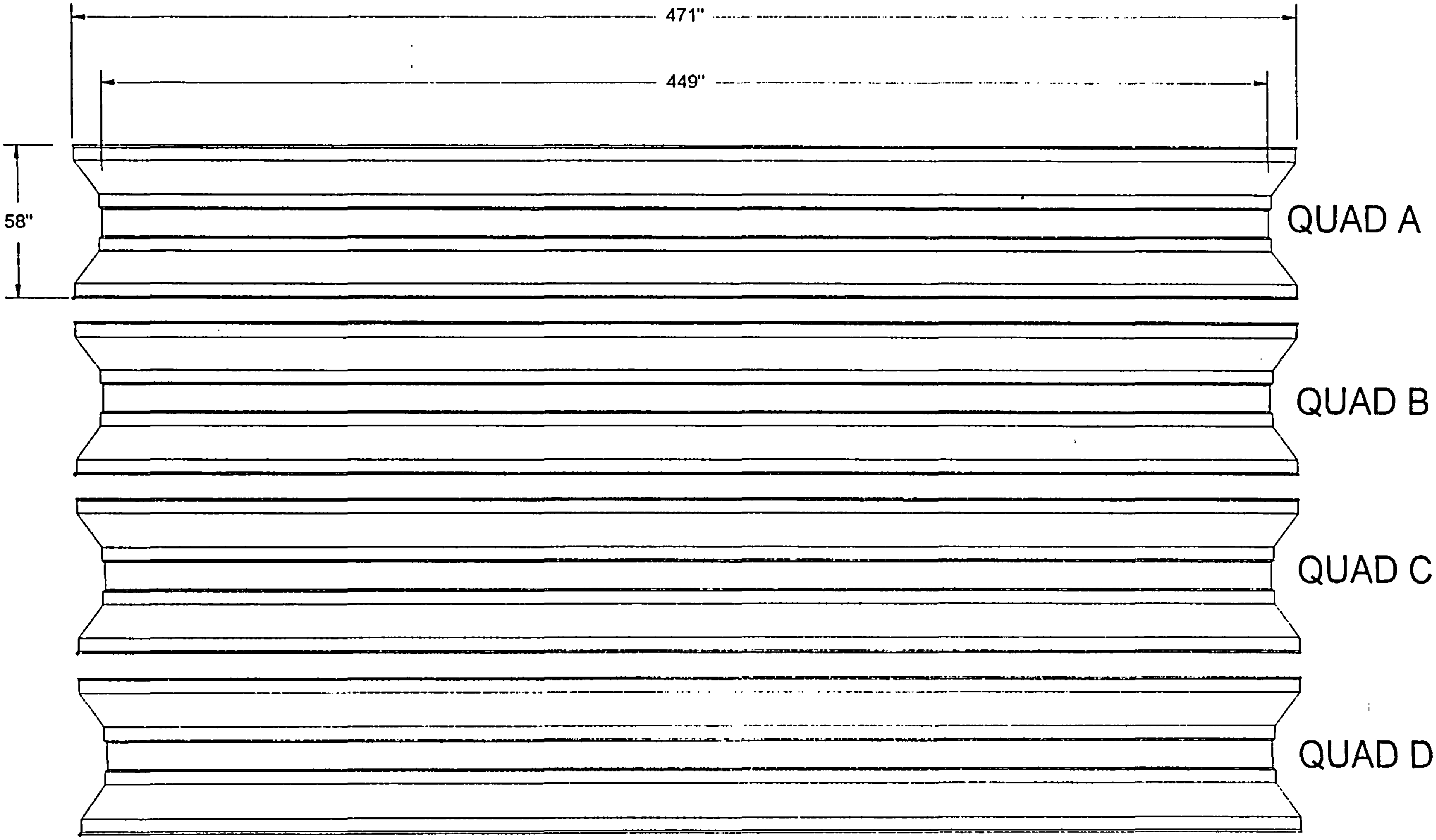
Internal Ring Support Beams (CV2-25, CV2-26, CV2-27, CV2-28)

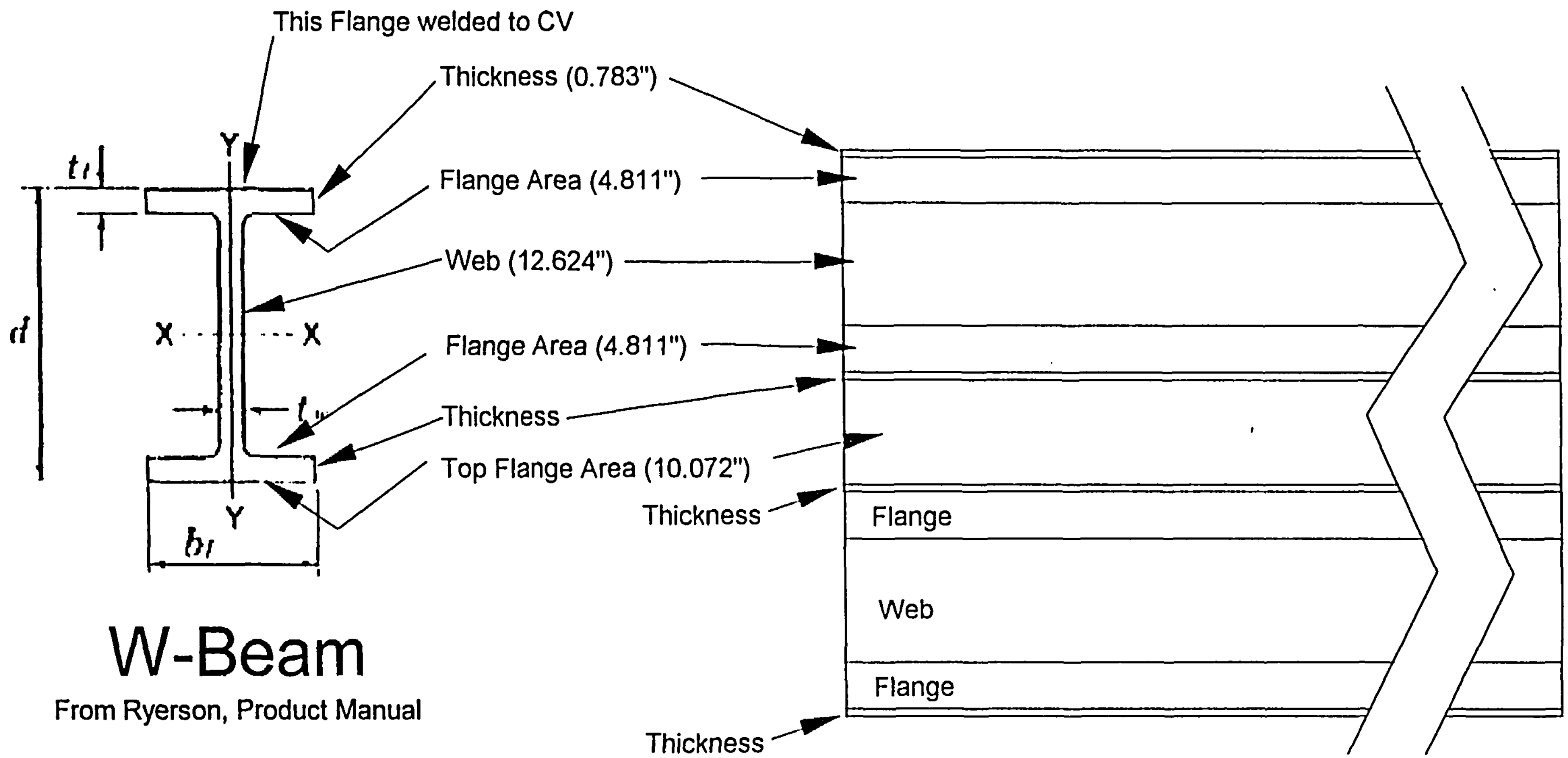
W-beam Quadrant is 17.05 Square Meters - Total Area is 68.21 Square Meters per Beam



ATTACHMENT 2 . 2

Internal Ring Support Details

W-Beam Support Shown Flattened



W-Beam

From Ryerson, Product Manual

ATTACHMENT 2.3

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SNEC SAMPLE RESULTS

LAB or LAB No.	Location/Description
Teledyne-80204; L19215-1	CV Steel Shell Internal Scrapings @ 782' El, Building Structure
SNEC Sample No.	470
SXSD3164	Comments:
Other Identifier	
Revised/Repeat	
Analysis Date=>	*September 24, 2002*

	Isotope	pCi/g (soilids) or pCi/l (if water) or pCi (if smears)
1	Am-241	< 0.167
2	C-14	< 0.201
3	Cm-243	---
4	Cm-244	---
5	Co-60	0.141
6	Cs-134	< 0.071
7	Cs-137	23.5
8	Eu-152	< 0.135
9	Eu-154	---
10	Eu-155	---
11	Fe-55	---
12	H-3	5.14
13	Nb-94	< 0.0562
14	Ni-59	---
15	Ni-63	< 8.47
16	Pu-238	< 0.127
17	Pu-239	< 0.0735
18	Pu-240	---
19	Pu-241	< 6.64
20	Pu-242	---
21	Sb-125	< 0.26
22	Sr-90	< 0.223
23	Tc-99	---
24	U-234	---
25	U-235	---
26	U-238	---

Other Isotopes	pCi/g (soilids) or pCi/l (if water) or pCi (if smears)
On-site Analysis for Cs-137	27.7
On-site Analysis for Co-60	< 0.19
On-site Analysis for H-3	---
I-129	---
Gross Alpha	---
Gross Beta	---
K-40	< 1.28
Ra-226	< 1.81
Th-232	< 0.349
Cm-242	---
Th-228	< 0.518
Np-237	---
Ce-144	< 0.38

Effective DCGL Calculator for Cs-137 (dpm/100 cm^2)

Gross Activity DCGLw		Gross Activity Administrative Limit	
3880	dpm/100 cm^2	2072	dpm/100 cm^2

25.0 mrem/y TEDE Limit

SAMPLE NO(s)⇒ SXSD3164 - 782' El SNEC CV Shell Scrape Sample

Cs-137 Limit		Cs-137 Administrative Limit	
2406	dpm/100 cm^2	1285	dpm/100 cm^2

SNEC AL	53%

	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	1.67E-01	0.445%	27	17.27	15.99	N/A	17.27	Am-241
2	C-14	2.01E-01	0.536%	3,700,000	20.78	0.00	20.78	N/A	C-14
3	Co-60	1.33E-01	0.354%	7,100	13.75	0.05	13.75	N/A	Co-60
4	Cs-137	2.33E+01	62.008%	28,000	2405.64	2.15	2405.6	N/A	Cs-137
5	Eu-152		0.000%	13,000	0.00	0.00	0.00	N/A	Eu-152
6	H-3	5.02E+00	13.367%	120,000,000	518.60	0.00	Not Detectable	N/A	H-3
7	Ni-63	8.45E+00	22.506%	1,800,000	873.12	0.01	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	7.30E-02	0.195%	28	7.55	6.74	N/A	7.55	Pu-239
10	Pu-241		0.000%	880	0.00	0.00	Not Detectable	N/A	Pu-241
11	Sr-90	2.21E-01	0.589%	8,700	22.85	0.07	22.85	N/A	Sr-90
			100.000%		3880	25.0	2463	25	
					Maximum Permissible dpm/100 cm^2				

ATTACHMENT 3-2

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ATTACHMENT 4.1

CV Shell Area		Administrative Limit (AL)=>	75%
	mrem/y		
Activated Steel =>	7.2		
Misc. Radionuclides =>	Included in AL	Remaining mrem/y	Remaining mrem/y after AL
Total=>	7.200	17.80	13.35
			Required Correction Factor
			53.4%

N/A

SSGS & DT	mrem/y		
SSGS. Pipe =>	0.611		
Misc. Radionuclides =>	Included in AL	Remaining mrem/y	Remaining mrem/y after AL
Total=>	0.[illegible]1	[illegible]4[illegible]	18.29
			Required Correction Factor
			73.2%

NOTE: Admin. Limit includes de-listed radionuclides dose of 0.8625 mrem/y

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ORIGINAL

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GFPC Radiation Measurement Instrument Calibration Worksheet

Performed By:	R. J. Reheard	Date:	6/24/03
Instrument S/N:	126218	Probe S/N:	95080
Instrument Vendor Cal. Date:	12/20/03	Cal. Due Date:	12/20/03

Source No.	ISO 7503-1 Values "εs"	Reference Date	As in µCi (± 6%)	2π β or α Emission Rate (sec-1) (± 3%)	
Am-241 (GO 535) S-023	0.25	4/8/99 12:00 GMT	4.24E-01	7.43E+03	☐ Am-241
Cs-137 (GO 536) S-024	0.50	4/8/99 12:00 GMT	3.11E-01	6.89E+03	☑ Cs-137

	Source Radionuclide	Decay Date
	Cs-137	6/24/03
Decay Factor⇒	9.075E-01	

Elapsed Time (days)⇒	1538
Activity (µCi)⇒	2.821E-01
Source dpm⇒	6.262E+05
Source dpm/in Probe Area (cm^2)⇒	5.260E+05
2π Emission Rate (sec-1)⇒	6.253E+03
2π Emission Rate (min-1)⇒	3.752E+05
2π Emission Rate in Probe Area (min-1)⇒	3.151E+05

Probe Area (cm^2)
126

☑ Check if using ISO 7503-1 Value

Record of 1 Minute Source & Background Counting Results

No.	OW Source Gross CPM	OW Background CPM	OW Source Net CPM
1	1.48E+05	181	1.483E+05
2	1.49E+05	203	1.490E+05
3	1.50E+05	186	1.499E+05
4	1.50E+05	193	1.502E+05
5	1.51E+05	182	1.507E+05
6	1.51E+05	164	1.508E+05
7	1.52E+05	170	1.515E+05
8	1.51E+05	177	1.513E+05
9	1.52E+05	161	1.520E+05
10	1.52E+05	162	1.515E+05
	Mean⇒	177.9	1.505E+05

RESULTS
Counts/Emission (εi)
47.8%
2π Emission/Disintigration (εs)
50.0%
Counts/Disintigration (εt)
23.9%

Approved: J Duskin / [signature]

Date: 6/25/03

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

ATTACHMENT 5.1

Survey Unit	Mean Shielded	Mean Unshielded	Estimate of Background
CV1-1	190.4	214.5	***201.4***
CV1-2	165	170.4	***176***
CV1-3	128.3	140.9	***139.3***
CV1-4	155.3	162.7	***166.3***
Williamsburg	200	211	

A background estimate is provided for each SU. The estimate assumes that the only difference between unshielded measurements in the CV and at Williamsburg (when no contamination is present), is the difference between shielded measurements at the two locations.

Support ring estimates are assumed to be the same as the measurements of the CV shell area where the rings reside.

$$\text{Background Estimate} = \text{Williamsburg Unshielded} - (\text{Williamsburg Shielded} - \text{Survey Unit Shielded})$$

ATTACHMENT 6.1

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CV1-1 Survey Unit

37122N21	126188	RM6220								Net	Shielded	Unshielded
9	CV1-1F11S	8/12/2003	11:39	1	1.83E+02	60	SCL	0			1.83E+02	
10	CV1-1F11U	8/12/2003	11:41	1	1.99E+02	60	SCL	0		16		1.99E+02
11	CV1-1F12S	8/12/2003	11:43	1	1.91E+02	60	SCL	0			1.91E+02	
12	CV1-1F12U	8/12/2003	11:45	1	2.08E+02	60	SCL	0		17		2.08E+02
13	CV1-1F13S	8/12/2003	11:47	1	1.98E+02	60	SCL	0			1.98E+02	
14	CV1-1F13U	8/12/2003	11:49	1	2.21E+02	60	SCL	0		23		2.21E+02
15	CV1-1F24S	8/12/2003	11:52	1	1.59E+02	60	SCL	0			1.59E+02	
16	CV1-1F24U	8/12/2003	11:53	1	1.85E+02	60	SCL	0		26		1.85E+02
17	CV1-1F25S	8/12/2003	11:56	1	1.69E+02	60	SCL	0			1.69E+02	
18	CV1-1F25U	8/12/2003	11:57	1	1.62E+02	60	SCL	0		-7		1.62E+02
19	CV1-1F26S	8/12/2003	12:00	1	1.57E+02	60	SCL	0			1.57E+02	
20	CV1-1F26U	8/12/2003	12:02	1	2.16E+02	60	SCL	0		59		2.16E+02
21	CV1-1F37S	8/12/2003	12:08	1	1.71E+02	60	SCL	0			1.71E+02	
22	CV1-1F37U	8/12/2003	12:09	1	2.25E+02	60	SCL	0		54		2.25E+02
23	CV1-1F38S	8/12/2003	12:12	1	1.84E+02	60	SCL	0			1.84E+02	
24	CV1-1F38U	8/12/2003	12:13	1	2.46E+02	60	SCL	0		62		2.46E+02
25	CV1-1F39S	8/12/2003	12:16	1	2.24E+02	60	SCL	0			2.24E+02	
26	CV1-1F39U	8/12/2003	12:17	1	2.00E+02	60	SCL	0		-24		2.00E+02
27	CV1-1F410S	8/12/2003	12:19	1	1.65E+02	60	SCL	0			1.65E+02	
28	CV1-1F410U	8/12/2003	12:21	1	2.14E+02	60	SCL	0		49		2.14E+02
29	CV1-1F411S	8/12/2003	12:23	1	2.17E+02	60	SCL	0			2.17E+02	
30	CV1-1F411U	8/12/2003	12:24	1	2.15E+02	60	SCL	0		-2		2.15E+02
31	CV1-1F412S	8/12/2003	12:26	1	1.97E+02	60	SCL	0			1.97E+02	
32	CV1-1F412U	8/12/2003	12:27	1	2.39E+02	60	SCL	0		42		2.39E+02
33	CV1-1F513S	8/12/2003	12:30	1	1.85E+02	60	SCL	0			1.85E+02	
34	CV1-1F513U	8/12/2003	12:31	1	2.17E+02	60	SCL	0		32		2.17E+02
35	CV1-1F514S	8/12/2003	12:33	1	2.10E+02	60	SCL	0			2.10E+02	
36	CV1-1F514U	8/12/2003	12:35	1	2.19E+02	60	SCL	0		9		2.19E+02
37	CV1-1F515S	8/12/2003	12:36	1	2.07E+02	60	SCL	0			2.07E+02	
38	CV1-1F515U	8/12/2003	12:38	1	2.20E+02	60	SCL	0		13		2.20E+02
39	CV1-1F516S	8/12/2003	12:40	1	2.30E+02	60	SCL	0			2.30E+02	
40	CV1-1F516U	8/12/2003	12:42	1	2.46E+02	60	SCL	0		16		2.46E+02
									Mean	24.1	190.4	214.5
									Sigma	24.6	22.9	21.5
									Minimum	-24.0	157.0	162.0
									Maximum	62.0	230.0	246.0

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CV1-2 Survey Unit

37122N21	126206	RM6220						Net	Shielded	Unshielded
5	CV1-2 F11S	8/13/2003	6:41	1	1.89E+02	60 SCL	0		1.89E+02	
6	CV1-2 F11U	8/13/2003	6:42	1	1.75E+02	60 SCL	0	-14		1.75E+02
7	CV1-2 F12S	8/13/2003	6:45	1	1.65E+02	60 SCL	0		1.65E+02	
8	CV1-2 F12U	8/13/2003	6:47	1	1.74E+02	60 SCL	0	9		1.74E+02
9	CV1-2 F13S	8/13/2003	6:49	1	1.46E+02	60 SCL	0		1.46E+02	
10	CV1-2 F13U	8/13/2003	6:51	1	1.53E+02	60 SCL	0	7		1.53E+02
11	CV1-2 F24S	8/13/2003	6:52	1	1.53E+02	60 SCL	0		1.53E+02	
12	CV1-2 F24U	8/13/2003	6:54	1	1.39E+02	60 SCL	0	-14		1.39E+02
13	CV1-2 F25S	8/13/2003	6:57	1	1.87E+02	60 SCL	0		1.87E+02	
14	CV1-2 F25U	8/13/2003	6:58	1	1.66E+02	60 SCL	0	-21		1.66E+02
15	CV1-2 F26S	8/13/2003	7:00	1	1.59E+02	60 SCL	0		1.59E+02	
16	CV1-2 F26U	8/13/2003	7:02	1	1.83E+02	60 SCL	0	24		1.83E+02
17	CV1-2 F37S	8/13/2003	7:04	1	1.72E+02	60 SCL	0		1.72E+02	
18	CV1-2 F37U	8/13/2003	7:06	1	1.81E+02	60 SCL	0	9		1.81E+02
19	CV1-2 F38S	8/13/2003	7:09	1	1.83E+02	60 SCL	0		1.83E+02	
20	CV1-2 F38U	8/13/2003	7:11	1	1.56E+02	60 SCL	0	-27		1.56E+02
21	CV1-2 F39S	8/13/2003	7:13	1	1.52E+02	60 SCL	0		1.52E+02	
22	CV1-2 F39U	8/13/2003	7:14	1	2.24E+02	60 SCL	0	72		2.24E+02
23	CV1-2 F4 10S	8/13/2003	7:17	1	1.54E+02	60 SCL	0		1.54E+02	
24	CV1-2 F4 10U	8/13/2003	7:19	1	1.67E+02	60 SCL	0	13		1.67E+02
25	CV1-2 F4 11S	8/13/2003	7:21	1	1.64E+02	60 SCL	0		1.64E+02	
26	CV1-2 F4 11U	8/13/2003	7:22	1	1.87E+02	60 SCL	0	23		1.87E+02
27	CV1-2 F4 12S	8/13/2003	7:24	1	1.53E+02	60 SCL	0		1.53E+02	
28	CV1-2 F4 12U	8/13/2003	7:25	1	1.61E+02	60 SCL	0	8		1.61E+02
29	CV1-2 F5 13S	8/13/2003	7:27	1	1.81E+02	60 SCL	0		1.81E+02	
30	CV1-2 F5 13U	8/13/2003	7:29	1	1.65E+02	60 SCL	0	-16		1.65E+02
31	CV1-2 F5 14S	8/13/2003	9:29	1	1.44E+02	60 SCL	0		1.44E+02	
32	CV1-2 F5 14U	8/13/2003	9:31	1	1.61E+02	60 SCL	0	17		1.61E+02
33	CV1-2 F5 15S	8/13/2003	9:42	1	1.73E+02	60 SCL	0		1.73E+02	
34	CV1-2 F5 15U	8/13/2003	9:44	1	1.64E+02	60 SCL	0	-9		1.64E+02
							Mean	5.4	165.0	170.4
							Sigma	24.6	15.0	19.3
							Minimum	-27.0	144.0	139.0
							Maximum	72.0	189.0	224.0

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CV1-3 Survey Unit

37122N21	126218	JG1135							Net	Shielded	Unshielded
2	CV1 3E2 1S	8/14/2003	7:53	1	1.26E+02	60	SCL	0		1.26E+02	
3	CV1 3E2 1U	8/14/2003	7:55	1	1.27E+02	60	SCL	0	1		1.27E+02
4	CV1 3E2 2S	8/14/2003	7:59	1	1.23E+02	60	SCL	0		1.23E+02	
5	CV1 3E2 2U	8/14/2003	8:01	1	1.20E+02	60	SCL	0	-3		1.20E+02
7	CV1 3E2 3S	8/14/2003	8:07	1	1.42E+02	60	SCL	0		1.42E+02	
8	CV1 3E2 3U	8/14/2003	8:08	1	1.66E+02	60	SCL	0	24		1.66E+02
9	CV1 3E3 4S	8/14/2003	8:12	1	1.31E+02	60	SCL	0		1.31E+02	
10	CV1 3E3 4U	8/14/2003	8:14	1	1.57E+02	60	SCL	0	26		1.57E+02
11	CV1 3E3 5S	8/14/2003	8:17	1	1.21E+02	60	SCL	0		1.21E+02	
12	CV1 3E3 5U	8/14/2003	8:18	1	1.31E+02	60	SCL	0	10		1.31E+02
13	CV1 3E3 6S	8/14/2003	8:20	1	1.37E+02	60	SCL	0		1.37E+02	
14	CV1 3E3 6U	8/14/2003	8:22	1	1.45E+02	60	SCL	0	8		1.45E+02
15	CV1 3E3 7S	8/14/2003	8:24	1	1.40E+02	60	SCL	0		1.40E+02	
16	CV1 3E4 7U	8/14/2003	8:25	1	1.42E+02	60	SCL	0	2		1.42E+02
17	CV1 3E4 8S	8/14/2003	8:31	1	1.12E+02	60	SCL	0		1.12E+02	
18	CV1 3E4 8U	8/14/2003	8:34	1	1.47E+02	60	SCL	0	35		1.47E+02
19	CV1 3E4 9S	8/14/2003	8:37	1	1.28E+02	60	SCL	0		1.28E+02	
20	CV1 3E4 9U	8/14/2003	8:39	1	1.46E+02	60	SCL	0	18		1.46E+02
21	CV1 3E510S	8/14/2003	8:42	1	1.40E+02	60	SCL	0		1.40E+02	
22	CV1 3E510U	8/14/2003	8:43	1	1.18E+02	60	SCL	0	-22		1.18E+02
23	CV1 3E511S	8/14/2003	8:50	1	1.34E+02	60	SCL	0		1.34E+02	
25	CV1 3E511U	8/14/2003	8:55	1	1.32E+02	60	SCL	0	-2		1.32E+02
27	CV1 3E512S	8/14/2003	9:00	1	1.04E+02	60	SCL	0		1.04E+02	
28	CV1 3E512U	8/14/2003	9:02	1	1.41E+02	60	SCL	0	37		1.41E+02
29	CV1 3E113S	8/14/2003	9:03	1	1.30E+02	60	SCL	0		1.30E+02	
30	CV1 3E113U	8/14/2003	9:05	1	1.21E+02	60	SCL	0	-9		1.21E+02
31	CV1 3E114S	8/14/2003	9:09	1	1.17E+02	60	SCL	0		1.17E+02	
32	CV1 3E114U	8/14/2003	9:10	1	1.58E+02	60	SCL	0	41		1.58E+02
33	CV1 3E115S	8/14/2003	9:13	1	1.39E+02	60	SCL	0		1.39E+02	
34	CV1 3E115U	8/14/2003	9:15	1	1.62E+02	60	SCL	0	23		1.62E+02
								Mean	12.6	128.3	140.9
								Sigma	18.4	11.2	15.7
								Minimum	-22.0	104.0	118.0
								Maximum	41.0	142.0	166.0

CV1-4 Survey Unit

37122N21	126206	BN8487							Net	Shielded	Unshielded
9	CV1-41S	8/14/2003	10:22	1	1.40E+02	60	SCL	0		1.40E+02	
10	CV1-41U	8/14/2003	10:24	1	1.73E+02	60	SCL	0	33		1.73E+02
11	CV1-42S	8/14/2003	10:31	1	1.40E+02	60	SCL	0		1.40E+02	
12	CV1-42U	8/14/2003	10:32	1	1.58E+02	60	SCL	0	18		1.58E+02
13	CV1-43S	8/14/2003	10:34	1	1.58E+02	60	SCL	0		1.58E+02	
14	CV1-43U	8/14/2003	10:35	1	1.54E+02	60	SCL	0	-4		1.54E+02
15	CV1-44S	8/14/2003	10:38	1	1.17E+02	60	SCL	0		1.17E+02	
16	CV1-44U	8/14/2003	10:39	1	1.32E+02	60	SCL	0	15		1.32E+02
17	CV1-45S	8/14/2003	10:44	1	1.53E+02	60	SCL	0		1.53E+02	
18	CV1-45U	8/14/2003	10:47	1	1.79E+02	60	SCL	0	26		1.79E+02
19	CV1-46S	8/14/2003	10:49	1	1.66E+02	60	SCL	0		1.66E+02	
20	CV1-46U	8/14/2003	10:51	1	1.74E+02	60	SCL	0	8		1.74E+02
21	CV1-47S	8/14/2003	10:54	1	1.67E+02	60	SCL	0		1.67E+02	
22	CV1-47U	8/14/2003	10:57	1	1.84E+02	60	SCL	0	17		1.84E+02
23	CV1-48S	8/14/2003	11:02	1	1.36E+02	60	SCL	0		1.36E+02	
24	CV1-48U	8/14/2003	11:05	1	1.60E+02	60	SCL	0	24		1.60E+02
25	CV1-49S	8/14/2003	11:09	1	1.69E+02	60	SCL	0		1.69E+02	
26	CV1-49U	8/14/2003	11:11	1	1.52E+02	60	SCL	0	-17		1.52E+02
27	CV1-410S	8/14/2003	11:17	1	1.61E+02	60	SCL	0		1.61E+02	
28	CV1-410U	8/14/2003	11:19	1	1.72E+02	60	SCL	0	11		1.72E+02
29	CV1-411S	8/14/2003	12:54	1	1.75E+02	60	SCL	0		1.75E+02	
30	CV1-411U	8/14/2003	12:56	1	1.61E+02	60	SCL	0	-14		1.61E+02
31	CV1-412S	8/14/2003	12:58	1	1.74E+02	60	SCL	0		1.74E+02	
32	CV1-412U	8/14/2003	13:00	1	1.72E+02	60	SCL	0	-2		1.72E+02
33	CV1-413S	8/14/2003	13:12	1	1.37E+02	60	SCL	0		1.37E+02	
34	CV1-413U	8/14/2003	13:14	1	1.55E+02	60	SCL	0	18		1.55E+02
35	CV1-414S	8/14/2003	13:16	1	1.60E+02	60	SCL	0		1.60E+02	
36	CV1-414U	8/14/2003	13:18	1	1.70E+02	60	SCL	0	10		1.70E+02
37	CV1-415S	8/14/2003	13:21	1	1.46E+02	60	SCL	0		1.46E+02	
38	CV1-415U	8/14/2003	13:23	1	1.67E+02	60	SCL	0	21		1.67E+02
39	CV1-416S	8/14/2003	13:30	1	1.37E+02	60	SCL	0		1.37E+02	
40	CV1-416U	8/14/2003	13:31	1	1.45E+02	60	SCL	0	8		1.45E+02
41	CV1-417S	8/14/2003	13:35	1	1.56E+02	60	SCL	0		1.56E+02	
42	CV1-417U	8/14/2003	13:37	1	1.71E+02	60	SCL	0	15		1.71E+02
43	CV1-418S	8/14/2003	13:41	1	1.43E+02	60	SCL	0		1.43E+02	
44	CV1-418U	8/14/2003	13:43	1	1.44E+02	60	SCL	0	1		1.44E+02
45	CV1-419S	8/14/2003	13:46	1	1.81E+02	60	SCL	0		1.81E+02	
46	CV1-419U	8/14/2003	13:49	1	1.66E+02	60	SCL	0	-15		1.66E+02
47	CV1-420S	8/14/2003	13:52	1	1.89E+02	60	SCL	0		1.89E+02	
48	CV1-420U	8/14/2003	13:54	1	1.64E+02	60	SCL	0	-25		1.64E+02
								Mean	7.4	155.3	162.7
								Sigma	15.9	18.1	12.9
								Minimum	-25.0	117.0	132.0
								Maximum	33.0	189.0	184.0

Williamsburg Steel Background Measurements SR-48

37122N21	Instrument 95348	RJR9291	Time	Detector	Counts	Count Time (sec)	Mode	Designator		FSS-004	BHB
0	BKGND	11/14/2002	6:47	1	6 54E+03	1800	SCL	Inital Background	β	Steel CF(cpm) ⇒	9.6
1	Source Check	11/14/2002	9:54	1	1.70E+05	60	SCL	Source	β	Shielded	Unshielded
2	STEELA1S	11/14/2002	10:32	1	2.13E+02	60	SCL	Shielded	β	2.13E+02	
3	STEELA1U	11/14/2002	10:33	1	2.04E+02	60	SCL	Unshielded	β		1.94E+02
4	STEELA2S	11/14/2002	10:37	1	2.03E+02	60	SCL	Shielded	β	2.03E+02	
5	STEELA2U	11/14/2002	10:38	1	2.25E+02	60	SCL	Unshielded	β		2.15E+02
6	STEELA3S	11/14/2002	10:39	1	1.85E+02	60	SCL	Shielded	β	1.85E+02	
7	STEELA3U	11/14/2002	10:40	1	2.09E+02	60	SCL	Unshielded	β		1.99E+02
8	STEELA4S	11/14/2002	10:42	1	2.03E+02	60	SCL	Shielded	β	2.03E+02	
9	STEELA4U	11/14/2002	10:43	1	1.67E+02	60	SCL	Unshielded	β		1.57E+02
10	STEELA5S	11/14/2002	10.44	1	1.55E+02	60	SCL	Shielded	β	1.55E+02	
11	STEELA5U	11/14/2002	10:45	1	2.26E+02	60	SCL	Unshielded	β		2.16E+02
12	STEELA6S	11/14/2002	10.46	1	1.92E+02	60	SCL	Shielded	β	1.92E+02	
13	STEELA6U	11/14/2002	10:47	1	1.95E+02	60	SCL	Unshielded	β		1.85E+02
14	STEELA7S	11/14/2002	10:48	1	1.96E+02	60	SCL	Shielded	β	1.96E+02	
15	STEELA7U	11/14/2002	10:50	1	2.01E+02	60	SCL	Unshielded	β		1.91E+02
16	STEELA8S	11/14/2002	10:51	1	2.15E+02	60	SCL	Shielded	β	2.15E+02	
17	STEELA8U	11/14/2002	10:52	1	2.38E+02	60	SCL	Unshielded	β		2.28E+02
18	STEELA9S	11/14/2002	10:53	1	2.00E+02	60	SCL	Shielded	β	2.00E+02	
19	STEELA9U	11/14/2002	10:54	1	1.92E+02	60	SCL	Unshielded	β		1.82E+02
20	STEELA10S	11/14/2002	10:56	1	1.83E+02	60	SCL	Shielded	β	1.83E+02	
21	STEELA10U	11/14/2002	10:57	1	2.25E+02	60	SCL	Unshielded	β		2.15E+02
22	STEELA11S	11/14/2002	10:58	1	1.95E+02	60	SCL	Shielded	β	1.95E+02	
23	STEELA11U	11/14/2002	10 59	1	2.15E+02	60	SCL	Unshielded	β		2.05E+02
24	STEELA12S	11/14/2002	11:00	1	1.77E+02	60	SCL	Shielded	β	1.77E+02	
25	STEELA12U	11/14/2002	11:01	1	2.34E+02	60	SCL	Unshielded	β		2.24E+02
26	STEELA13S	11/14/2002	11:03	1	2.02E+02	60	SCL	Shielded	β	2.02E+02	
27	STEELA13U	11/14/2002	11:05	1	2.18E+02	60	SCL	Unshielded	β		2.08E+02
28	STEELA14S	11/14/2002	11:06	1	1.89E+02	60	SCL	Shielded	β	1.89E+02	
29	STEELA14U	11/14/2002	11:07	1	1.99E+02	60	SCL	Unshielded	β		1.89E+02
30	STEELA15S	11/14/2002	11:08	1	2 16E+02	60	SCL	Shielded	β	2.16E+02	
31	STEELA15U	11/14/2002	11:09	1	2.15E+02	60	SCL	Unshielded	β		2.05E+02
32	STEELA16S	11/14/2002	11:10	1	1.88E+02	60	SCL	Shielded	β	1.88E+02	
33	STEELA16U	11/14/2002	11:11	1	2.05E+02	60	SCL	Unshielded	β		1.95E+02
34	STEELA17S	11/14/2002	11:13	1	2.12E+02	60	SCL	Shielded	β	2.12E+02	
35	STEELA17U	11/14/2002	11:14	1	2.11E+02	60	SCL	Unshielded	β		2.01E+02
36	STEELA18S	11/14/2002	11:15	1	2.00E+02	60	SCL	Shielded	β	2.00E+02	
37	STEELA18U	11/14/2002	11:16	1	1.93E+02	60	SCL	Unshielded	β		1.83E+02
38	STEELA19S	11/14/2002	11:17	1	1.84E+02	60	SCL	Shielded	β	1.84E+02	
39	STEELA19U	11/14/2002	11:18	1	2.09E+02	60	SCL	Unshielded	β		1.99E+02
40	STEELA20S	11/14/2002	11:19	1	1.94E+02	60	SCL	Shielded	β	1.94E+02	
41	STEELA20U	11/14/2002	11:20	1	2.30E+02	60	SCL	Unshielded	β		2.20E+02
42	STEELA21S	11/14/2002	11:22	1	2.10E+02	60	SCL	Shielded	β	2.10E+02	
43	STEELA21U	11/14/2002	11:23	1	1.93E+02	60	SCL	Unshielded	β		1.83E+02
44	STEELA22S	11/14/2002	11:24	1	2.05E+02	60	SCL	Shielded	β	2.05E+02	
45	STEELA22U	11/14/2002	11:25	1	1.91E+02	60	SCL	Unshielded	β		1.81E+02
46	STEELA23S	11/14/2002	11:26	1	1.77E+02	60	SCL	Shielded	β	1.77E+02	
47	STEELA23U	11/14/2002	11:27	1	1.98E+02	60	SCL	Unshielded	β		1.88E+02
48	STEELA24S	11/14/2002	11:28	1	1.88E+02	60	SCL	Shielded	β	1.88E+02	
49	STEELA24U	11/14/2002	11:30	1	2.44E+02	60	SCL	Unshielded	β		2.34E+02
50	STEELQC11S	11/14/2002	11:33	1	2.13E+02	60	SCL	Shielded	β	2.13E+02	
51	STEELQC11U	11/14/2002	11:34	1	2.10E+02	60	SCL	Unshielded	β		2.00E+02
52	STEELQC19S	11/14/2002	11:36	1	1.80E+02	60	SCL	Shielded	β	1.80E+02	
53	STEELQC19U	11/14/2002	11:37	1	1.99E+02	60	SCL	Unshielded	β		1.89E+02
58	STEELB1S	11/14/2002	13:09	1	2.25E+02	60	SCL	Shielded	β	2.25E+02	
59	STEELB1U	11/14/2002	13:10	1	1.94E+02	60	SCL	Unshielded	β		1.84E+02
60	STEELB2S	11/14/2002	13:12	1	1.78E+02	60	SCL	Shielded	β	1.78E+02	
61	STEELB2U	11/14/2002	13:13	1	2.50E+02	60	SCL	Unshielded	β		2.40E+02
62	STEELB3S	11/14/2002	13:14	1	2.03E+02	60	SCL	Shielded	β	2.03E+02	
63	STEELB3U	11/14/2002	13:15	1	2.11E+02	60	SCL	Unshielded	β		2.01E+02
64	STEELB4S	11/14/2002	13:17	1	2.03E+02	60	SCL	Shielded	β	2.03E+02	
65	STEELB4U	11/14/2002	13:18	1	1.78E+02	60	SCL	Unshielded	β		1.68E+02
66	STEELB5S	11/14/2002	13:19	1	2.32E+02	60	SCL	Shielded	β	2.32E+02	
67	STEELB5U	11/14/2002	13:20	1	2.08E+02	60	SCL	Unshielded	β		1.98E+02
68	STEELB6S	11/14/2002	13:22	1	2.22E+02	60	SCL	Shielded	β	2.22E+02	
69	STEELB6U	11/14/2002	13:23	1	2.22E+02	60	SCL	Unshielded	β		2.12E+02
70	STEELB7S	11/14/2002	13:24	1	2.21E+02	60	SCL	Shielded	β	2.21E+02	
71	STEELB7U	11/14/2002	13:25	1	2.18E+02	60	SCL	Unshielded	β		2.08E+02
72	STEELB8S	11/14/2002	13:26	1	2.18E+02	60	SCL	Shielded	β	2.18E+02	
73	STEELB8U	11/14/2002	13:28	1	2.15E+02	60	SCL	Unshielded	β		2.05E+02
74	STEELB9S	11/14/2002	13:29	1	1.90E+02	60	SCL	Shielded	β	1.90E+02	
75	STEELB9U	11/14/2002	13:30	1	2.17E+02	60	SCL	Unshielded	β		2.07E+02
76	STEELB10S	11/14/2002	13:41	1	2.45E+02	60	SCL	Shielded	β	2.45E+02	
77	STEELB10U	11/14/2002	13:42	1	2.32E+02	60	SCL	Unshielded	β		2.22E+02
78	STEELQCB5S	11/14/2002	13:44	1	1.81E+02	60	SCL	Shielded	β	1.81E+02	
79	STEELQCB5U	11/14/2002	13:45	1	2.13E+02	60	SCL	Unshielded	β		2.03E+02
									Minimum ⇒	1.55E+02	1.57E+02
									Maximum ⇒	2.45E+02	2.40E+02
									Mean ⇒	2.00E+02	2.01E+02
									Sigma ⇒	1.81E+01	1.77E+01

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Williamsburg Steel Background Measurements SR-48

37122N21	Instrument 95348	RJR9291	Time	Detector	Counts	Count Time (sec)	Mode	Designator		FSS-004	BHB
0	BKGND	11/14/2002	6:47	1	6.54E+03	1800	SCL	Inital Background	β	*Steel CF(cpm)* ⇒	35
1	Source Check	11/14/2002	9:54	1	1.70E+05	60	SCL	Source	β	*Shielded*	*Unshielded*
2	STEELA1S	11/14/2002	10:32	1	2.13E+02	60	SCL	Shielded	β	2.13E+02	
3	STEELA1U	11/14/2002	10:33	1	2.04E+02	60	SCL	Unshielded	β		1.69E+02
4	STEELA2S	11/14/2002	10:37	1	2.03E+02	60	SCL	Shielded	β	2.03E+02	
5	STEELA2U	11/14/2002	10:38	1	2.25E+02	60	SCL	Unshielded	β		1.90E+02
6	STEELA3S	11/14/2002	10:39	1	1.85E+02	60	SCL	Shielded	β	1.85E+02	
7	STEELA3U	11/14/2002	10:40	1	2.09E+02	60	SCL	Unshielded	β		1.74E+02
8	STEELA4S	11/14/2002	10:42	1	2.03E+02	60	SCL	Shielded	β	2.03E+02	
9	STEELA4U	11/14/2002	10:43	1	1.67E+02	60	SCL	Unshielded	β		1.32E+02
10	STEELA5S	11/14/2002	10:44	1	1.55E+02	60	SCL	Shielded	β	1.55E+02	
11	STEELA5U	11/14/2002	10:45	1	2.26E+02	60	SCL	Unshielded	β		1.91E+02
12	STEELA6S	11/14/2002	10:46	1	1.92E+02	60	SCL	Shielded	β	1.92E+02	
13	STEELA6U	11/14/2002	10:47	1	1.95E+02	60	SCL	Unshielded	β		1.60E+02
14	STEELA7S	11/14/2002	10:48	1	1.96E+02	60	SCL	Shielded	β	1.96E+02	
15	STEELA7U	11/14/2002	10:50	1	2.01E+02	60	SCL	Unshielded	β		1.66E+02
16	STEELA8S	11/14/2002	10:51	1	2.15E+02	60	SCL	Shielded	β	2.15E+02	
17	STEELA8U	11/14/2002	10:52	1	2.38E+02	60	SCL	Unshielded	β		2.03E+02
18	STEELA9S	11/14/2002	10:53	1	2.00E+02	60	SCL	Shielded	β	2.00E+02	
19	STEELA9U	11/14/2002	10:54	1	1.92E+02	60	SCL	Unshielded	β		1.57E+02
20	STEELA10S	11/14/2002	10:56	1	1.83E+02	60	SCL	Shielded	β	1.83E+02	
21	STEELA10U	11/14/2002	10:57	1	2.25E+02	60	SCL	Unshielded	β		1.90E+02
22	STEELA11S	11/14/2002	10:58	1	1.95E+02	60	SCL	Shielded	β	1.95E+02	
23	STEELA11U	11/14/2002	10:59	1	2.15E+02	60	SCL	Unshielded	β		1.80E+02
24	STEELA12S	11/14/2002	11:00	1	1.77E+02	60	SCL	Shielded	β	1.77E+02	
25	STEELA12U	11/14/2002	11:01	1	2.34E+02	60	SCL	Unshielded	β		1.99E+02
26	STEELA13S	11/14/2002	11:03	1	2.02E+02	60	SCL	Shielded	β	2.02E+02	
27	STEELA13U	11/14/2002	11:05	1	2.18E+02	60	SCL	Unshielded	β		1.83E+02
28	STEELA14S	11/14/2002	11:06	1	1.89E+02	60	SCL	Shielded	β	1.89E+02	
29	STEELA14U	11/14/2002	11:07	1	1.99E+02	60	SCL	Unshielded	β		1.64E+02
30	STEELA15S	11/14/2002	11:08	1	2.16E+02	60	SCL	Shielded	β	2.16E+02	
31	STEELA15U	11/14/2002	11:09	1	2.15E+02	60	SCL	Unshielded	β		1.80E+02
32	STEELA16S	11/14/2002	11:10	1	1.88E+02	60	SCL	Shielded	β	1.88E+02	
33	STEELA16U	11/14/2002	11:11	1	2.05E+02	60	SCL	Unshielded	β		1.70E+02
34	STEELA17S	11/14/2002	11:13	1	2.12E+02	60	SCL	Shielded	β	2.12E+02	
35	STEELA17U	11/14/2002	11:14	1	2.11E+02	60	SCL	Unshielded	β		1.76E+02
36	STEELA18S	11/14/2002	11:15	1	2.00E+02	60	SCL	Shielded	β	2.00E+02	
37	STEELA18U	11/14/2002	11:16	1	1.93E+02	60	SCL	Unshielded	β		1.58E+02
38	STEELA19S	11/14/2002	11:17	1	1.84E+02	60	SCL	Shielded	β	1.84E+02	
39	STEELA19U	11/14/2002	11:18	1	2.09E+02	60	SCL	Unshielded	β		1.74E+02
40	STEELA20S	11/14/2002	11:19	1	1.94E+02	60	SCL	Shielded	β	1.94E+02	
41	STEELA20U	11/14/2002	11:20	1	2.30E+02	60	SCL	Unshielded	β		1.95E+02
42	STEELA21S	11/14/2002	11:22	1	2.10E+02	60	SCL	Shielded	β	2.10E+02	
43	STEELA21U	11/14/2002	11:23	1	1.93E+02	60	SCL	Unshielded	β		1.58E+02
44	STEELA22S	11/14/2002	11:24	1	2.05E+02	60	SCL	Shielded	β	2.05E+02	
45	STEELA22U	11/14/2002	11:25	1	1.91E+02	60	SCL	Unshielded	β		1.56E+02
46	STEELA23S	11/14/2002	11:26	1	1.77E+02	60	SCL	Shielded	β	1.77E+02	
47	STEELA23U	11/14/2002	11:27	1	1.98E+02	60	SCL	Unshielded	β		1.63E+02
48	STEELA24S	11/14/2002	11:28	1	1.88E+02	60	SCL	Shielded	β	1.88E+02	
49	STEELA24U	11/14/2002	11:30	1	2.44E+02	60	SCL	Unshielded	β		2.09E+02
50	STEELQC11S	11/14/2002	11:33	1	2.13E+02	60	SCL	Shielded	β	2.13E+02	
51	STEELQC11U	11/14/2002	11:34	1	2.10E+02	60	SCL	Unshielded	β		1.75E+02
52	STEELQC19S	11/14/2002	11:36	1	1.80E+02	60	SCL	Shielded	β	1.80E+02	
53	STEELQC19U	11/14/2002	11:37	1	1.99E+02	60	SCL	Unshielded	β		1.64E+02
58	STEELB1S	11/14/2002	13:09	1	2.25E+02	60	SCL	Shielded	β	2.25E+02	
59	STEELB1U	11/14/2002	13:10	1	1.94E+02	60	SCL	Unshielded	β		1.59E+02
60	STEELB2S	11/14/2002	13:12	1	1.78E+02	60	SCL	Shielded	β	1.78E+02	
61	STEELB2U	11/14/2002	13:13	1	2.50E+02	60	SCL	Unshielded	β		2.15E+02
62	STEELB3S	11/14/2002	13:14	1	2.03E+02	60	SCL	Shielded	β	2.03E+02	
63	STEELB3U	11/14/2002	13:15	1	2.11E+02	60	SCL	Unshielded	β		1.76E+02
64	STEELB4S	11/14/2002	13:17	1	2.03E+02	60	SCL	Shielded	β	2.03E+02	
65	STEELB4U	11/14/2002	13:18	1	1.78E+02	60	SCL	Unshielded	β		1.43E+02
66	STEELB5S	11/14/2002	13:19	1	2.32E+02	60	SCL	Shielded	β	2.32E+02	
67	STEELB5U	11/14/2002	13:20	1	2.08E+02	60	SCL	Unshielded	β		1.73E+02
68	STEELB6S	11/14/2002	13:22	1	2.22E+02	60	SCL	Shielded	β	2.22E+02	
69	STEELB6U	11/14/2002	13:23	1	2.22E+02	60	SCL	Unshielded	β		1.87E+02
70	STEELB7S	11/14/2002	13:24	1	2.21E+02	60	SCL	Shielded	β	2.21E+02	
71	STEELB7U	11/14/2002	13:25	1	2.18E+02	60	SCL	Unshielded	β		1.83E+02
72	STEELB8S	11/14/2002	13:26	1	2.18E+02	60	SCL	Shielded	β	2.18E+02	
73	STEELB8U	11/14/2002	13:28	1	2.15E+02	60	SCL	Unshielded	β		1.80E+02
74	STEELB9S	11/14/2002	13:29	1	1.90E+02	60	SCL	Shielded	β	1.90E+02	
75	STEELB9U	11/14/2002	13:30	1	2.17E+02	60	SCL	Unshielded	β		1.82E+02
76	STEELB10S	11/14/2002	13:41	1	2.45E+02	60	SCL	Shielded	β	2.45E+02	
77	STEELB10U	11/14/2002	13:42	1	2.32E+02	60	SCL	Unshielded	β		1.97E+02
78	STEELQCB5S	11/14/2002	13:44	1	1.81E+02	60	SCL	Shielded	β	1.81E+02	
79	STEELQCB5U	11/14/2002	13:45	1	2.13E+02	60	SCL	Unshielded	β		1.78E+02
									Minimum ⇒	1.55E+02	1.32E+02
									Maximum ⇒	2.45E+02	2.15E+02
									Mean ⇒	2.00E+02	1.76E+02
									Sigma ⇒	1.81E+01	1.77E+01

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Williamsburg Steel Background Measurements SR-48

37122N21	Instrument 95348	RJR9291	Time	Detector	Counts	Count Time (sec)	Mode	Designator		FSS-004	BHB
0	BKGND	11/14/2002	6 47	1	6.54E+03	1800	SCL	Inital Background	β	*Steel CF(cpm)* ⇒	71.7
1	Source Check	11/14/2002	9:54	1	1.70E+05	60	SCL	Source	β	Shielded	Unshielded
2	STEELA1S	11/14/2002	10:32	1	2.13E+02	60	SCL	Shielded	β	2.13E+02	
3	STEELA1U	11/14/2002	10:33	1	2.04E+02	60	SCL	Unshielded	β		1.32E+02
4	STEELA2S	11/14/2002	10:37	1	2.03E+02	60	SCL	Shielded	β	2.03E+02	
5	STEELA2U	11/14/2002	10:38	1	2.25E+02	60	SCL	Unshielded	β		1.53E+02
6	STEELA3S	11/14/2002	10:39	1	1.85E+02	60	SCL	Shielded	β	1.85E+02	
7	STEELA3U	11/14/2002	10:40	1	2.09E+02	60	SCL	Unshielded	β		1.37E+02
8	STEELA4S	11/14/2002	10:42	1	2.03E+02	60	SCL	Shielded	β	2.03E+02	
9	STEELA4U	11/14/2002	10 43	1	1.67E+02	60	SCL	Unshielded	β		9.53E+01
10	STEELA5S	11/14/2002	10.44	1	1.55E+02	60	SCL	Shielded	β	1.55E+02	
11	STEELA5U	11/14/2002	10.45	1	2.26E+02	60	SCL	Unshielded	β		1.54E+02
12	STEELA6S	11/14/2002	10.46	1	1.92E+02	60	SCL	Shielded	β	1.92E+02	
13	STEELA6U	11/14/2002	10 47	1	1.95E+02	60	SCL	Unshielded	β		1.23E+02
14	STEELA7S	11/14/2002	10:48	1	1.96E+02	60	SCL	Shielded	β	1.96E+02	
15	STEELA7U	11/14/2002	10 50	1	2.01E+02	60	SCL	Unshielded	β		1.29E+02
16	STEELA8S	11/14/2002	10.51	1	2.15E+02	60	SCL	Shielded	β	2.15E+02	
17	STEELA8U	11/14/2002	10.52	1	2.38E+02	60	SCL	Unshielded	β		1.66E+02
18	STEELA9S	11/14/2002	10 53	1	2.00E+02	60	SCL	Shielded	β	2.00E+02	
19	STEELA9U	11/14/2002	10.54	1	1.92E+02	60	SCL	Unshielded	β		1.20E+02
20	STEELA10S	11/14/2002	10:56	1	1.83E+02	60	SCL	Shielded	β	1.83E+02	
21	STEELA10U	11/14/2002	10 57	1	2.25E+02	60	SCL	Unshielded	β		1.53E+02
22	STEELA11S	11/14/2002	10.58	1	1.95E+02	60	SCL	Shielded	β	1.95E+02	
23	STEELA11U	11/14/2002	10:59	1	2.15E+02	60	SCL	Unshielded	β		1.43E+02
24	STEELA12S	11/14/2002	11:00	1	1.77E+02	60	SCL	Shielded	β	1.77E+02	
25	STEELA12U	11/14/2002	11:01	1	2.34E+02	60	SCL	Unshielded	β		1.62E+02
26	STEELA13S	11/14/2002	11:03	1	2.02E+02	60	SCL	Shielded	β	2.02E+02	
27	STEELA13U	11/14/2002	11:05	1	2.18E+02	60	SCL	Unshielded	β		1.46E+02
28	STEELA14S	11/14/2002	11:06	1	1.89E+02	60	SCL	Shielded	β	1.89E+02	
29	STEELA14U	11/14/2002	11:07	1	1.99E+02	60	SCL	Unshielded	β		1.27E+02
30	STEELA15S	11/14/2002	11:08	1	2.16E+02	60	SCL	Shielded	β	2.16E+02	
31	STEELA15U	11/14/2002	11:09	1	2.15E+02	60	SCL	Unshielded	β		1.43E+02
32	STEELA16S	11/14/2002	11:10	1	1.88E+02	60	SCL	Shielded	β	1.88E+02	
33	STEELA16U	11/14/2002	11:11	1	2.05E+02	60	SCL	Unshielded	β		1.33E+02
34	STEELA17S	11/14/2002	11:13	1	2.12E+02	60	SCL	Shielded	β	2.12E+02	
35	STEELA17U	11/14/2002	11:14	1	2.11E+02	60	SCL	Unshielded	β		1.39E+02
36	STEELA18S	11/14/2002	11:15	1	2.00E+02	60	SCL	Shielded	β	2.00E+02	
37	STEELA18U	11/14/2002	11:16	1	1.93E+02	60	SCL	Unshielded	β		1.21E+02
38	STEELA19S	11/14/2002	11:17	1	1.84E+02	60	SCL	Shielded	β	1.84E+02	
39	STEELA19U	11/14/2002	11:18	1	2.09E+02	60	SCL	Unshielded	β		1.37E+02
40	STEELA20S	11/14/2002	11:19	1	1.94E+02	60	SCL	Shielded	β	1.94E+02	
41	STEELA20U	11/14/2002	11:20	1	2.30E+02	60	SCL	Unshielded	β		1.58E+02
42	STEELA21S	11/14/2002	11:22	1	2.10E+02	60	SCL	Shielded	β	2.10E+02	
43	STEELA21U	11/14/2002	11:23	1	1.93E+02	60	SCL	Unshielded	β		1.21E+02
44	STEELA22S	11/14/2002	11:24	1	2.05E+02	60	SCL	Shielded	β	2.05E+02	
45	STEELA22U	11/14/2002	11:25	1	1.91E+02	60	SCL	Unshielded	β		1.19E+02
46	STEELA23S	11/14/2002	11:26	1	1.77E+02	60	SCL	Shielded	β	1.77E+02	
47	STEELA23U	11/14/2002	11:27	1	1.98E+02	60	SCL	Unshielded	β		1.26E+02
48	STEELA24S	11/14/2002	11:28	1	1.88E+02	60	SCL	Shielded	β	1.88E+02	
49	STEELA24U	11/14/2002	11:30	1	2.44E+02	60	SCL	Unshielded	β		1.72E+02
50	STEELQC11S	11/14/2002	11:33	1	2.13E+02	60	SCL	Shielded	β	2.13E+02	
51	STEELQC11U	11/14/2002	11:34	1	2.10E+02	60	SCL	Unshielded	β		1.38E+02
52	STEELQC19S	11/14/2002	11:36	1	1.80E+02	60	SCL	Shielded	β	1.80E+02	
53	STEELQC19U	11/14/2002	11:37	1	1.99E+02	60	SCL	Unshielded	β		1.27E+02
58	STEELB1S	11/14/2002	13.09	1	2.25E+02	60	SCL	Shielded	β	2.25E+02	
59	STEELB1U	11/14/2002	13:10	1	1.94E+02	60	SCL	Unshielded	β		1.22E+02
60	STEELB2S	11/14/2002	13:12	1	1.78E+02	60	SCL	Shielded	β	1.78E+02	
61	STEELB2U	11/14/2002	13:13	1	2.50E+02	60	SCL	Unshielded	β		1.78E+02
62	STEELB3S	11/14/2002	13:14	1	2.03E+02	60	SCL	Shielded	β	2.03E+02	
63	STEELB3U	11/14/2002	13:15	1	2.11E+02	60	SCL	Unshielded	β		1.39E+02
64	STEELB4S	11/14/2002	13:17	1	2.03E+02	60	SCL	Shielded	β	2.03E+02	
65	STEELB4U	11/14/2002	13:18	1	1.78E+02	60	SCL	Unshielded	β		1.06E+02
66	STEELB5S	11/14/2002	13:19	1	2.32E+02	60	SCL	Shielded	β	2.32E+02	
67	STEELB5U	11/14/2002	13:20	1	2.08E+02	60	SCL	Unshielded	β		1.36E+02
68	STEELB6S	11/14/2002	13.22	1	2.22E+02	60	SCL	Shielded	β	2.22E+02	
69	STEELB6U	11/14/2002	13:23	1	2.22E+02	60	SCL	Unshielded	β		1.50E+02
70	STEELB7S	11/14/2002	13:24	1	2.21E+02	60	SCL	Shielded	β	2.21E+02	
71	STEELB7U	11/14/2002	13:25	1	2.18E+02	60	SCL	Unshielded	β		1.46E+02
72	STEELB8S	11/14/2002	13:26	1	2.18E+02	60	SCL	Shielded	β	2.18E+02	
73	STEELB8U	11/14/2002	13:28	1	2.15E+02	60	SCL	Unshielded	β		1.43E+02
74	STEELB9S	11/14/2002	13:29	1	1.90E+02	60	SCL	Shielded	β	1.90E+02	
75	STEELB9U	11/14/2002	13:30	1	2.17E+02	60	SCL	Unshielded	β		1.45E+02
76	STEELB10S	11/14/2002	13:41	1	2.45E+02	60	SCL	Shielded	β	2.45E+02	
77	STEELB10U	11/14/2002	13:42	1	2.32E+02	60	SCL	Unshielded	β		1.60E+02
78	STEELQCB5S	11/14/2002	13:44	1	1.81E+02	60	SCL	Shielded	β	1.81E+02	
79	STEELQCB5U	11/14/2002	13:45	1	2.13E+02	60	SCL	Unshielded	β		1.41E+02
									Minimum ⇒	1.56E+02	9.53E+01
									Maximum ⇒	2.46E+02	1.78E+02
									Mean ⇒	2.00E+02	1.39E+02
									Sigma ⇒	1.81E+01	1.77E+01

ATTACHMENT 6 - 8

Williamsburg Steel Background Measurements SR-48

37122N21	Instrument 95348	RJR9291	Time	Detector	Counts	Count Time (sec)	Mode	Designator		FSS-004	BHB
0	BKGND	11/14/2002	6:47	1	6.54E+03	1800	SCL	Inital Background	β	Steel CF(cpm) ⇒	44.7
1	Source Check	11/14/2002	9:54	1	1.70E+05	60	SCL	Source	β	Shielded	Unshielded
2	STEELA1S	11/14/2002	10:32	1	2.13E+02	60	SCL	Shielded	β	2.13E+02	
3	STEELA1U	11/14/2002	10:33	1	2.04E+02	60	SCL	Unshielded	β		1.59E+02
4	STEELA2S	11/14/2002	10:37	1	2.03E+02	60	SCL	Shielded	β	2.03E+02	
5	STEELA2U	11/14/2002	10:38	1	2.25E+02	60	SCL	Unshielded	β		1.80E+02
6	STEELA3S	11/14/2002	10:39	1	1.85E+02	60	SCL	Shielded	β	1.85E+02	
7	STEELA3U	11/14/2002	10:40	1	2.09E+02	60	SCL	Unshielded	β		1.64E+02
8	STEELA4S	11/14/2002	10:42	1	2.03E+02	60	SCL	Shielded	β	2.03E+02	
9	STEELA4U	11/14/2002	10:43	1	1.67E+02	60	SCL	Unshielded	β		1.22E+02
10	STEELA5S	11/14/2002	10:44	1	1.55E+02	60	SCL	Shielded	β	1.55E+02	
11	STEELA5U	11/14/2002	10:45	1	2.26E+02	60	SCL	Unshielded	β		1.81E+02
12	STEELA6S	11/14/2002	10:46	1	1.92E+02	60	SCL	Shielded	β	1.92E+02	
13	STEELA6U	11/14/2002	10:47	1	1.95E+02	60	SCL	Unshielded	β		1.50E+02
14	STEELA7S	11/14/2002	10:48	1	1.96E+02	60	SCL	Shielded	β	1.96E+02	
15	STEELA7U	11/14/2002	10:50	1	2.01E+02	60	SCL	Unshielded	β		1.56E+02
16	STEELA8S	11/14/2002	10:51	1	2.15E+02	60	SCL	Shielded	β	2.15E+02	
17	STEELA8U	11/14/2002	10:52	1	2.38E+02	60	SCL	Unshielded	β		1.93E+02
18	STEELA9S	11/14/2002	10:53	1	2.00E+02	60	SCL	Shielded	β	2.00E+02	
19	STEELA9U	11/14/2002	10:54	1	1.92E+02	60	SCL	Unshielded	β		1.47E+02
20	STEELA10S	11/14/2002	10:56	1	1.83E+02	60	SCL	Shielded	β	1.83E+02	
21	STEELA10U	11/14/2002	10:57	1	2.25E+02	60	SCL	Unshielded	β		1.80E+02
22	STEELA11S	11/14/2002	10:58	1	1.95E+02	60	SCL	Shielded	β	1.95E+02	
23	STEELA11U	11/14/2002	10:59	1	2.15E+02	60	SCL	Unshielded	β		1.70E+02
24	STEELA12S	11/14/2002	11:00	1	1.77E+02	60	SCL	Shielded	β	1.77E+02	
25	STEELA12U	11/14/2002	11:01	1	2.34E+02	60	SCL	Unshielded	β		1.89E+02
26	STEELA13S	11/14/2002	11:03	1	2.02E+02	60	SCL	Shielded	β	2.02E+02	
27	STEELA13U	11/14/2002	11:05	1	2.18E+02	60	SCL	Unshielded	β		1.73E+02
28	STEELA14S	11/14/2002	11:06	1	1.89E+02	60	SCL	Shielded	β	1.89E+02	
29	STEELA14U	11/14/2002	11:07	1	1.99E+02	60	SCL	Unshielded	β		1.54E+02
30	STEELA15S	11/14/2002	11:08	1	2.16E+02	60	SCL	Shielded	β	2.16E+02	
31	STEELA15U	11/14/2002	11:09	1	2.15E+02	60	SCL	Unshielded	β		1.70E+02
32	STEELA16S	11/14/2002	11:10	1	1.88E+02	60	SCL	Shielded	β	1.88E+02	
33	STEELA16U	11/14/2002	11:11	1	2.05E+02	60	SCL	Unshielded	β		1.60E+02
34	STEELA17S	11/14/2002	11:13	1	2.12E+02	60	SCL	Shielded	β	2.12E+02	
35	STEELA17U	11/14/2002	11:14	1	2.11E+02	60	SCL	Unshielded	β		1.66E+02
36	STEELA18S	11/14/2002	11:15	1	2.00E+02	60	SCL	Shielded	β	2.00E+02	
37	STEELA18U	11/14/2002	11:16	1	1.93E+02	60	SCL	Unshielded	β		1.48E+02
38	STEELA19S	11/14/2002	11:17	1	1.84E+02	60	SCL	Shielded	β	1.84E+02	
39	STEELA19U	11/14/2002	11:18	1	2.09E+02	60	SCL	Unshielded	β		1.64E+02
40	STEELA20S	11/14/2002	11:19	1	1.94E+02	60	SCL	Shielded	β	1.94E+02	
41	STEELA20U	11/14/2002	11:20	1	2.30E+02	60	SCL	Unshielded	β		1.85E+02
42	STEELA21S	11/14/2002	11:22	1	2.10E+02	60	SCL	Shielded	β	2.10E+02	
43	STEELA21U	11/14/2002	11:23	1	1.93E+02	60	SCL	Unshielded	β		1.48E+02
44	STEELA22S	11/14/2002	11:24	1	2.05E+02	60	SCL	Shielded	β	2.05E+02	
45	STEELA22U	11/14/2002	11:25	1	1.91E+02	60	SCL	Unshielded	β		1.46E+02
46	STEELA23S	11/14/2002	11:26	1	1.77E+02	60	SCL	Shielded	β	1.77E+02	
47	STEELA23U	11/14/2002	11:27	1	1.98E+02	60	SCL	Unshielded	β		1.53E+02
48	STEELA24S	11/14/2002	11:28	1	1.88E+02	60	SCL	Shielded	β	1.88E+02	
49	STEELA24U	11/14/2002	11:30	1	2.44E+02	60	SCL	Unshielded	β		1.99E+02
50	STEELQC11S	11/14/2002	11:33	1	2.13E+02	60	SCL	Shielded	β	2.13E+02	
51	STEELQC11U	11/14/2002	11:34	1	2.10E+02	60	SCL	Unshielded	β		1.65E+02
52	STEELQC19S	11/14/2002	11:36	1	1.80E+02	60	SCL	Shielded	β	1.80E+02	
53	STEELQC19U	11/14/2002	11:37	1	1.99E+02	60	SCL	Unshielded	β		1.54E+02
58	STEELB1S	11/14/2002	13:09	1	2.25E+02	60	SCL	Shielded	β	2.25E+02	
59	STEELB1U	11/14/2002	13:10	1	1.94E+02	60	SCL	Unshielded	β		1.49E+02
60	STEELB2S	11/14/2002	13:12	1	1.78E+02	60	SCL	Shielded	β	1.78E+02	
61	STEELB2U	11/14/2002	13:13	1	2.50E+02	60	SCL	Unshielded	β		2.05E+02
62	STEELB3S	11/14/2002	13:14	1	2.03E+02	60	SCL	Shielded	β	2.03E+02	
63	STEELB3U	11/14/2002	13:15	1	2.11E+02	60	SCL	Unshielded	β		1.66E+02
64	STEELB4S	11/14/2002	13:17	1	2.03E+02	60	SCL	Shielded	β	2.03E+02	
65	STEELB4U	11/14/2002	13:18	1	1.78E+02	60	SCL	Unshielded	β		1.33E+02
66	STEELB5S	11/14/2002	13:19	1	2.32E+02	60	SCL	Shielded	β	2.32E+02	
67	STEELB5U	11/14/2002	13:20	1	2.08E+02	60	SCL	Unshielded	β		1.63E+02
68	STEELB6S	11/14/2002	13:22	1	2.22E+02	60	SCL	Shielded	β	2.22E+02	
69	STEELB6U	11/14/2002	13:23	1	2.22E+02	60	SCL	Unshielded	β		1.77E+02
70	STEELB7S	11/14/2002	13:24	1	2.21E+02	60	SCL	Shielded	β	2.21E+02	
71	STEELB7U	11/14/2002	13:25	1	2.18E+02	60	SCL	Unshielded	β		1.73E+02
72	STEELB8S	11/14/2002	13:26	1	2.18E+02	60	SCL	Shielded	β	2.18E+02	
73	STEELB8U	11/14/2002	13:28	1	2.15E+02	60	SCL	Unshielded	β		1.70E+02
74	STEELB9S	11/14/2002	13:29	1	1.90E+02	60	SCL	Shielded	β	1.90E+02	
75	STEELB9U	11/14/2002	13:30	1	2.17E+02	60	SCL	Unshielded	β		1.72E+02
76	STEELB10S	11/14/2002	13:41	1	2.45E+02	60	SCL	Shielded	β	2.45E+02	
77	STEELB10U	11/14/2002	13:42	1	2.32E+02	60	SCL	Unshielded	β		1.87E+02
78	STEELQCB5S	11/14/2002	13:44	1	1.81E+02	60	SCL	Shielded	β	1.81E+02	
79	STEELQCB5U	11/14/2002	13:45	1	2.13E+02	60	SCL	Unshielded	β		1.68E+02
									Minimum ⇒	1.55E+02	1.22E+02
									Maximum ⇒	2.45E+02	2.05E+02
									Mean ⇒	2.00E+02	1.66E+02
									Sigma ⇒	1.81E+01	1.77E+01

Gross Alpha/Beta Static Measurement MDC Calculation [redacted]

Use when Background Count Time = Sample Count Time

$CV1 - 1$, *and* $CV2 - 24$

$\varepsilon_i := .478$ $\varepsilon_s := .5 \cdot .62008$ $A := 126$ $B := 201.4$ $T := 1$

$L_C := 2.33 \cdot \sqrt{B}$ *Calculation of critical level (page 6-34 of MARSSIM)*

$\varepsilon_t := \varepsilon_i \cdot \varepsilon_s$

$\varepsilon_t = 0.148$

$L_C = 33.1$ *Critical level*

$L_C + B = 234.5$ *Any count above this value should be regarded as being greater than background (page 6-37 of MARSSIM).*

$$C := \frac{1}{T \cdot \varepsilon_i \cdot \varepsilon_s} \cdot \frac{100}{A}$$

Calculation of constant "C" that includes probe area correction, source and instrument efficiencies and counting time (page 6-37 of MARSSIM).

$$MDC := C \cdot \left(3 + 4.65 \cdot \sqrt{B}\right)$$

$MDC = 369.466$ *Calculation of MDC. Results are in* **dpm/100 cm²** *(page 6-37 of MARSSIM).*

where:

L_C = critical level (counts)
B = number of background counts that are expected to occur while performing an actual measurement in time *T*
MDC = Minimum Detectable Concentration (dpm/100 square centimeters)
C = constant (see above)
ε_i = instrument efficiency
ε_s = source efficiency
A = instrument probe area (in square centimeters)
T = count time (in minutes)

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Gross Alpha/Beta Static Measurement MDC Calculation [redacted]

Use when Background Count Time = Sample Count Time

$CV1 - 2$, and $CV2 - 25$

$\varepsilon_i := .478$ $\varepsilon_s := .5 \cdot .62008$ $A := 126$ $B := 176$ $T := 1$

$L_C := 2.33 \cdot \sqrt{B}$ *Calculation of critical level (page 6-34 of MARSSIM)* $\varepsilon_t := \varepsilon_i \cdot \varepsilon_s$

$L_C = 30.9$ *Critical level* $\varepsilon_t = 0.148$

$L_C + B = 206.9$ *Any count above this value should be regarded as being greater than background (page 6-37 of MARSSIM).*

$$C := \frac{1}{T \cdot \varepsilon_i \cdot \varepsilon_s} \cdot \frac{100}{A}$$

Calculation of constant "C" that includes probe area correction, source and instrument efficiencies and counting time (page 6-37 of MARSSIM).

$$MDC := C \cdot (3 + 4.65 \cdot \sqrt{B}$$

$MDC = 346.43$ *Calculation of MDC. Results are in **dpm/100 cm²** (page 6-37 of MARSSIM).*

where:

L_C = critical level (counts)
B = number of background counts that are expected to occur while performing an actual measurement in time *T*
MDC = Minimum Detectable Concentration (dpm/100 square centimeters)
C = constant (see above)
ε_i = instrument efficiency
ε_s = source efficiency
A = instrument probe area (in square centimeters)
T = count time (in minutes)

ATTACHMENT 7-2

Gross Alpha/Beta Static Measurement MDC Calculation [redacted]

Use when Background Count Time = Sample Count Time

$CV1 - 3$, and $CV2 - 26$

$\varepsilon_i := .478$ $\varepsilon_s := .5 \cdot .62008$ $A := 126$ $B := 139.3$ $T := 1$

$L_C := 2.33 \cdot \sqrt{B}$ *Calculation of critical level (page 6-34 of MARSSIM)*

$\varepsilon_t := \varepsilon_i \cdot \varepsilon_s$

$\varepsilon_t = 0.148$

$L_C = 27.5$ *Critical level*

$L_C + B = 166.8$ *Any count above this value should be regarded as being greater than background (page 6-37 of MARSSIM).*

$C := \frac{1}{T \cdot \varepsilon_i \cdot \varepsilon_s} \cdot \frac{100}{A}$ *Calculation of constant "C" that includes probe area correction, source and instrument efficiencies and counting time (page 6-37 of MARSSIM).*

$MDC := C \cdot \left(3 + 4.65 \cdot \sqrt{B}\right)$

$MDC = 309.975$ *Calculation of MDC. Results are in* ***dpm/100 cm²*** *(page 6-37 of MARSSIM).*

where:

L_C = critical level (counts)
B = number of background counts that are expected to occur while performing an actual measurement in time *T*
MDC = Minimum Detectable Concentration (dpm/100 square centimeters)
C = constant (see above)
ε_i = instrument efficiency
ε_s = source efficiency
A = instrument probe area (in square centimeters)
T = count time (in minutes)

Gross Alpha/Beta Static Measurement MDC Calculation [redacted]

Use when Background Count Time = Sample Count Time

CV1 - 4, and CV2 - 27, and CV2 - 28

$\varepsilon_i := .478$ $\varepsilon_s := .5 \cdot .62008$ $A := 126$ $B := 166.3$ $T := 1$

$L_C := 2.33 \cdot \sqrt{B}$ *Calculation of critical level (page 6-34 of MARSSIM)*

$\varepsilon_t := \varepsilon_i \cdot \varepsilon_s$

$\varepsilon_t = 0.148$

$L_C = 30$ *Critical level*

$L_C + B = 196.3$ *Any count above this value should be regarded as being greater than background (page 6-37 of MARSSIM).*

$$C := \frac{1}{T \cdot \varepsilon_i \cdot \varepsilon_s} \cdot \frac{100}{A}$$

Calculation of constant "C" that includes probe area correction, source and instrument efficiencies and counting time (page 6-37 of MARSSIM).

$$MDC := C \cdot (3 + 4.65 \cdot \sqrt{B})$$

$MDC = 337.197$ *Calculation of MDC. Results are in dpm/100 cm² (page 6-37 of MARSSIM).*

where:

L_C = critical level (counts)
B = number of background counts that are expected to occur while performing an actual measurement in time *T*
MDC = Minimum Detectable Concentration (dpm/100 square centimeters)
C = constant (see above)
ε_i = instrument efficiency
ε_s = source efficiency
A = instrument probe area (in square centimeters)
T = count time (in minutes)

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Beta Scan Measurement MDC Calculation

$CV1-1$ and $CV2-24$

$\varepsilon_i := .478$ $\varepsilon_s := .5\cdot .62$ $b := 201.4$ $p := 0.5$ $W_d := 8.8$ $S_r := 2.2$ $d := 1.38$

$A := 126$

$\frac{W_d}{S_r} = 4$ Observation Interval (seconds)

$O_i := \frac{W_d}{S_r}$ Observation Interval (seconds)

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

$\varepsilon_t := \varepsilon_i\cdot\varepsilon_s$

$\varepsilon_t = 0.148$

$b_i = 13.4$ Counts in observation Interval

$$C := \frac{1}{\varepsilon_i\cdot\varepsilon_s\cdot\frac{A}{100}\cdot\sqrt{p}}$$

$C = 7.575$

$$MDCR_i := \left(d\cdot\sqrt{b_i}\right)\cdot\frac{60}{O_i}$$

$MDCR_i = 75.8$ <u>net counts per minute</u>

$MDCR_i + b = 277.25$ <u>gross counts per minute</u>

$\frac{MDCR_i}{O_i} = 19$ <u>net counts per minute in observation interval</u>

$$MDC_{scan} := C\cdot MDCR_i$$

$MDC_{scan} = 574.526$ dpm per 100 cm^2

ATTACHMENT 8 . 1

Beta Scan Measurement MDC Calculation

CVI – 2 and CV2 – 25

$\varepsilon_i := .478$ $\varepsilon_s := .5 \cdot .62$ $b := 176$ $p := 0.5$ $W_d := 8.8$ $S_r := 2.2$ $d := 1.38$

$A := 126$

$\frac{W_d}{S_r} = 4$ Observation Interval (seconds) $O_i := \frac{W_d}{S_r}$ Observation Interval (seconds)

$\varepsilon_t := \varepsilon_i \cdot \varepsilon_s$

$\varepsilon_t = 0.148$

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

$b_i = 11.7$ Counts in observation Interval

$$C := \frac{1}{\varepsilon_i \cdot \varepsilon_s \cdot \frac{A}{100} \cdot \sqrt{p}}$$

$C = 7.575$

$$MDCR_i := \left(d \cdot \sqrt{b_i}\right) \cdot \frac{60}{O_i}$$

$MDCR_i = 70.9$ net counts per minute

$MDCR_i + b = 246.906$ gross counts per minute

$\frac{MDCR_i}{O_i} = 17.7$ net counts per minute in observation interval

$$MDC_{scan} := C \cdot MDCR_i$$

$MDC_{scan} = 537.076$ dpm per 100 cm^2

ATTACHMENT 8 . 2

Beta Scan Measurement MDC Calculation

CV1 – 3 and CV2 – 26

$\varepsilon_i := .478$ $\varepsilon_s := .5 \cdot .62$ $b := 139.3$ $p := 0.5$ $W_d := 8.8$ $S_r := 2.2$ $d := 1.38$

$A := 126$

$\frac{W_d}{S_r} = 4$ Observation Interval (seconds) $O_i := \frac{W_d}{S_r}$ Observation Interval (seconds)

$\varepsilon_t := \varepsilon_i \cdot \varepsilon_s$

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

$\varepsilon_t = 0.148$

$b_i = 9.3$ Counts in observation Interval

$$C := \frac{1}{\varepsilon_i \cdot \varepsilon_s \cdot \frac{A}{100} \cdot \sqrt{p}}$$

$C = 7.575$

$$MDCR_i := \left(d \cdot \sqrt{b_i}\right) \cdot \frac{60}{O_i}$$

$MDCR_i = 63.1$ net counts per minute

$MDCR_i + b = 202.381$ gross counts per minute

$\frac{MDCR_i}{O_i} = 15.8$ net counts per minute in observation interval

$MDC_{scan} := C \cdot MDCR_i$

$MDC_{scan} = 477.81$ dpm per 100 cm^2

ATTACHMENT 8 . 3

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Beta Scan Measurement MDC Calculation

$CV1 - 4$ and $CV2 - 27$ and $CV2 - 28$

$\varepsilon_i := .478$ $\varepsilon_s := .5 \cdot .62$ $b := 166.3$ $p := 0.5$ $W_d := 8.8$ $S_r := 2.2$ $d := 1.38$

$A := 126$

$\frac{W_d}{S_r} = 4$ Observation Interval (seconds)

$O_i := \frac{W_d}{S_r}$ Observation Interval (seconds)

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

$\varepsilon_t := \varepsilon_i \cdot \varepsilon_s$

$\varepsilon_t = 0.148$

$b_i = 11.1$ Counts in observation Interval

$$C := \frac{1}{\varepsilon_i \cdot \varepsilon_s \cdot \frac{A}{100} \cdot \sqrt{p}}$$

$C = 7.575$

$$MDCR_i := \left(d \cdot \sqrt{b_i}\right) \cdot \frac{60}{O_i}$$

$MDCR_i = 68.9$ net counts per minute

$MDCR_i + b = 235.224$ gross counts per minute

$\frac{MDCR_i}{O_i} = 17.2$ net counts per minute in observation interval

$MDC_{scan} := C \cdot MDCR_i$

$MDC_{scan} = 522.066$ dpm per 100 cm^2

ATTACHMENT 8 . 4

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where:

b = *background counts per minute*

b_i = *background counts in observation interval*

p = *human performance factor*

W_d = *detector width in centimeters*

S_r = *scan rate in centimeters per second*

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

MDC_{scan} = *Minimum Detectable Concentration for scanning (dpm/100 square centimeters)*

C = *constant used to convert MDCR to MDC*

ε_i = *instrument efficiency (counts/emission)*

ε_s = *source efficiency (emissions/disintegration)*

A = *instrument physical probe area (in square centimeters)*

ATTACHMENT 8.5

SAXTON NUCLEAR	Saxton Nuclear Experimental Corporation Facility Policy and Procedure Manual	Number E900-IMP-4520.06
Title Survey Unit Inspection in Support of FSS Design		Revision No. 0

EXHIBIT 1

Survey Unit Inspection Check Sheet

SECTION 1 - SURVEY UNIT INSPECTION DESCRIPTION					
Survey Unit #	CV1-1		Survey Unit Location	INTERIOR VERTICAL wall of CV <804'	
Date	8/20/03	Time	1400	Inspection Team Members	JDuskin

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?			✓
2. Do the surveys (from Question 1) demonstrate that the survey unit will most likely pass the FSS?			✓
3. Is the physical work (i.e., remediation & housekeeping) in or around the survey unit complete?	✓		
4. Have all tools, non-permanent equipment, and material not needed to perform the FSS been removed?	✓		✗ 8/20/03
5. Are the survey surfaces relatively free of loose debris (i.e., dirt, concrete dust, metal filings, etc.)?			✓
6. Are the survey surfaces relatively free of liquids (i.e., water, moisture, oil, etc.)?			✓
7. Are the survey surfaces free of all paint, which has the potential to shield radiation?			✓
8. Have the Surface Measurement Test Areas (SMTA) been established? (Refer to Exhibit 2 for instructions.)			✓
9. Have the Surface Measurement Test Areas (SMTA) data been collected? (Refer to Exhibit 2 for instructions.)			✓
10. Are the survey surfaces easily accessible? (No scaffolding, high reach, etc. is needed to perform the FSS)			✓
11. Is lighting adequate to perform the FSS?			✓
12. Is the area industrially safe to perform the FSS? (Evaluate potential fall & trip hazards, confined spaces, etc.)			✓
13. Have photographs been taken showing the overall condition of the area?			✓
14. Have all unsatisfactory conditions been resolved?	✓		

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:

Survey Unit Inspector (print/sign)	J Duskin / [signature]	Date	8/20/03
Survey Designer (print/sign)	B. Brosey / B. Brosey	Date	8/20/03

SAXTON NUCLEAR	Saxton Nuclear Experimental Corporation Facility Policy and Procedure Manual	Number E900-IMP-4520.06
Title: Survey Unit Inspection in Support of FSS Design		Revision No. 0

EXHIBIT 1

Survey Unit Inspection Check Sheet

SECTION 1 - SURVEY UNIT INSPECTION DESCRIPTION

Survey Unit #	CV 1-1	Survey Unit Location	INTERIOR VERTICAL WALL OF CV <80'
Date 8/18/03	Time 1030	Inspection Team Members	JDUSKIN

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?	✓		
2. Do the surveys (from Question 1) demonstrate that the survey unit will most likely pass the FSS?	✓		
3. Is the physical work (i.e., remediation & housekeeping) in or around the survey unit complete? 8/18/03	✗	✓	
4. Have all tools, non-permanent equipment, and material not needed to perform the FSS been removed? 8/18/03	✗	✓	
5. Are the survey surfaces relatively free of loose debris (i.e., dirt, concrete dust, metal filings, etc.)?	✓		
6. Are the survey surfaces relatively free of liquids (i.e., water, moisture, oil, etc.)?	✓		
7. Are the survey surfaces free of all paint, which has the potential to shield radiation?	✓		
8. Have the Surface Measurement Test Areas (SMTA) been established? (Refer to Exhibit 2 for instructions)	✓		
9. Have the Surface Measurement Test Areas (SMTA) data been collected? (Refer to Exhibit 2 for instructions)	✓		
10. Are the survey surfaces easily accessible? (No scaffolding, high reach, etc. is needed to perform the FSS)	✓		
11. Is lighting adequate to perform the FSS?	✓		
12. Is the area industrially safe to perform the FSS? (Evaluate potential fall & trip hazards, confined spaces, etc.)	✓		
13. Have photographs been taken showing the overall condition of the area?	✓		
14. Have all unsatisfactory conditions been resolved? 8/18/03	✗	✓	

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:
HouseKeeping is needed to prepare survey unit for FSS

Survey Unit Inspector (print/sign)	JDUSKIN / [signature]	Date	8/18/03
Survey Designer (print/sign)	B. Brosey [signature] / B. BROSEY	Date	8/20/03

ATTACHMENT 9.2

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EXHIBIT 3

Surface Measurement Test Area (SMTA) Data Sheet

SECTION 1 - DESCRIPTION

SMTA Number	SMTA - CV1-1-1	Survey Unit Number	CV1-1		
SMTA Location	INTERIOR VERTICAL WALL OF CV <~804'				
Survey Unit Inspector	J DUSKIN	Date	8/18/03	Time	1030

SECTION 2 - CALIPER INFORMATION & PERSONNEL INVOLVED

Caliper Manufacturer	MITUTOYO CORP	Caliper Model Number	CD-6"CS		
Caliper Serial Number	0763893	Calibration Due Date (as applicable)	10/03		
Rad Con Technician	NA	Date	NA	Time	NA
Survey Unit Inspector Approval	J Duskin / [signature]	Date	8/18/03		

SECTION 3 - MEASUREMENT RESULTS

SMTA Grid Map & Measurement Results in Units of mm (Insert Results in White Blocks Below)

1: 1.9	7: 0.0	13: 0.5	19: 1.0	25: 0.1	31: 0.0
2: 2.7	8: 0.0	14: 0.5	20: 0.3	26: 0.2	32: 0.0
3: 0.3	9: 0.1	15: 0.8	21: 0.1	27: 0.1	33: 0.8
4: 1.7	10: 0.1	16: 0.1	22: 0.0	28: 0.0	34: 0.2
5: 1.1	11: 0.0	17: 0.0	23: 0.0	29: 0.0	35: 0.1
6: 0.9	12: 0.5	18: 0.1	24: 0.1	30: 0.1	36: 0.1

Average Measurement 0.4 mm

Comments

SURFACE Roughness of The SMTA is EQUIVALENT TO OR GREATER THAN the roughness of the SURVEY UNIT.

Additional Measurements Required

CV1-1-A 7.1MM
CV-1-1-B 16.8MM
CV1-1-C 5.9MM

ATTACHMENT 9.3

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EXHIBIT 1

Survey Unit Inspection Check Sheet

SECTION 1 - SURVEY UNIT INSPECTION DESCRIPTION

Survey Unit #	CV 1-2	Survey Unit Location	interior vertical wall of cv <804'		
Date	8/20/03	Time	1415	Inspection Team Members	JDuskin

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

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:

None

Survey Unit Inspector (print/sign)	JDuskin / [signature]	Date	8/20/03
Survey Designer (print/sign)	B. Brosey [signature] / B. BROSEY	Date	8/20/03

ATTACHMENT 9.4 6

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EXHIBIT 1

Survey Unit Inspection Check Sheet

SECTION 1 - SURVEY UNIT INSPECTION DESCRIPTION

Survey Unit #	CU 1-2	Survey Unit Location	INTERIOR Vertical wall of CV <804'
Date 8/18/03	Time 1100	Inspection Team Members	J DUSKIN

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

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:

Housekeeping is needed to prepare survey unit for FSS

Survey Unit Inspector (print/sign)	J DUSKIN / [signature]	Date	8/18/03
Survey Designer (print/sign)	B. Brosey / B. BROSEY	Date	8/20/03

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EXHIBIT 3

Surface Measurement Test Area (SMTA) Data Sheet

SECTION 1 - DESCRIPTION					
SMTA Number	SMTA - CV1-2	Survey Unit Number	JDUSKIN		
SMTA Location	INTERIOR VERTICAL WALL of CV <8CU'				
Survey Unit Inspector	JDUSKIN	Date	8/18/03	Time	1100
SECTION 2 - CALIPER INFORMATION & PERSONNEL INVOLVED					
Caliper Manufacturer	MITUTOYO CORP	Caliper Model Number	CD-6" CS		
Caliper Serial Number	0763893	Calibration Due Date (as applicable)	10/03		
Rad Con Technician	NA	Date	NA	Time	NA
Survey Unit Inspector Approval	JDUSKIN / [signature]	Date	8/18/03		
SECTION 3 - MEASUREMENT RESULTS					

SMTA Grid Map & Measurement Results in Units of mm
(Insert Results in White Blocks Below)

1: 0.1	7: 0.1	13: 0.1	19: 0.1	25: 0.0	31: 0.0
2: 0.0	8: 1.5	14: 0.1	20: 0.0	26: 0.0	32: 0.1
3: 0.0	9: 0.0	15: 0.0	21: 0.0	27: 0.0	33: 0.2
4: 0.0	10: 0.0	16: 0.0	22: 0.0	28: 0.0	34: 0.1
5: 0.0	11: 0.0	17: 0.1	23: 0.0	29: 0.0	35: 0.0
6: 0.1	12: 0.0	18: 0.1	24: 0.0	30: 0.0	36: 0.0

Average Measurement 0.1 mm

Comments

SURFACE Roughness of SMTA IS TYPICAL of SURVEY UNIT

Additional Measurements Required

CV1-2-A 6.0 mm
CV1-2-B 7.3 mm
CV1-2-C 6.8 mm
CV1-2-D 16.1 mm
CV1-2-E 23.4 mm
CV1-2-F 6.3 mm

ATTACHMENT 9.6

EXHIBIT 1

Survey Unit Inspection Check Sheet

SECTION 1 - SURVEY UNIT INSPECTION DESCRIPTION

Survey Unit #	CV1-3	Survey Unit Location	INTERIOR VERTICAL WALL OF CV <804
Date	8/20/03	Time 1340	Inspection Team Members: JDUSKIN

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

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:

ATTACHMENT 9.7

Survey Unit Inspector (print/sign)	J Duskin / [signature]	Date	8/20/03
Survey Designer (print/sign)	[signature] / B. Brosey	Date	8/20/03

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EXHIBIT 1

Survey Unit Inspection Check Sheet

SECTION 1 - SURVEY UNIT INSPECTION DESCRIPTION

Survey Unit #	CV1-3	Survey Unit Location	INTERIOR VERTICAL Wall of CV < 804
Date 8/18/03	Time 1140	Inspection Team Members	JDUSKIN

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

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:
Housekeeping is needed to prepare survey unit for FSS

ATTACHMENT 9-8

Survey Unit Inspector (print/sign)	JDUSKIN / [signature]	Date	8/18/03
Survey Designer (print/sign)	[signature] / B. BRASEY	Date	8/20/03

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EXHIBIT 3

Surface Measurement Test Area (SMTA) Data Sheet

SECTION 1 - DESCRIPTION

SMTA Number	SMTA - CV 1-3-1	Survey Unit Number	CV 1-3		
SMTA Location	INTERIOR VERTICAL wall of CV <807				
Survey Unit Inspector	JDUSLIN	Date	8/18/03	Time	1140

SECTION 2 - CALIPER INFORMATION & PERSONNEL INVOLVED

Caliper Manufacturer	Mitutoyo Corp.	Caliper Model Number	CD-6" CS		
Caliper Serial Number	0763893	Calibration Due Date (as applicable)	8 10/03		
Rad Con Technician	NA	Date	NA	Time	NA
Survey Unit Inspector Approval	JDUSLIN / JB [illegible]	Date	8/18/03		

SECTION 3 - MEASUREMENT RESULTS

SMTA Grid Map & Measurement Results in Units of mm
(Insert Results in White Blocks Below)

1: 0.0	7: 0.1	13: 0.1	19: 1.6	25: 0.1	31: 0.1
2: 0.3	8: 0.0	14: 0.0	20: 0.1	26: 0.4	32: 0.1
3: 0.2	9: 0.0	15: 0.0	21: 0.1	27: 0.7	33: 0.3
4: 1.0	10: 0.2	16: 0.0	22: 0.0	28: 0.2	34: 0.1
5: 0.1	11: 2.0	17: 0.0	23: 0.0	29: 0.0	35: 0.0
6: 0.3	12: 0.3	18: 0.2	24: 0.3	30: 0.3	36: 0.2

Average Measurement 0.2 mm

Comments

SURFACE Roughness of the SMTA is TYPICAL of survey unit.

Additional Measurements Required

CV1-3-A 8.6 mm
CV1-3-B 9.7 mm
~~CV3~~ 8/18/03 JD
CV1-3-C 10.6 mm
CV1-3-D 6.2 mm
CV1-3-E 5.4 mm
CV1-3-F 7.7 mm

ATTACHMENT 9 . 9

EXHIBIT 1

Survey Unit Inspection Check Sheet

SECTION 1 - SURVEY UNIT INSPECTION DESCRIPTION

Survey Unit #	CV1-4	Survey Unit Location	INTERIOR vertical wall of CV <800'
Date	8/20/03	Time 1350	Inspection Team Members: J Duskin —

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

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: None.

ATTACHMENT 9 - 10

Survey Unit Inspector (print/sign)	J Duskin / [signature]	Date	8/20/03
Survey Designer (print/sign)	B. Brosey / B Brosey	Date	8/20/03

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EXHIBIT 1

Survey Unit Inspection Check Sheet

SECTION 1 - SURVEY UNIT INSPECTION DESCRIPTION					
Survey Unit #	CV 1-4	Survey Unit Location	INTERIOR VERTICAL wall of CV < 804'		
Date	8/18/03	Time	1310	Inspection Team Members	JDUSKIN

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

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: House Keeping is Required to prepare survey unit for FSS

ATTACHMENT 9-11

Survey Unit Inspector (print/sign)	JDUSKIN / [signature]	Date	8/18/03
Survey Designer (print/sign)	B. BROSEY / B. Brosey	Date	8/20/03

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EXHIBIT 3

Surface Measurement Test Area (SMTA) Data Sheet

SECTION 1 - DESCRIPTION

SMTA Number	SMTA - CV1-4-1	Survey Unit Number	CV1-4		
SMTA Location	INTERIOR VERTICAL WALL OF CV <80'				
Survey Unit Inspector	JDUSKIN	Date	8/18/03	Time	1310

SECTION 2 - CALIPER INFORMATION & PERSONNEL INVOLVED

Caliper Manufacturer	MITUTOYO CORP	Caliper Model Number	CD-6"CS		
Caliper Serial Number	0763898	Calibration Due Date (as applicable)	10/03		
Rad Con Technician	NA	Date	NA	Time	NA
Survey Unit Inspector Approval	JDUSKIN / [signature]	Date	8/18/03		

SECTION 3 - MEASUREMENT RESULTS

SMTA Grid Map & Measurement Results in Units of mm (Insert Results in White Blocks Below)

1: 0.0	7: 6.0	13: 0.0	19: 0.1	25: 0.4	31: 0.0
2: 0.5	8: 0.1	14: 0.5	20: 0.0	26: 0.0	32: 0.0
3: 0.9	9: 0.2	15: 0.0	21: 0.0	27: 0.0	33: 0.1
4: 0.0	10: 0.0	16: 0.1	22: 0.6	28: 0.1	34: 0.0
5: 0.1	11: 0.1	17: 0.0	23: 0.1	29: 0.0	35: 0.1
6: 0.1	12: 0.2	18: 0.7	24: 0.1	30: 0.0	36: 0.0

Average Measurement 0.1 mm

Comments

SURFACE ROUGHNESS OF THE SMTA IS TYPICAL OF THE SURVEY UNIT.

Additional Measurements Required

CV1-4-A 2.9 mm
CV1-4-B 1.6 mm
CV1-4-C 3.2 mm
CV1-4-D 5.1 mm

ATTACHMENT 9 . 12

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EXHIBIT 1

Survey Unit Inspection Check Sheet

SECTION 1 - SURVEY UNIT INSPECTION DESCRIPTION					
Survey Unit #	CV2-24	Survey Unit Location	CV INTERIOR SUPPORT RINGS 802', 798'		
Date	8/20/03	Time	1415	Inspection Team Members	J DUSKIN

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

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:

NONE

Survey Unit Inspector (print/sign)	J DUSKIN / J Dusk	Date	8/20/03
Survey Designer (print/sign)	B BROSEY / B. Brosey	Date	8/20/03

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Title Survey Unit Inspection in Support of FSS Design		Revision No. 0

EXHIBIT 1

Survey Unit Inspection Check Sheet

SECTION 1 - SURVEY UNIT INSPECTION DESCRIPTION			
Survey Unit #	CV 2-24	Survey Unit Location	CV INTERIOR SUPPORT RINGS 802', 798'
Date 8/11/03	Time 1430	Inspection Team Members	J DUSKIN

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

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: ① RINGS WERE INSTALLED AS NEW MATERIAL WITH PAINT ALREADY APPLIED.
② PLYWOOD AND OTHER MATERIALS to be Removed FROM RING, Housekeeping to be completed

Survey Unit Inspector (print/sign)	J DUSKIN / [signature]	Date	8/19/03
Survey Designer (print/sign)	B. BROSEY / B. Brosey	Date	8/20/03

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EXHIBIT 3

Surface Measurement Test Area (SMTA) Data Sheet

SECTION 1 - DESCRIPTION

SMTA Number	SMTA - CV 2-24-1	Survey Unit Number	CV 2-24		
SMTA Location	CV INTERIOR SUPPORT RINGS EL 802, 798'				
Survey Unit Inspector	J DUSKIN	Date	8/19/03	Time	1430

SECTION 2 - CALIPER INFORMATION & PERSONNEL INVOLVED

Caliper Manufacturer	Mitutoyo Corp	Caliper Model Number	CD-6" CS		
Caliper Serial Number	0763893	Calibration Due Date (as applicable)	10/03		
Rad Con Technician	NA	Date	NA	Time	NA
Survey Unit Inspector Approval	J DUSKIN / JDK	Date	8/19/03		

SECTION 3 - MEASUREMENT RESULTS

SMTA Grid Map & Measurement Results in Units of mm (Insert Results in White Blocks Below)

1: 0.2	7: 0.1	13: 0.0	19: 0.1	25: 0.1	31: 0.1
2: 0.1	8: 0.2	14: 0.0	20: 0.1	26: 0.2	32: 0.1
3: 0.0	9: 0.0	15: 0.0	21: 0.1	27: 0.0	33: 0.0
4: 0.1	10: 0.1	16: 0.0	22: 0.1	28: 0.0	34: 0.0
5: 0.1	11: 0.2	17: 0.3	23: 0.3	29: 0.0	35: 0.1
6: 0.0	12: 0.1	18: 0.1	24: 0.0	30: 0.1	36: 0.2

Average Measurement 0.1 mm

Comments

SURFACE ROUGHNESS OF THE SMTA IS TYPICAL OF THE SURVEY UNIT

Additional Measurements Required

NONE

ATTACHMENT 9 - 15

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EXHIBIT 1

Survey Unit Inspection Check Sheet

SECTION 1 - SURVEY UNIT INSPECTION DESCRIPTION					
Survey Unit #	CV 2-25	Survey Unit Location	CV INTERIOR RING 792'		
Date	8/20/03	Time	1130	Inspection Team Members	J DUSKIN

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

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:
None

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Survey Unit Inspector (print/sign)	J DUSKIN / [signature]	Date	8/20/03
Survey Designer (print/sign)	B. BROSEY / B. Brosey	Date	8/20/03

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EXHIBIT 1

Survey Unit Inspection Check Sheet

SECTION 1 - SURVEY UNIT INSPECTION DESCRIPTION

Survey Unit #	CV 2-25	Survey Unit Location	CV INTERIOR Ring 792'
Date 8/19/03	Time 1400	Inspection Team Members	J DUSKIN

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

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:

(1) Rings were 'new material', ANT paint was applied before Ring ~~was~~ was ~~introduced~~ introduced to radioactive materials 8/19/03
(2) Additional housekeeping and removal of plywood from the survey unit is required

Survey Unit Inspector (print/sign)	J DUSKIN / J DK	Date	8/19/03
Survey Designer (print/sign)	B. BROSEY / B. Brosey	Date	8/20/03

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EXHIBIT 3

Surface Measurement Test Area (SMTA) Data Sheet

SECTION 1 - DESCRIPTION					
SMTA Number	SMTA - CV2-25-1	Survey Unit Number	CV2-25		
SMTA Location	CV INTERIOR RING 792				
Survey Unit Inspector	JDUSKIW	Date	8/19/03	Time	1400
SECTION 2 - CALIPER INFORMATION & PERSONNEL INVOLVED					
Caliper Manufacturer	Mitutoyo	Caliper Model Number	CD-6" CS		
Caliper Serial Number	0763893	Calibration Due Date (as applicable)	10/03		
Rad Con Technician	NA	Date	NA	Time	NA
Survey Unit Inspector Approval	JDUSKIW / [signature]	Date	8/19/03		
SECTION 3 - MEASUREMENT RESULTS					

SMTA Grid Map & Measurement Results in Units of mm
(Insert Results in White Blocks Below)

1: 0.1	7: 0.1	13: 0.1	19: 0.5	25: 0.3	31: 0.2
2: 0.1	8: 0.0	14: 0.3	20: 0.2	26: 0.1	32: 0.0
3: 0.0	9: 0.0	15: 0.0	21: 0.3	27: 0.3	33: 0.2
4: 0.2	10: 0.7	16: 0.8	22: 0.3	28: 0.7	34: 0.0
5: 0.2	11: 0.0	17: 0.5	23: 0.3	29: 0.5	35: 0.8
6: 0.0	12: 0.3	18: 0.1	24: 0.0	30: 0.0	36: 0.1

Average Measurement 0.2 mm

Comments

SURFACE Roughness of The SMTA IS TYPICAL OF THE SURVEY unit.

Additional Measurements Required

NONE

EXHIBIT 1

Survey Unit Inspection Check Sheet

SECTION 1 - SURVEY UNIT INSPECTION DESCRIPTION					
Survey Unit #	CV2-26	Survey Unit Location	CV INTERIOR RING EL 787'		
Date	8/20/03	Time	1440	Inspection Team Members	JDUSKW

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

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: None

Survey Unit Inspector (print/sign)	JDUSKW / [signature]	Date	8/20/03
Survey Designer (print/sign)	B. BROSEY / B. Brosey	Date	8/20/03

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EXHIBIT 1

Survey Unit Inspection Check Sheet

SECTION 1 - SURVEY UNIT INSPECTION DESCRIPTION

Survey Unit #: CV2-26 Survey Unit Location: CV INTERIOR Ring EL 787'

Date: 8/19/03 Time: 1315 Inspection Team Members: JDUSKIN

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

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: RINGS ARE 'NEW MATERIAL' AND
① ANY PAINT ON THE RINGS WAS APPLIED BEFORE AREA WAS EXPOSED to CONTAMINATION.
ADDITIONAL HOUSEKEEPING AND REMOVAL OF PLYWOOD FROM THE SURVEY UNIT IS REQUIRED.

Survey Unit Inspector (print/sign)	JDUSKIN / [signature]	Date	8/19/03
Survey Designer (print/sign)	B. BROSEY / B. Brosey	Date	8/20/03

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EXHIBIT 3

Surface Measurement Test Area (SMTA) Data Sheet

SECTION 1 - DESCRIPTION					
SMTA Number	SMTA - CV2-26-1	Survey Unit Number	CV2-26		
SMTA Location	CV INTERIOR RING EL 787'				
Survey Unit Inspector	J DUSKIN	Date	8/19/03	Time	1315
SECTION 2 - CALIPER INFORMATION & PERSONNEL INVOLVED					
Caliper Manufacturer	MITUTOYO CORP	Caliper Model Number	CD-6" CS		
Caliper Serial Number	0763893	Calibration Due Date (as applicable)	10/03		
Rad Con Technician	NA	Date	NA	Time	NA
Survey Unit Inspector Approval	J Duskin / J Dk	Date	8/19/03		
SECTION 3 - MEASUREMENT RESULTS					

SMTA Grid Map & Measurement Results in Units of mm (Insert Results in White Blocks Below)

1: 0.0	7: 0.0	13: 0.0	19: 0.0	25: 0.0	31: 0.0
2: 0.0	8: 0.0	14: 0.0	20: 0.0	26: 0.0	32: 0.0
3: 0.0	9: 0.1	15: 0.3	21: 0.0	27: 0.1	33: 0.2
4: 0.0	10: 0.1	16: 0.0	22: 0.0	28: 0.1	34: 0.0
5: 0.0	11: 0.0	17: 0.0	23: 0.0	29: 0.0	35: 0.0
6: 0.3	12: 0.0	18: 0.2	24: 0.1	30: 0.0	36: 0.0

Average Measurement <0.1 mm

Comments

~~NONE~~ 8/19/03 JD
SURFACE roughness of the SMTA IS TYPICAL of SURVEY UNIT.

Additional Measurements Required

NONE

ATTACHMENT 9 - 21

SAXTON NUCLEAR	Saxton Nuclear Experimental Corporation Facility Policy and Procedure Manual	Number E900-IMP-4520.06
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EXHIBIT 1

Survey Unit Inspection Check Sheet

SECTION 1 - SURVEY UNIT INSPECTION DESCRIPTION					
Survey Unit #	CV2-27	Survey Unit Location	CV INTERIOR RING 782'		
Date	8/20/03	Time	1325	Inspection Team Members	JDUSKIN

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

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:

NONE

Survey Unit Inspector (print/sign)	JDUSKIN / [signature]	Date	8/20/03
Survey Designer (print/sign)	B. BROSEY / B. Brosey	Date	8/20/03

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SAXTON NUCLEAR	Saxton Nuclear Experimental Corporation Facility Policy and Procedure Manual	Number E900-IMP-4520.06
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EXHIBIT 1

Survey Unit Inspection Check Sheet

SECTION 1 - SURVEY UNIT INSPECTION DESCRIPTION				
Survey Unit # CV2-27	Survey Unit Location CV INTERIOR Ring EL 782'			
Date 8/19/03 Time 1215	Inspection Team Members JDUSKIN			
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?	✓		
2	Do the surveys (from Question 1) demonstrate that the survey unit will most likely pass the FSS?	✓		
3	Is the physical work (i.e., remediation & housekeeping) in or around the survey unit complete?		✓	
4	Have all tools, non-permanent equipment, and material not needed to perform the FSS been removed?		✓	
5	Are the survey surfaces relatively free of loose debris (i.e., dirt, concrete dust, metal filings, etc.)?	✓		
6	Are the survey surfaces relatively free of liquids (i.e., water, moisture, oil, etc.)?	✓		
7	Are the survey surfaces free of all paint, which has the potential to shield radiation?	① ✓		
8	Have the Surface Measurement Test Areas (SMTA) been established? Refer to Exhibit 2 for instructions	✓		
9	Have the Surface Measurement Test Areas (SMTA) data been collected? Refer to Exhibit 2 for instructions	✓		
10.	Are the survey surfaces easily accessible? (No scaffolding, high reach, etc. is needed to perform the FSS)	✓		
11	Is lighting adequate to perform the FSS?	✓		
12.	Is the area industrially safe to perform the FSS? (Evaluate potential fall & trip hazards, confined spaces, etc.)	✓		
13.	Have photographs been taken showing the overall condition of the area?	✓		
14.	Have all unsatisfactory conditions been resolved?		✓	

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:

① RING WAS PRE-PAINTED BEFORE INTRODUCED TO CV AN "NEW" MATERIAL. ADDITIONAL HOUSEKEEPING AND REMOVAL OF PLYWOOD FROM THE SURVEY UNIT IS REQUIRED.

Survey Unit Inspector (print/sign)	JDUSKIN / [signature]	Date	8/19/03
Survey Designer (print/sign)	B. BROSEY / B. Brosey	Date	8/20/03

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SAXTON NUCLEAR	Saxton Nuclear Experimental Corporation Facility Policy and Procedure Manual	Number E900-IMP-4520.06
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EXHIBIT 3

Surface Measurement Test Area (SMTA) Data Sheet

SECTION 1 - DESCRIPTION

SMTA Number	SMTA - CV2-27-1	Survey Unit Number	CV2-27		
SMTA Location	CV INTERIOR RING EL 782'				
Survey Unit Inspector	J DUSKIN	Date	8/19/03	Time	1215

SECTION 2 - CALIPER INFORMATION & PERSONNEL INVOLVED

Caliper Manufacturer	Mitutoyo CORP.	Caliper Model Number	CD-6" CS		
Caliper Serial Number	0763893	Calibration Due Date (as applicable)	10/03		
Rad Con Technician	J DUSKIN 8/19/03	Date	NA	Time	NA
Survey Unit Inspector Approval	J DUSKIN / JBK	Date	8/19/03		

SECTION 3 - MEASUREMENT RESULTS

SMTA Grid Map & Measurement Results in Units of mm (Insert Results in White Blocks Below)

1: 0.0	7: 0.0	13: 0.0	19: 0.0	25: 0.0	31: 0.1
2: 0.0	8: 0.1	14: 0.1	20: 0.0	26: 0.1	32: 0.1
3: 0.5	9: 0.0	15: 0.0	21: 0.0	27: 0.1	33: 0.0
4: 0.0	10: 0.1	16: 0.0	22: 0.1	28: 0.4	34: 0.1
5: 0.1	11: 0.0	17: 0.1	23: 0.0	29: 0.1	35: 0.3
6: 0.0	12: 0.1	18: 0.2	24: 0.0	30: 0.1	36: 0.0

Average Measurement 0.1 mm

Comments

SURFACE Roughness of The SMTA IS TYPICAL of The SURVEY UNIT.

Additional Measurements Required

None

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EXHIBIT 1

Survey Unit Inspection Check Sheet

SECTION 1 - SURVEY UNIT INSPECTION DESCRIPTION						
Survey Unit #	CV 2-28		Survey Unit Location	CV INTERIOR RING 778'		
Date	8/20/03	Time	135	Inspection Team Members	J DUSKIN	

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

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:

NONE

Survey Unit Inspector (print/sign)	J DUSKIN / [signature]	Date	8/20/03
Survey Designer (print/sign)	B. BROSEY / B. Brosey	Date	8/20/03

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EXHIBIT 1

Survey Unit Inspection Check Sheet

SECTION 1 - SURVEY UNIT INSPECTION DESCRIPTION			
Survey Unit #: CV2-28	Survey Unit Location: CV INTERIOR RING EL 778'		
Date: 8/19/03	Time: 1130	Inspection Team Members: J DUSKIN	
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?	✓		
2. Do the surveys (from Question 1) demonstrate that the survey unit will most likely pass the FSS?	✓		
3. Is the physical work (i.e., remediation & housekeeping) in or around the survey unit complete?		✓	
4. Have all tools, non-permanent equipment, and material not needed to perform the FSS been removed?		✓	
5. Are the survey surfaces relatively free of loose debris (i.e., dirt, concrete dust, metal filings, etc.)?	✓		
6. Are the survey surfaces relatively free of liquids (i.e., water, moisture, oil, etc.)?	✓		
7. Are the survey surfaces free of all paint, which has the potential to shield radiation?	① ✓		
8. Have the Surface Measurement Test Areas (SMTA) been established? Refer to Exhibit 2 for instructions.	✓		
9. Have the Surface Measurement Test Areas (SMTA) data been collected? Refer to Exhibit 2 for instructions.	✓		
10. Are the survey surfaces easily accessible? (No scaffolding, high reach, etc. is needed to perform the FSS.)	✓		
11. Is lighting adequate to perform the FSS?	✓		
12. Is the area industrially safe to perform the FSS? (Evaluate potential fall & trip hazards, confined spaces, etc.)	✓		
13. Have photographs been taken showing the overall condition of the area?	✓		
14. Have all unsatisfactory conditions been resolved?		✓	

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:
① - RINGS ARE "NEW" MATERIAL INTRODUCED TO THE CV WITH PAINT APPLIED. PAINT WILL NOT AFFECT OR "SHIELD RADIATION". PLYWOOD TO BE REMOVED FROM SURVEY UNIT, HOUSEKEEPING TO BE COMPLETED.

Survey Unit Inspector (print/sign)	J DUSKIN / [signature]	Date	8/19/03
Survey Designer (print/sign)	B. BROSEY / B. Brosey	Date	8/20/03

ATTACHMENT 9-26

SAXTON NUCLEAR	Saxton Nuclear Experimental Corporation Facility Policy and Procedure Manual	Number E900-IMP-4520.06
Title: Survey Unit Inspection in Support of FSS Design		Revision No. 0

EXHIBIT 3

Surface Measurement Test Area (SMTA) Data Sheet

SECTION 1 - DESCRIPTION

SMTA Number	SMTA - CV 2-28-1	Survey Unit Number	CV 2-28		
SMTA Location	CV INTERIOR RING EL 778'				
Survey Unit Inspector	J DUSKIN	Date	8/19/03	Time	1130

SECTION 2 - CALIPER INFORMATION & PERSONNEL INVOLVED

Caliper Manufacturer	MITUTOYO CORP	Caliper Model Number	CD-6" CS		
Caliper Serial Number	0763893	Calibration Due Date (as applicable)	10/03		
Rad Con Technician	NA	Date	NA	Time	NA
Survey Unit Inspector Approval	J DUSKIN / [signature]	Date	8/19/03		

SECTION 3 - MEASUREMENT RESULTS

SMTA Grid Map & Measurement Results in Units of mm (Insert Results in White Blocks Below)

1: 0.2	7: 0.2	13: 0.1	19: 0.3	25: 0.0	31: 0.1
2: 0.0	8: 0.0	14: 0.1	20: 0.1	26: 0.1	32: 0.0
3: 0.0	9: 0.2	15: 0.2	21: 0.0	27: 0.0	33: 0.1
4: 0.0	10: 0.0	16: 0.0	22: 0.0	28: 0.1	34: 0.0
5: 0.0	11: 0.0	17: 0.1	23: 0.0	29: 0.1	35: 0.2
6: 0.1	12: 0.1	18: 0.0	24: 0.1	30: 0.0	36: 0.1

Average Measurement 0.1 mm

Comments

SURFACE ROUGHNESS OF THE SMTA IS TYPICAL OF THE SURVEY UNIT.

Additional Measurements Required

NONE

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Site Report

Site Summary

Site Name: Remaining CV Shell Surveys

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
Gross Activity	Building Surface	2,100	No	36	1
				25	1.2
				16	1.5
				9	2
				4	3.4
				1	10.1

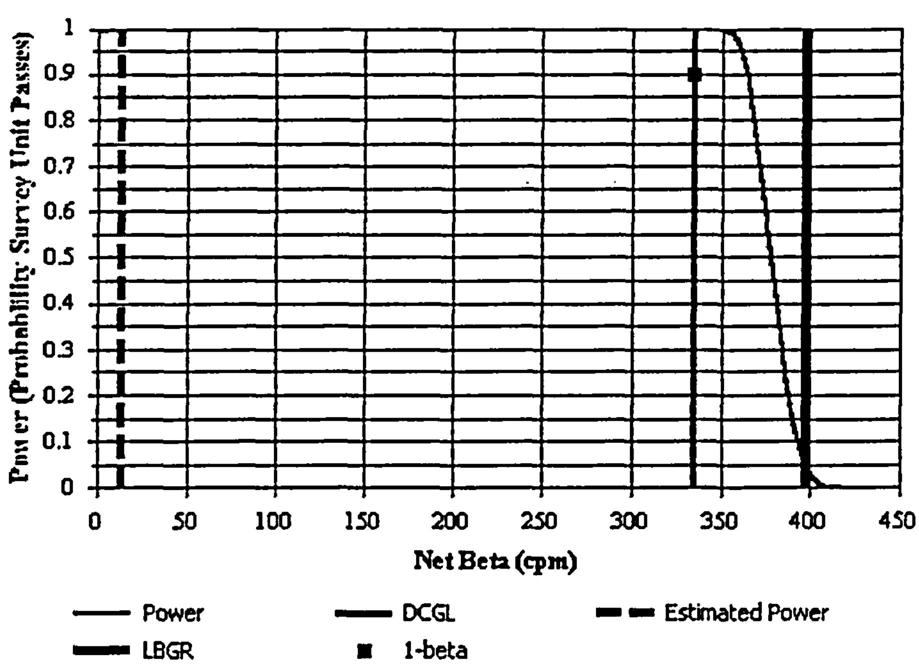
ATTACHMENT 10 - 1

Building Surface Survey Plan

Survey Plan Summary

Site:	Remaining CV Shell Surveys		
Planner(s):	BHB		
Survey Unit Name:	CV1-1 Survey Unit - Near CV Cutoff		
Comments:			
Area (m²):	100	Classification:	1
Selected Test:	WRS	Estimated Sigma (cpm):	21.5
DCGL (cpm):	397	Sample Size (N/2):	8
LBGR (cpm):	335	Estimated Conc. (cpm):	13.6
Alpha:	0.050	Estimated Power:	1.00
Beta:	0.100	EMC Sample Size (N):	8

Prospective Power Curve



ATTACHMENT 10.2

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Building Surface Survey Plan

Contaminant Summary

Contaminant	DCGLw (dpm/100 cm²)
Gross Activity	2,100

Beta Instrumentation Summary

Gross Beta DCGLw (dpm/100 cm²): 2,100
Total Efficiency: 0.15
Gross Beta DCGLw (cpm): 397

ID	Type	Mode	Area (cm²)
3	GFPC	Beta	126

Contaminant	Energy[1]	Fraction[2]	Inst. Eff.	Surf. Eff.	Total Eff.
Gross Activity	187.87	1.0000	0.48	0.31	0.1488

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

Gross Survey Unit Mean (cpm): 215 ± 22 (1-sigma)
Count Time (min): 1

Material	Number of BKG Counts	Average (cpm)	Standard Deviation (cpm)	MDC (dpm/100 cm²)
Steel	37	200.9	17.7	365

ATTACHMENT 10.3

Elevated Measurement Comparison (EMC) for Beta — CV1-1

Follow the order of each tab below to perform the EMC.

1) Enter Scanning Instrument Efficiencies | 2) Enter Scan MDC Parameters | 3) View EMC Results

Scan MDC Required per Contaminant

Contaminant	DCGLw*	Area Factor	Scan MDC Required*
Gross Activity	2,100	1.75	3,675

Statistical Design

N/2	8
Bounded Area (m²)	12.5
Area Factor	1.75
DCGLw*	2,100
Scan MDC Required*	3,675

Hot Spot Design

Actual Scan MDC*	714
Area Factor	N/A
Bounded Area (m²)	N/A
Post EMC N/2	8

*dpm/100 cm²

Enable Training
v1.0.0

COMPASS

No additional samples are required because the actual scan MDC is less than the DCGLw for each contaminant.

OK

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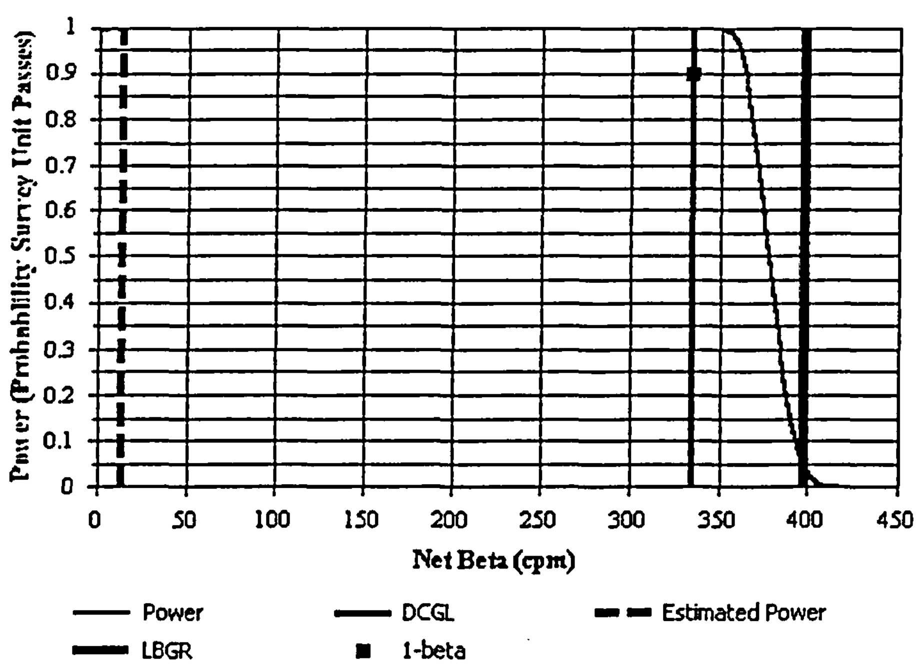
E900-03-020

Building Surface Survey Plan

Survey Plan Summary

Site:	Remaining CV Shell Surveys		
Planner(s):	BHB		
Survey Unit Name:	CV2-24 Upper Two Short Rings		
Comments:	Assumes variability & other parameters of CV1-1		
Area (m^2):	34	Classification:	1
Selected Test:	WRS	Estimated Sigma (cpm):	21.5
DCGL (cpm):	397	Sample Size (N/2):	8
LBGR (cpm):	335	Estimated Conc. (cpm):	13.6
Alpha:	0.050	Estimated Power:	1.00
Beta:	0.100	EMC Sample Size (N):	8

Prospective Power Curve



ATTACHMENT 10.5

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E900-03-020

Building Surface Survey Plan

Contaminant Summary

Contaminant	DCGLw (dpm/100 cm²)
Gross Activity	2,100

Beta Instrumentation Summary

Gross Beta DCGLw (dpm/100 cm²): 2,100
Total Efficiency: 0.15
Gross Beta DCGLw (cpm): 397

ID	Type	Mode	Area (cm²)
3	GFPC	Beta	126

Contaminant	Energy[1]	Fraction[2]	Inst. Eff.	Surf. Eff.	Total Eff.
Gross Activity	187.87	1.0000	0.48	0.31	0.1482

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

Gross Survey Unit Mean (cpm): 215 ± 22 (1-sigma)
Count Time (min): 1

Material	Number of BKG Counts	Average (cpm)	Standard Deviation (cpm)	MDC (dpm/100 cm²)
Steel	37	200.9	17.7	365

ATTACHMENT: 10 - 6

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E900-03-020

Elevated Measurement Comparison (EMC) for Beta

CV2-24

Follow the order of each tab below to perform the EMC

1) Enter Scanning Instrument Efficiencies | 2) Enter Scan MDC Parameters | **3) View EMC Results**

Scan MDC Required per Contaminant

Contaminant	DCGLw*	Area Factor	Scan MDC Required*
Gross Activity	2,100	3.34	7,014

Statistical Design

N/2:	8
Bounded Area (m²):	4.2
Area Factor:	3.34
DCGLw*:	2,100
Scan MDC Required*:	7,014

Hot Spot Design

Actual Scan MDC*:	714
Area Factor:	N/A
Bounded Area (m²):	N/A
Post EMC N/2:	8

*dpm/100cm²

☑ Enable Training

v1.0.0

COMPASS

No additional samples are required because the actual scan MDC is less than the DCGLw for each contaminant.

OK

ATTACHMENT 10 7

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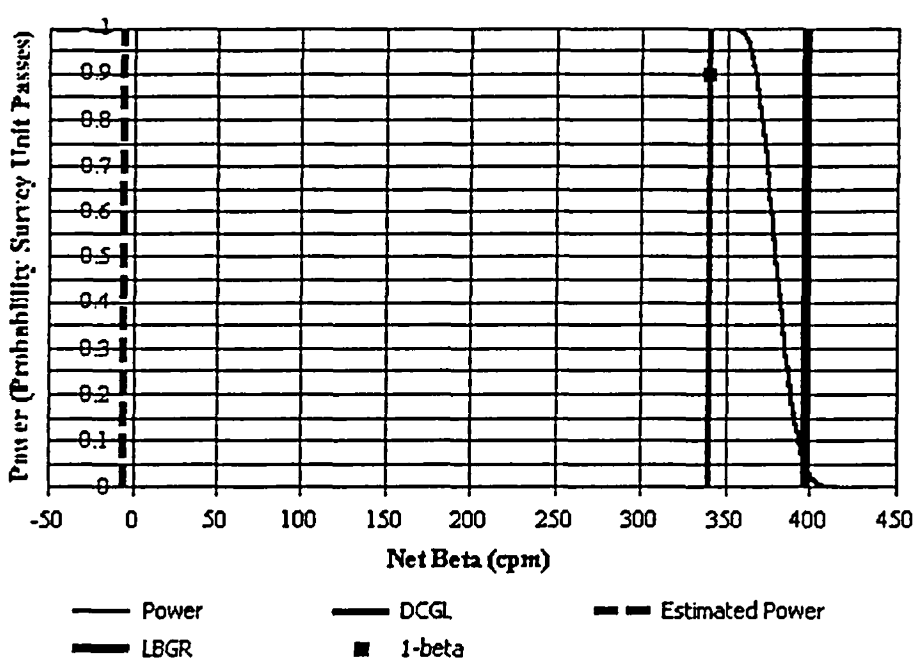
E900-63-020

Building Surface Survey Plan

Survey Plan Summary

Site:	Remaining CV Shell Surveys		
Planner(s):	BHB		
Survey Unit Name:	CV1-2 Survey Unit		
Comments:	2nd SU Down		
Area (m²):	100	Classification:	1
Selected Test:	WRS	Estimated Sigma (cpm):	19.3
DCGL (cpm):	397	Sample Size (N/2):	8
LBGR (cpm):	340	Estimated Conc. (cpm):	-5.5
Alpha:	0.050	Estimated Power:	1.00
Beta:	0.100	EMC Sample Size (N):	8

Prospective Power Curve



ATTACHMENT 10 - 8

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E900-03-020

Building Surface Survey Plan

Contaminant Summary

Contaminant	DCGLw (dpm/100 cm²)
Gross Activity	2,100

Beta Instrumentation Summary

Gross Beta DCGLw (dpm/100 cm²): 2,100
Total Efficiency: 0.15
Gross Beta DCGLw (cpm): 397

ID	Type	Mode	Area (cm²)
3	GFPC	Beta	126

Contaminant	Energy[1]	Fraction[2]	Inst. Eff.	Surf. Eff.	Total Eff.
Gross Activity	187.87	1.0000	0.48	0.31	0.1482

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

Gross Survey Unit Mean (cpm): 170 ± 19 (1-sigma)
Count Time (min): 1

Material	Number of BKG Counts	Average (cpm)	Standard Deviation (cpm)	MDC (dpm/100 cm²)
Steel 2	37	175.9	17.7	342

ATTACHMENT: 10 . 9

Elevated Measurement Comparison (EMC) for Beta

CV1-2

Follow the order of each tab below to perform the EMC.

1) Enter Scanning Instrument Efficiencies | 2) Enter Scan MDC Parameters | **3) View EMC Results**

Scan MDC Required per Contaminant

Contaminant	DCGLw*	Area Factor	Scan MDC Required*
Gross Activity	2,100	1.75	3,675

Statistical Design

N/2:	8
Bounded Area (m²):	12.5
Area Factor:	1.75
DCGLw:	2,100
Scan MDC Required*:	3,675

Hot Spot Design

Actual Scan MDC*:	668
Area Factor:	N/A
Bounded Area (m²):	N/A
Post EMC N/2:	8

* dpm/100 cm²

☑ Enable Training

COMPASS

No additional samples are required because the actual scan MDC is less than the DCGLw for each contaminant.

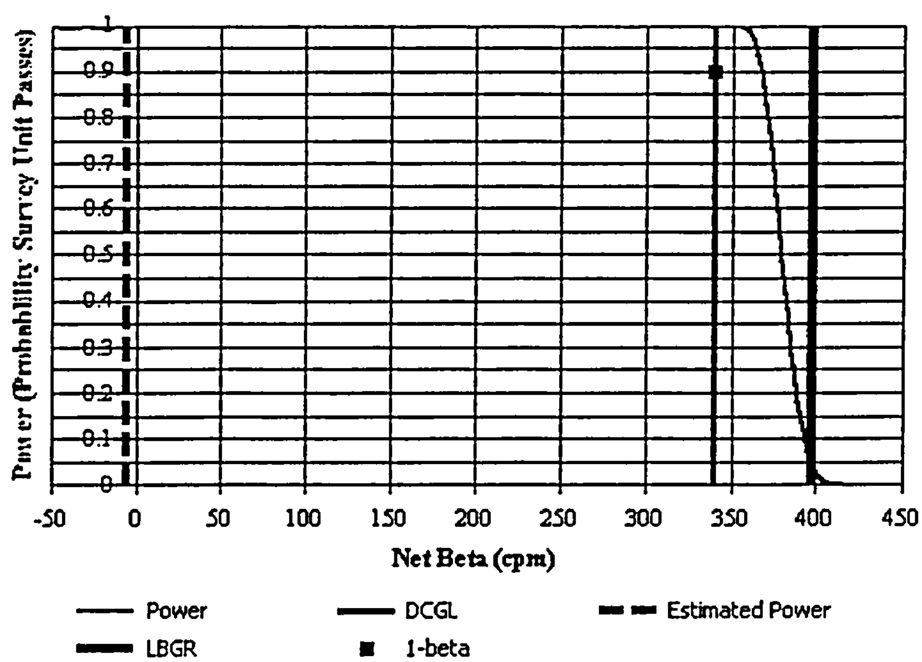
OK

Building Surface Survey Plan

Survey Plan Summary

Site:	Remaining CV Shell Surveys		
Planner(s):	BHB		
Survey Unit Name:	CV2-25		
Comments:	Support Ring in CV1-2 Area		
Area (m^2):	68	Classification:	1
Selected Test:	WRS	Estimated Sigma (cpm):	19.3
DCGL (cpm):	397	Sample Size (N/2):	8
LBGR (cpm):	340	Estimated Conc. (cpm):	-5.5
Alpha:	0.050	Estimated Power:	1.00
Beta:	0.100	EMC Sample Size (N):	8

Prospective Power Curve



ATTACHMENT 10 - 11

Building Surface Survey Plan

Contaminant Summary

Contaminant	DCGLw (dpm/100 cm²)
Gross Activity	2,100

Beta Instrumentation Summary

Gross Beta DCGLw (dpm/100 cm²): 2,100
Total Efficiency: 0.15
Gross Beta DCGLw (cpm): 397

ID	Type	Mode	Area (cm²)
3	GFPC	Beta	126

Contaminant	Energy[1]	Fraction[2]	Inst. Eff.	Surf. Eff.	Total Eff.
Gross Activity	187.87	1.0000	0.48	0.31	0.1482

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

Gross Survey Unit Mean (cpm): 170 ± 19 (1-sigma)
Count Time (min): 1

Material	Number of BKG Counts	Average (cpm)	Standard Deviation (cpm)	MDC (dpm/100 cm²)
Steel 2	37	175.9	17.7	342

Elevated Measurement Comparison (EMC) for Beta

CV2-25

Follow the order of each tab below to perform the EMC.

1] Enter Scanning Instrument Efficiencies | 2] Enter Scan MDC Parameters | **3] View EMC Results**

Scan MDC Required per Contaminant

Contaminant	DCGLw*	Area Factor	Scan MDC Required*
Gross Activity	2,100	2.14	4,494

Statistical Design

N/2	8
Bounded Area (m²)	8.5
Area Factor	2.14
DCGLw*	2,100
Scan MDC Required*	4,494

Hot Spot Design

Actual Scan MDC*	668
Area Factor	N/A
Bounded Area (m²)	N/A
Post EMC N/2	8

*dpm/100 cm²

☑ Enable Trainin

v1.00

COMPASS

No additional samples are required because the actual scan MDC is less than the DCGLW for each contaminant.

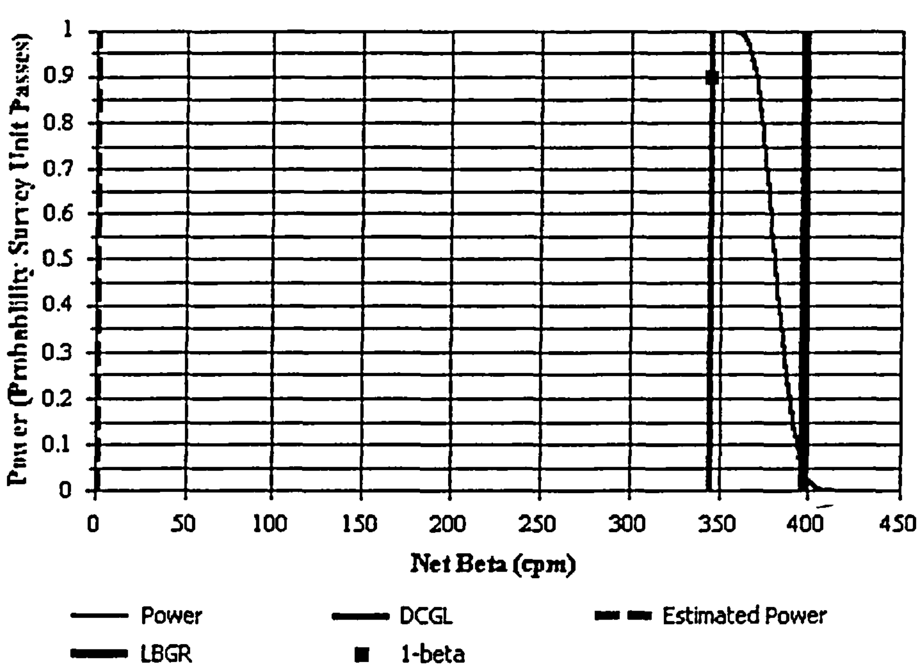
OK

Building Surface Survey Plan

Survey Plan Summary

Site:	Remaining CV Shell Surveys		
Planner(s):	BHB		
Survey Unit Name:	CV1-3 Survey Unit		
Comments:	Third Major SU Down from Top		
Area (m^2):	91	Classification:	1
Selected Test:	WRS	Estimated Sigma (cpm):	17.7
DCGL (cpm):	397	Sample Size (N/2):	8
LBGR (cpm):	345	Estimated Conc. (cpm):	2
Alpha:	0.050	Estimated Power:	1.00
Beta:	0.100	EMC Sample Size (N):	8

Prospective Power Curve



ATTACHMENT 10 - 14

Building Surface Survey Plan

Contaminant Summary

Contaminant	DCGLw (dpm/100 cm²)
Gross Activity	2,100

Beta Instrumentation Summary

Gross Beta DCGLw (dpm/100 cm²): 2,100
Total Efficiency: 0.15
Gross Beta DCGLw (cpm): 397

ID	Type	Mode	Area (cm²)
3	GFPC	Beta	126

Contaminant	Energy[1]	Fraction[2]	Inst. Eff.	Surf. Eff.	Total Eff.
Gross Activity	187.87	1.0000	0.48	0.31	0.1482

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

Gross Survey Unit Mean (cpm): 141 ± 16 (1-sigma)
Count Time (min): 1

Material	Number of BKG Counts	Average (cpm)	Standard Deviation (cpm)	MDC (dpm/100 cm²)
Steel 3	37	138.9	17.7	306

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Elevated Measurement Comparison (EMC) for Beta

CV1-3

Follow the order of each tab below to perform the EMC.

1] Enter Scanning Instrument Efficiencies | 2] Enter Scan MDC Parameters | **3] View EMC Results**

Scan MDC Required per Contaminant

Contaminant	DCGLw*	Area Factor	Scan MDC Required*
Gross Activity	2,100	1.83	3,843

Statistical Design

N/2	8
Bounded Area (m²)	11.4
Area Factor	1.83
DCGLw*	2,100
Scan MDC Required*	3,843

Hot Spot Design

Actual Scan MDC*	594
Area Factor	N/A
Bounded Area (m²)	N/A
Post EMC N/2	8

* dpm/100 cm²

Enable Trainin

v1.0.0

COMPASS

No additional samples are required because the actual scan MDC is less than the DCGLW for each contaminant.

OK

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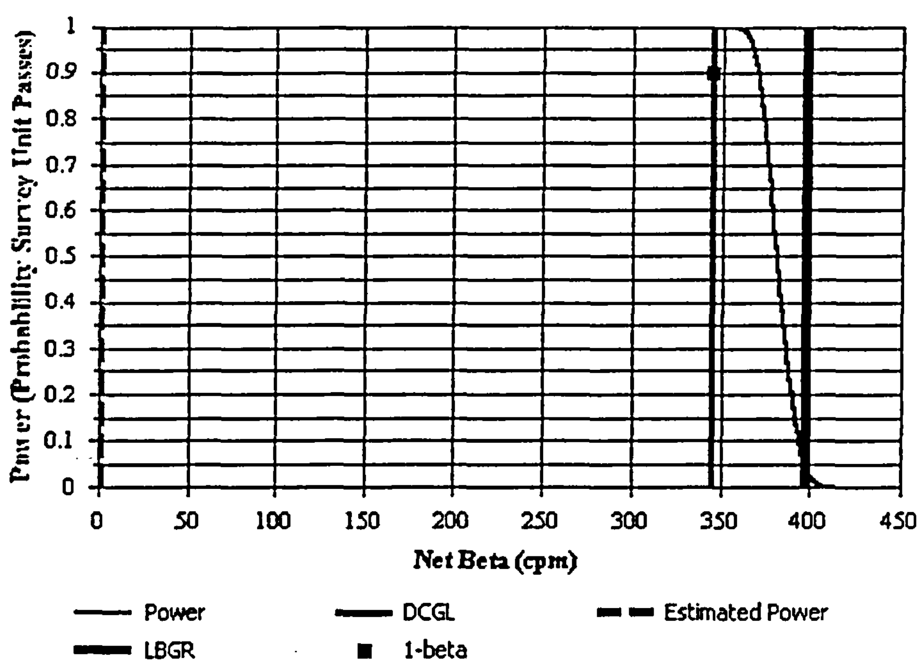
E900-03-020

Building Surface Survey Plan

Survey Plan Summary

Site:	Remaining CV Shell Surveys		
Planner(s):	BHB		
Survey Unit Name:	CV2-26		
Comments:	CV2-26 in CV1-3 Area		
Area (m²):	68	Classification:	1
Selected Test:	WRS	Estimated Sigma (cpm):	17.7
DCGL (cpm):	397	Sample Size (N/2):	8
LBGR (cpm):	345	Estimated Conc. (cpm):	2
Alpha:	0.050	Estimated Power:	1.00
Beta:	0.100	EMC Sample Size (N):	8

Prospective Power Curve



ATTACHMENT 10 - 17

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E900-03-620

Building Surface Survey Plan

Contaminant Summary

Contaminant	DCGLw (dpm/100 cm²)
Gross Activity	2,100

Beta Instrumentation Summary

Gross Beta DCGLw (dpm/100 cm²): 2,100
Total Efficiency: 0.15
Gross Beta DCGLw (cpm): 397

ID	Type	Mode	Area (cm²)
3	GFPC	Beta	126

Contaminant	Energy[1]	Fraction[2]	Inst. Eff.	Surf. Eff.	Total Eff.
Gross Activity	187.87	1.0000	0.48	0.31	0.1482

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

Gross Survey Unit Mean (cpm): 141 ± 16 (1-sigma)
Count Time (min): 1

Material	Number of BKG Counts	Average (cpm)	Standard Deviation (cpm)	MDC (dpm/100 cm²)
Steel 3	37	138.9	17.7	306

ATTACHMENT 10 - 18

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E900-03-020

Elevated Measurement Comparison (EMC) for Beta

CV2-26

Follow the order of each tab below to perform the EMC.

1) Enter Scanning Instrument Efficiencies | 2) Enter Scan MDC Parameters | 3) View EMC Results

Scan MDC Required per Contaminant

Contaminant	DCGLw*	Area Factor	Scan MDC Required*
Gross Activity	2,100	2.14	4,494

Statistical Design

N/2	8
Bounded Area (m²)	8.5
Area Factor	2.14
DCGLw*	2,100
Scan MDC Required*	4,494

Hot Spot Design

Actual Scan MDC*	594
Area Factor	N/A
Bounded Area (m²)	N/A
Post EMC N/2	8

* dpm/100 cm²

☑ Enable Training

v1.0.1

COMPASS

No additional samples are required because the actual scan MDC is less than the DCGLw for each contaminant.

OK

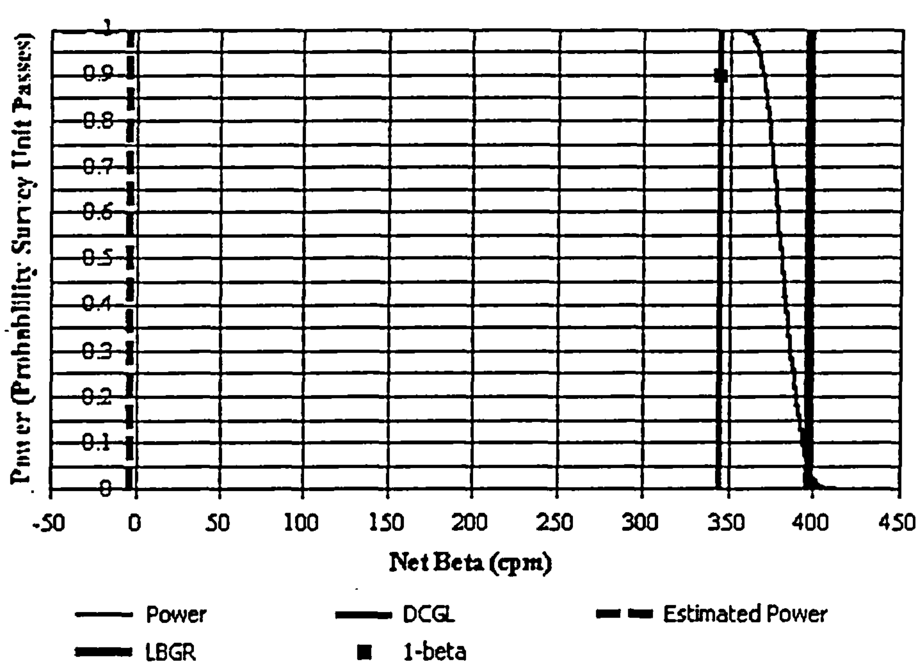
ATTACHMENT 10 . 19

Building Surface Survey Plan

Survey Plan Summary

Site:	Remaining CV Shell Surveys		
Planner(s):	BHB		
Survey Unit Name:	CV1-4 Survey Unit		
Comments:	Last Major Survey Unit		
Area (m²):	95	Classification:	1
Selected Test:	WRS	Estimated Sigma (cpm):	17.7
DCGL (cpm):	397	Sample Size (N/2):	8
LBGR (cpm):	345	Estimated Conc. (cpm):	-3.2
Alpha:	0.050	Estimated Power:	1.00
Beta:	0.100	EMC Sample Size (N):	8

Prospective Power Curve



ATTACHMENT 10.20

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E900-03-020

Building Surface Survey Plan

Contaminant Summary

Contaminant	DCGLw (dpm/100 cm²)
Gross Activity	2,100

Beta Instrumentation Summary

Gross Beta DCGLw (dpm/100 cm²): 2,100
Total Efficiency: 0.15
Gross Beta DCGLw (cpm): 397

ID	Type	Mode	Area (cm²)
3	GFPC	Beta	126

Contaminant	Energy[1]	Fraction[2]	Inst. Eff.	Surf. Eff.	Total Eff.
Gross Activity	187.87	1.0000	0.48	0.31	0.1482

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

Gross Survey Unit Mean (cpm): 163 ± 13 (1-sigma)
Count Time (min): 1

Material	Number of BKG Counts	Average (cpm)	Standard Deviation (cpm)	MDC (dpm/100 cm²)
Steel 4	37	165.9	17.7	333

ATTACHMENT 10 - 21

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Elevated Measurement Comparison (EMC) for Beta

CV1-4

Follow the order of each tab below to perform the EMC.

1) Enter Scanning Instrument Efficiencies | 2) Enter Scan MDC Parameters | **3) View EMC Results**

Scan MDC Required per Contaminant

Contaminant	DCGLw*	Area Factor	Scan MDC Required*
Gross Activity	2,100	1.79	3,759

Statistical Design

N/2:	8
Bounded Area (m²):	11.9
Area Factor:	1.79
DCGLw*:	2,100
Scan MDC Required:	3,759

Hot Spot Design

Actual Scan MDC*:	649
Area Factor:	N/A
Bounded Area (m²):	N/A
Post-EMC N/2:	8

COMPASS

No additional samples are required because the actual scan MDC is less than the DCGLw for each contaminant.

OK

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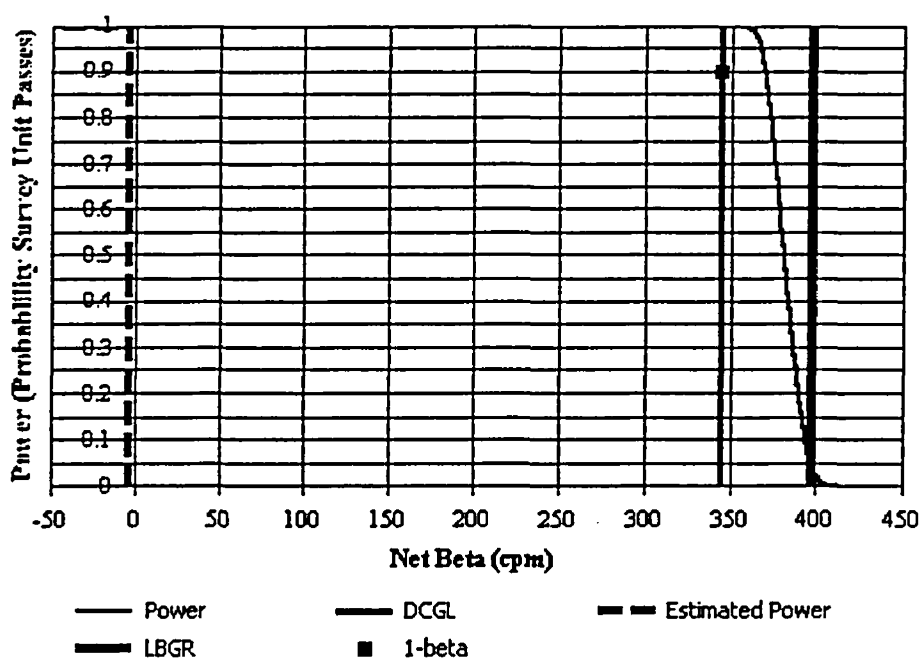
Building Surface Survey Plan

Survey Plan Summary

Site:	Remaining CV Shell Surveys		
Planner(s):	BHB		
Survey Unit Name:	CV2-27~~a~~ BHB 8/19/03		
Comments:	Corrected Report - SU in CV1-4 Area		
Area (m²):	68	Classification:	1
Selected Test:	WRS	Estimated Sigma (cpm):	17.7
DCGL (cpm):	397	Sample Size (N/2):	8
LBGR (cpm):	345	Estimated Conc. (cpm):	-3.2
Alpha:	0.050	Estimated Power:	1.00
Beta:	0.100	EMC Sample Size (N):	8

Prospective Power Curve



ATTACHMENT 10 - 23

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Building Surface Survey Plan

Contaminant Summary

Contaminant	DCGLw (dpm/100 cm²)
Gross Activity	2,100

Beta Instrumentation Summary

Gross Beta DCGLw (dpm/100 cm²): 2,100
Total Efficiency: 0.15
Gross Beta DCGLw (cpm): 397

ID	Type	Mode	Area (cm²)
3	GFPC	Beta	126

Contaminant	Energy[1]	Fraction[2]	Inst. Eff.	Surf. Eff.	Total Eff.
Gross Activity	187.87	1.0000	0.48	0.31	0.1482

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

Gross Survey Unit Mean (cpm): 163 ± 13 (1-sigma)
Count Time (min): 1

Material	Number of BKG Counts	Average (cpm)	Standard Deviation (cpm)	MDC (dpm/100 cm²)
Steel 4	37	165.9	17.7	333

ATTACHMENT 10.24

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E900-03-020

Elevated Measurement Comparison (EMC) for Beta **CV2-27**

Follow the order of each tab below to perform the EMC.

1) Enter Scanning Instrument Efficiencies | 2) Enter Scan MDC Parameters | 3) View EMC Results

Scan MDC Required per Contaminant

Contaminant	DCGLw*	Area Factor	Scan MDC Required*
Gross Activity	2,100	2.14	4,494

Statistical Design

N/2	8
Bounded Area (m²)	8.5
Area Factor	2.14
DCGLw*	2,100
Scan MDC Required*	4,494

Hot Spot Design

Actual Scan MDC*	649
Area Factor	N/A
Bounded Area (m²)	N/A
Post-EMC N/2	8

*dpm/100 cm²

Enable Trainin[g]

COMPASS

No additional samples are required because the actual scan MDC is less than the DCGLw for each contaminant.

OK

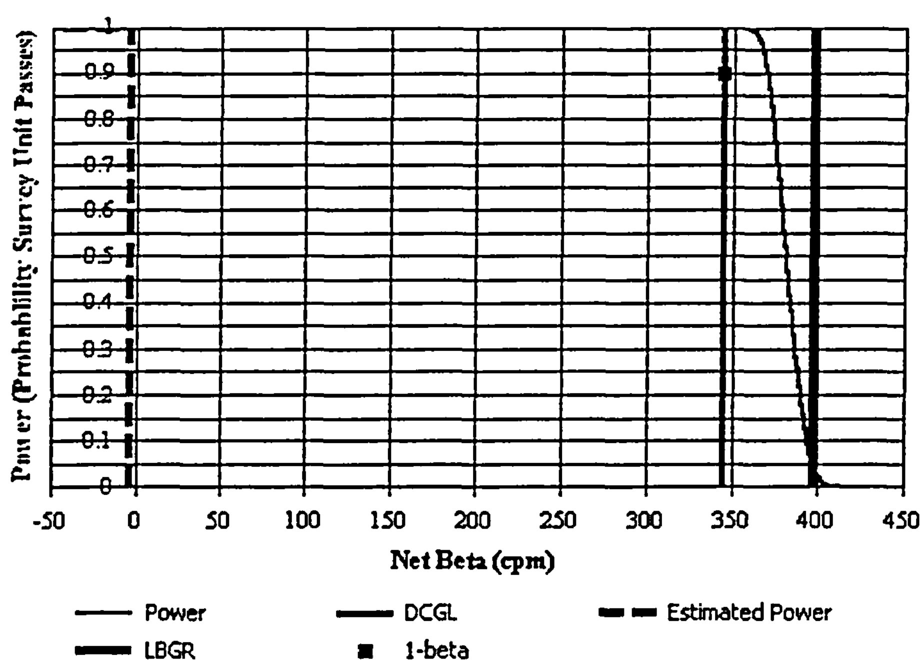
ATTACHMENT 10 25

Building Surface Survey Plan

Survey Plan Summary

Site:	Remaining CV Shell Surveys		
Planner(s):	BHB		
Survey Unit Name:	CV2-28		
Comments:	SU in CV1-4 Area - Last Ring Down in SA		
Area (m²):	68	Classification:	1
Selected Test:	WRS	Estimated Sigma (cpm):	17.7
DCGL (cpm):	397	Sample Size (N/2):	8
LBGR (cpm):	345	Estimated Conc. (cpm):	-3.2
Alpha:	0.050	Estimated Power:	1.00
Beta:	0.100	EMC Sample Size (N):	8

Prospective Power Curve



ATTACHMENT 10 - 26

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Building Surface Survey Plan

Contaminant Summary

Contaminant	DCGLw (dpm/100 cm²)
Gross Activity	2,100

Beta Instrumentation Summary

Gross Beta DCGLw (dpm/100 cm²): 2,100
Total Efficiency: 0.15
Gross Beta DCGLw (cpm): 397

ID	Type	Mode	Area (cm²)
3	GFPC	Beta	126

Contaminant	Energy[1]	Fraction[2]	Inst. Eff.	Surf. Eff.	Total Eff.
Gross Activity	187.87	1.0000	0.48	0.31	0.1482

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

Gross Survey Unit Mean (cpm): 163 ± 13 (1-sigma)
Count Time (min): 1

Material	Number of BKG Counts	Average (cpm)	Standard Deviation (cpm)	MDC (dpm/100 cm²)
Steel 4	37	165.9	17.7	333

ATTACHMENT 10 - 27

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Elevated Measurement Comparison (EMC) for Beta

CV2-28

Follow the order of each tab below to perform the EMC.

1) Enter Scanning Instrument Efficiencies | 2) Enter Scan MDC Parameters | **3) View EMC Results**

Scan MDC Required per Contaminant

Contaminant	DCGLw*	Area Factor	Scan MDC Required*
Gross Activity	2,100	2.14	4,494

Statistical Design	
N/2:	8
Bounded Area (m²):	8.5
Area Factor:	2.14
DCGLw*:	2,100
Scan MDC Required*:	4,494

Hot Spot Design	
Actual Scan MDC*:	649
Area Factor:	N/A
Bounded Area (m²):	N/A
Req. EMC N/2:	8

*Bq/100 cm²

Enable Training

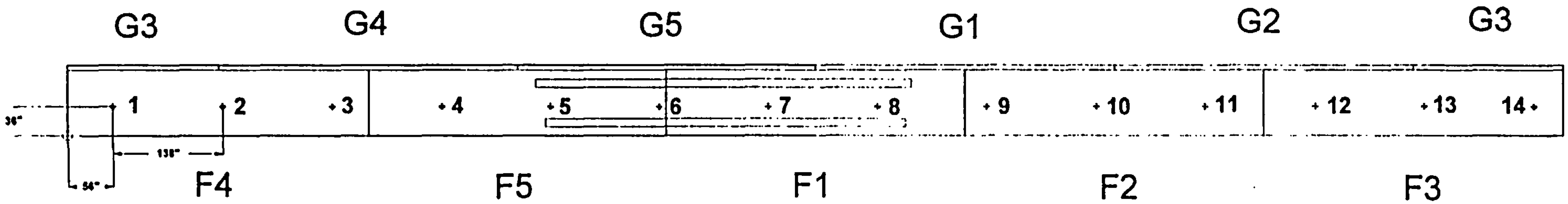
COMPASS

No additional samples are required because the actual scan MDC is less than the DCGLw for each contaminant.

OK

ATTACHMENT 10 28

CV Shell Survey Unit- CV1-1



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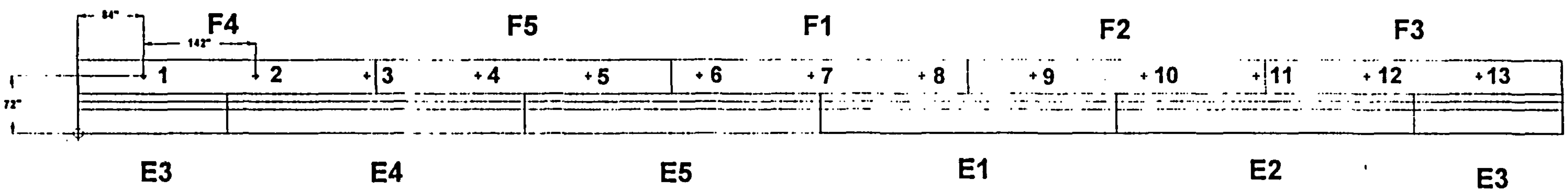
ATTACHMENT 11 - 1

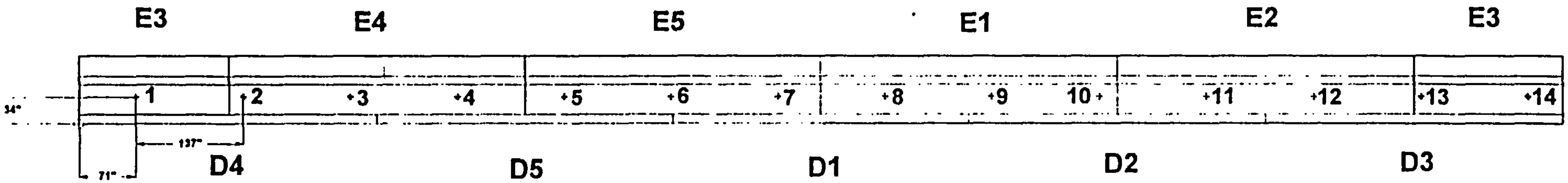
CV Shell Survey Unit - CV1-2



ATTACHMENT 11 . 2

E900-03-020

CV Shell Survey Unit - CV1-3



ATTACHMENT 11.3

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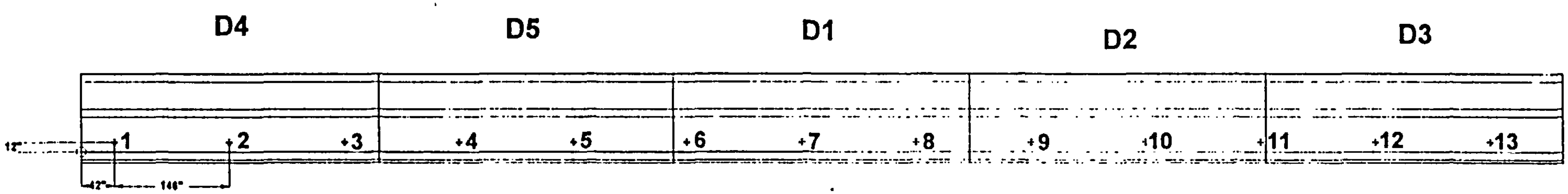
CV Shell Surveu Unit - CV1-4



ATTACHMENT 11-4

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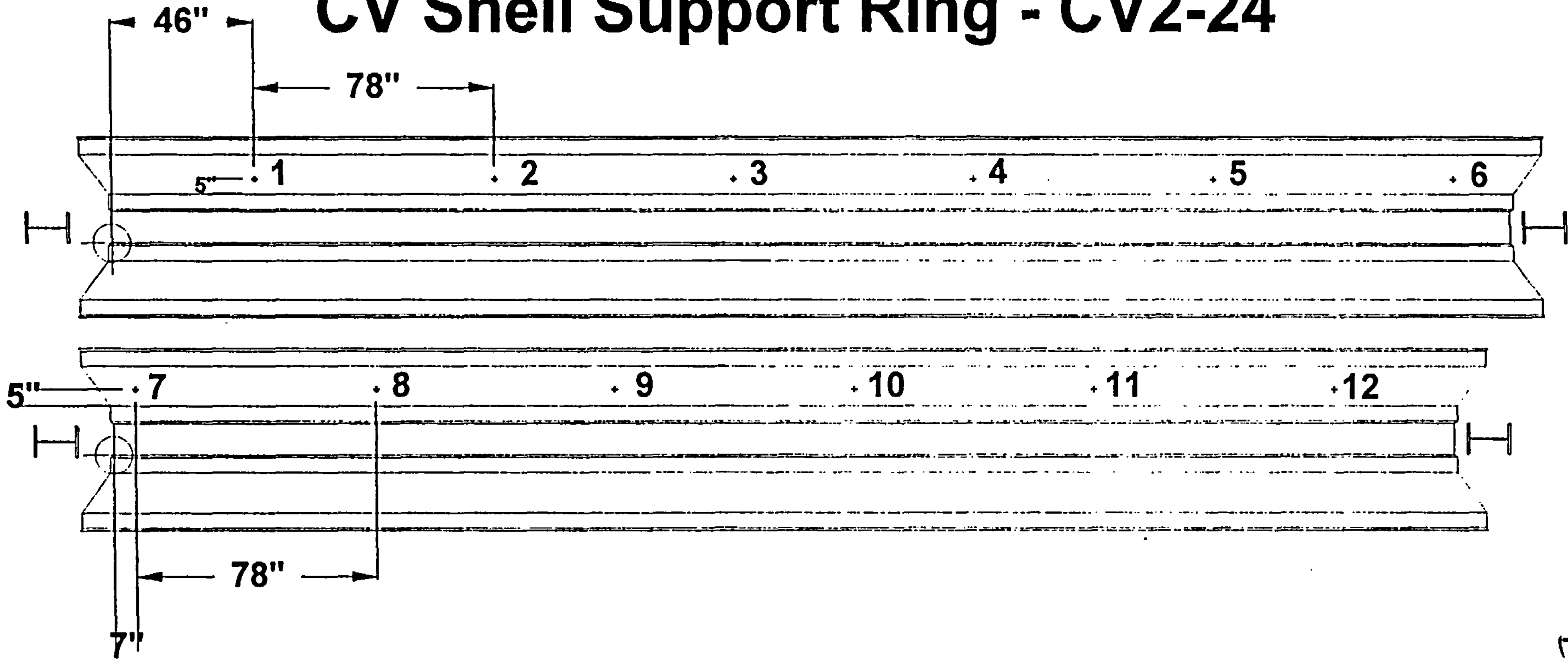
CV Shell Support Ring - CV2-24



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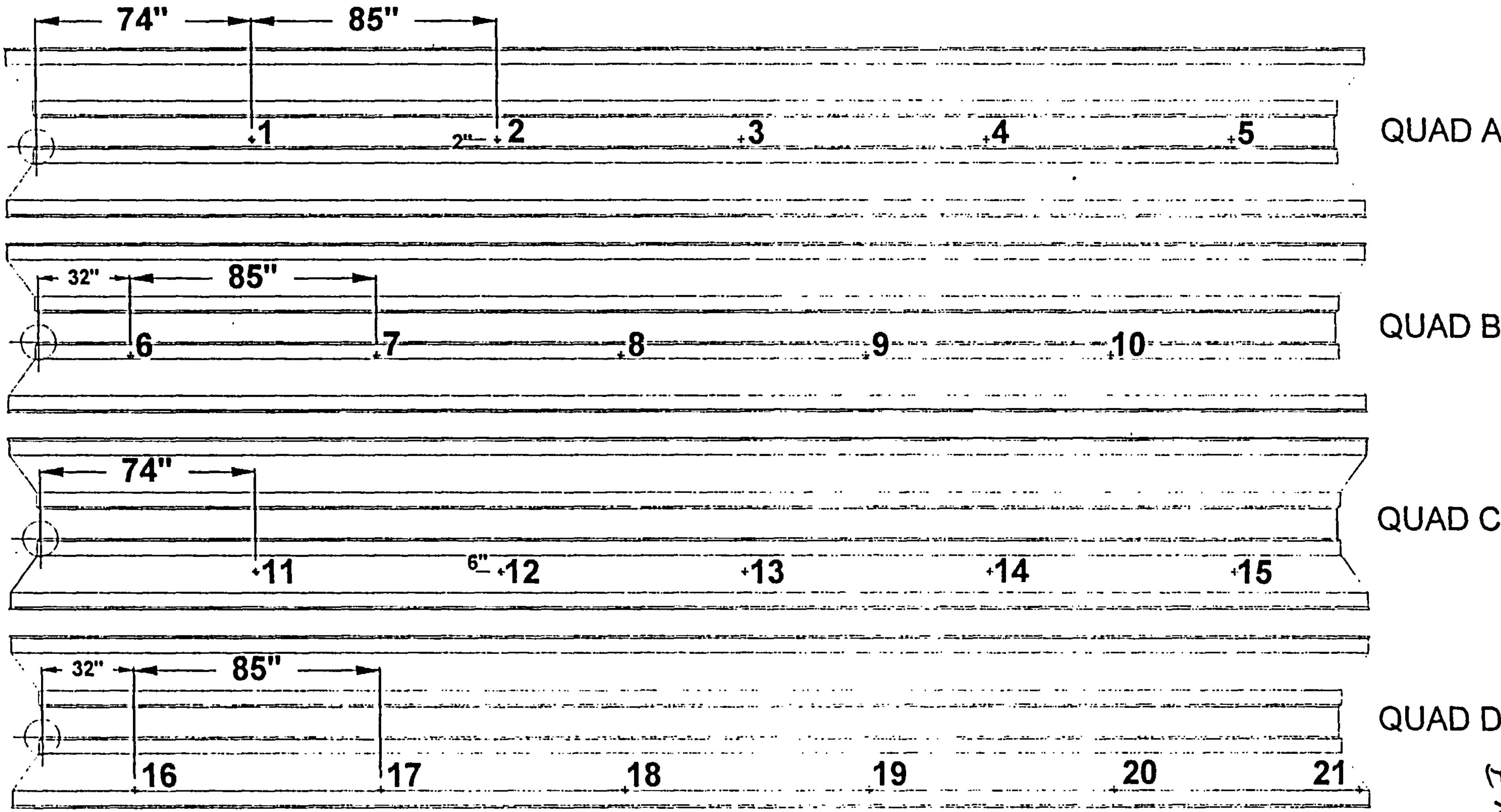
ATTACHMENT 11.5

CV Shell Support Ring - CV2-25



ATTACHMENT 11 . 6

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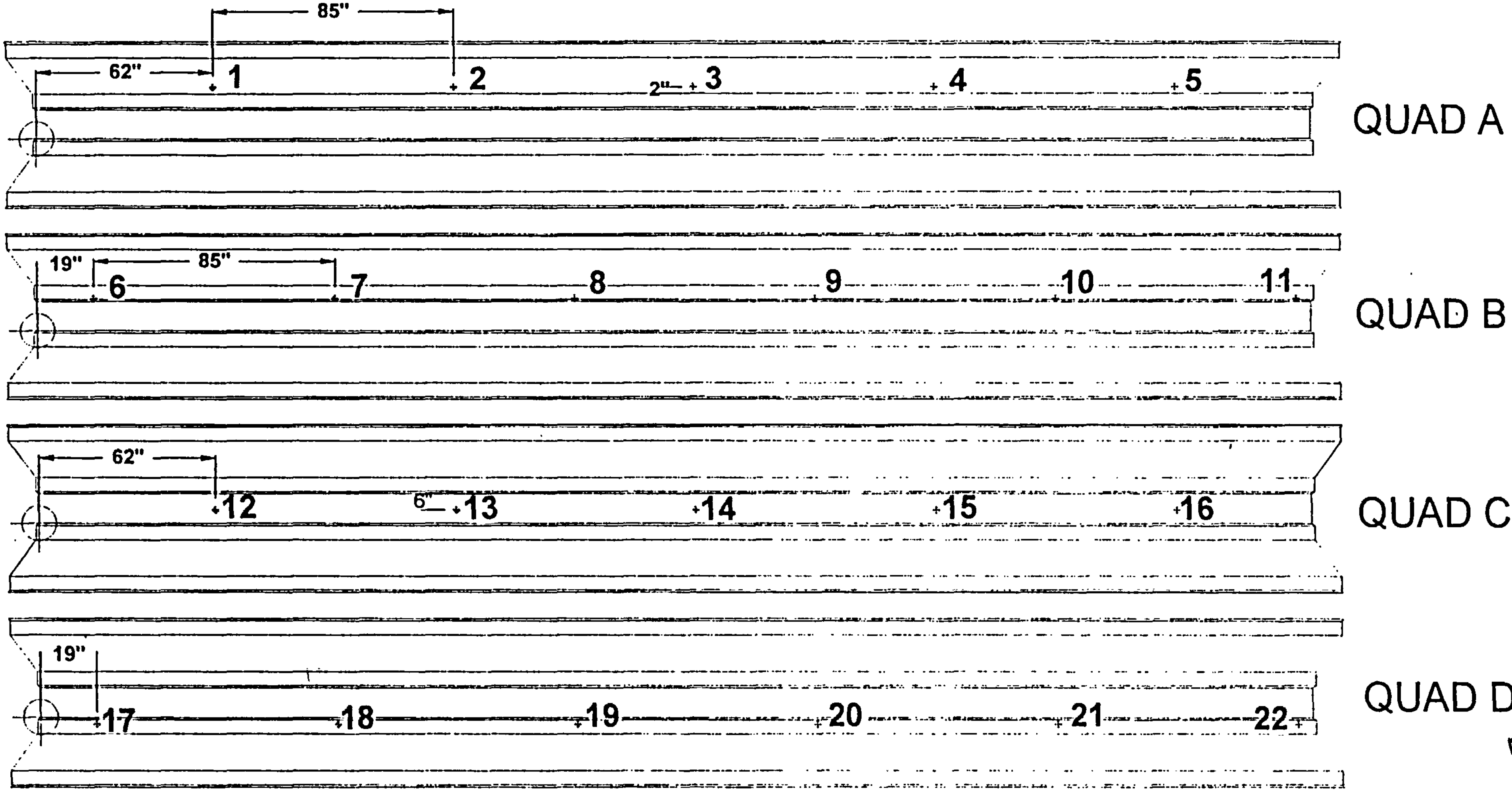
CV Shell Support Ring - CV2-26



ATTACHMENT 11 . 7

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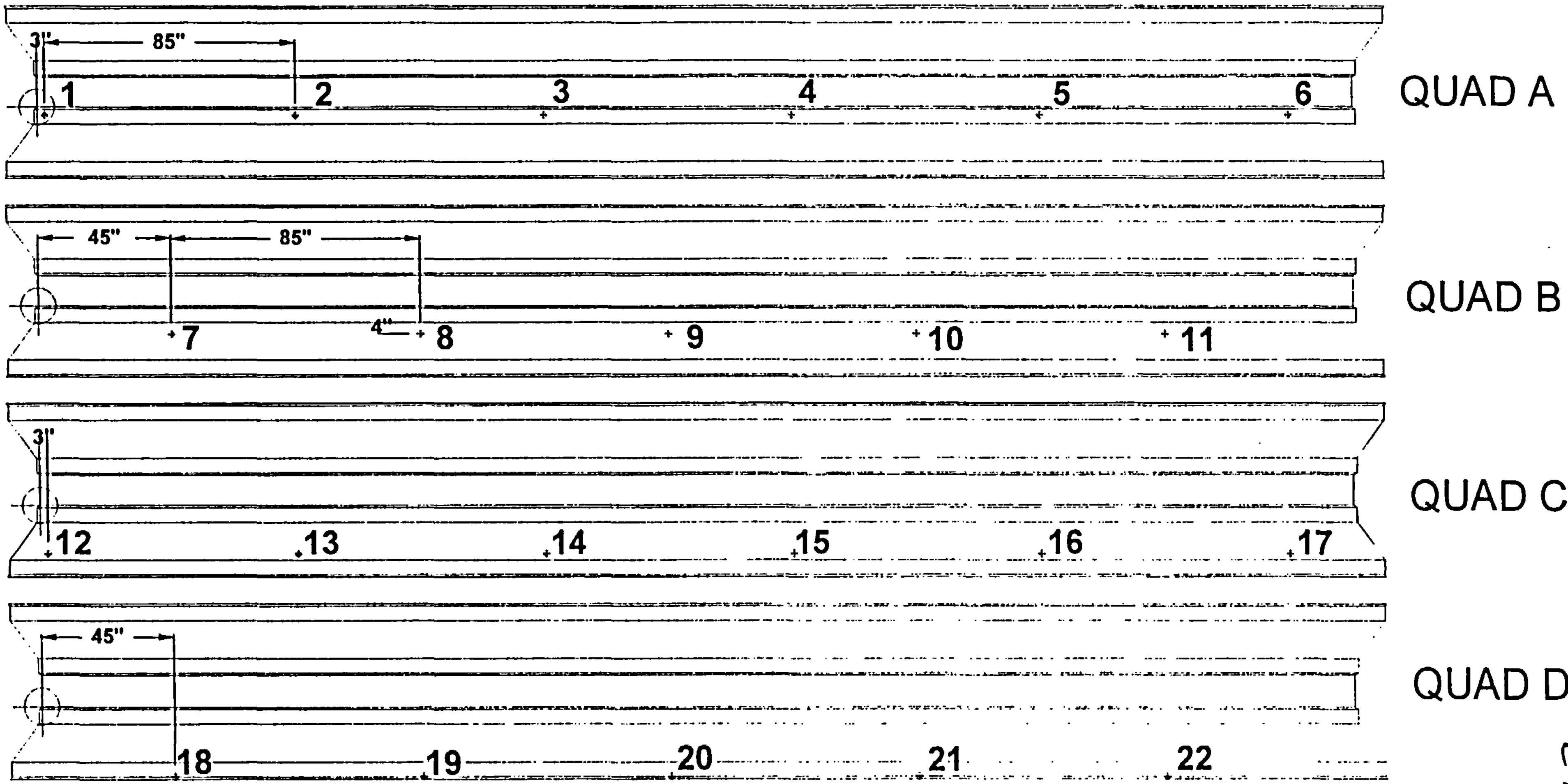
CV Shell Support Ring - CV2-27



ATTACHMENT 11 - 8

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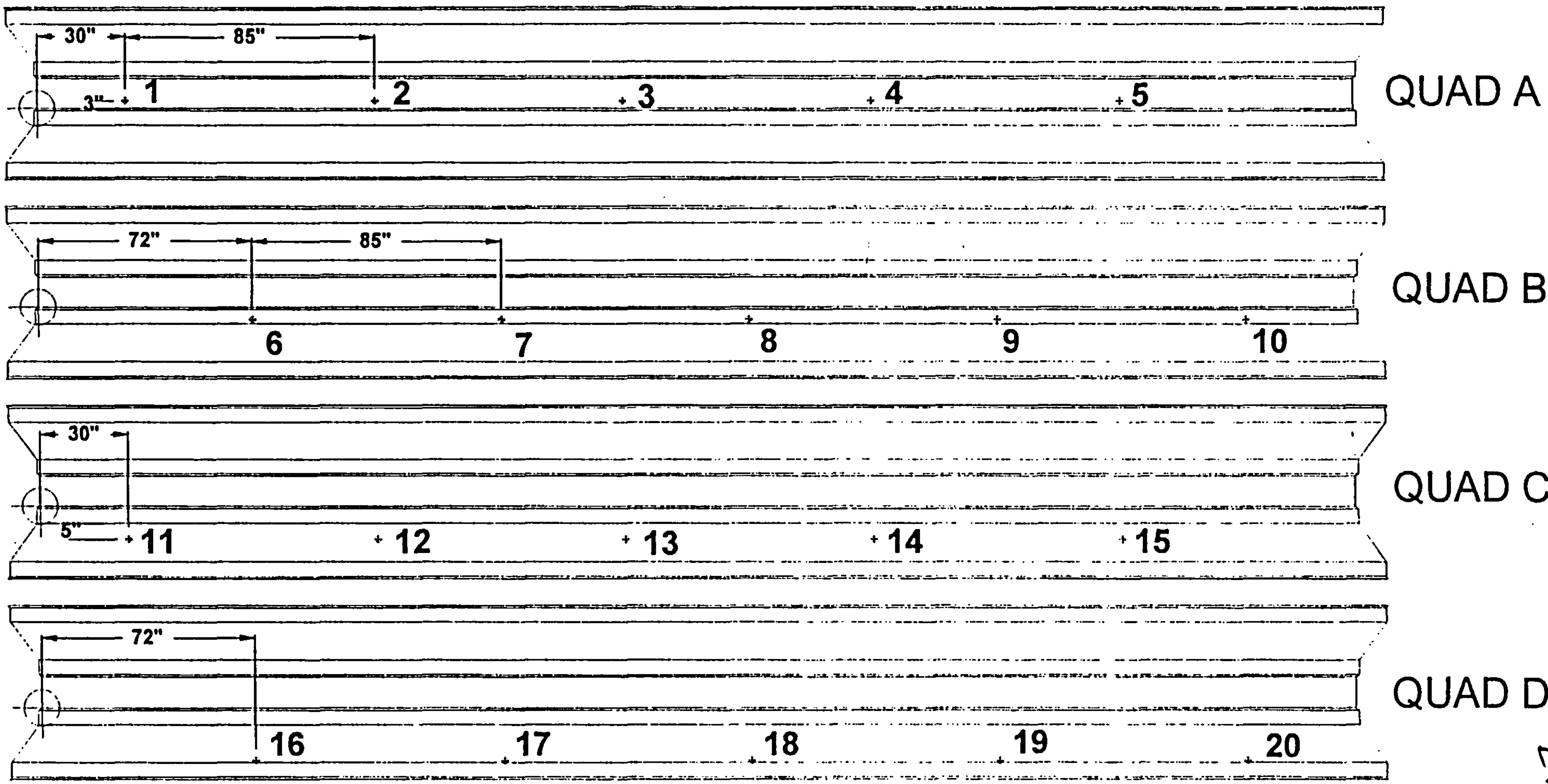
CV Shell Support Ring - CV2-28



ATTACHMENT 11 . 9

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FirstEnergy GPU

SNEC CALCULATION COVER SHEET

CALCULATION DESCRIPTION

Calculation Number	Revision Number	Effective Date	Page Number
E900-03-021	0	9/18/03	1 of 38

Subject

CV Dome Exterior Below Grade Survey Design

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

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

Question 3 - Does the calculation have the potential to affect an SSC as described in the USAR? Yes ☐ No ☒

NOTES: If a "Yes" answer is obtained for Question 1, the calculation must meet the requirements of the SNEC Facility Decommissioning Quality Assurance Plan. If a "Yes" answer is obtained for Question 2, the Calculation Originator's immediate supervisor should not review the calculation as the Technical Reviewer. If a "YES" answer is obtained for Question 3, SNEC Management approval is required to implement the calculation. Calculations that do not have the potential to affect SSC's may be implemented by the TR.

DESCRIPTION OF REVISION

APPROVAL SIGNATURES

Calculation Originator	B. Brosey/ B. Brosey	Date	9/17/03
Technical Reviewer	P. Donnachie/ [signature]	Date	9/18/03
Additional Review	A. Paynter/ [signature]	Date	9/23/03
Additional Review		Date	
SNEC Management Approval		Date	

1.0 PURPOSE

1.1 The purpose of this calculation is to develop a survey design for three (3) survey units. Two (2) of these survey units will be treated as Class 1 survey units. The third will be treated as a Class 2 survey unit. These survey units are sections of the exterior CV shell wall that extend from about the 804' El down to about the 796' El, and along the circumference of the CV building approximately 280 degrees. Each of these survey units have been aggressively decontaminated by SNEC personnel using methods described in Section 4.7 of this calculation. One (1) survey unit is part of CV6 which was previously surveyed in order to allow attachment of the exterior ring support assembly (see FirstEnergy/GPU Calculation No.'s 6900-02-013, **Reference 3.1**). The re-surveyed section of CV6 will be designated CV6-1. All of these survey units are shown collectively on **Attachment 1-1** and **1-2.**

1.2 The total combined area for all 3 survey units is ~***46.4 square meters***. A short description of each survey unit is included below.

1.2.1 Survey unit designation ***CV4-1***, is ~ ***7.17 square meters*** and extends upward from the top edge of the installed support ring assembly to about the 804' El. This survey unit will be surveyed IAW Class 1 survey criteria.

1.2.2 Survey unit designation ***CV6-1***, is composed of the center portion of the CV6 survey unit, and is ~ ***22.94 square meters***. This survey unit will be re-surveyed IAW Class 1 survey criteria.

1.2.3 Survey unit designation ***CV5***, is ~ ***16.32 square meters*** and extends down from the bottom of the support ring assembly to about the 796' El. This survey unit will be surveyed IAW Class 2 survey criteria.

2.0 SUMMARY OF RESULTS

2.1 The following information should be used to develop a survey request for this survey design:

2.1.1 The number of required static measurement points indicated for each survey unit by Compass is listed below. However, VSP adds additional points in cases where the diagram is odd shaped (edge effect) and/or because of the location of the random starting point. Additionally, the bounded area dictates survey point spacing which may also influence the number of survey points located on the diagrams. For this design, the minimum number of static survey points per survey unit is ***8*** (see **Attachment 2-1** to **2-8**).

2.1.2 The starting point (0, 0) for physically locating each survey point is shown on the attachments (see **Attachment 3-1** to **3-3**). Check the indicated attachment for the correct location as some starting points must occasionally be adjusted for odd shaped areas.

2.1.3 The scan speed is set at ***2.2 cm/sec***. ***Scan coverage is set at 100%*** for ***Class 1*** areas, and at least ***50% of the Class 2*** area. The location of the Class 2 scanned area must be documented. Note that scanning downward 10" below the lower beam will yield at least 50% coverage for this area (judgmental/systematic).

2.1.4 If a net count rate of greater than ***2300 cpm*** is encountered ***in the Class 2 survey*** unit (CV5), **stop** and **report** this information to the SR coordinator. Note that ***a Class 2 survey unit should not show greater than the DCGLw*** value at any location.

2.1.5 This survey design requires the detector be in ***contact with the surface*** during all measurement phases except in areas where this is not physically possible (debits, etc.).

2.1.6 Static measurement points are to be ***clearly marked/identified*** in each survey unit.

2.1.7 Scanning efforts shall be based on ***audible speaker output*** levels. Earphones are recommended.

2.1.8 The DCGLw is ***8,000 dpm/100 cm²*** or ***2300 cpm above background*** for a static measurement.

2.1.9 The action level during first phase scanning is ***1000 cpm above background***. If this level is reached, the surveyor should stop and perform ***a count of at least 1/2 minute*** duration to identify the actual count rate.

NOTE: Static and Scan MDC values are listed in the tables in Section 4.14 and 4.15.

2.1.10 ***Areas greater than the DCGLw (2300 ncpm) must be identified, documented, marked, and bounded to include an area estimate (Class 1 only)***.

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

2.1.12 When an obstruction is encountered during the static measurement phase that will not allow placement of a static survey point, contact the cognizant SR coordinator for permission to delete the survey point. Document the reason for the deletion. Note that at least two (2) survey points in any of these survey units, may be deleted without reducing survey design effectiveness.

2.1.13 A smear survey shall be performed in each survey unit at static measurement point locations. These smears shall be obtained after static measurements are acquired. Smears shall be assayed for beta/gamma and alpha contamination. Report results in net counts per minute. A composite gamma scan of each survey units smear grouping shall also be performed and reported.

2.1.14 A gas flow proportional counter (GFPC) shall be used in the beta detection mode for this survey work (Ludlum 2350-1 with a 43-68B probe).

2.1.15 ***Other instruments of the type specified in 2.1.14 above may be used during the FSS but they must demonstrate an efficiency at or above the value listed in Attachment 4-1 (23.9%).***

3.0 REFERENCES

3.1 SNEC Calculation No. 6900-02-013, Exterior CV Weld Area Survey Plan.

3.2 Plan SNEC Facility License Termination Plan.

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

3.6 Westinghouse Electric Corporation, Gilbert Associates, Inc., Drawing No. D-37798, Saxton Reactor Project, "Containment Vessel Penetration Access", 7/21/60.

3.7 GPU Nuclear, SNEC Facility, "Containment Vessel Survey", SNECRM-019, Rev 1, 1/18/02.

3.8 Ryerson Structural Products Handbook, Joseph T. Ryerson & Son, Inc., 1972.

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

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

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

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

3.13 ISO 7503-1, Evaluation of Surface Contamination, Part 1: Beta-emitters (maximum beta energy greater than 0.15 MeV) and alpha-emitters, 1988.

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

3.15 SNEC Calculation No. 6900-02-028, GFPC Instrument Efficiency Loss Study.

4.0 ASSUMPTIONS AND BASIC DATA

4.1 A gas flow proportional counter (GFPC) will be used in the beta detection mode as the survey instrument (a Ludlum 2350-1 with a 43-68B probe).

4.2 The Compass computer program is used to develop the number of fixed point measurement locations to be taken within each Class 1 and Class 2 survey unit **(Reference 3.3)**

4.3 The WRS statistical testing criteria will be applicable for this survey design.

4.4 The number of points chosen by Compass are located on survey maps for each survey unit by the Visual Sample Plan (VSP) computer code **(Reference 3.4)**.

4.5 VSP is used to plot random and random start systematically spaced fixed point survey locations on diagrams used in the field by survey personnel. The coordinates of the survey points are provided for each survey unit. Because of edge effects and a desire to error on the conservative side, additional measurement points have been forced either by increasing the MARSSIM overage above the required 20%, or by extending the systematically spaced static point placements over the entire length of the survey unit.

4.6 **Reference 3.5** was used as guidance during the survey design development phase.

The construction/assembly drawings used to determine the physical extent of these areas are listed as **Reference 3.6** and **3.7**.

4.7 Remediation History

Remediation of the SNEC CV began with gross decontamination and equipment removal e.g., piping, the steam generator, the pressurizer and the reactor vessel (fall of 1998). Extensive attempts at clean-up of the internal concrete structure indicated that the concrete had to be removed from the facility. In order to accomplish this, ground water abatement around the exterior of the CV was necessary and established. By the fall of 2002 the SNEC CV internal concrete structure was removed in total. With the concrete removed, several external and internal stiffener rings were required to maintain structural integrity. These assemblies were welded to the steel shell to add rigidity and produce a safe working environment for remediation crews and survey personnel.

The internal surface of the CV steel shell (below about the 804' El) was cleaned to remove radiological contamination, paint, residual concrete dirt and weld and surface scale. Original weld areas between the sections of steel plate that make up the steel shell were vigorously decontaminated along with apparent surface defects (dents, etc.). Remediation efforts of the CV exterior steel surface included combinations of the following techniques:

- surface grinding
- surface scraping
- wipe-downs

Past survey experience with respect to the CV shell exterior surface (below grade), indicated very little surface contamination existed except at elevations where systems piping penetrated the building (well above the elevations of these survey units). This meant that almost no remediation was necessary in these survey units. However, the exterior below grade surface was covered with a tar like material as a rust protection. Surface cleaning of the area was necessary to remove this material and prepare the surface for survey work. The tar like material was scraped and/or ground off leaving a shiny steel surface.

4.8 This survey design uses an effective gross activity DCGLw value developed from analysis of the following SNEC samples of soil, sediment and surface scrapings taken at various elevations below grade (~811' El) down to about the 798' El:

- SX9SL00341 – CV Yard soil in grid AY-128 (F-7) adjacent to the CV.
- CV Tunnel composite materials – sediment collected from within the CV Tunnel adjacent to the CV. The inside wall of the CV Tunnel was the SNEC CV steel shell.
- SXSL1281 - CV Yard soil in grid AX-128 (E-7) adjacent to the CV.
- SX1531, 1532 and 1533 – CV shell scrapings of tar below grade.
- SX1552 and 1553 - CV shell scrapings of tar below grade.
- SXSL1122 CV Yard soil in grid AY-129 (F-8) adjacent to the CV, and
- SXSL1130 CV Yard soil in grid AX-129 (E-8) adjacent to the CV.

In all, about twenty five sample results were reviewed to determine the best representative sample group for the below grade portion of the SNEC CV shell. This list was reduced to the seven samples listed above (see **Attachment 5-1**).

The SNEC License Termination Plan (LTP) (**Reference 3.2**) allows the use of a 2 sigma plus the mean treatment when combining multiple sample results to form an effective concentration mix. This approach was used to determine the effective DCGLw for the SNEC CV exterior shell area based on the seven samples listed previously. However, it should be noted that the CV Tunnel composite sample is thought to be the most representative sample in the mix because of its proximity to the CV steel shell. Additionally, the CV Tunnel composite sediment sample exhibited detectable levels of typical SNEC site radionuclides, whereas most other sample results did not exhibit greater than MDA values for these same radionuclides.

Four (4) radionuclides were not considered since there was no positive values in any sample result for these nuclides (Pu-241, C-14, Ni-63 and Eu-152). All samples were decayed to 9/13/03 before they were combined as a single representative concentration (see **Attachment 5-1**).

The decayed "2 sigma plus the mean" sample result were used as input to the spreadsheet titled "Effective DCGL Calculator for Cs-137" (**Reference 3-14**), to determine the effective DCGL value for the CV (below grade) exterior steel shell. This spreadsheet calculates a gross activity DCGLw value of 15,131 dpm/100 cm^2 (see **Attachment 6-1**). A further correction to the gross activity DCGLw is necessary to address de-listed radionuclides and to correct for activated steel from the SNEC CV. These correction factors are reported in the SNEC LTP (Chapter 6 – **Reference 3.2**). In addition, the SNEC facility has instituted an administrative limit of 75% of the allowable dose for the area. The de-listed radionuclide dose is accounted for within the 75% administrative limit, but the activated steel dose correction is not. Therefore, the 15,131 dpm/100 cm^2 gross activity DCGLw is lowered by the fraction (25 mrem/y-7.2 mrem/y)/25 mrem/y, which results in 10,773 dpm/100 cm^2 as the effective limit. The 75% administrative limit is then applied as follows: 0.75 x 10,773 dpm/100 cm^2 = 8080 dpm/100 cm^2. This value is rounded to ***8000 dpm/100 cm^2***.

4.9 Cs-137 and H-3 account for the majority of radionuclides in the modified sample result.

- The SNEC modified sample is (96.6% Cs-137 + 2.5% H-3) = 99.1%.

H-3 provides no additional counting efficiency for this survey design. Cs-137 provides the only reasonably detectable radionuclide in this mix. Cs-137's detection efficiency has been checked by SNEC personnel using ISO standard 7503-1 methodology (**Reference 3.13**). The SNEC facility uses only the lowest reported efficiency for any of the instruments available for the survey work as input to the survey design process. **Attachment 4-1** indicates an ***instrument efficiency of 0.478***. The ***ISO value of 0.5*** is used as the source efficiency. The instrument S/N used to determine this value is 126218 and the probe S/N is 95080.

Other instruments may be used during the FSS but they must demonstrate an efficiency at or above 0.478 for the instrument efficiency.

4.10 The current version of Compass (version 1.0) does not perform correctly when using the gross activity option. Therefore, an alternative will be implemented for this survey design.

The alternative approach involves several small changes that will not negatively impact the survey design process. These changes are:

4.10.1 For this survey design, the effective efficiency will be calculated using the following:

- $\varepsilon_i = 0.478$
- ε_s = [0.5 (ISO for Cs-137 energy betas)] x [the fraction of Cs-137 in the source area, which would be 1 for the Cs-137 calibration source or 0.966 for Cs-137 in the exterior CV survey units] x [any surface condition correction factor that impacts efficiency e.g., the impact from an increase in the average distance between the detector and source caused by a rough surface].

4.10.2 A radionuclide will be created in the library of Compass called "Gross Activity". This radionuclide will have the same nuclear parameters as Cs-137 (half-life, decay time, etc.). The effect will be (when called up) that "Gross Activity" will replace Cs-137 on the print-out from the Compass program (an administrative impact only).

4.10.3 Only "Gross Activity" will be used in the Compass program for this survey design. However, the Area Factors (AF) input to Compass will be for Co-60, which is the more conservative of all the AF values for radionuclides present in the mix. Note that Co-60 AF values are very close to Cs-137 AF values so there is little additional impact from using Co-60 area factors.

4.11 The detectors physical probe area is 126 cm^2, and the instrument is calibrated to the same source area for Cs-137. The gross activity DCGLw is taken to be 8000 dpm/100 cm^2 x (126 cm^2 physical probe area/100 cm^2) = 10,080 x (0.966 disintegrations Cs-137/disintegrations in mix) x ε_i (0.478) x ε_s (0.5) which yields ~2327 net cpm above background which is then rounded to 2300 ncpm (Compass calculates 2318 as the gross beta DCGLw). The 0.23 count per disintegration counting efficiency considers only the Cs-137 contaminant present in the sample material matrix, and is calculated by: ε_i (0.478) x ε_s (0.5) x 0.966 disintegrations Cs-137/total disintegrations in mix = 0.23 cts/gamma.

4.12 No corrections for backscatter are made for the steel surfaces. Therefore, the source term will be overestimated in all areas where there is no loss in efficiency due to surface defects. Since all areas of the CV shell were rigorously cleaned using the same technique(s), it is assumed that areas having any surface defects (dents, weld buildup, etc.), are well represented by adjacent areas that do not have significant surface defects. Defect areas represent an extremely small fraction of the total surface area of these survey units. Therefore no additional efficiency correction factors will be applied for this survey design.

4.13 The survey units on the exterior CV shell surface are below grade. Since below grade ambient background radiation levels (shielded measurements) are typically lower than grade level background levels, the Williamsburg background unshielded steel survey data will be adjusted downward to estimate this effect. To accomplish this, the shielded measurement data mean from the CV exterior is subtracted from the shielded Williamsburg mean value. The difference is assumed to be the result of differences in elevation between the two sites. This difference is then subtracted from the mean open window mean Williamsburg result as an estimate of the real steel open window background level. **Attachment 7-1 and 7-2** presents these data sets.

Attachment 7-1, is the adjusted Williamsburg background data.

4.14 The static beta-gamma MDC calculation result for these three survey units are as shown in **Attachments 2-1** through **2-8**. The results are summarized below for a 1 minute count time and show an adequate static MDC for this survey work.

Survey Units	Estimated Background (cts/min)	MDC_{STATIC} (dpm/100 cm^2)
CV4-1, CV6-1 & CV5	170 (corrected WB data)	Compass = 226

4.15 The scan MDC calculation is determined based on a 2.2 cm/sec scan rate, a 1.38 index of sensitivity (95% correct detection probability and 60% false positive), 0.23 counts/disintegration and a 126 cm^2 probe area. Compass calculates a value of ~441 dpm/100 cm^2 but does not use the 126 cm^2 probe correction factor in the equation.

Since the scan MDC is less than the gross activity DCGLw for every survey unit, there is no need to add additional survey points to these survey designs for purposes of meeting hot spot design criteria.

Survey Units	Estimated Background (cts/min)	MDC_{SCAN} (dpm/100 cm^2)
CV4-1, CV6-1 & CV5	170 (corrected WB data)	Compass = 441

4.16 The survey units described in this survey design were inspected after remediation efforts were shown effective. A copy of portions of the SNEC facility post-remediation inspection report (**Reference 3.10**), is included as **Attachment 8-1** to **8-6**.

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

4.18 The decision error for this survey design is 0.05 for the α value and 0.1 for the β value.

4.19 Special measurements including gamma-ray spectroscopy are not included in this survey design.

4.20 No additional sampling will be performed IAW this survey design.

4.21 The applicable SNEC site radionuclides and their associated DCGLw values are listed on **Exhibit 1** of this calculation.

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

4.23 The applicable Area Factors for these survey units are shown below (Co-60). These values were input to the Compass computer program (see **Attachment 9-1**). The lower limit area factor for areas less than 1 square meter is the value 10.1. Area factors for values between the values listed in the following table, may be interpolated from a curve fit of the data (see the example on **Attachment 9-2** and **9-3**).

AREA (m^2)	AREA FACTOR
1	10.1
4	3.4
9	2
16	1.5
25	1.2
36	1

5.0 CALCULATIONS

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

6.0 APPENDICES

6.1 **Attachment 1-1** and **1-2**, are diagrams of survey units on the exterior surface of the SNEC CV shell showing the three survey units and their approximate elevations. (CV4-1, CV6-1, and CV5).

6.2 **Attachment 2-1** to **2-3**, is the Compass output as a result of the survey design input parameters for survey unit CV4-1.

6.3 **Attachment 2-4** to **2-6**, is the Compass output as a result of the survey design input parameters for survey unit CV6-1.

6.4 **Attachment 2-7** and **2-8**, is the Compass output as a result of the survey design input parameters for survey unit CV5.

6.5 **Attachment 3-1** to **3-3**, is the static measurement points for the three survey units as plotted by the VSP computer program.

6.6 **Attachment 4-1**, is the SNEC site calibration sheet for the radiation measurement instrument with the lowest Cs-137 detection efficiency.

6.7 **Attachment 5-1**, is the SNEC sample results for seven (7) samples used to develop a representative mix for these survey units.

6.8 **Attachment 6-1**, the "Effective DCGL Calculator" spreadsheet result for the sample mix.

6.9 **Attachment 7-1**, is the GFPC Williamsburg steel background data and the estimated background count rate for the SNEC CV exterior survey units.

6.10 **Attachment 7-2**, is GFPC measurement results from the three survey units taken to estimate the variability of the survey units.

6.11 **Attachment 8-1** to **8-6**, is the CV inspection report results for these three survey units.

6.12 **Attachment 9-1** to **9-3**, is the area factor data used for these survey units.

Exhibit 1

SNEC Facility 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).

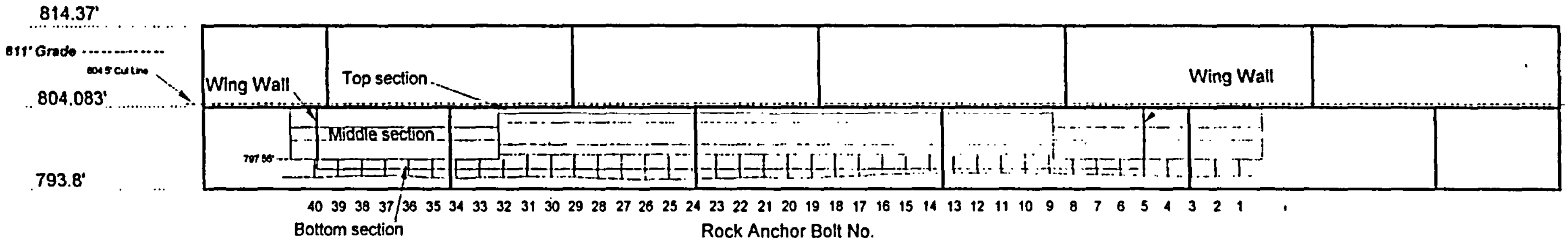
Exhibit 2

Survey Design Checklist

Calculation No. E900-03-021	Location Codes CV4-1, CV6-1 and CV5		
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	[initials] 9/18/03
2	Are drawings/diagrams adequate for the subject area (drawings should have compass headings)?	(Yes,) N/A	
3	Are boundaries properly identified and is the survey area classification clearly indicated?	(Yes,) N/A	
4	Has the survey area(s) been properly divided into survey units IAW EXHIBIT 10	(Yes,) N/A	
5	Are physical characteristics of the area/location or system documented?	(Yes,) N/A	
6	Is a remediation effectiveness discussion included?	(Yes,) N/A	
7	Have characterization survey and/or sampling results been converted to units that are comparable to applicable DCGL values?	(Yes,) N/A	
8	Is survey and/or sampling data that was used for determining survey unit variance included?	(Yes,) N/A	
9	Is a description of the background reference areas (or materials) and their survey and/or sampling results included along with a justification for their selection?	(Yes,) N/A	
10	Are applicable survey and/or sampling data that was used to determine variability included?	(Yes,) N/A	
11	Will the condition of the survey area have an impact on the survey design, and has the probable impact been considered in the design?	(Yes,) N/A	
12	Has any special area characteristic including any additional residual radioactivity (not previously noted during characterization) been identified along with its impact on survey design?	(Yes,) N/A	
13	Are all necessary supporting calculations and/or site procedures referenced or included?	(Yes) N/A	
14	Has an effective DCGLw been identified for the survey unit(s)?	(Yes) N/A	
15	Was the appropriate $DCGL_{EMC}$ included in the survey design calculation?	(Yes) N/A	
16	Has the statistical tests that will be used to evaluate the data been identified?	(Yes,) N/A	
17	Has an elevated measurement comparison been performed (Class 1 Area)?	(Yes,) N/A	
18	Has the decision error levels been identified and are the necessary justifications provided?	(Yes,) N/A	
19	Has scan instrumentation been identified along with the assigned scanning methodology?	(Yes,) N/A	
20	Has the scan rate been identified, and is the MDCscan adequate for the survey design?	(Yes,) N/A	
21	Are special measurements e.g., in-situ gamma-ray spectroscopy required under this design, and is the survey methodology, and evaluation methods described?	Yes (N/A)	
22	Is survey instrumentation calibration data included and are detection sensitivities adequate?	(Yes) N/A	
23	Have the assigned sample and/or measurement locations been clearly identified on a diagram or CAD drawing of the survey area(s) along with their coordinates?	(Yes,) N/A	
24	Are investigation levels and administrative limits adequate, and are any associated actions clearly indicated?	(Yes,) N/A	
25	For sample analysis, have the required MDA values been determined.?	Yes (N/A)	
26	Has any special sampling methodology been identified other than provided in Reference 6.3?	Yes (N/A)	[initials] 9/18/03

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

CV STEEL SHELL - External Ring Area



ATTACHMENT 1 - 1

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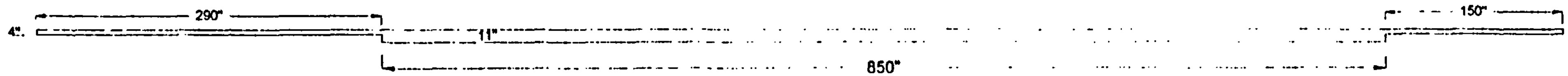
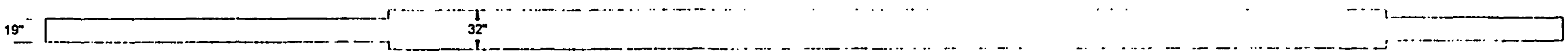
Exterior CV Dome - Below Grade Survey Units

CV4-1 - TOP SECTION - Class 1 (7.17 m^2)



CV6-1 - MIDDLE SECTION - Class 1 (22.94 m^2)



CV5 - BOTTOM SECTION - Class 2 (16.32 m^2)

ATTACHMENT 1.2

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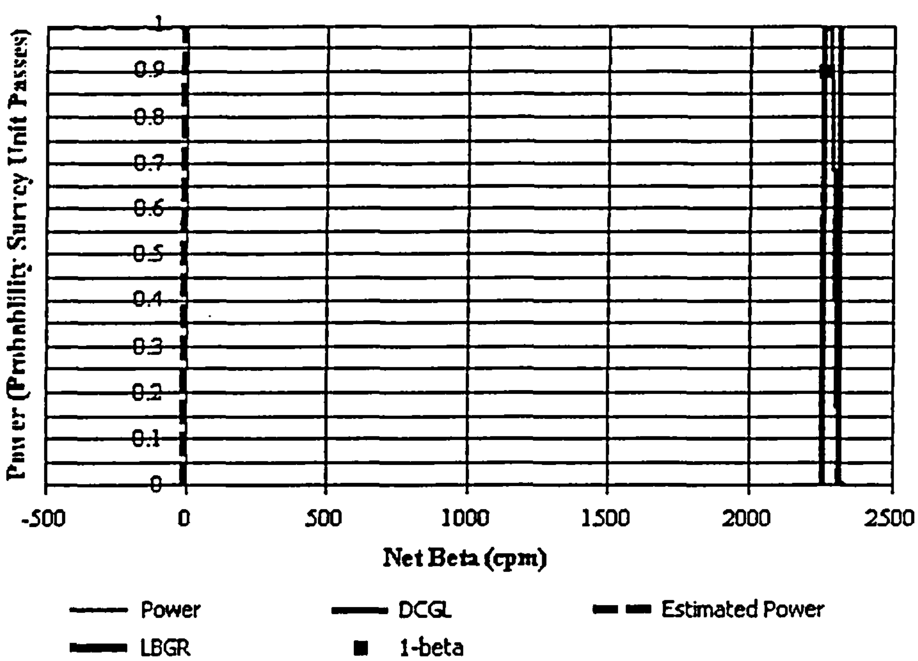
Building Surface Survey Plan

Survey Plan Summary

Site:	Exterior of SNEC CV Shell		
Planner(s):	BHB		
Survey Unit Name:	Small Area Above Support Ring Assembly		
Comments:	CV4-1		
Area (m^2):	7	Classification:	1
Selected Test:	WRS	Estimated Sigma (cpm):	18.4
DCGL (cpm):	2,318	Sample Size (N/2):	8
LBGR (cpm):	2,263	Estimated Conc. (cpm):	-9.9
Alpha:	0.050	Estimated Power:	1.00
Beta:	0.100	EMC Sample Size (N):	8

Prospective Power Curve



ATTACHMENT 2-1

Building Surface Survey Plan

Contaminant Summary

Contaminant	DCGLw (dpm/100 cm²)
Gross Activity	8,000

Beta Instrumentation Summary

Gross Beta DCGLw (dpm/100 cm²): 8,000
Total Efficiency: 0.23
Gross Beta DCGLw (cpm): 2,318

ID	Type	Mode	Area (cm²)
6	GFPC	Beta	126

Contaminant	Energy[1]	Fraction[2]	Inst. Eff.	Surf. Eff.	Total Eff.
Gross Activity	187.87	1.0000	0.48	0.48	0.2309

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

Gross Survey Unit Mean (cpm): 170 ± 18 (1-sigma)
Count Time (min): 1

Material	Number of BKG Counts	Average (cpm)	Standard Deviation (cpm)	MDC (dpm/100 cm²)
Steel	37	179.9	17.7	226

Elevated Measurement Comparison (EMC) for Beta

Follow the order of each tab below to perform the EMC.

1) Enter Scanning Instrument Efficiencies | 2) Enter Scan MDC Parameters | **3) View EMC Results**

Scan MDC Required per Contaminant

Contaminant	DCGLw*	Area Factor	Scan MDC Required*
Gross Activity	8,000	10.10	80,800

Statistical Design

N/2	8
Bounded Area (m²)	.9
Area Factor	10.10
DCGLw	8,000
Scan MDC Required	80,800

Hot Spot Design

Actual Scan MDC*	441
Area Factor	N/A
Bounded Area (m²)	N/A
Post-EMC N/2	8

* dpm/100 cm²

☑ Enable Trainin[g]

COMPASS

No additional samples are required because the actual scan MDC is less than the DCGLw for each contaminant.

OK

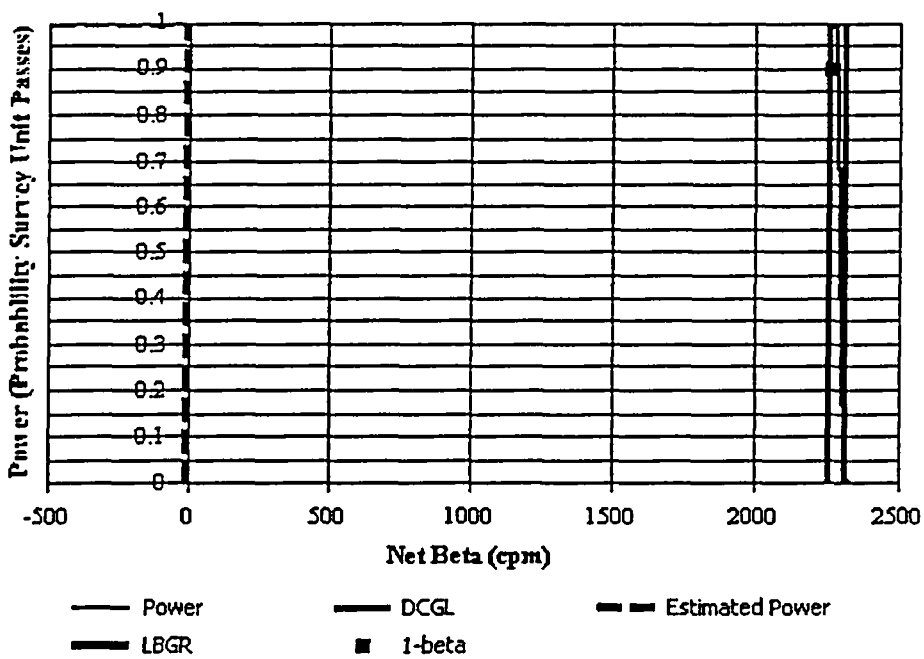
ATTACHMENT 2.3

Building Surface Survey Plan

Survey Plan Summary

Site:	Exterior of SNEC CV Shell		
Planner(s):	BHB		
Survey Unit Name:	Middle Section of CV6		
Comments:	CV6-1		
Area (m²):	23	Classification:	1
Selected Test:	WRS	Estimated Sigma (cpm):	18.4
DCGL (cpm):	2,318	Sample Size (N/2):	8
LBGR (cpm):	2,263	Estimated Conc. (cpm):	-9.9
Alpha:	0.050	Estimated Power:	1.00
Beta:	0.100	EMC Sample Size (N):	8

Prospective Power Curve



ATTACHMENT 2 . 4

Building Surface Survey Plan

Contaminant Summary

Contaminant	DCGLw (dpm/100 cm²)
Gross Activity	8,000

Beta Instrumentation Summary

Gross Beta DCGLw (dpm/100 cm²): *	8,000
Total Efficiency:	0.23
Gross Beta DCGLw (cpm):	2,318

ID	Type	Mode	Area (cm²)
6	GFPC	Beta	126

Contaminant	Energy[1]	Fraction[2]	Inst. Eff.	Surf. Eff.	Total Eff.
Gross Activity	187.87	1.0000	0.48	0.48	0.2309

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

Gross Survey Unit Mean (cpm): 170 ± 18 (1-sigma)
Count Time (min): 1

Material	Number of BKG Counts	Average (cpm)	Standard Deviation (cpm)	MDC (dpm/100 cm²)
Steel	37	179.9	17.7	226

ATTACHMENT 2.5

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Elevated Measurement Comparison (EMC) for Beta

Follow the order of each tab below to perform the EMC.

1) Enter Scanning Instrument Efficiencies | 2) Enter Scan MDC Parameters | **3) View EMC Results**

Scan MDC Required per Contaminant

Contaminant	DCGLw*	Area Factor	Scan MDC Required*
Gross Activity	8,000	5.86	46,880

Statistical Design

N/2	8
Bounded Area (m^2)	2.9
Area Factor	5.86
DCGLw*	8,000
Scan MDC Required*	46,880

Hot Spot Design

Actual Scan MDC*	441
Area Factor	N/A
Bounded Area (m^2)	N/A
Post-EMC N/2	8

* dpm/100 cm²

☑ Enable Trainin[g]

v1.0...

COMPASS

No additional samples are required because the actual scan MDCs are less than the DCGLw for each contaminant.

OK

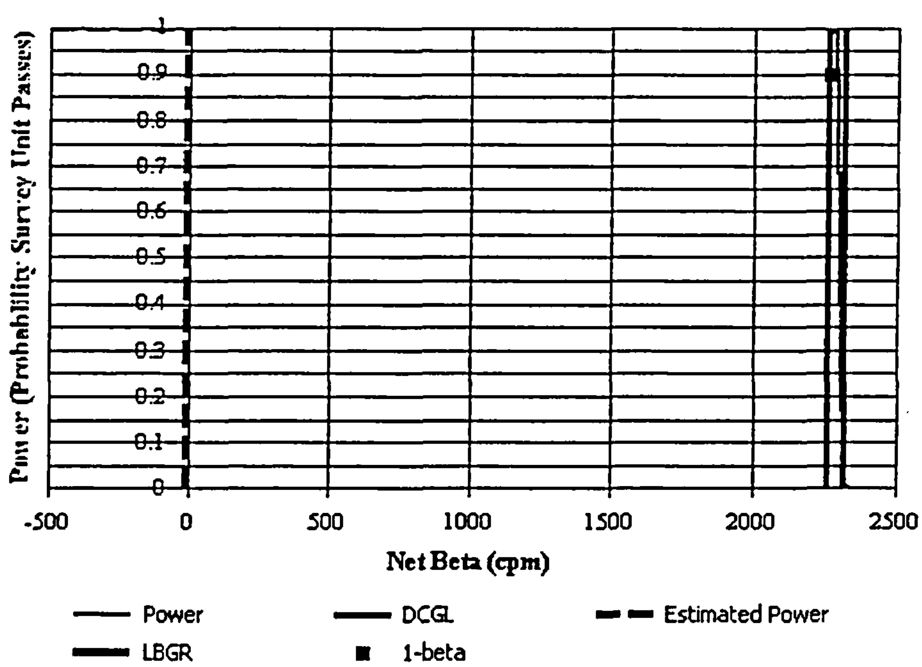
ATTACHMENT 2 - 6

Building Surface Survey Plan

Survey Plan Summary

Site:	Exterior of SNEC CV Shell		
Planner(s):	BHB		
Survey Unit Name:	Lower Section Below Support Ring Assembly		
Comments:	CV5		
Area (m²):	16	Classification:	2
Selected Test:	WRS	Estimated Sigma (cpm):	18.4
DCGL (cpm):	2,318	Sample Size (N/2):	8
LBGR (cpm):	2,263	Estimated Conc. (cpm):	-9.9
Alpha:	0.050	Estimated Power:	1.00
Beta:	0.100		

Prospective Power Curve



ATTACHMENT 2-7

Building Surface Survey Plan

Contaminant Summary

Contaminant	DCGLw (dpm/100 cm²)
Gross Activity	8,000

Beta Instrumentation Summary

Gross Beta DCGLw (dpm/100 cm²):	8,000
Total Efficiency:	0.23
Gross Beta DCGLw (cpm):	2,318

ID	Type	Mode	Area (cm²)
6	GFPC	Beta	126

Contaminant	Energy[1]	Fraction[2]	Inst. Eff.	Surf. Eff.	Total Eff.
Gross Activity	187.87	1.0000	0.48	0.48	0.2309

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

Gross Survey Unit Mean (cpm): 170 ± 18 (1-sigma)
Count Time (min): 1

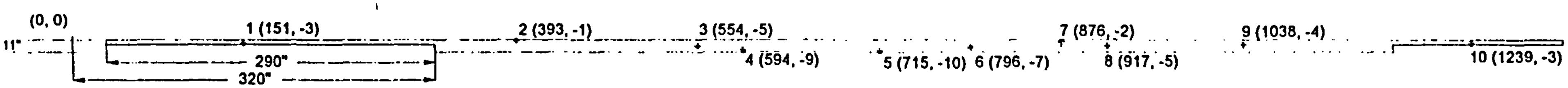
Material	Number of BKG Counts	Average (cpm)	Standard Deviation (cpm)	MDC (dpm/100 cm²)
Steel	37	179.9	17.7	226

ATTACHMENT 2 - 8

CV4-1 Area Above External Support Assembly

10 Points - Randomly Placed

Start Point 4" (0, 0) Above Top Edge of Support Ring - At Top Left Corner of Upper Survey Area



ATTACHMENT 3 . 1

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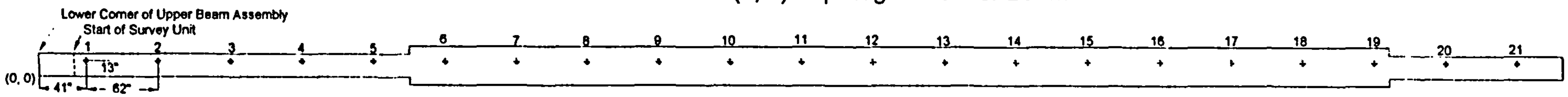
CV6-1 Survey Area - External Support Assembly

Random Start Systematic Spacing - First Point 13" Above Top Edge of Lower Beam

Start Point (0, 0) Top Edge of Lower Beam

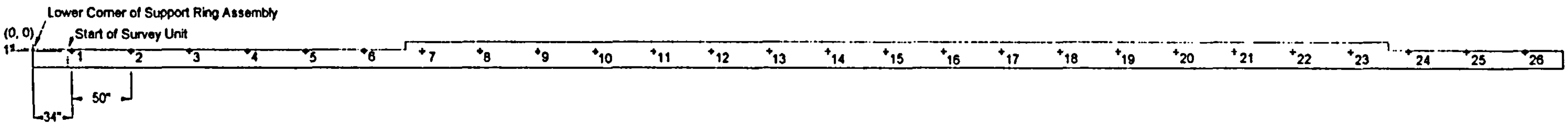


ATTACHMENT 3 . 2

CV5 Survey Area - External Support Assembly

Random Start Systematic Spacing - First Point 1" Below Bottom Edge of Support Ring

Start Point (0, 0) Top Edge of Lower Survey Unit



ATTACHMENT 3 . 3

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ORIGINAL

GFPC Radiation Measurement Instrument Calibration Worksheet

Performed By:	R. J. Reheard (signature)	Date:	6/24/03
Instrument S/N:	126218	Probe S/N:	35080
Instrument Vendor Cal. Date:	12/20/03	Cal. Due Date:	12/20/03

Source No.	ISO 7503-1 Values "Es"	Reference Date	A in µCi (± 6%)	2π β or α Emission Rate (sec-1) (± 3%)	
Am-241 (GO 535) S-023	0.25	4/8/99 12:00 GMT	4.24E-01	7.43E+03	☐ Am-241
Cs-137 (GO 536) S-024	0.50	4/8/99 12:00 GMT	3.11E-01	6.89E+03	☑ Cs-137

	Source Radionuclide	Decay Date
	Cs-137	6/24/03
Decay Factor⇒	9.075E-01	

Elapsed Time (days)⇒	1538
Activity (µCi)⇒	2.821E-01
Source dpm⇒	6.262E+05
Source dpm/in Probe Area (cm^2)⇒	5.260E+05
2π Emission Rate (sec-1)⇒	6.253E+03
2π Emission Rate (min-1)⇒	3.752E+05
2π Emission Rate in Probe Area (min-1)⇒	3.151E+05

Probe Area (cm^2)
126

Record of 1 Minute Source & Background Counting Results

No.	OW Source Gross CPM	OW Background CPM	OW Source Net CPM
1	1.48E+05	181	1.483E+05
2	1.49E+05	203	1.490E+05
3	1.50E+05	186	1.499E+05
4	1.50E+05	193	1.502E+05
5	1.51E+05	182	1.507E+05
6	1.51E+05	164	1.508E+05
7	1.52E+05	170	1.515E+05
8	1.51E+05	177	1.513E+05
9	1.52E+05	161	1.520E+05
10	1.52E+05	162	1.515E+05
	Mean⇒	177.9	1.505E+05

☑ Check if using ISO 7503-1 Value

RESULTS
Counts/Emission (εi)
47.8%
2π Emission/Disintigration (εs)
50.0%
Counts/Disintigration (εt)
23.9%

Approved: J Duskin / J DC

Date: 6/25/03

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

ATTACHMENT 4-1

	Half-Life (days)						
	H-3	Sr-90	Co-60	Cs-137	Am-241	Pu-238	Pu-239
	4485.3	10446.2	1925.23	11019.6	157861	32050.7	8813848

Decay Date

9/13/2003

Analysis Date	Elapsed (d)	H-3	Sr-90	Co-60	Cs-137	Am-241	Pu-238	Pu-239
		Original Values						
May 4, 2000	1227.00	30	0.03	0.0248	1.55	0.06	0.2	0.09
February 14, 2001	941.00	9.4	9.67	1.26	1250	0.18	0.55	0.22
July 26, 2001	779.00	11.52	0.03	0.01	4.38	0.031	0.016	0.007
October 11, 2001	702.00		0.04	0.0331	0.177	0.0246	0.0517	0.0231
October 11, 2001	702.00		0.04	0.0305	0.297	0.0113	0.0372	0.0131
June 29, 2002	441.00	3.44	0.0529	0.0279	4.77	0.183	0.0894	0.04
July 3, 2002	437.00	4.99	0.0648	0.0298	22.6	0.149	0.0856	0.0246

Sample Numbers	H-3	Sr-90	Co-60	Cs-137	Am-241	Pu-238	Pu-239
	Decayed Values						
SX9SL00341	24.819	0.028	0.016	1.435	0.060	0.195	0.090
CV Tunnel	8.128	9.085	0.898	1178.174	0.179	0.539	0.220
SXSL1281	10.214	0.028	0.008	4.171	0.031	0.016	0.007
SXSD1531,1532, 1533		0.038	0.026	0.169	0.025	0.051	0.023
SXSD1552, 1553		0.038	0.024	0.284	0.011265	0.037	0.013
SXSL1122	3.213	0.051	0.024	4.640	0.183	0.089	0.040
SXSL1130	4.664	0.063	0.025	21.987	0.149	0.085	0.025
Mean ⇒	10.208	1.333	0.146	172.98	0.091	0.144	0.060
Median ⇒	8.128	0.038	0.024	4.17	0.060	0.085	0.025
Sigma ⇒	8.624	3.418	0.332	443.31	0.076	0.183	0.076
2 Sigma + Mean ⇒	27.455	8.169	0.809	1059.61	0.244	0.511	0.211
75 Percentile ⇒	10.214	0.057	0.026	13.31	0.164	0.142	0.065
Max ⇒	24.819	9.085	0.898	1178.17	0.183	0.539	0.220
Min ⇒	3.213	0.028	0.008	0.17	0.011	0.016	0.007

NOTE: Am-241 and Pu-238 have been positively detected in the vacinity of the CV and have been included in this spreadsheet even though the representative sample mix only shows "Less Than" values.

Positively detected values depicted in yellow=>

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ATTACHMENT 5.1

C01

Effective DCGL Calculator for Cs-137 (dpm/100 cm^2)

Gross Activity DCGLw		Gross Activity Administrative Limit	
15131	dpm/100 cm^2	11348	dpm/100 cm^2

25.0 mrem/y TEDE Limit

SAMPLE NO(s)⇒ CV Dome Below Grade Exterior Sample Results

Cs-137 Limit		Cs-137 Administrative Limit	
14615	dpm/100 cm^2	10961	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	2.44E-01	0.022%	27	3.37	3.12	N/A	3.37	Am-241
2	C-14		0.000%	3,700,000	0.00	0.00	0.00	N/A	C-14
3	Co-60	8.09E-01	0.074%	7,100	11.16	0.04	11.16	N/A	Co-60
4	Cs-137	1.06E+03	96.591%	28,000	14614.82	13.05	14614.8	N/A	Cs-137
5	Eu-152		0.000%	13,000	0.00	0.00	0.00	N/A	Eu-152
6	H-3	2.75E+01	2.503%	120,000,000	378.68	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	5.11E-01	0.047%	30	7.05	5.87	N/A	7.05	Pu-238
9	Pu-239	2.11E-01	0.019%	28	2.91	2.60	N/A	2.91	Pu-239
10	Pu-241		0.000%	880	0.00	0.00	Not Detectable	N/A	Pu-241
11	Sr-90	8.17E+00	0.745%	8,700	112.67	0.32	112.67	N/A	Sr-90
			100.000%		15131	25.0	14739	13	
					Maximum Permissible dpm/100 cm^2				

ATTACHMENT 6-1

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Williamsburg Steel Background Measurements SR-48

22N21	Instrument 95348	RJR9291	Time	Detector	Counts	Count Time (sec)	Mode	Designator		FSS-004	BHB	
0	BKGND	11/14/2002	6 47	1	6.54E+03	1800	SCL	Inital Background	β	Steel CF(cpm) ⇒	31	
1	Source Check	11/14/2002	9 54	1	1 70E+05	60	SCL	Source	β	Shielded	Unshielded	NET cpm
2	STEELA1S	11/14/2002	10:32	1	2.13E+02	60	SCL	Shielded	β	2 13E+02		
3	STEELA1U	11/14/2002	10.33	1	2.04E+02	60	SCL	Unshielded	β		1 73E+02	4 00E+01
4	STEELA2S	11/14/2002	10 37	1	2.03E+02	60	SCL	Shielded	β	2 03E+02		
5	STEELA2U	11/14/2002	10 38	1	2.25E+02	60	SCL	Unshielded	β		1 94E+02	9 00E+00
6	STEELA3S	11/14/2002	10 39	1	1.85E+02	60	SCL	Shielded	β	1 85E+02		
7	STEELA3U	11/14/2002	10 40	1	2.09E+02	60	SCL	Unshielded	β		1 78E+02	7 00E+00
8	STEELA4S	11/14/2002	10 42	1	2.03E+02	60	SCL	Shielded	β	2 03E+02		
9	STEELA4U	11/14/2002	10:43	1	1.67E+02	60	SCL	Unshielded	β		1 36E+02	6 70E+01
10	STEELA5S	11/14/2002	10 44	1	1.55E+02	60	SCL	Shielded	β	1 55E+02		
11	STEELA5U	11/14/2002	10 45	1	2.26E+02	60	SCL	Unshielded	β		1 95E+02	-4 00E+01
12	STEELA6S	11/14/2002	10 46	1	1.92E+02	60	SCL	Shielded	β	1 92E+02		
13	STEELA6U	11/14/2002	10 47	1	1.95E+02	60	SCL	Unshielded	β		1 64E+02	2 80E+01
14	STEELA7S	11/14/2002	10:48	1	1.96E+02	60	SCL	Shielded	β	1 96E+02		
15	STEELA7U	11/14/2002	10:50	1	2.01E+02	60	SCL	Unshielded	β		1 70E+02	2 60E+01
16	STEELA8S	11/14/2002	10:51	1	2.15E+02	60	SCL	Shielded	β	2 15E+02		
17	STEELA8U	11/14/2002	10:52	1	2.38E+02	60	SCL	Unshielded	β		2 07E+02	8 00E+00
18	STEELA9S	11/14/2002	10:53	1	2.00E+02	60	SCL	Shielded	β	2 00E+02		
19	STEELA9U	11/14/2002	10:54	1	1.92E+02	60	SCL	Unshielded	β		1 61E+02	3 90E+01
20	STEELA10S	11/14/2002	10:56	1	1.83E+02	60	SCL	Shielded	β	1 83E+02		
21	STEELA10U	11/14/2002	10 57	1	2.25E+02	60	SCL	Unshielded	β		1 94E+02	-1 10E+01
22	STEELA11S	11/14/2002	10:58	1	1.95E+02	60	SCL	Shielded	β	1 95E+02		
23	STEELA11U	11/14/2002	10 59	1	2.15E+02	60	SCL	Unshielded	β		1 84E+02	1.10E+01
24	STEELA12S	11/14/2002	11:00	1	1.77E+02	60	SCL	Shielded	β	1 77E+02		
25	STEELA12U	11/14/2002	11.01	1	2.34E+02	60	SCL	Unshielded	β		2 03E+02	-2 60E+01
26	STEELA13S	11/14/2002	11 03	1	2.02E+02	60	SCL	Shielded	β	2 02E+02		
27	STEELA13U	11/14/2002	11 05	1	2.18E+02	60	SCL	Unshielded	β		1 87E+02	1 50E+01
28	STEELA14S	11/14/2002	11.06	1	1.89E+02	60	SCL	Shielded	β	1 89E+02		
29	STEELA14U	11/14/2002	11 07	1	1.99E+02	60	SCL	Unshielded	β		1 68E+02	2 10E+01
30	STEELA15S	11/14/2002	11:08	1	2.16E+02	60	SCL	Shielded	β	2 16E+02		
31	STEELA15U	11/14/2002	11.09	1	2.15E+02	60	SCL	Unshielded	β		1 84E+02	3 20E+01
32	STEELA16S	11/14/2002	11:10	1	1.88E+02	60	SCL	Shielded	β	1 88E+02		
33	STEELA16U	11/14/2002	11:11	1	2 05E+02	60	SCL	Unshielded	β		1 74E+02	1 40E+01
34	STEELA17S	11/14/2002	11.13	1	2.12E+02	60	SCL	Shielded	β	2 12E+02		
35	STEELA17U	11/14/2002	11:14	1	2.11E+02	60	SCL	Unshielded	β		1 80E+02	3 20E+01
36	STEELA18S	11/14/2002	11:15	1	2.00E+02	60	SCL	Shielded	β	2 00E+02		
37	STEELA18U	11/14/2002	11:16	1	1.93E+02	60	SCL	Unshielded	β		1 62E+02	3 80E+01
38	STEELA19S	11/14/2002	11:17	1	1.84E+02	60	SCL	Shielded	β	1 84E+02		
39	STEELA19U	11/14/2002	11:18	1	2.09E+02	60	SCL	Unshielded	β		1 78E+02	6 00E+00
40	STEELA20S	11/14/2002	11:19	1	1.94E+02	60	SCL	Shielded	β	1 94E+02		
41	STEELA20U	11/14/2002	11:20	1	2.30E+02	60	SCL	Unshielded	β		1 99E+02	-5 00E+00
42	STEELA21S	11/14/2002	11:22	1	2.10E+02	60	SCL	Shielded	β	2 10E+02		
43	STEELA21U	11/14/2002	11:23	1	1.93E+02	60	SCL	Unshielded	β		1 62E+02	4 80E+01
44	STEELA22S	11/14/2002	11:24	1	2.05E+02	60	SCL	Shielded	β	2 05E+02		
45	STEELA22U	11/14/2002	11:25	1	1.91E+02	60	SCL	Unshielded	β		1 60E+02	4 50E+01
46	STEELA23S	11/14/2002	11:26	1	1.77E+02	60	SCL	Shielded	β	1 77E+02		
47	STEELA23U	11/14/2002	11:27	1	1.98E+02	60	SCL	Unshielded	β		1 67E+02	1 00E+01
48	STEELA24S	11/14/2002	11:28	1	1.88E+02	60	SCL	Shielded	β	1 88E+02		
49	STEELA24U	11/14/2002	11:30	1	2.44E+02	60	SCL	Unshielded	β		2 13E+02	-2 50E+01
50	STEELQC11S	11/14/2002	11:33	1	2.13E+02	60	SCL	Shielded	β	2 13E+02		
51	STEELQC11U	11/14/2002	11:34	1	2.10E+02	60	SCL	Unshielded	β		1 79E+02	3 40E+01
52	STEELQC19S	11/14/2002	11:36	1	1.80E+02	60	SCL	Shielded	β	1 80E+02		
53	STEELQC19U	11/14/2002	11:37	1	1.99E+02	60	SCL	Unshielded	β		1 68E+02	1 20E+01
58	STEELB1S	11/14/2002	13.09	1	2.25E+02	60	SCL	Shielded	β	2 25E+02		
59	STEELB1U	11/14/2002	13:10	1	1.94E+02	60	SCL	Unshielded	β		1 63E+02	6 20E+01
60	STEELB2S	11/14/2002	13:12	1	1.78E+02	60	SCL	Shielded	β	1 78E+02		
61	STEELB2U	11/14/2002	13:13	1	2.50E+02	60	SCL	Unshielded	β		2 19E+02	-4 10E+01
62	STEELB3S	11/14/2002	13:14	1	2.03E+02	60	SCL	Shielded	β	2 03E+02		
63	STEELB3U	11/14/2002	13:15	1	2.11E+02	60	SCL	Unshielded	β		1 80E+02	2 30E+01
64	STEELB4S	11/14/2002	13:17	1	2.03E+02	60	SCL	Shielded	β	2 03E+02		
65	STEELB4U	11/14/2002	13:18	1	1.78E+02	60	SCL	Unshielded	β		1 47E+02	5 60E+01
66	STEELB5S	11/14/2002	13:19	1	2.32E+02	60	SCL	Shielded	β	2 32E+02		
67	STEELB5U	11/14/2002	13:20	1	2.08E+02	60	SCL	Unshielded	β		1.77E+02	5 50E+01
68	STEELB6S	11/14/2002	13:22	1	2.22E+02	60	SCL	Shielded	β	2 22E+02		
69	STEELB6U	11/14/2002	13 23	1	2.22E+02	60	SCL	Unshielded	β		1.91E+02	3 10E+01
70	STEELB7S	11/14/2002	13.24	1	2.21E+02	60	SCL	Shielded	β	2 21E+02		
71	STEELB7U	11/14/2002	13:25	1	2.18E+02	60	SCL	Unshielded	β		1 87E+02	3 40E+01
72	STEELB8S	11/14/2002	13:26	1	2.18E+02	60	SCL	Shielded	β	2 18E+02		
73	STEELB8U	11/14/2002	13:28	1	2.15E+02	60	SCL	Unshielded	β		1 84E+02	3 40E+01
74	STEELB9S	11/14/2002	13:29	1	1.90E+02	60	SCL	Shielded	β	1 90E+02		
75	STEELB9U	11/14/2002	13:30	1	2.17E+02	60	SCL	Unshielded	β		1 86E+02	4 00E+00
76	STEELB10S	11/14/2002	13:41	1	2.45E+02	60	SCL	Shielded	β	2 45E+02		
77	STEELB10U	11/14/2002	13:42	1	2.32E+02	60	SCL	Unshielded	β		2 01E+02	4 40E+01
78	STEELQCB5S	11/14/2002	13.44	1	1.81E+02	60	SCL	Shielded	β	1 81E+02		
79	STEELQCB5U	11/14/2002	13:45	1	2.13E+02	60	SCL	Unshielded	β		1 82E+02	-1.00E+00
									Minimum ⇒	1.55E+02	1.36E+02	-4.10E+01
									Maximum ⇒	2.45E+02	2.19E+02	6.70E+01
									Mean ⇒	2.00E+02	1.80E+02	1.99E+01
									Sigma ⇒	1.81E+01	1.77E+01	2.65E+01

ATTACHMENT 7-1

CV Exterior Steel Shell (Below Grade) Variability Measurements

CV4/CV5	Instrument 80500	BLB7173	Time	Detector	Counts	Count Time (sec)	Mode	Designator		FSS-291 Shielded	BHB Unshielded	NET cpm
										Steel CF(cpm) ⇒	0	
2	CV-5 5S B	9/9/2003	8:37	1	1.85E+02	60	SCL	Shielded	β	1.85E+02		
3	CV-5 5U B	9/9/2003	8:39	1	1.84E+02	60	SCL	Unshielded	β		1.84E+02	1.00E+00
4	CV-4 5S	9/9/2003	8:44	1	1.53E+02	60	SCL	Shielded	β	1.53E+02		
5	CV-4 5U	9/9/2003	8:46	1	1.41E+02	60	SCL	Unshielded	β		1.41E+02	1.20E+01
6	CV-4 5S T	9/9/2003	9:00	1	1.66E+02	60	SCL	Shielded	β	1.66E+02		
7	CV-4 5U T	9/9/2003	9:01	1	1.57E+02	60	SCL	Unshielded	β		1.57E+02	9.00E+00
8	CV-4 7S	9/9/2003	9:05	1	1.63E+02	60	SCL	Shielded	β	1.63E+02		
9	CV-4 7U	9/9/2003	9:06	1	1.75E+02	60	SCL	Unshielded	β		1.75E+02	-1.20E+01
10	CV-4 9S	9/9/2003	9:08	1	1.67E+02	60	SCL	Shielded	β	1.67E+02		
11	CV-4 9U	9/9/2003	9:10	1	1.70E+02	60	SCL	Unshielded	β		1.70E+02	-3.00E+00
12	CV-4 11S	9/9/2003	9:12	1	1.82E+02	60	SCL	Shielded	β	1.82E+02		
13	CV-4 11U	9/9/2003	9:13	1	1.71E+02	60	SCL	Unshielded	β		1.71E+02	1.10E+01
14	CV-4 13S	9/9/2003	9:15	1	1.72E+02	60	SCL	Shielded	β	1.72E+02		
15	CV-4 13U	9/9/2003	9:17	1	1.71E+02	60	SCL	Unshielded	β		1.71E+02	1.00E+00
16	CV-4 15S	9/9/2003	9:21	1	1.58E+02	60	SCL	Shielded	β	1.58E+02		
17	CV-4 15U	9/9/2003	9:23	1	1.75E+02	60	SCL	Unshielded	β		1.75E+02	-1.70E+01
18	CV-4 17S	9/9/2003	10:02	1	1.58E+02	60	SCL	Shielded	β	1.58E+02		
19	CV-4 17U	9/9/2003	10:04	1	1.52E+02	60	SCL	Unshielded	β		1.52E+02	6.00E+00
20	CV-5 19S	9/9/2003	10:07	1	1.57E+02	60	SCL	Shielded	β	1.57E+02		
21	CV-5 19U	9/9/2003	10:09	1	1.70E+02	60	SCL	Unshielded	β		1.70E+02	-1.30E+01
22	CV-4 19S T	9/9/2003	10:11	1	1.73E+02	60	SCL	Shielded	β	1.73E+02		
23	CV-4 19U T	9/9/2003	10:12	1	1.55E+02	60	SCL	Unshielded	β		1.55E+02	1.80E+01
24	CV-5 19S B	9/9/2003	10:16	1	1.83E+02	60	SCL	Shielded	β	1.83E+02		
25	CV-5 19U B	9/9/2003	10:17	1	1.75E+02	60	SCL	Unshielded	β		1.75E+02	8.00E+00
26	CV-4 21S	9/9/2003	10:20	1	1.70E+02	60	SCL	Shielded	β	1.70E+02		
27	CV-4 21U	9/9/2003	10:22	1	1.67E+02	60	SCL	Unshielded	β		1.67E+02	3.00E+00
28	CV-4 23S	9/9/2003	10:24	1	1.67E+02	60	SCL	Shielded	β	1.67E+02		
29	CV-4 23U	9/9/2003	10:26	1	1.64E+02	60	SCL	Unshielded	β		1.64E+02	3.00E+00
30	CV-4 25S	9/9/2003	10:29	1	1.29E+02	60	SCL	Shielded	β	1.29E+02		
31	CV-4 25U	9/9/2003	10:31	1	1.52E+02	60	SCL	Unshielded	β		1.52E+02	-2.30E+01
32	CV-4 25S T	9/9/2003	10:34	1	1.30E+02	60	SCL	Shielded	β	1.30E+02		
33	CV-4 25U T	9/9/2003	10:35	1	1.58E+02	60	SCL	Unshielded	β		1.58E+02	-2.80E+01
34	CV-5 25S B	9/9/2003	10:38	1	1.75E+02	60	SCL	Shielded	β	1.75E+02		
35	CV-5 25U B	9/9/2003	10:40	1	1.57E+02	60	SCL	Unshielded	β		1.57E+02	1.80E+01
36	CV-4 28S	9/9/2003	10:42	1	1.42E+02	60	SCL	Shielded	β	1.42E+02		
37	CV-4 28U	9/9/2003	10:45	1	1.64E+02	60	SCL	Unshielded	β		1.64E+02	-2.20E+01
38	CV-4 32S	9/9/2003	10:47	1	1.45E+02	60	SCL	Shielded	β	1.45E+02		
39	CV-4 32U	9/9/2003	10:49	1	1.55E+02	60	SCL	Unshielded	β		1.55E+02	-1.00E+01
40	CV-4 34S T	9/9/2003	10:55	1	1.74E+02	60	SCL	Shielded	β	1.74E+02		
41	CV-4 34U T	9/9/2003	10:57	1	1.73E+02	60	SCL	Unshielded	β		1.73E+02	1.00E+00
42	CV-4 36S	9/9/2003	11:01	1	1.57E+02	60	SCL	Shielded	β	1.57E+02		
43	CV-4 36U	9/9/2003	11:02	1	1.47E+02	60	SCL	Unshielded	β		1.47E+02	1.00E+01
44	CV-4 36S T	9/9/2003	11:05	1	1.80E+02	60	SCL	Shielded	β	1.80E+02		
45	CV-4 36U T	9/9/2003	11:06	1	1.76E+02	60	SCL	Unshielded	β		1.76E+02	4.00E+00
46	CV-5 36S B	9/9/2003	11:09	1	2.15E+02	60	SCL	Shielded	β	2.15E+02		
47	CV-5 36U B	9/9/2003	11:14	1	2.09E+02	60	SCL	Unshielded	β		2.09E+02	6.00E+00
48	CV-4 40S	9/9/2003	13:01	1	1.98E+02	60	SCL	Shielded	β	1.98E+02		
49	CV-4 40U	9/9/2003	13:03	1	1.94E+02	60	SCL	Unshielded	β		1.94E+02	4.00E+00
50	CV-4 40S T	9/9/2003	13:05	1	1.84E+02	60	SCL	Shielded	β	1.84E+02		
51	CV-4 40U T	9/9/2003	13:07	1	2.11E+02	60	SCL	Unshielded	β		2.11E+02	-2.70E+01
52	CV-5 40S B	9/9/2003	13:10	1	2.14E+02	60	SCL	Shielded	β	2.14E+02		
53	CV-5 40U B	9/9/2003	13:11	1	2.07E+02	60	SCL	Unshielded	β		2.07E+02	7.00E+00
									Minimum ⇒	1.29E+02	1.41E+02	-2.80E+01
									Maximum ⇒	2.15E+02	2.11E+02	1.80E+01
									Mean ⇒	1.69E+02	1.70E+02	-1.27E+00
									Sigma ⇒	2.13E+01	1.84E+01	1.35E+01

SAXTON NUCLEAR	Saxton Nuclear Experimental Corporation Facility Policy and Procedure Manual	Number E900-IMP-4520.06
Title Survey Unit Inspection in Support of FSS Design		Revision No. 0

EXHIBIT 1

Survey Unit Inspection Check Sheet

SECTION 1 - SURVEY UNIT INSPECTION DESCRIPTION					
Survey Unit #	CV 4-1	Survey Unit Location	CV EXTERNAL shell, TOP RING to cutoff		
Date	9/15/03	Time	1130	Inspection Team Members	JDUSKIN

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

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:
LADDERS OR SCAFFLD will Be Required to ACCESS the SURVEY AREA.

Survey Unit Inspector (print/sign)	JDUSKIN / [signature]	Date	9/15/03
Survey Designer (print/sign)	B. BROSEY / B. Brosey	Date	9/17/03

ATTACHMENT 8-1

SAXTON NUCLEAR	Saxton Nuclear Experimental Corporation Facility Policy and Procedure Manual	Number E900-IMP-4520.06
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EXHIBIT 3

Surface Measurement Test Area (SMTA) Data Sheet

SECTION 1 - DESCRIPTION					
SMTA Number	SMTA - CV4-1-001	Survey Unit Number	CV4-1		
SMTA Location	CV Exterior shell, ~~Above~~ 9-15-03 802.6' To cutoff				
Survey Unit Inspector	JDUSKIN	Date	9/15/03	Time	1130
SECTION 2 - CALIPER INFORMATION & PERSONNEL INVOLVED					
Caliper Manufacturer	Mitutoyo Corp	Caliper Model Number	CD-6"-CS		
Caliper Serial Number	0763893	Calibration Due Date (as applicable)	10/03		
Rad Con Technician	NA	Date	NA	Time	NA
Survey Unit Inspector Approval	JDUSKIN/[signature]	Date	9/15/03 ~~10/~~ 9/15/03		
SECTION 3 - MEASUREMENT RESULTS					

SMTA Grid Map & Measurement Results in Units of mm
(Insert Results in White Blocks Below)

1 0.2	7 0.1	13 0.1	19 1.4	25 0.1	31 1.8
2 1.2	8 0.5	14 0.1	20 0.4	26 0.0	32 0.0
3 0.1	9 0.2	15 0.1	21 2.3	27 0.0	33 0.1
4 0.1	10 0.0	16 0.1	22 0.1	28 0.0	34 0.0
5 0.0	11 0.0	17 0.1	23 0.1	29 0.1	35 0.0
6 1.7	12 0.2	18 0.1	24 0.0	30 0.0	36 0.1

Average Measurement 0.3 mm

Comments

SURFACE roughness of the SMTA IS TYPICAL of the SURVEY UNIT CV4-1-001A AND CV 4-1-002A ARE TYPICAL of some 79 AREAS of the SURVEY UNIT where SUPPORT Steel was Removed from the CV shell.

Additional Measurements Required

CV4-1-001A 7.4mm (1/2" x 3")
CV 4-1-002A 4.8mm (1/2" x 1")

ATTACHMENT 8-2

SAXTON NUCLEAR	Saxton Nuclear Experimental Corporation Facility Policy and Procedure Manual	Number E900-IMP-4520.06
Title Survey Unit Inspection in Support of FSS Design		Revision No. 0

EXHIBIT 1

Survey Unit Inspection Check Sheet

SECTION 1 - SURVEY UNIT INSPECTION DESCRIPTION					
Survey Unit #	CVG-1	Survey Unit Location	CV External Shell Between Rings		
Date	9/15/03	Time	1045	Inspection Team Members	JDuskin

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

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:

Survey Unit Inspector (print/sign)	JDuskin / [signature]	Date	9/15/03
Survey Designer (print/sign)	B. BROSEY / B. Brosey	Date	9/17/03

ATTACHMENT 8 . 3

SAXTON NUCLEAR	Saxton Nuclear Experimental Corporation Facility Policy and Procedure Manual	Number E900-IMP-4520.06
Title: Survey Unit Inspection in Support of FSS Design		Revision No. 0

EXHIBIT 3

Surface Measurement Test Area (SMTA) Data Sheet

SECTION 1 - DESCRIPTION					
SMTA Number	SMTA - CV6-1-001	Survey Unit Number	CV 6-1		
SMTA Location	CV EXTERIOR Shell AREA, BETWEEN SUPPORT RINGS				
Survey Unit Inspector	JDUSKIN	Date	9/15/03	Time	1045
SECTION 2 - CALIPER INFORMATION & PERSONNEL INVOLVED					
Caliper Manufacturer	Mitutoyo CORP	Caliper Model Number	CD-6"-CS		
Caliper Serial Number	0763893	Calibration Due Date (as applicable)	10/03		
Rad Con Technician	NA	Date	NA	Time	NA
Survey Unit Inspector Approval	JDUSKIN / [signature]	Date	9/15/03		
SECTION 3 - MEASUREMENT RESULTS					

SMTA Grid Map & Measurement Results in Units of mm (Insert Results in White Blocks Below)

1: 0.1	7: 0.0	13: 0.0	19: 0.0	25: 5.9	31: 0.1
2: 0.3	8: 0.2	14: 0.2	20: 0.0	26: 0.0	32: 0.0
3: 0.3	9: 0.0	15: 0.0	21: 0.0	27: 0.0	33: 0.0
4: 0.0	10: 0.0	16: 0.1	22: 0.0	28: 0.0	34: 0.0
5: 0.2	11: 0.0	17: 0.0	23: 0.0	29: 0.0	35: 0.1
6: 0.0	12: 0.0	18: 0.1	24: 8.6	30: 0.0	36: 1.5

Average Measurement 0.5 mm

Comments

CV6-1-003A AND CV6-1-004A ARE TYPICAL of SOME 90 AREAS where the Remainder of Support Steel was cut from the shell.

The SMTA SURFACE Roughness is typical of the survey unit.

Additional Measurements Required

CV6-1-001A 5.6MM (½" x ½")
CV6-1-002A 3.9MM (½" x ½")
CV6-1-003A 9.8MM (½" x 3")
CV6-1-004A 6.6MM (½" x 1")

ATTACHMENT 8-4

SAXTON NUCLEAR	Saxton Nuclear Experimental Corporation Facility Policy and Procedure Manual	Number E900-03-021 E900-IMP-4520.06
Title Survey Unit Inspection in Support of FSS Design		Revision No. 0

EXHIBIT 1

Survey Unit Inspection Check Sheet

SECTION 1 - SURVEY UNIT INSPECTION DESCRIPTION						
Survey Unit #	CV5-001			Survey Unit Location	CV EXTERNAL Shell, Below Lowest RING	
Date	9/15/03	Time	0820	Inspection Team Members	JDUSKIN	

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

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:

Survey Unit Inspector (print/sign)	JDUSKIN / [signature]	Date	9/15/03
Survey Designer (print/sign)	B. BROSEY / B. Brosey	Date	9/17/03

ATTACHMENT 8-5

SAXTON NUCLEAR	Saxton Nuclear Experimental Corporation Facility Policy and Procedure Manual	Number E900-IMP-4520.06
Title: Survey Unit Inspection in Support of FSS Design		Revision No. 0

EXHIBIT 3

Surface Measurement Test Area (SMTA) Data Sheet

SECTION 1 - DESCRIPTION			
SMTA Number	SMTA - CVS-001	Survey Unit Number	CVS
SMTA Location	CV EXTERIOR WALL BELOW CLASS 1 AREA TO 797'.6"		
Survey Unit Inspector	JDUSKIN	Date 9/15/03	Time 0830

SECTION 2 - CALIPER INFORMATION & PERSONNEL INVOLVED			
Caliper Manufacturer	Mitutoyo Corp.	Caliper Model Number	CD-6" CS + 9-15-03
Caliper Serial Number	0763893	Calibration Due Date (as applicable)	10/03
Rad Con Technician	NA	Date NA	Time NA
Survey Unit Inspector Approval	JDUSKIN / [signature]	Date	9/15/03

SECTION 3 - MEASUREMENT RESULTS

SMTA Grid Map & Measurement Results in Units of mm
(Insert Results in White Blocks Below)

1: 0.0	7: 0.1	13: 0.3	19: 0.1	25: 0.1	31: 0.0
2: 0.0	8: 0.0	14: 0.1	20: 0.1	26: 1.0	32: 0.1
3: 0.0	9: 0.2	15: 0.1	21: 0.6	27: 0.0	33: 0.1
4: 0.1	10: 0.1	16: 0.1	22: 0.0	28: 0.0	34: 0.1
5: 0.1	11: 0.0	17: 0.2	23: 0.0	29: 0.0	35: 0.1
6: 0.0	12: 0.0	18: 0.0	24: 0.1	30: 0.0	36: 0.1

Average Measurement 0.1 mm

Comments

SMTA surface roughness is typical of survey unit.

Additional Measurements Required

CVS-001A 6.5mm
CVS-002A 10.3mm
} These two additional measurements are typical of about 67 areas (~1/2" x 3") where support steel was removed from the shell in this survey unit.

ATTACHMENT 8-6

Site Report

Site Summary

Site Name: Exterior of SNEC CV Shell

Planner(s): BHB

Contaminant Summary

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

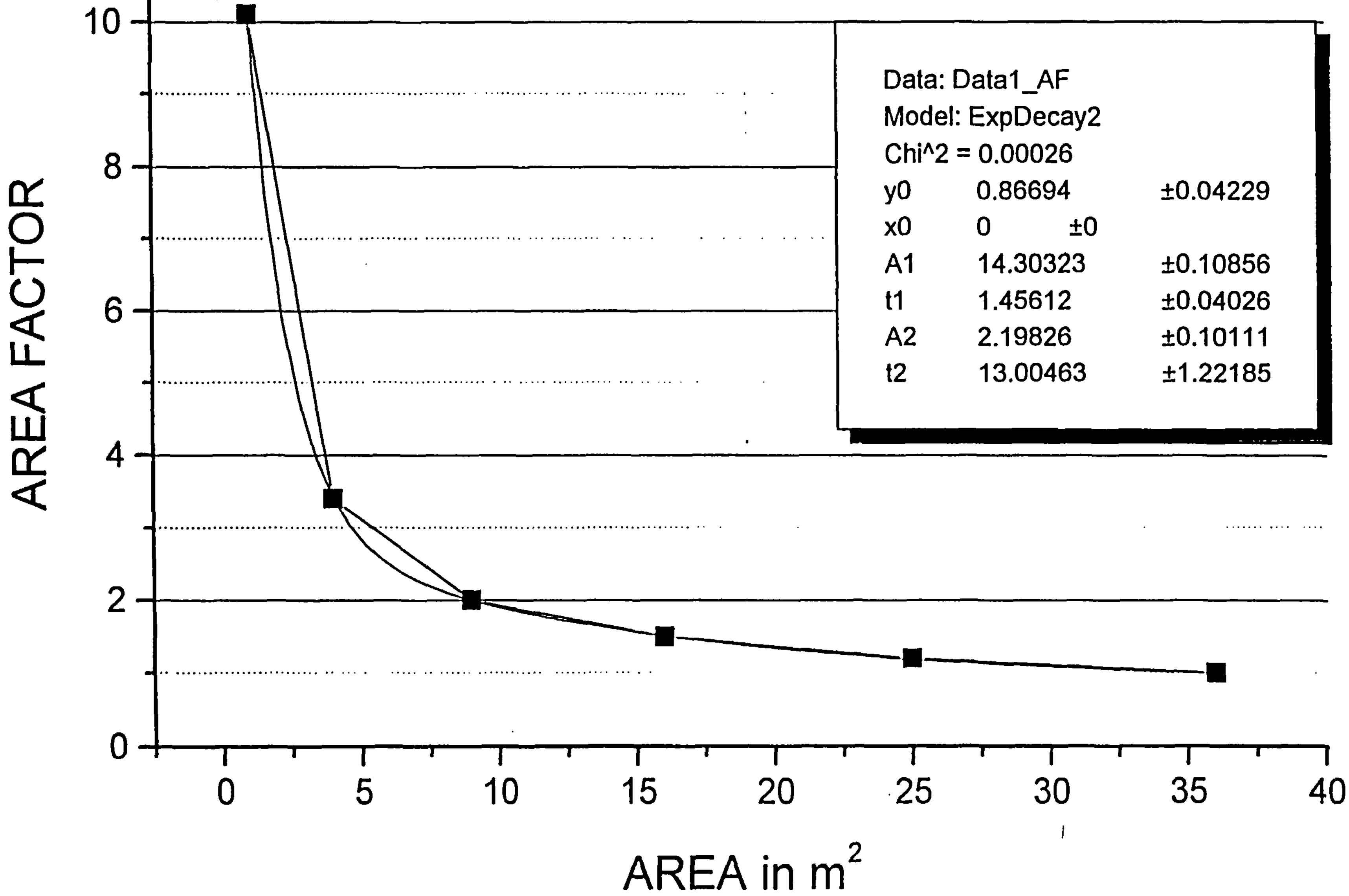
Contaminant	Type	DCGLw	Screening Value Used?	Area (m²)	Area Factor
Gross Activity	Building Surface	8,000	No	36	1
				25	1.2
				16	1.5
				9	2
				7	2.2
				4	3.4
				1	10.1
				0.5	10.1

BHB 9/17/03

ATTACHMENT 9-1

Co-60 Area Factor Graph

$$AF = 0.86694 + A1e^{(-(x-x_0)/t1)} + A2e^{(-(x-x_0)/t2)}$$



ATTACHMENT 9.2

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E900-03-021

Co-60 Area Factor Estimator

Y0=	0.86694
X0=	0
A1=	14.30323
t1=	1.45612
A2=	2.19826
t2=	13.00463

	AREA (m^2)	Area Factor
X=	7.17	2.2

ATTACHMENT 9.3

FirstEnergy GPU

SNEC CALCULATION COVER SHEET

CALCULATION DESCRIPTION

Calculation Number	Revision Number	Effective Date	Page Number
E900-03-022	0	9/26/03	1 of 32

Subject

CV Yard Soil - Survey Design to El 803'

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

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

Question 3 - Does the calculation have the potential to affect an SSC as described in the USAR? Yes ☐ No ☒

NOTES: If a "Yes" answer is obtained for Question 1, the calculation must meet the requirements of the SNEC Facility Decommissioning Quality Assurance Plan. If a "Yes" answer is obtained for Question 2, the Calculation Originator's immediate supervisor should not review the calculation as the Technical Reviewer. If a "YES" answer is obtained for Question 3, SNEC Management approval is required to implement the calculation. Calculations that do not have the potential to affect SSC's may be implemented by the TR.

DESCRIPTION OF REVISION

APPROVAL SIGNATURES

Calculation Originator	B. Brosey/ B. Brosey	Date	9/26/03
Technical Reviewer	P. Donnachie/ [signature]	Date	9/26/03
Additional Review	A. Paynter/ [signature]	Date	9/26/03
Additional Review		Date	
SNEC Management Approval		Date	

1.0 PURPOSE

1.1 The purpose of this calculation is to develop a survey design for one (1) CV Yard area soil survey unit. This is a below grade Class 1 open land area that is adjacent to the SNEC CV structure. It extends upward from about the 796' El (at the base of the exposed portion of the SNEC CV) to the 803' El. This survey unit is bounded on the South side by "wing walls" that have been added to isolate this survey unit from the remaining section of the CV Tunnel structure. This area has been aggressively decontaminated by SNEC personnel using methods described in Section 4.6 of this calculation. This survey unit is designated ***OL1-1*** and is a part of the larger survey unit designated OL1. This survey unit is shown on **Attachment 1-1** and **1-2**.

1.2 The total area for this Class 1 survey unit is ***~350 square meters***. This area estimate is an assessment of the exposed and sloped area within site grid markers AX-130, AX-128, AX-127, AY-130, AY-129, AY-128, AY-127, AZ-130, AZ-129, AZ-128 and AZ-127, up to the ~803' El (see **Attachment 2-1**).

2.0 SUMMARY OF RESULTS

2.1 The following information should be used to develop a survey request for this survey design:

2.1.1 Scanning shall be performed using a ***2" diameter by 2" long NaI detector*** with a Cs-137 window setting. The window will be ~100 keV wide and will straddle the Cs-137 662 keV full energy peak width (see **Attachment 3-1**).

2.1.2 The instrument conversion factor/efficiency shall be no less than the value reported in **Attachment 3-1** (***~221 cpm/uR/h***).

2.1.3 The scan speed is set at a maximum of ***25 cm/sec***. ***Scan coverage is set at 100%*** for this ***Class 1*** survey unit. The ***distance from the surface*** being scanned should be ***no more than 4"*** IAW the MicroShield model used to develop this MDCscan (see **Attachment 4-1**). Use a serpentine scan pattern.

2.1.4 Background has been measured in the area and on similar background materials. Background ranges from about 100 cpm to approximately 400 cpm (see **Reference 3.1**). If a ***net count rate*** of greater than ***200 cpm*** (**~3.7 pCi/g – see Attachment 5-1** and **5-2**) is encountered during the scanning process, **stop** and **locate the boundary** of the elevated area. ***Mark*** the elevated area with stakes or another appropriate marking method. ***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 occuring materials) is greater than ~550 counts per minute.

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

2.1.6 All survey personnel ***shall be trained to identify 200 (~3.7 pCi/g) ncpm above background*** based on audible and instrument readout indicators.

2.1.7 ***Other instruments of the type specified in Section 2.1.1 above may be used during the FSS but they must demonstrate an efficiency at or above the value listed in Section 2.1.2 (~221 cpm/uR/h).***

2.1.8 ***Samples taken during the scanning phase should be assayed and reviewed by the survey design team before laying out the random start systematic grid sampling points.***

2.1.9 If remediation actions are taken as a result of this survey effort, this survey design must be revised or re-written entirely (see also 2.1.8 above).

2.1.10 The minimum number of sampling points indicated for this survey unit by the Compass (**Reference 3.3**) computer program is 23. VSP (**Reference 3.4**) adds additional sampling points in cases where the diagram is odd shaped (edge effect) and/or because of the selected location of the random starting point on the drawing or diagram. Additionally, bounded area size dictates sampling point spacing which may also influence the number of survey points allowed. Since this survey unit is sharply sloped exhibiting a rough surface texture, five (5) additional sampling points have been added to this design to counter difficulties in identifying sample point locations. Therefore, for this design, ***the number of sampling points*** is ***28*** (see **Attachment 6-1** to **6-3** and **6-4** to **6-9**).

2.1.11 The starting point for physically locating sample points in the excavation area is based on ***key measurement points 1 to 5, 11 & 10***, which are dimensioned from the CV wall at the back of selected rock anchor bolt positions. Rock anchor bolts are systematically spaced around the CV (1 to 40). All key measurement point locations are marked on **Attachment 6-4** through **6-9**. Once the key points are located in the survey unit, a standard triangular grid system can be laid out over the sloped survey area. ***Distances should be measured over the contour of the survey unit.***

2.1.12 Some starting points may need to be re-adjusted to accommodate obstructions within the survey unit. ***Contact the SR coordinator to report any difficulties encountered when laying out the systematic grid sampling locations.***

2.1.13 When an obstruction is encountered during the random start systematic sampling phase that will not allow collection of a sample, ***contact the cognizant SR coordinator for permission to delete*** the ***survey point***. Document the reason for the deletion. Note that **(5)** sample points may be deleted without reducing survey design effectiveness.

2.1.14 The effective DCGLw for sampling work is ***4.5 pCi/g (Cs-137)***.

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 Westinghouse Electric Corporation, Gilbert Associates, Inc., Drawing No. D-37798, Saxton Reactor Project, "Containment Vessel Penetration Access", 7/21/60.

3.8 GPU Nuclear, SNEC Facility, "Containment Vessel Survey", SNECRM-019, Rev 1, 1/18/02.

3.9 SNEC Facility Historical Site Assessment, Rev 0, March, 2000.

3.10 1994 Saxton Soil Remediation Project Report, GPU Nuclear Inc., May 11, 1995.

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-2, 1985-1997.

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

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 The MARSSIM Sign Test will be applicable for this survey design. No background subtraction will be performed under this criteria.

4.3 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**).

4.4 VSP is used to plot random start systematically spaced sampling points. The coordinates of the survey points are provided for each survey unit referenced to an existing survey area landmark (key point measurement location). Because of edge effects and a desire to error on the conservative side, additional measurement points have been forced by increasing the MARSSIM overage above the required 20%.

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

The construction/assembly drawings used to determine the original physical extent of these areas are listed as **Reference 3.7** and **3.8.**

4.6 Remediation History

A review of survey request data pertaining to this open land area adjacent to the CV shell was conducted in support of this survey design. Analysis of soil samples taken after remediation of the area (from SR-0019), shows that the region between anchor bolt number 5 and proceeding clockwise to anchor bolt number 40 (below the 803' elevation), has been reduced to an average of 0.82 pCi/g (Cs-137) with a maximum value of 4.5 pCi/g (see **Attachment 7-1**). Other subsurface sample data collected in conjunction with installation of the anchor bolts, grout curtain, and various wells within this area were also reviewed. These data are compiled and summarized in SR-0029. The highest activity of this sample group was 1.46 pCi/g for Cs-137. Earlier remediation history in this area is reported in the SNEC facility Historical Site Assessment document (**Reference 3-9**) and the 1994 Soil Remediation Project Report (**Reference 3-10**).

Remediation of the area under the MHB (south of the wing wall installations) between anchor bolt No. 40 and No. 5, will be completed after removal of the exposed section of the CV shell structure.

4.7 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 has been set that further lowers the permissible Cs-137 concentration to an effective DCGLw for this radionuclide. The sample data base 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 as **Attachment 8-1** and **8-2**, and includes over ninety (90) analysis results. Review of the data points out that several radionuclides have not been positively identified at any concentration. These radionuclides have been removed from the data set and will not be considered further. Radionuclides removed include Pu-241, C-14, Ni-63 and Eu-152.

Inspection of the data also shows that Cs-137 is by far the predominant radioactive contaminant found in this area. Sr-90 on the other hand, was positively identified in only two (2) samples out of forty five (45) analysis. H-3 was identified as a positive contaminant in seven (7) samples out of 31 analysis. Positively identified TRU concentrations were few as well (12 out of 155 analyses), and were at or near minimum detectable concentration limits.

Remediation has further impacted the radionuclide concentration levels in this area. Remediation efforts have been shown to be effective in lowering the average concentration of Cs-137 in this survey unit to less than 4.5 pCi/g (see **Attachment 7-1**). Therefore, the impact of remediation must be considered in determining the effective Cs-137 DCGLw surrogate value. Remediation of this survey unit was completed by about July of 2001. Therefore, samples collected prior to this date have been disqualified in the final listing which was decayed to September 20th, 2003, and is shown as **Attachment 9-1**. In all, about twenty five sample results were used to determine the best representative sample mix for the OL1-1 survey unit.

The SNEC License Termination Plan (LTP) (**Reference 3.5**) allows the use of a 2 sigma plus the mean treatment when combining multiple sample results to form an effective concentration mix. This approach was used to determine the effective volumetric DCGLw for the SNEC CV yard area.

The decayed "2 sigma plus the mean" sample result was then used as input to the spreadsheet titled "Effective DCGL Calculator for Cs-137" (**Reference 3-14**) to determine the effective volumetric DCGLw value for OL1-1. This spreadsheet calculates a volumetric DCGLw of 6 pCi/g (Cs-137) (see **Attachment 10-1**). As stated previously, a further correction to the volumetric DCGLw is necessary to accommodate the site administrative limit of 75%. The administrative limit address de-listed radionuclides IAW the site dose model and provides a conservative buffer for site management. The resulting effective volumetric DCGLw value is then ***4.5 pCi/g*** (***Cs-137***).

4.8 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 221 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 that will be from about 100 cpm to ~400 cpm. The resulting MDCscan is ~3.7 pCi/g (see **Attachment 5-1** and **5-2**). This value is based on the higher background value of 400 cpm.

Since the scan MDC is less than the gross activity DCGLw for this survey unit, there is no need to add additional survey points for purposes of meeting hot spot design criteria IAW the Compass computer program (see **Attachment 6-3**).

4.9 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 3.11**), is included as **Attachment 11-1.**

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

4.11 The decision error for this survey design is 0.05 for the α value and 0.1 for the β value.

4.12 *Special measurements including gamma-ray spectroscopy are not included in this survey design.*

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

4.14 The applicable SNEC site radionuclides and their associated DCGLw values are listed on **Exhibit 1** of this calculation.

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

4.16 Area factors are not applicable in subsurface volumes. Therefore, the area factor input requirement 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 12-1**).

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** and **1-2**, are diagrams of survey unit OL1-1 adjacent to the CV shell.

6.2 **Attachment 2-1**, is the locations of the survey unit shown on a section of the site grid map along with SR-0019 sample results from this area.

6.3 **Attachment 3-1**, is a copy of the calibration data from two typical NaI radiation detectors 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.

6.5 **Attachment 5-1** and **5-2**, is the MDCscan calculation sheets.

6.6 **Attachment 6-1** to **6-3**, is the Compass output for this survey design.

6.7 **Attachment 6-4** to **6-9**, are the VSP designated random start systematic grid sample locations.

6.8 **Attachment 7-1**, is onsite analysis results for post remediation samples of the OL1-1 survey unit.

6.9 **Attachment 8-1** to **8-2**, is the initial off-site sample analysis results for the OL1-1 survey area.

6.10 **Attachment 9-1**, is the final list of sample results decayed to September 20th, 2003.

6.11 **Attachment 10-1**, is the "Effective DCGLw Calculator" spreadsheet file used to determine the effective Cs-137 soil concentration for the OL1-1 area.

6.12 **Attachment 11-1**, is the site inspection report for OL1-1.

6.13 **Attachment 12-1**, is the Compass "Site Report" listing the applicable area factors.

Exhibit 1

SNEC Facility DCGL Values [(a)]

Radionuclide	25 mrem/y Limit Surface Area (dpm/100cm²)	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

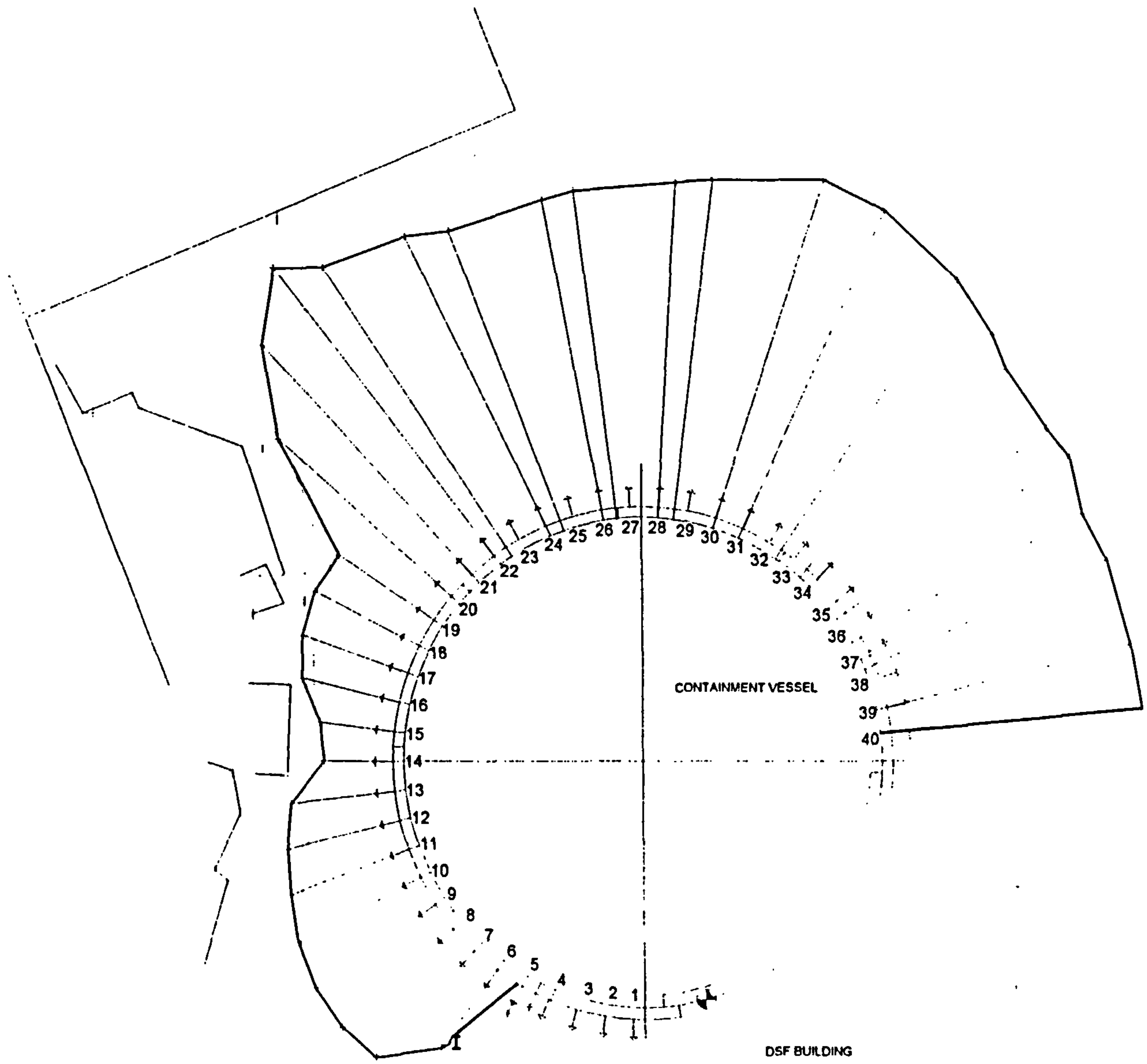
Survey Design Checklist

Calculation No. E900-03-022	Location Codes ~~CV4-1, CV5-1 and CV6~~ OL1		
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	9/26/03
2	Are drawings/diagrams adequate for the subject area (drawings should have compass headings)?	(Yes) N/A	
3	Are boundaries properly identified and is the survey area classification clearly indicated?	(Yes) N/A	
4	Has the survey area(s) been properly divided into survey units IAW EXHIBIT 10	(Yes) N/A	
5	Are physical characteristics of the area/location or system documented?	(Yes) N/A	
6	Is a remediation effectiveness discussion included?	(Yes) N/A	
7	Have characterization survey and/or sampling results been converted to units that are comparable to applicable DCGL values?	(Yes) N/A	
8	Is survey and/or sampling data that was used for determining survey unit variance included?	(Yes) N/A	
9	Is a description of the background reference areas (or materials) and their survey and/or sampling results included along with a justification for their selection?	(Yes) N/A	
10	Are applicable survey and/or sampling data that was used to determine variability included?	(Yes) N/A	
11	Will the condition of the survey area have an impact on the survey design, and has the probable impact been considered in the design?	(Yes) N/A	
12	Has any special area characteristic including any additional residual radioactivity (not previously noted during characterization) been identified along with its impact on survey design?	(Yes) N/A	
13	Are all necessary supporting calculations and/or site procedures referenced or included?	(Yes) N/A	
14	Has an effective DCGLw been identified for the survey unit(s)?	(Yes) N/A	
15	Was the appropriate $DCGL_{EMC}$ included in the survey design calculation?	(Yes) N/A	
16	Has the statistical tests that will be used to evaluate the data been identified?	(Yes) N/A	
17	Has an elevated measurement comparison been performed (Class 1 Area)?	(Yes) N/A	
18	Has the decision error levels been identified and are the necessary justifications provided?	(Yes) N/A	
19	Has scan instrumentation been identified along with the assigned scanning methodology?	(Yes) N/A	
20	Has the scan rate been identified, and is the MDCscan adequate for the survey design?	(Yes) N/A	
21	Are special measurements e.g., in-situ gamma-ray spectroscopy required under this design, and is the survey methodology, and evaluation methods described?	Yes (N/A)	
22	Is survey instrumentation calibration data included and are detection sensitivities adequate?	Yes (N/A)	
23	Have the assigned sample and/or measurement locations been clearly identified on a diagram or CAD drawing of the survey area(s) along with their coordinates?	(Yes) N/A	
24	Are investigation levels and administrative limits adequate, and are any associated actions clearly indicated?	(Yes) N/A	
25	For sample analysis, have the required MDA values been determined.? stated in SR	(Yes) N/A	
26	Has any special sampling methodology been identified other than provided in Reference 6.3?	Yes (N/A)	9/26/03

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

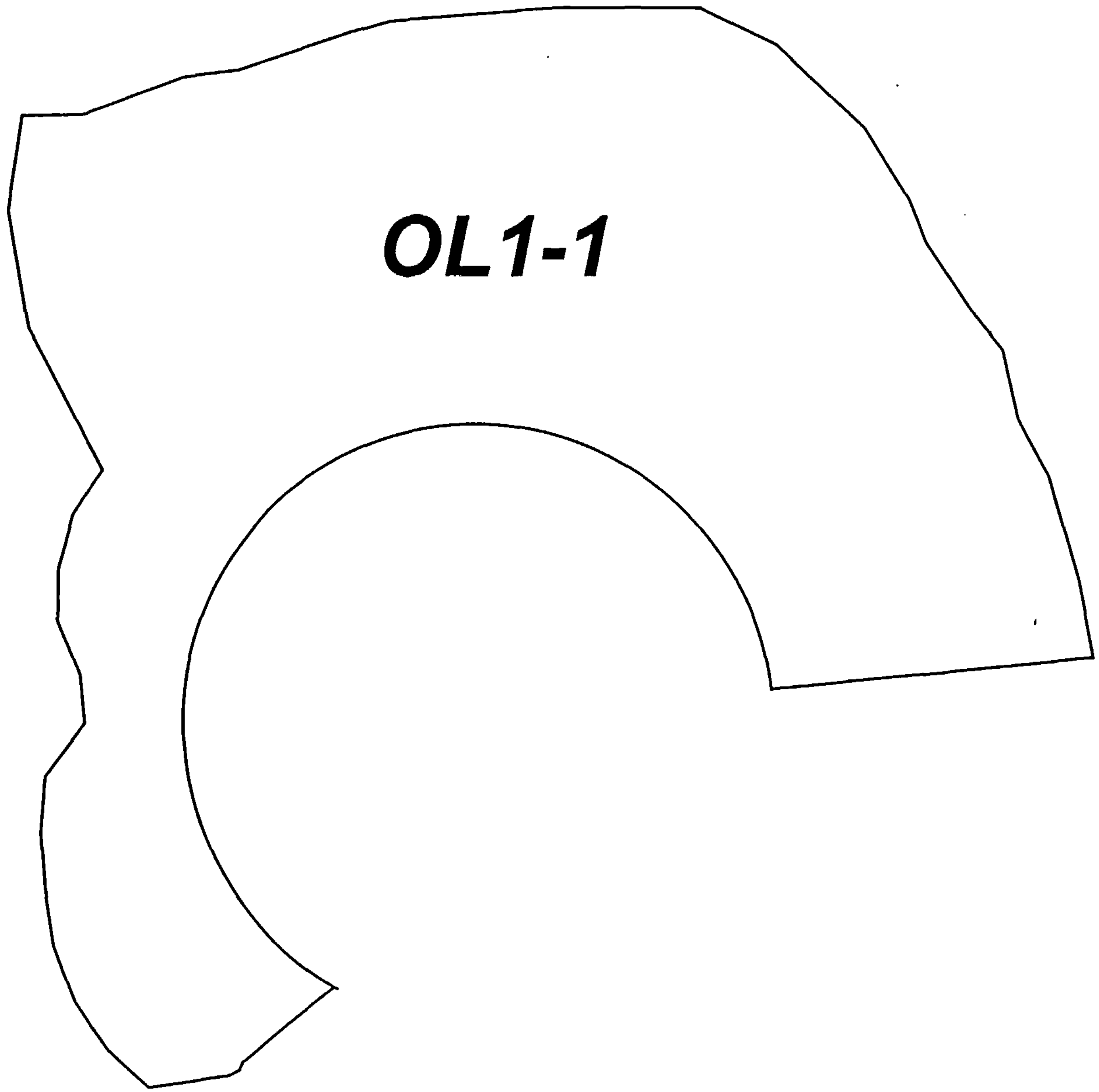
SN(; CV YARD AREA EXCAVA..ON

~796' El to ~803' Elevation (~350 square meters)



Attachment 1 - 1

SNEC CV YARD AREA EXCAVATION



Attachment 1 - 2

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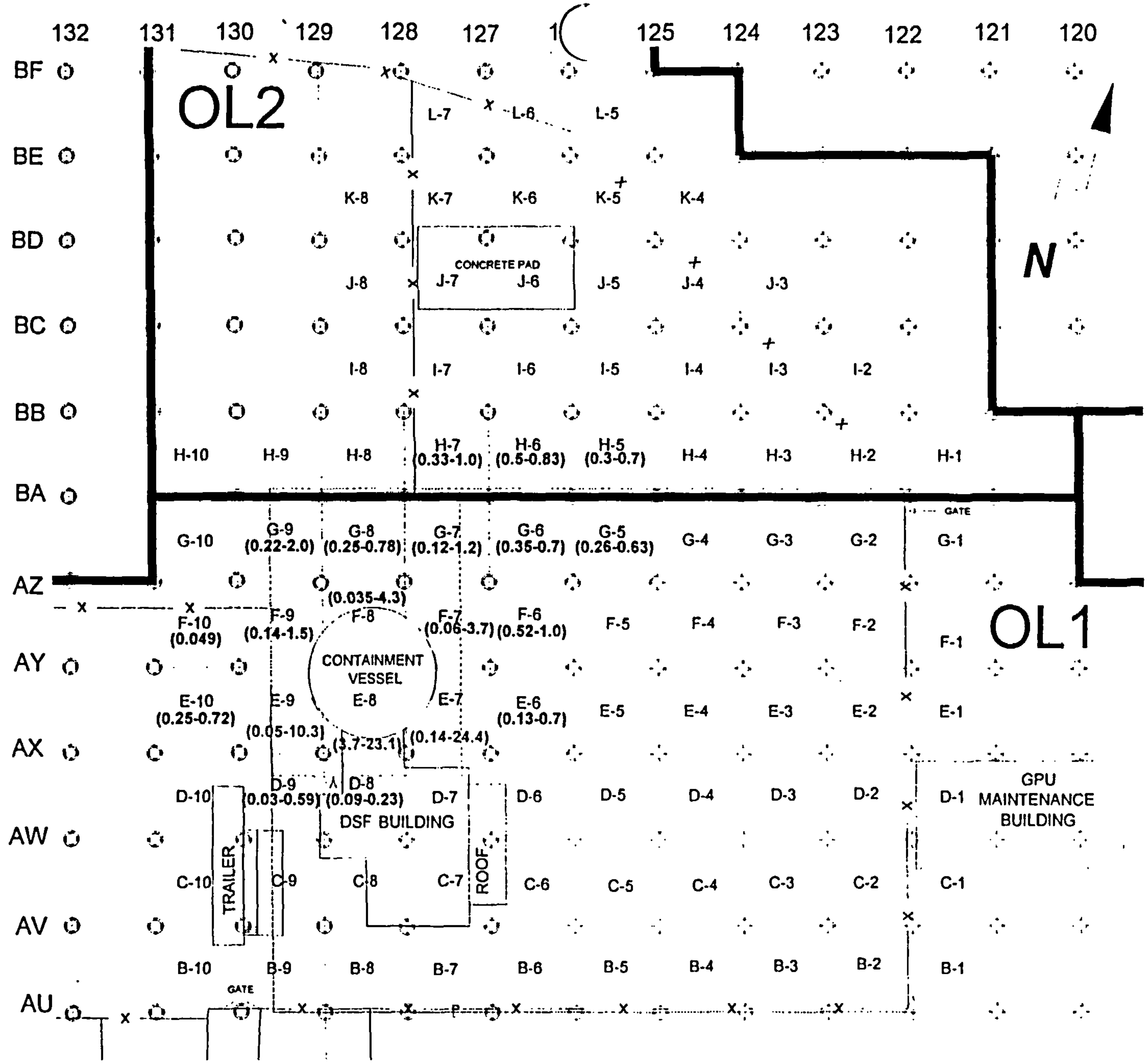

SR-0019 Cs-137 Sample Results

Values in RED South of Wing Walls

Attachment 2 - 1

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LUDLUM MODEL 44-10 HIGH VOLTAGE PLATEAU DATA SHEET
(Detector peaked using Cs137 #019454 5uCi button)

Serial Number: 196022 .

HIGH VOLTAGE	SOURCE (10 second count)	
705	34,636	
706	36,264	
707	37,529	
708	37,718	
709	38,471	
710	38,124	
711	37,737	
712	36,616	
713	N/A	
714	N/A	
715	N/A	
716	N/A	
Detector Parameters for Peaking		
Parameter	Setting	Comments
Threshold (10mV/100)	612	Peaked for Cs^{137} at 662keV
Window (On)	100	
High Voltage	709	
CPM/mR/Hr	221,206	
FWHM values performed with Threshold = 642 and Window = 40		
FWHM = $\frac{680-610}{662} \times 100\%$	10.6%	

Detector peaked for Cs^{137} using Ludlum peaking procedure and threshold setting of 612 and window setting of 100 as requested by John Duskin. 2350-1 #117566 calibration due 01/22/04 used for peaking 44-10 detector.

Performed By: [signature] Date: 7/22/03 .

Reviewed By: [signature] Date: 9-18-03 .

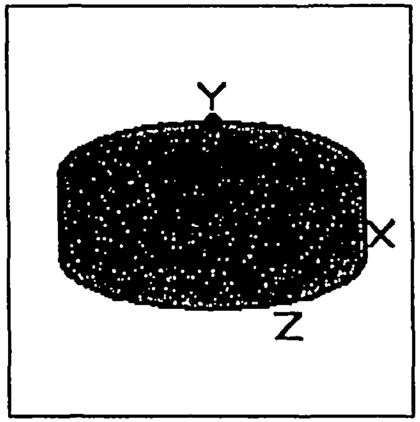
ATTACHMENT 3 - 1

MicroShield v5.0(05-00121)
GPU Nu( )r

age	: 1
)S File	: MODEL.MS5
un Date	: September 23, 2003
un Time	: 2:43:26 PM
uration	: 00:00:02

File Ref:	
Date:	
By:	
Checked:	

Case Title: Cs-137 Soil
Description: Model for Scanning
Geometry: 8 - Cylinder Volume - End Shields



ATTACHMENT 4-1

Source Dimensions

Height	15.24 cm	6.0 in
Radius	28.0 cm	11.0 in

Dose Points

A	X	Y	Z
# 1	0 cm	25.4 cm	0 cm
	0.0 in	10.0 in	0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	3.75e+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	5.6815e-008	2.1022e+003	1.5136e-006	5.6003e-002
Cs-137	6.0058e-008	2.2221e+003	1.6000e-006	5.9200e-002

Buildup
The material reference is : Source

Integration Parameters

Radial	50
Circumferential	50
Y Direction (axial)	50

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	4.352e+01	7.617e-06	9.220e-06	6.345e-08	7.680e-08
0.0322	8.030e+01	1.465e-05	1.784e-05	1.179e-07	1.436e-07
0.0364	2.922e+01	8.118e-06	1.060e-05	4.613e-08	6.024e-08
0.6616	1.892e+03	7.060e-02	1.260e-01	1.369e-04	2.443e-04
TOTALS:	2.045e+03	7.063e-02	1.261e-01	1.371e-04	2.446e-04

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NaI Scan MDC Calculation

$b := 400 \quad p := 0.5 \quad HS_d := 56 \quad SR := 25 \quad d := 1.38$

$Conv := 221 \quad MS_{output} := 2.473 \cdot 10^{-4}$

$\frac{HS_d}{SR} = 2.24$ *Observation Interval (seconds)*

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

$b_i := \frac{b \cdot O_i}{60}$ = 14.9

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

$MDCR_i = 142.844$ *net counts per minute*

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

$MDCR_{surveyor} = 202.011$ *net counts per minute*

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

$MDER = 0.914$ μR/h

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

$MDC_{scan} = 3.696$ pCi/g

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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

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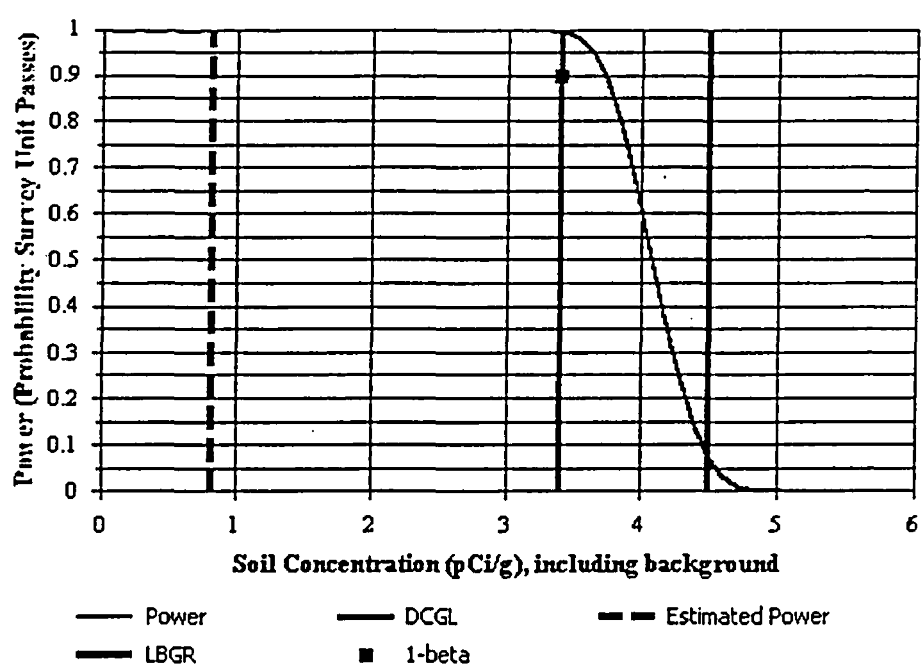
Surface Soil Survey Plan

Survey Plan Summary

Site:	CV Yard Area (OL1)		
Planner(s):	BHB		
Survey Unit Name:	Yard Area Adjacent to SNEC CV		
Comments:	Base of CV to ~803' El		
Area (m²):	350	Classification:	1
Selected Test:	Sign	Estimated Sigma (pCi/g):	1.06
DCGL (pCi/g):	4.50	Sample Size (N):	23
LBGR (pCi/g):	3.4	Estimated Conc. (pCi/g):	0.8
Alpha:	0.050	Estimated Power:	1
Beta:	0.100	EMC Sample Size (N):	23

Scanning Instrumentation: 2" by 2" NaI - Cs-137 W

Prospective Power Curve



ATTACHMENT 6-1

Surface Soil Survey Plan

Contaminant Summary

Contaminant	DCGLw (pCi/g)	Inferred Contaminant	Ratio	Modified DCGLw (pCi/g)	Scan MDC (pCi/g)
Cs-137	4.50	N/A	N/A	N/A	3.7

Contaminant	Survey Unit Estimate (Mean ± 1-Sigma) (pCi/g)	Reference Area Estimate (Mean ± 1-Sigma) (pCi/g)
Cs-137	0.82 ± 1.06	0.28 ± 0.39

Elevated Measurement Comparison (EMC)

Enter in a description for the scanning instrumentation used. Then enter a scan MDC for each measured contaminant. Click the CALCULATE button to view the integrated survey design results. All entered and calculated scan MDC and DCGL units are in pCi/g.

Scanning Instrumentation Description: 2" by 2" NaI - Cs-137 W

Contaminant	Scan MDC
Cs-137	3.7

NUREG-1507

CALCULATE

Statistical Design

N:	23
Bounded Area (m^2):	15.2
Area Factor:	1
DCGLw:	4.50
Scan MDC Required:	N/A

Hot Spot Design

Actual Scan MDC:	3.7
Area Factor:	N/A
Bounded Area (m^2):	N/A
Post-EMC N:	23

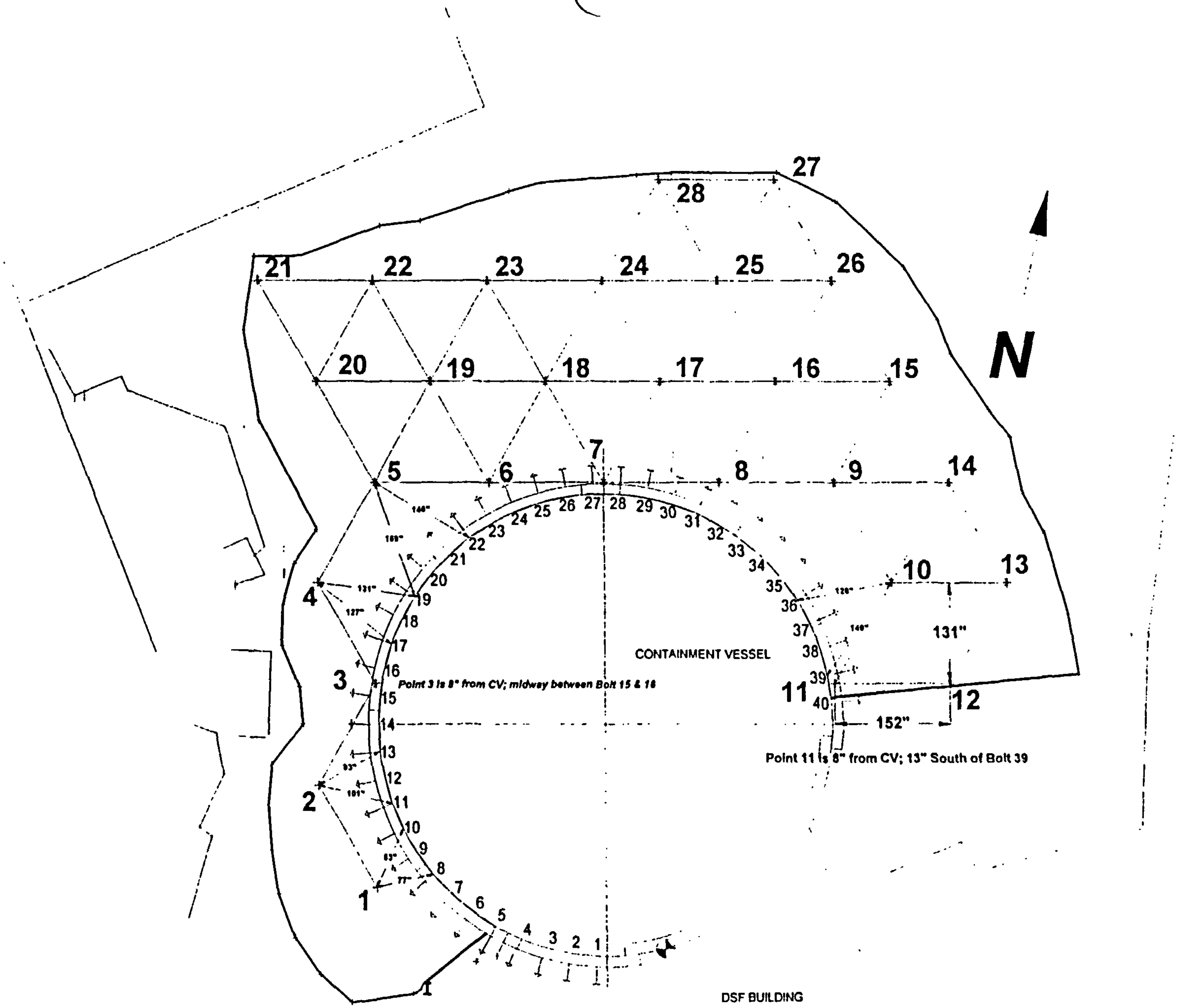
COMPASS

No additional samples are required because the actual scan MDC is less than the DCGLw.

OK

☑ Enable Trainin

ATTACHMENT 6.4



SNEC CV YARD AREA EXCAVATION - Sampling Points

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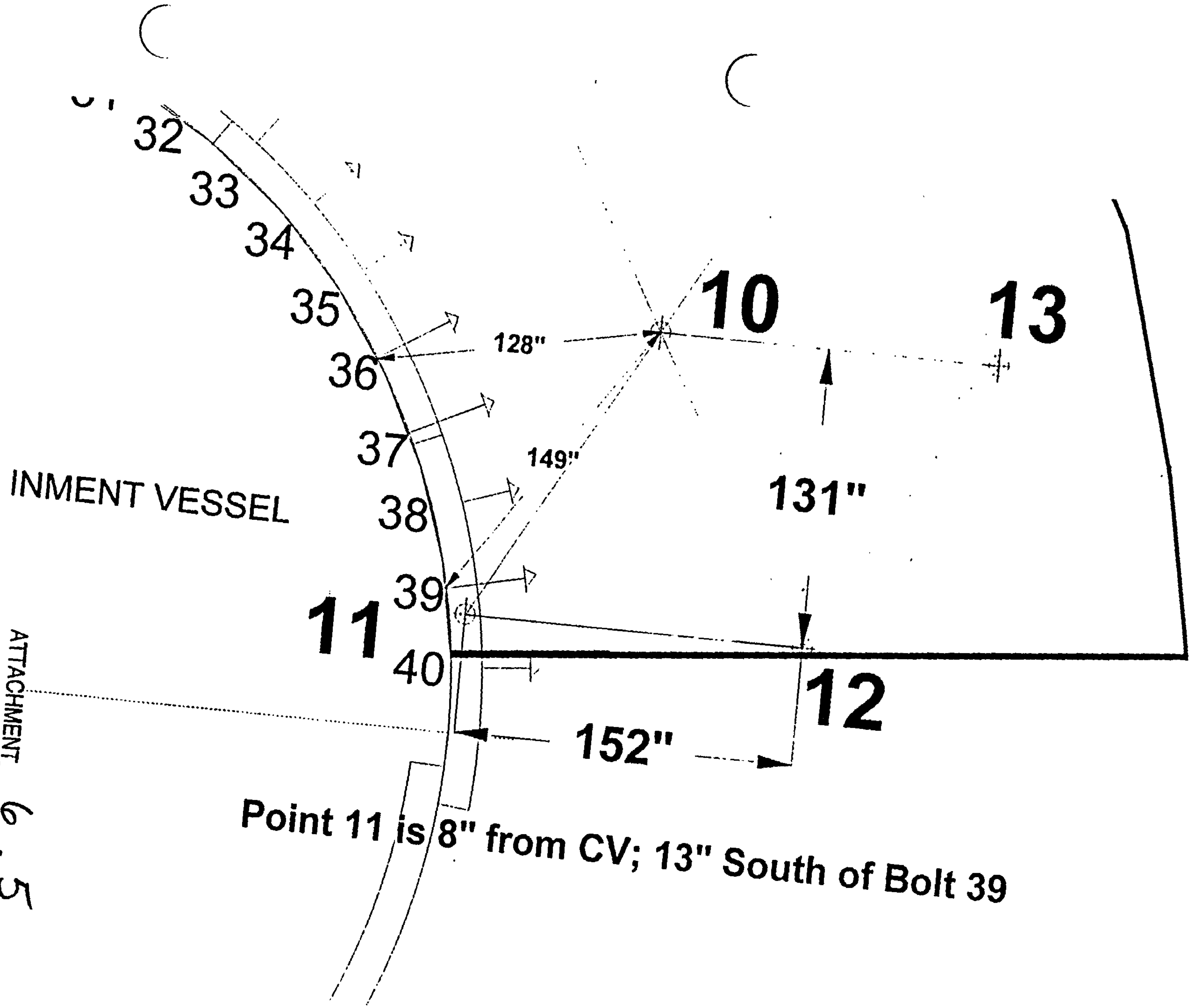

ATTACHMENT 6.5

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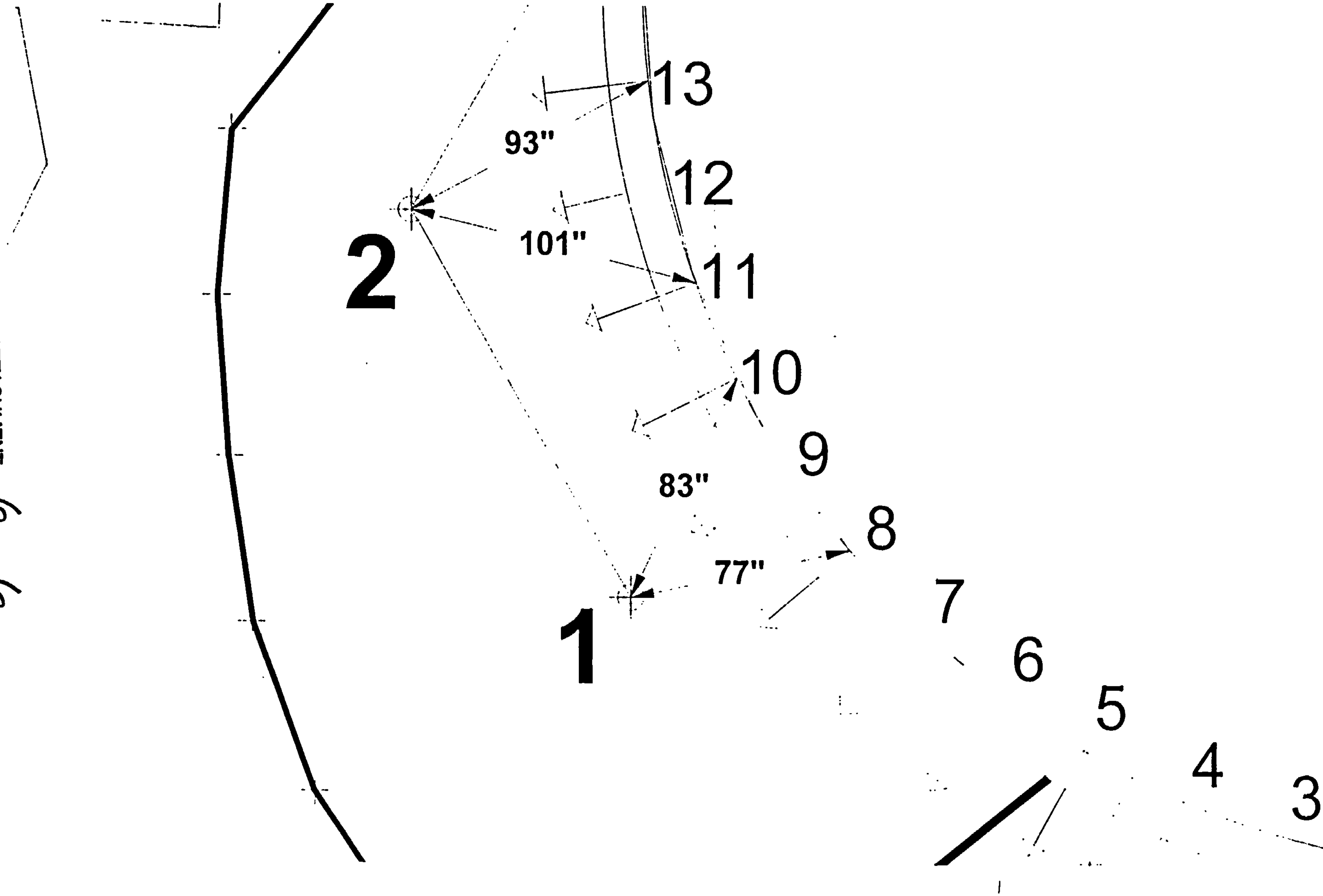
ATTACHMENT 6.6



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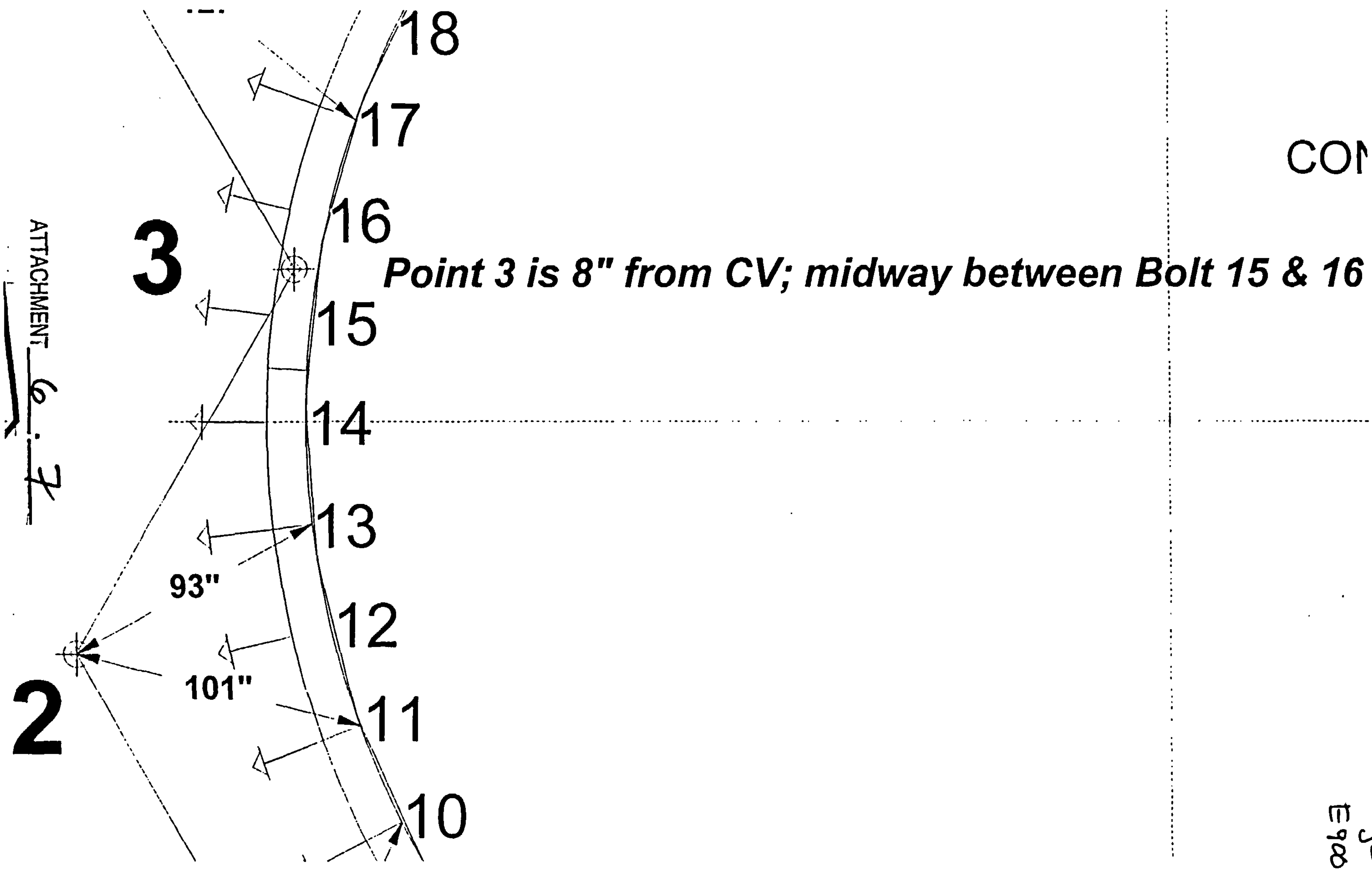
ATTACHMENT 6.7



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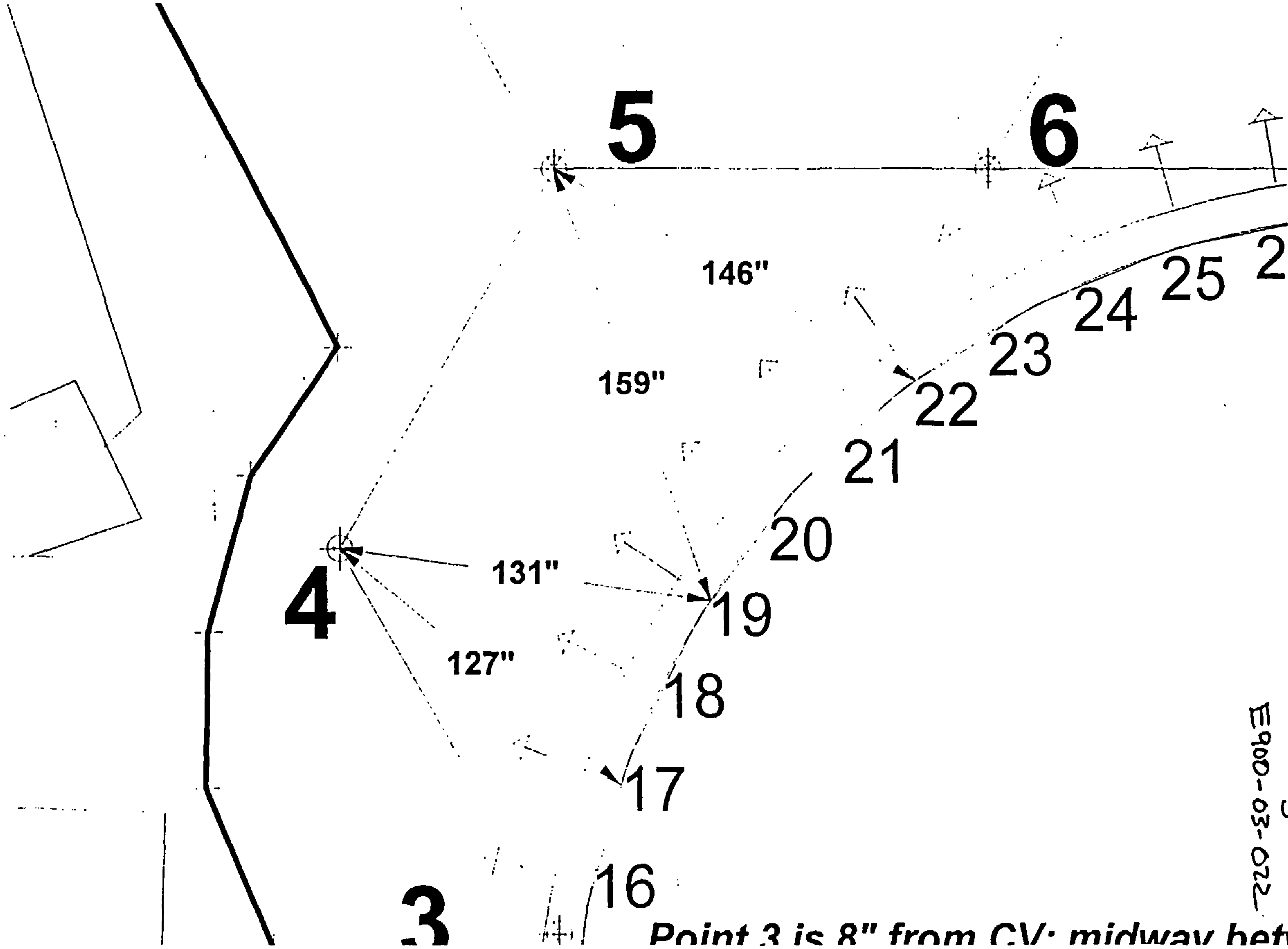
ATTACHMENT 6.8



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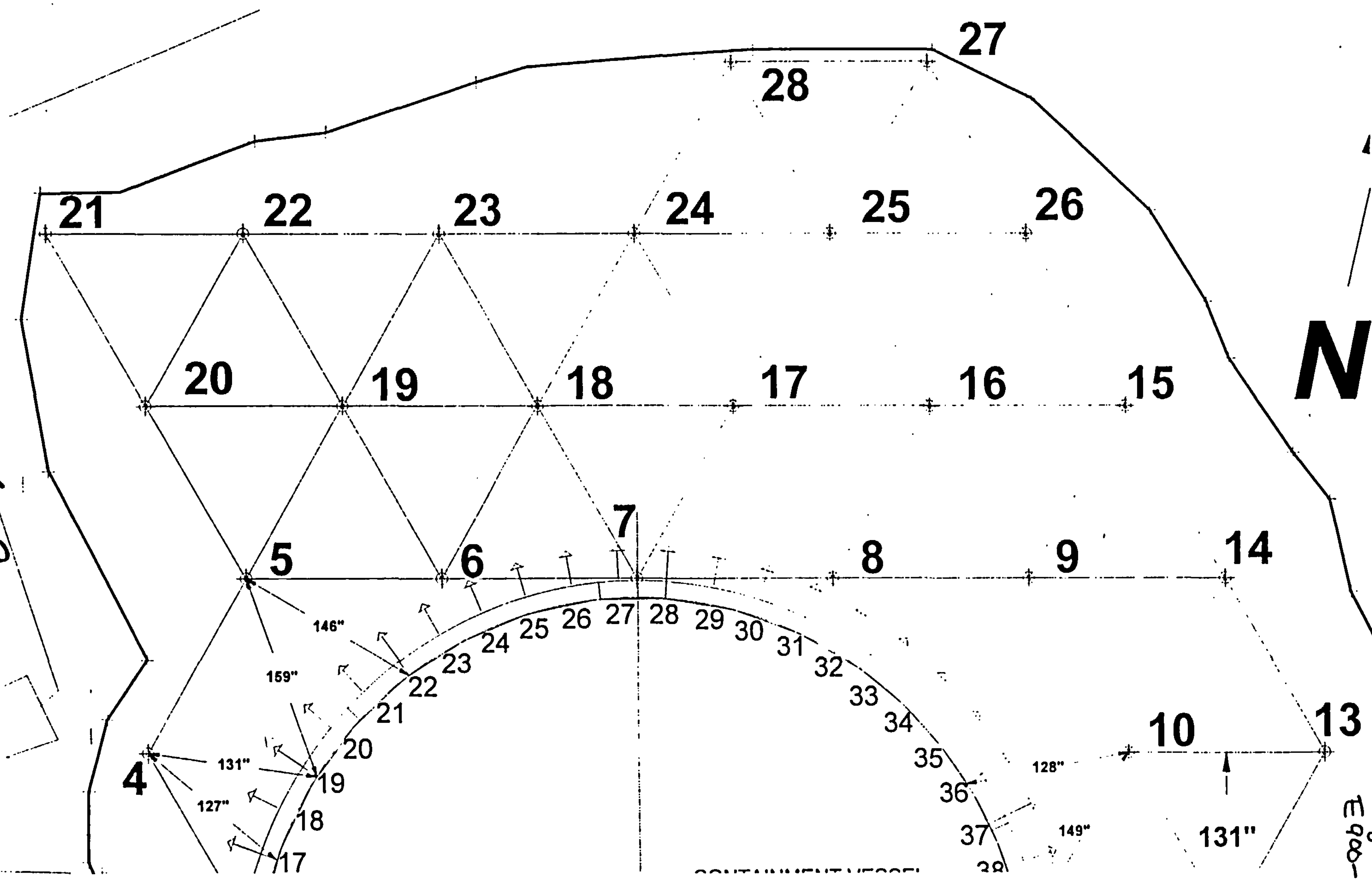
ATTACHMENT 6.9



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OL1-1 POST REMEDIATION SAMPLES		
Onsite analysis		
Sample Number	Grid	Cs-137 pCi/g
SX-SL-1281	AX-128	4.5
SX-SL-1282	AX-128	0.94
SX-SL-1283	AX-128	3
SX-SL-1284	AX-128	1.4
SX-SL-4076	AX-128	0.9
SX-SL-4073	AX-128	0.07
SX-SL-1285	AX-128	1.5
SX-SL-1228	AX-130	0.48
SX-SL-1229	AX-130	0.15
SX-SL-1230	AX-130	3.7
SX-SL-1231	AX-130	0.49
SX-SL-1232	AX-130	1.25
SX-SL-1126	AZ-130	0.36
SX-SL-1127	AZ-130	0.64
SX-SL-1128	AZ-130	0.22
SX-SL-1132	AZ-130	2
SX-SL-1104	AZ-129	0.08
SX-SL-1105	AZ-129	0.34
SX-SL-1106	AZ-129	0.78
SX-SL-1107	AZ-129	0.25
SX-SL-1108	AZ-129	0.28
SX-SL-1099	AZ-128	1.2
SX-SL-1100	AZ-128	0.12
SX-SL-1101	AZ-128	0.07
SX-SL-1102	AZ-128	0.2
SX-SL-1103	AZ-128	0.23
SX-SL-1075	AX-127	0.23
SX-SL-1076	AX-127	0.16
SX-SL-1077	AX-127	0.7
SX-SL-1078	AX-127	0.13
SX-SL-1079	AX-127	0.13
SX-SL-1087	AY-127	0.08
SX-SL-1088	AY-127	0.07
SX-SL-1089	AY-127	0.05
SX-SL-1090	AY-127	0.06
SX-SL-1091	AY-127	0.07
SX-SL-1027	AZ-127	0.35
SX-SL-1028	AZ-127	0.57
SX-SL-1029	AZ-127	0.5
SX-SL-1030	AZ-127	0.45
SX-SL-1031	AZ-127	0.7
SX-SL-1233	AY-130	0.14
SX-SL-1234	AY-130	0.6
SX-SL-1235	AY-130	1.3
SX-SL-1121	AY-129	0.035
SX-SL-1122	AY-129	4.3
SX-SL-1221	AY-128	0.17
SX-SL-1222	AY-128	1.1
SX-SL-1223	AY-128	2.1
SX-SL-1224	AY-128	2
SX-SL-1225	AY-128	1.75
SX-SL-4083	AX-129	0.3
SX-SL-4082	AX-129	0.14
	Max	4.50
	Avg	0.82
	STDEV	1.06
Denotes < MDA		

ATTACHMENT 7.1

	SNEC Sample No	LAB 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
1	#6386	**BWXT, 0101037-01**	SSGS Soil Bag #05, OL1 or OL2	10.9	0.54	0.4	11.4	0.008	0.029	0.02	3.26	5.85	8.7	0.03	November 22, 2000
2	SX10SL99182	111053	Subsurface Sample #17 (0-3 ft), AT-125, OL1			0.16	0.19								November 16, 1999
3	SX10SL99243	111144	Subsurface Sample #38 @1" in 3 Areas (2' Radius), OL1			0.18	0.17								November 18, 1999
4	SX10SL99244	111015	Subsurface Sample #37 (0-4'), OL1			0.06	0.1								November 19, 1999
5	SX10SL99246	111017	Subsurface Sample #37 (4-6'), OL1			0.15	0.12								November 19, 1999
6	SX10SL99247	111018	Subsurface Sample #39 (0-2'), AW-133, OL1			0.09	0.07								November 19, 1999
7	SX11SL99190	111127	Subsurface Sample #22 (0-3'), AZ-122, OL1			0.15	0.33								November 16, 1999
8	SX11SL99192	111129	Subsurface Sample #23 (0-3'), BC-123, OL2			0.1	0.12								November 16, 1999
9	SX11SL99193	111130	Subsurface Sample #22 (4-6'), AZ-122, OL1			0.06	0.07								November 16, 1999
10	CV Tunnel	**BWXT, 0102059-01**	CV Tunnel Sediment Composite, OL1	9.4	9.67	1.26	1250	0.18	0.55	0.22	44.69	9.34	4.02	0.13	February 14, 2001
11	SXSGF81S	**Teledyne-43023**	1994 Soil Remediation Report Results, F8, OL1		0.5	0.968	33.1		0.01	0.01	6	2	1		November 9, 1994
12	SXSGF81S(5)	**Teledyne-43023RD**	1994 Soil Remediation Report Results (Recount 1999), F8, OL1			1.1	38.6					0.4			November 9, 1994
13	SXSGG72S	**Teledyne-43024**	1994 Soil Remediation Report Results, G7, OL1		0.5	0.04	3.58		0.03	0.03	7	3	1		November 9, 1994
14	SXSGG761	**Teledyne-43022**	1994 Soil Remediation Report Results, G7, OL1		0.4	2.35	319		0.02	0.04	4	4	1		November 19, 1994
15	SXSGL84S	**Teledyne-43025**	1994 Soil Remediation Report Results, L8, OL2		0.4	0.03	0.45		0.04	0.08	8	3	1		November 5, 1994
16	DA-SX9SL99201	111061	Subsurface Sample #10 (0-8'), AZ-129, OL1			0.18	0.51								November 17, 1999
17	DA-SX9SL99249	111021	Subsurface Sample #36 (8-12'), AX-130, OL1			0.19	0.36								November 19, 1999
18	SX10SL99187	111125	Subsurface Sample #24 (5-6'), BD-126, OL2			0.08	0.078								November 16, 1999
19	SX10SL99189	111126	Subsurface Sample #34 (4-6'), AT-126, OL1			0.08	0.08								November 16, 1999
20	SX10SL99191	111128	Subsurface Sample #24 (0-4'), BD-126, OL2			0.17	0.57								November 16, 1999
21	SX10SL99198	111058	Subsurface Sample #24 (0-4'), BD-126, OL2			0.14	0.38								November 16, 1999
22	SX10SL99225	111078	Subsurface Sample #9 (0-3'), AY-130, OL1			0.19	0.56								November 16, 1999
23	SX11SL990053	**Teledyne; L20270-1**	Soil, Grid AV-127, SURFA01, OL1	1.78	0.0339	0.0321	0.0243	0.0785	0.102	0.0787	4.67	0.243	2.92	0.0605	September 28, 1999
24	SX11SL99231	111083	Subsurface Sample #35 (0-4'), BE-128, OL2			0.14	0.11								November 18, 1999
25	SX11SL99234	111085	Subsurface Sample #35 (0-3'), BE-128, OL2			0.13	0.13								November 18, 1999
26	SX5SD99202	111158	Actual Sample Number SX9SL99202 (Subsurface #11 (4-6')), AZ-129, OL1					0.012	0.0007	0.003					November 17, 1999
27	SX9SL00339	114210	Grid F-8 @ 809' El. (SMPRQ Soil001), OL1		0.015	0.07	43	0.016	0.007	0.006	0.4				May 2, 2000
28	SX9SL00340	114211	CV Yard G-8 Loc. # 12 (SMPRQ Soil001), OL1		0.018	0.13	3.2	0.03	0.0013	0.006	0.3				May 4, 2000
29	SX9SL00341	**Teledyne-TI#-38249**	CV Yard F-7, Lco.# 11-9 (SMPRQ Soil001), OL1	30	0.03	0.0248	1.55	0.06	0.2	0.09	60	0.6	9	0.0556	May 4, 2000
30	SX9SL00342	114212	CV Yard G-8 Loc. # 12/Truck #7 (SMPRQ Soil001), OL1		0.014	0.06	5	0.03	0.007	0.006	0.4				May 4, 2000
31	SX9SL00343	**Teledyne-TI#-38250**	CV Yard F-7, Loc.# 2, Truck R-2 (SMPRQ Soil001), OL1	40	0.07	0.175	210	0.1	0.2	0.1	80	2	20	0.144	May 8, 2000
32	SX9SL00347	**Teledyne-TI#-38251**	CV Yard Grid# F-8 AY-129, (SMPRQ Soil001), OL1	50	0.07	0.104	612	0.08	0.08	0.08	60	0.5	10	0.0898	May 16, 2000
33	SX9SL00363	**Teledyne-TI#-38252**	CV Yard R-2-4 (G-8) AZ-129 (SMPRQ Soil001), OL1	110	0.06	0.0842	555	0.06	0.07	0.1	50	0.4	8	0.0656	May 17, 2000
34	SX9SL00364	114213	CV Yard Truck 18-2 (SMPRQ Soil001), OL1 or OL2		0.016	0.05	0.07	0.1	0.002	0.006	0.5				May 18, 2000
35	SX9SL01746-#6889	**BWXT, 0104005-01**	North CV Yard Area Soil Bag #34L, OL1 orOL2	12.29	0.27	1.31	5.04	0.07	0.02	0.04	1.23	4.21	1.29	0.23	March 26, 2001
36	SX9SL99185	111054	Subsurface Sample #13 (0-3 ft) CV Yard, AY-128, OL1			0.08	1.5								November 16, 1999
37	SX9SL99186	111055	Subsurface Sample #13 (10-14.5 ft), CV Yard, AY-128, OL1			0.1	3.3								November 16, 1999
38	SX9SL99194	111131	Subsurface Sample #M-1 (4-8'), CV Yard, AY-125, OL1			0.14	0.66								November 17, 1999
39	SX9SL99195	111056	Subsurface Sample #M-2 (0-3'), CV Yard, AX-125, OL1			0.19	1.8								November 17, 1999
40	SX9SL99197	111057	Subsurface Sample #M-2 (7-12'), CV Yard, AX-125, OL1			0.12	0.49								November 17, 1999
41	SX9SL99200	111059	Subsurface Sample #21 (0-3'), AY-127, OL1			0.13	0.2								November 17, 1999
42	SX9SL99201	111060	Subsurface Sample #10 (0-8'), AZ-129, OL1			0.07	0.51								November 17, 1999
43	SX9SL99202	111062	Subsurface Sample #11 (4-6'), AZ-129, OL1			0.3	9.3								November 17, 1999
44	SX9SL99203	111063	Subsurface Sample #11 (7-12'), AZ-129, OL1			0.15	0.34								November 17, 1999
45	SX9SL99206	111066	Subsurface Sample #M-1 (0-3'), AY-125, OL1			0.18	0.18								November 17, 1999
46	SX9SL99207	111067	Subsurface Sample #M-1 (9-16'), AY-125, OL1			0.14	0.17								November 17, 1999
47	SX9SL99209	111069	Subsurface Sample #11 (0-3'), AZ-129, OL1			0.13	0.79								November 17, 1999
48	SX9SL99210	111132	Subsurface Sample #10 (7-12'), AZ-129, OL1			0.2	1.4								November 17, 1999
49	SX9SL99211	111133	Subsurface Sample #18 (0-2'), AV-124, OL1			0.09	0.48								November 17, 1999
50	SX9SL99212	111070	Subsurface Sample #21 (4-6'), AY-127, OL1			0.11	0.12								November 17, 1999
51	SX9SL99213	111071	Subsurface Sample #19 (0-3'), AV-124, OL1			0.2	0.2								November 17, 1999
52	SX9SL99214	111134	Subsurface Sample #20 (9-12'), AX-124, OL1			0.11	0.11								November 17, 1999
53	SX9SL99215	111072	Subsurface Sample #19 (3-4'), AV-124, OL1			0.2	0.32								November 17, 1999
54	SX9SL99216	111135	Subsurface Sample #20 (0-3'), AX-124, OL1			0.14	0.27								November 17, 1999

55	SX9SL99217	111136	Subsurface Sample #28 (7-12'), AX-126, OL1			0.12	0.69								November 17, 1999
56	SX9SL99218	111073	Subsurface Sample #12 (0-3'), AZ-128, OL1			0.04	0.11								November 17, 1999
57	SX9SL99219	111074	Subsuface Sample #29 (0-5'), AY-128, OL1			0.07	0.59								November 17, 1999
58	SX9SL99220	111075	Subsuface Sample #20 (4-8'), AX-124, OL1			0.12	0.2								November 17, 1999
59	SX9SL99224	111077	Subsurface Sample #14 (4-5'), AV-129, OL1			0.11	0.08								November 18, 1999
60	SX9SL99227	111079	Subsurface Sample #28 (4-6'), AX-126, OL1			0.08	0.42								November 17, 1999
61	SX9SL99228	111138	Subsurface Sample #14 (0-3'), AV-129, OL1			0.2	0.12								November 18, 1999
62	SX9SL99236	111139	Subsurface Sample #15 (4-5'), AV-127, OL1			0.09	0.06								November 18, 1999
63	SX9SL99242	111014	Subsuface Sample #15 (0-4'), AV-127, OL1			0.14	0.1								November 18, 1999
64	SX9SL99245	111016	Subsurface Sample #36 (4-8'), AX-130, OL1			0.1	0.69								November 19, 1999
65	SX9SL99248	111019	Subsurface Sample #36 (0-4'), AX-130, OL1			0.09	1.1								November 19, 1999
66	SX9SL99249	111020	Subsurface Sample #36 (8-12'), AX-130, OL1			0.15	0.33								November 19, 1999
67	SX9SL99250	111022	Subsurface Sample #36 (0-6'), AX-130, OL1			0.08	0.44								November 19, 1999
68	SXSL1063	**Teledyne-80018; L19184-1**	North CV Yard Soil BA-127, 812' El, Sample # 5, OL2	4.58	0.0531	0.0192	0.886	0.0961	0.0721	0.0327	3.77	0.21	10.9	0.0525	June 27, 2002
69	SXSL1089	**Teledyne-80019; L19184-2**	North CV Yard Soil AY-127, 810' El, Sample # 3, OL1	3.03	0.0695	0.0332	1.29	0.0993	0.128	0.05	4.97	0.21	7.54	0.0828	June 28, 2002
70	SXSL1115	**Teledyne-80020; L19184-3**	North CV Yard Soil AY-128, 804' El, Sample # 2, OL1	4.88	0.0536	0.0243	1.8	0.24	0.138	0.0407	4.21	0.21	7.6	0.0571	June 29, 2002
71	SXSL1122	**Teledyne-80021; L19184-4**	North CV Yard Soil AY-129, 798' El, Sample # 2, OL1	3.44	0.0529	0.0279	4.77	0.183	0.0894	0.04	3.68	0.206	8.75	0.0862	June 29, 2002
72	SXSL1130	**Teledyne-80022; L19184-5**	North CV Yard Soil AX-129, 803' El, Sample # 4, OL1	4.99	0.0648	0.0298	22.6	0.149	0.0856	0.0246	3.55	0.231	13.4	0.0989	July 3, 2002
73	SXSL1132	**Teledyne-80023; L19184-6**	North CV Yard Soil AZ-130, Sample # 5, OL1	2.98	0.0715	0.035	2.59	0.164	0.0746	0.0646	5.27	0.215	12.6	0.0734	July 3, 2002
74	SXSL1270	**BWXT, 0108055-02**	AX-129, 3-3, Soil, CV SE Side 5' From CV, 800' El., OL1	11.31	0.02	0.01	23.1	0.037	0.007	0.007	2.104	3.93	8.68	0.07	July 26, 2001
75	SXSL1281	**BWXT, 0108055-01**	AX-128, 3-1, Soil, CV SW Side 5' From CV, 800' El, OL1	11.52	0.03	0.01	4.38	0.031	0.016	0.007	1.908	4	7.78	0.04	July 26, 2001
76	SXSL2374	**Teledyne-73293; L18076-8**	South East CV Yard, ABH 40, 30 to 40' Depth, OL1 or Ol2	1.87	0.0268	0.1	0.1	0.0585	0.019	0.0134	2.37	0.186	1.64		January 3, 2002
77	SXSL2376	**Teledyne-73287; L18076-2**	South East CV Yard, # 40, 50 to 60' Depth, OL1 or Ol2	2.04	0.0323	0.08	0.07	0.0382	0.0336	0.0137	2.48	0.187	1.67		January 3, 2002
78	SXSL2425	**Teledyne-73286; L18076-1**	East CV Yard, ABH # 33, 60 to 70' Depth, OL1 or OL2	1.99	0.0339	0.09	0.1	0.0261	0.0264	0.0118	1.71	0.188	1.57		January 21, 2002
79	SXSL2456	**Teledyne-73289; L18076-4**	East CV Yard, # 35, 60 to 70' Depth, OL1 or Ol2	2.02	0.0277	0.07	0.05	0.0207	0.0367	0.013	2.03	0.188	1.17		January 21, 2002
80	SXSL2484	**Teledyne-73288; L18076-3**	North CV Yard, # 22, 50 to 60' Depth, OL1 or Ol2	2	0.038	0.1	0.1	0.0273	0.0269	0.0155	2.45	0.178	1.84		January 22, 2002
81	SXSL2610	**Teledyne-73290; L18076-5**	North CV Yard, # 21, 20 to 30' Depth, OL1 or OL2	1.83	0.0336	0.06	0.05	0.0259	0.0182	0.0129	2.21	0.189	1.51		February 11, 2002
82	SXSL2634	**Teledyne-73219; L18077-1**	West CV Yard ABH # 9, 10 to 15' Depth, OL1 or OL2	2.06	0.0287	0.1	0.1	0.0324	0.0295	0.0104	1.68	0.191	2.3		February 12, 2002
83	SXSL2649	**Teledyne-73220; L18077-2**	Anulus Well, A-2, 5 to 10' Depth, OL1	2	0.0314	0.1	0.6	0.00978	0.0133	0.0216	1.87	0.183	1.75		February 13, 2002
84	SXSL2655	**Teledyne-73291; L18076-6**	Anulus Well, A-4, 0 to 5' Depth, OL1	1.89	0.0497	0.09	0.09	0.0135	0.03	0.0123	2.28	0.187	1.94		February 14, 2002
85	SXSL2660	**Teledyne-73292; L18076-7**	Anulus Well, A-3, 15 to 20' Depth, OL1	1.9	0.0268	0.09	0.09	0.0372	0.00949	0.0134	1.65	0.189	2		February 14, 2002
86	SXSL2662	**Teledyne-73294; L18076-9, L20243-1**	West CV Yard ABH # 10, 20 to 30' Depth (SR-29), OL1 or OL2	1.98	0.0338	0.0251	0.0213	0.041	0.0307	0.0293	1.96	0.189	1.34	0.0611	February 15, 2002
87	SXSL2664	**Teledyne-73221; L18077-3**	West CV Yard ABH # 10, 40 to 50' Depth, OL1 or OL2	1.99	0.0303	0.08	0.13	0.0216	0.0105	0.0256	2.28	0.182	1.84		February 15, 2002
88	SXSL2871	**Teledyne-71949; L17838-11**	CV Area - East Yard Dirt Pile - Middle, 1/2 Way Up, OL1		0.03	0.07	0.56								March 6, 2002
89	SXSL2872	**Teledyne-71948; L17838-10**	CV Area - East Yard Dirt Pile - Bottom (also top center), OL1		0.03	0.06	0.1								March 6, 2002
90	SXSL3133	**Teledyne; L20326-1**	Soil Pile, CV Yard, Three Feet on West Side, SR-37, OL1		0.0263	0.06	0.24								August 13, 2002
91	SXSL3138	**Teledyne; L20326-2**	Soil Pile, CV Yard, Six Feet on West Side, SR-37, OL1		0.0307	0.07	0.4								August 13, 2002
92	SXSL3140	**BWXT,1030-003-10-01**	East CV Yard, Soil Pile @ 6' on West Side (6" Depth), OL1	1.892	0.012	0.014	0.825	0.007	0.005	0.005	0.369	0.086	3.406	0.03	8/13/2002, 8/30/02
93	SXSL3142	**Teledyne; L20326-3**	Soil Pile, CV Yard, Three Feet on East Side, SR-37, OL1		0.0295	0.07	0.6								August 13, 2002
94	SXSL3145	**BWXT,1030-003-10-01**	East CV Yard, Soil Pile @ 3' on East Side (6" Depth), OL1	1.897	0.017	0.013	1.26	0.004	0.005	0.005	0.376	0.083	3.69	0.038	8/13/2002,8/30/02
95	SXSL3149	**Teledyne; L20326-4**	Soil Pile, CV Yard, Six Feet on East Side, SR-37, OL1		0.0297	0.08	0.3								August 13, 2002
96	SXSL3153	**BWXT,1030-003-10-01**	East CV Yard, Soil Pile @ Top (6" Depth), OL1	1.937	0.043	0.023	0.3	0.003	0.005	0.005	0.343	0.087	4.177	0.051	8/13/2002, 8/30/02
97	SXSL2649	**Teledyne-76150; L18709-3, L20243-2**	Anulus Well, A-2, 5 to 10' Depth SR-29, OL1			0.0142	0.0137							0.0377	1/21/2001, 2/13/02
98	SXSL2664	**Teledyne-76151; L18709-4, L20243-3**	West CV Yard ABH # 10, 40 to 50' Depth, SR-29, OL1 or OL2			0.015	0.0138							0.0374	1/21/2001, 2/13/02
			Number of Analysis Results=>	**31**	**45**	**97**	**97**	**36**	**40**	**40**	**39**	**36**	**35**	**22**	
			Number of Positive Analysis Results=>	**7**	**2**	**9**	**63**	**5**	**2**	**5**	**0**	**0**	**0**	**0**	
			Mean Concentration Including MDC Values=>	**10.98**	**0.30**	**0.17**	**32.88**	**0.06**	**0.06**	**0.03**	**9.90**	**1.31**	**5.06**	**0.07**	
			Sigma=>	**21.71**	**1.43**	**0.32**	**154.51**	**0.06**	**0.09**	**0.04**	**19.63**	**2.09**	**4.60**	**0.05**	
			2 * sigma + Mean=>	**54.40**	**3.17**	**0.80**	**341.91**	**0.18**	**0.25**	**0.12**	**49.16**	**5.48**	**14.25**	**0.17**	
			Median Concentration Including MDC Values=>	**2.06**	**0.03**	**0.09**	**0.38**	**0.04**	**0.03**	**0.02**	**2.37**	**0.21**	**2.92**	**0.06**	
			DCGLw in pCi/g (25 mrem/y)=>	**132**	**1.2**	**3.5**	**6.6**	**9.9**	**1.8**	**1.6**	**86**	**2**	**747**	**10.1**	
			Mean Concentration Percentage of DCGLw=>	**8.3%**	**25.3%**	**4.8%**	**498.2%**	**0.6%**	**3.2%**	**2.2%**	**11.5%**	**65.6%**	**0.7%**	**0.7%**	
			Maximum Value=>	**110**	**9.67**	**2.35**	**1250**	**0.24**	**0.55**	**0.22**	**80.00**	**9.34**	**20.00**	**0.23**	
			Minimum Value=>	**1.78**	**0.01**	**0.01**	**0.01**	**0.00**	**0.00**	**0.00**	**0.30**	**0.08**	**1.00**	**0.03**	

NOTE 1: Yellow background denotes positive result. All others are "Less Than" values.

NOTE 2: Red numbers indicates on-site analysis

Decayed Values

September 20, 2003

		H-3	Sr-90	Co-60	Cs-137	Am-241	Pu-238	Pu-239		
		T 1/2	T 1/2	T 1/2	T 1/2	T 1/2	T 1/2	T 1/2		
	Years=>	12.28	28.6	5.271	30.17	432.2	87.75	24131		
	Days=>	4.4853E+03	1.0446E+04	1.9252E+03	1.1020E+04	1.5786E+05	3.2051E+04	8.8138E+06		
Analysis Date	**Elapsed Time (d)**	**H-3**	**Sr-90**	**Co-60**	**Cs-137**	**Am-241**	**Pu-238**	**Pu-239**		
July 3, 2002	444	4.659	0.063	0.025	21.978	0.149	0.085	0.025	SXSL1130	1
July 3, 2002	444	2.782	0.069	0.030	2.519	0.164	0.074	0.065	SXSL1132	2
July 26, 2001	786	10.017	0.019	0.008	21.986	0.037	0.007	0.007	SXSL1270	3
July 26, 2001	786	10.203	0.028	0.008	4.169	0.031	0.016	0.007	SXSL1281	4
January 3, 2002	625	1.698	0.026	0.080	0.096	0.058	0.019	0.013	SXSL2374	5
January 3, 2002	625	1.852	0.031	0.064	0.067	0.038	0.033	0.014	SXSL2376	6
January 21, 2002	607	1.812	0.033	0.072	0.096	0.026	0.026	0.012	SXSL2425	7
January 21, 2002	607	1.839	0.027	0.064	0.048	0.021	0.036	0.013	SXSL2456	8
January 22, 2002	606	1.821	0.037	0.080	0.096	0.027	0.027	0.015	SXSL2484	9
February 11, 2002	586	1.672	0.032	0.049	0.048	0.026	0.018	0.013	SXSL2610	10
February 12, 2002	585	1.882	0.028	0.081	0.096	0.032	0.029	0.010	SXSL2634	11
February 13, 2002	584	1.827	0.030	0.081	0.578	0.010	0.013	0.022	SXSL2649	12
February 14, 2002	583	1.727	0.048	0.073	0.087	0.013	0.030	0.012	SXSL2655	13
February 14, 2002	583	1.736	0.026	0.073	0.087	0.037	0.009	0.013	SXSL2660	14
February 15, 2002	582	1.810	0.033	0.020	0.021	0.041	0.030	0.029	SXSL2662	15
February 15, 2002	582	1.819	0.029	0.065	0.125	0.022	0.010	0.026	SXSL2664	16
March 6, 2002	563		0.029	0.057	0.541				SXSL2871	17
March 6, 2002	563		0.029	0.049	0.097				SXSL2872	18
August 13, 2002	403		0.026	0.052	0.234				SXSL3133	19
August 13, 2002	403		0.030	0.061	0.390				SXSL3138	20
August 13, 2002	403	1.778	0.012	0.012	0.804	0.007	0.005	0.005	SXSL3140	21
August 13, 2002	403		0.029	0.061	0.585				SXSL3142	22
August 13, 2002	403	1.782	0.017	0.011	1.228	0.004	0.005	0.005	SXSL3145	23
August 13, 2002	403		0.029	0.069	0.292				SXSL3149	24
August 13, 2002	403	1.820	0.042	0.020	0.292	0.003	0.005	0.005	SXSL3153	25
	Number of Analysis Results=>	19	25	25	25	19	19	19		
	Number of Positive Analysis Results=>	2	0	0	16	3	0	4		
	Mean Concentration Including MDC Values=>	2.87	0.03	0.05	2.26	0.04	0.03	0.02		
	Sigma=>	2.64	0.01	0.03	6.01	0.04	0.02	0.01		
	2 * sigma + Mean=>	8.15	0.06	0.10	14.27	0.13	0.07	0.04		
	Median Concentration Including MDC Values=>	1.82	0.03	0.06	0.23	0.03	0.02	0.01		
	DCGLw in pCi/g (25 mrem/y)=>	132	1.2	3.5	6.6	9.9	1.8	1.6		
	Mean Concentration Percentage of DCGLw=>	2.2%	2.7%	1.4%	34.3%	0.4%	1.4%	1.0%		
	Maximum Value=>	10	0.07	0.08	22	0.16	0.08	0.06		
	Minimum Value=>	1.67	0.01	0.01	0.02	0.00	0.00	0.00		

Positively detected results depicted in yellow=>

Values in red are on-site analysis results.

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CV YARD AREA SOIL SAMPLES

ATTACHMENT 9-1

10/17/2003

C04

SNEC AL	75%	Total Activity Limit DCGLw		Administrative Limit	
		9.59	pCi/g	7.19	pCi/g

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

SAMPLE NUMBER(s)⇒ CV Yard Samples - OL1 & OL2

Cs-137 Limit		Cs-137 Administrative Limit	
6.00	pCi/g	4.50	pCi/g

237.95%	25.0	mrem/y TEDE Limit
73.32%	4.0	mrem/y Drinking Water (DW) Limit

☑ Check for 25 mrem/y

	Isotope	Sample Input (pCi/g, uCi, 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	0.130	0.570%	9.9	2.3	0.05	0.18	0.05	0.33	0.23	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	0.100	0.438%	3.5	67.0	0.04	0.14	0.04	0.71	0.01	Co-60
4	Cs-137	14.27	62.533%	6.6	397	6.00	19.46	6.00	54.05	0.14	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	8.15	35.714%	132	31.1	3.43	11.12	3.43	1.54	1.05	H-3
7	Ni-63		0.000%	747	19000	0.00	0.00	0.00	0.00	0.00	Ni-63
8	Pu-238	0.070	0.307%	1.8	0.41	0.03	0.10	0.03	0.97	0.68	Pu-238
9	Pu-239	0.040	0.175%	1.6	0.37	0.02	0.05	0.02	0.63	0.43	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	0.060	0.263%	1.2	0.61	0.03	0.08	0.03	1.25	0.39	Sr-90
		2.28E+01	100.000%			9.59	31.12	9.59	59.486	2.933	
						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		

ATTACHMENT 10 - 1

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SAXTON NUCLEAR	Saxton Nuclear Experimental Corporation Facility Policy and Procedure Manual	Number E900-IMP-4520.06
Title Survey Unit Inspection in Support of FSS Design		Revision No. 0

EXHIBIT 1

Survey Unit Inspection Check Sheet

SECTION 1 - SURVEY UNIT INSPECTION DESCRIPTION					
Survey Unit #	OL1-1		Survey Unit Location	OPEN LAND ADJACENT TO CV Shell	
Date	9/23/03	Time	1730	Inspection Team Members	J Duslin

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

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:

Survey Unit Inspector (print/sign)	J Duslin / [signature]	Date	9/23/03
Survey Designer (print/sign)	B. BROSEY / B. Brosey	Date	9/25/03

ATTACHMENT 11-1

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Site Report

Site Summary

Site Name: CV Yard Area (OL1)

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	4.50	No	1	1
				10,000	1

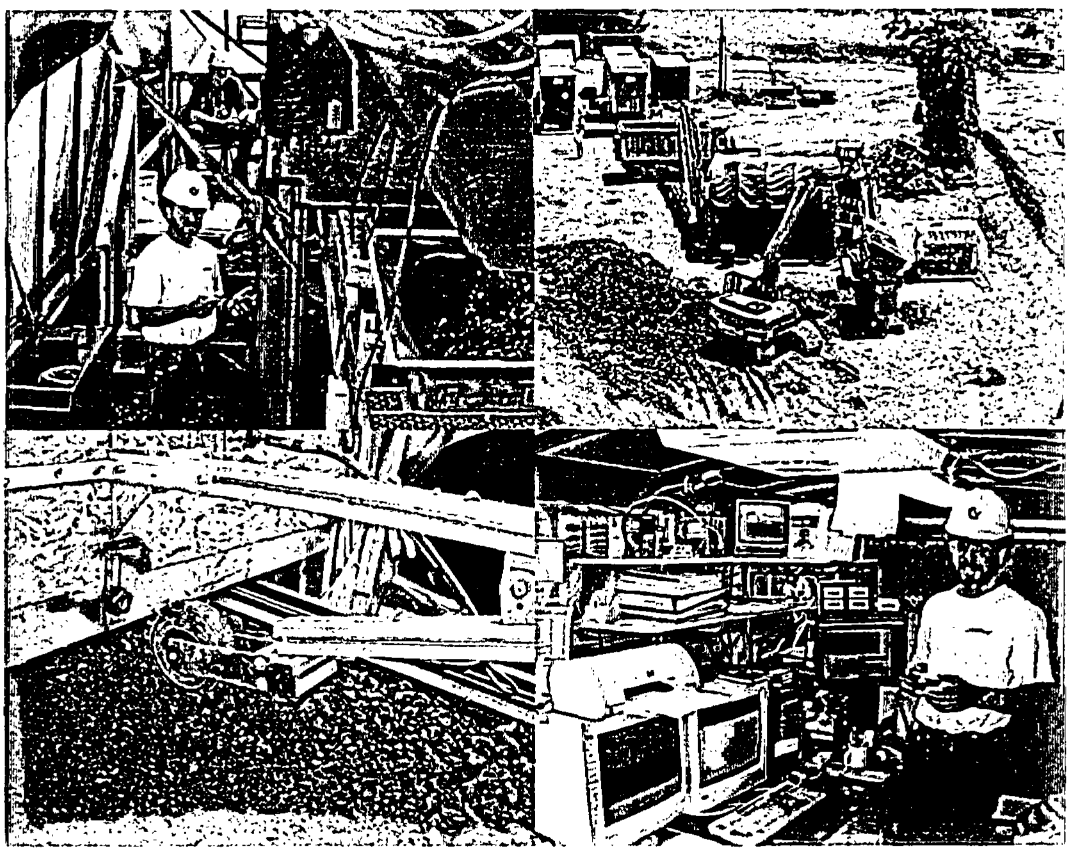
ATTACHMENT 12.1

Final Report for Survey of Debris Pile

Revision 1

September 22, 2003

Prepared For:
GPU Nuclear Corporation
SNEC Facility
Saxton, PA
Contract # 55001244



Prepared By:
Shonka Research Associates, Inc.
4939 Lower Roswell Rd., Suite 106
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Acronyms:

Acronym	Description
AVI	Audio Video Interleaved
CAM	Continuous Air Monitor
CFD	Cumulative Frequency Distribution
cpm	Counts per Minute
cps	Counts per Second
D&D	Decontamination & Decommissioning
DOE	Department Of Energy
$DCGL_{EMC}$	Derived Concentration Guideline Level – Elevated Measurement Comparison
$DCGL_{W}$	Derived Concentration Guideline Level - Wilcoxon Rank Sum
EDA	Exploratory Data Analysis
FSS	Final Status Survey
GM	Geiger-Muller [detector]
GPU	GPU Nuclear
IAEA	International Atomic Energy Agency
ICRU	International Commission on Radiation Units and Measurements
KUT	Potassium, Uranium and Thorium primordial nuclides
LCL	Lower Confidence Level
LLD	Low Level Discriminator
LTP	License Termination Plan
MARSSIM	Multi-Agency Radiation and Site Survey Investigation Manual
MCA	Multi-Channel Analyzer
MDC	Minimum Detectable Contamination
MCC	Mobile Control Center
NaI	Sodium Iodide
NASVD	Noise Adjusted Single Value Decomposition
NIST	National Institute for Standards and Technology
NRC	Nuclear Regulatory Commission
NUREG	Nuclear Regulatory Commission Research Report
PBC	Performance Based Check
PDF	Probability Density Function
QA	Quality Assurance
QC	Quality Control
ROI	Region Of Interest
SAB	Survey Area Block
SLC	Survey Location Code
SMCM	Sub-Surface Multi-Spectral Contamination Monitor
SNEC	Saxton Nuclear Experimental Corporation
SR	Survey Request

Acronym	Description
SRR	Survey Release Record
SRA	Shonka Research Associates
SRC	Source Response Check
SSGS	Saxton Steam Generating Station
StDev	Standard Deviation
UCL	Upper Confidence Level

1. INTRODUCTION

The Saxton Nuclear Experimental Corporation (SNEC) Facility located in Saxton, Pennsylvania accumulated approximately 11,200 tons of building debris (primarily concrete) and approximately 5,000 tons of soils that would be suitable for use as fill for excavations that will remain following decontamination and decommissioning (D&D). GPU Nuclear (GPU) determined that the concentration of man-made radionuclides in the materials would be measured prior to using the soil and debris for fill. Materials with concentrations above a fraction of the DCGLw stated in the License Termination Plan (LTP) (5.6 pCi/g) were separated from the material used for fill.

GPU used a system of conveyors and radiation monitors, along with sampling and laboratory analysis, to document that the material is substantially below limits proscribed in the facility LTP filed with the Nuclear Regulatory Commission (NRC). Shonka Research Associates, Inc (SRA) was contracted to build, operate, and summarize data from the radiation monitors.

SRA utilized a system called the Subsurface Multi-spectral Contamination Monitor (SMCM), which was developed with funding from the NRC (NRC-04-92-096. "Continued Development of a High Sensitivity Landfill Monitor: The Results of a Phase II SBIR Grant". December, 1994). SMCM combines into one instrument the capabilities of both scanning surveys with *in situ* gamma spectrometry. The SMCM is a scanning spectrometer. The data is processed with Noise Adjusted Single Value Decomposition (NASVD) algorithms originally developed for sonar. This treatment of the data greatly reduces the statistical fluctuation normally encountered in scanning surveys. Over the past three years, the SMCM has been used in support of land area release surveys at several nuclear power plant sites across the United States, including Forked River, LaSalle, Nuclear Fuel Services, Point Beach, Rancho Seco, Saxton (open land areas), and Yankee Rowe, as well as for non-power plant licensees and United States Department of Energy (DOE) Facilities.

The conveyor system utilized a complement of four sodium iodide radiation detectors mounted in an enclosure that was placed above a section of the conveyor. The detectors were operated as energy spectrometers. The system measured the concentration of cesium (Cs-137) as well as natural potassium (K-40), uranium (via Bi-214), and thorium (via Tl-208).

The GPU survey request number 55 (SR-55) comprised 38 batches that included over 11,200 tons of building debris. Based on the data recorded the system operated with a minimum detectable contamination (MDC) of 0.36 pCi/g Cs-137 on a batch basis assuming a uniformly distributed contamination. The system operated with an alarm setpoint of 2.91 pCi/g Cs-137 on a 5-acquisition (25-second) basis assuming a uniformly distributed contamination within 7.3 cubic feet of material. No alarms occurred during the survey. The SMCM net potassium, uranium, and thorium showed good agreement with the soil samples, which were collected and counted independently by GPU. Thirty-one ten-hour days were required to survey the 38 each SR-55 batches.

The GPU SR-62 survey comprised 18 batches that included over 5,000 tons of soil. Twenty-eight alarms occurred during the survey. The system operated with an alarm setpoint of 2.91 pCi/g Cs-137 on a 5-acquisition (25-second) basis assuming a uniformly distributed contamination. The SMCM net potassium, uranium, and thorium showed good agreement with the soil samples, which were collected and counted independently by GPU. Twenty-six 10-hour days were required to survey the 18 SR-62 batches.

2. METHODOLOGY

2.1 The Conveyor Mounted SMCM

The radiation detection system is a conveyor version of the SMCM that utilizes four-each, 5-inch (12.7 cm) diameter by 2-inch (5.1 cm) thick thallium-doped sodium iodide (NaI (Tl)) detectors. The detectors are arranged in a line along the path of the conveyor, and are located one-half meter apart. Spectra in the energy range from 0.1 to 3 MeV are collected every five seconds via Ortec µAce Multi-Channel Analyzers (MCAs). The nominal conveyor speed was established at 4 inches per second (0.1 meters per second), with spectra collected every 19.7 inches (0.5 meters) of conveyor travel. The conveyor had material limited to 32 inches (0.8 m) wide and 4 inches (0.1 m) deep, with the face of the detectors located 13 inches (0.3 m) from the surface of the conveyed material. This height was chosen to provide a reasonable compromise between uniformity of response and sensitivity to localized sources.

The detectors were centered in 19.7 inch (0.5 meter) diameter barrels (see Figure 2-1 and Figure 2-2). The detectors have thermal shielding, heaters, thermocouples and controls for temperature stabilization, and are shielded with approximately 4 inches (10.2 cm) of sand to reduce the radiation background as well as reducing any variability from changes in background (due to radon in air, moving vehicles, or changes in nearby soil and building debris piles). The detector array is located in an enclosure above the conveyor that is also heated to provide a uniform thermal environment without diurnal variation. The sand shielding restricts the field of view of the detectors to a downward looking, nominal 90 degree angle cone (see Figure 2-3). A 12-foot (3.6 m) by 5-foot (1.5 m) trailer served as a mobile command center (MCC). The SMCM process computer and post-processing computer were operated from within the MCC (See Figure 2-4).

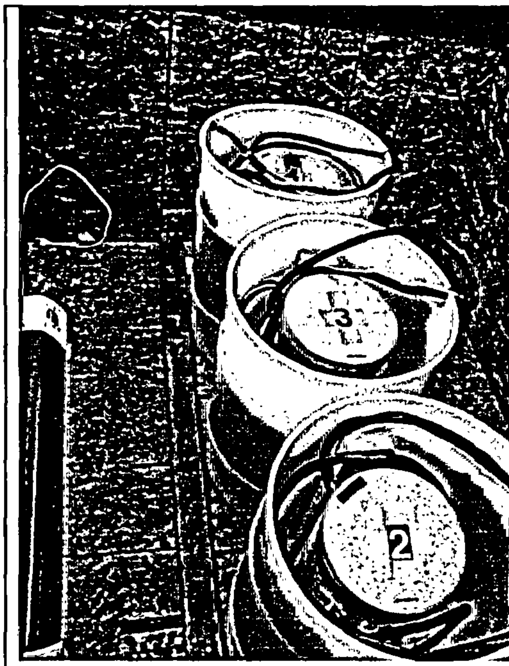

Figure 2-1. Detector assemblies inside barrels. Three of four barrels are shown in the monitoring enclosure.

Figure 2-2. Monitoring enclosure partially built. The detector barrels are centered on top of the four holes shown.

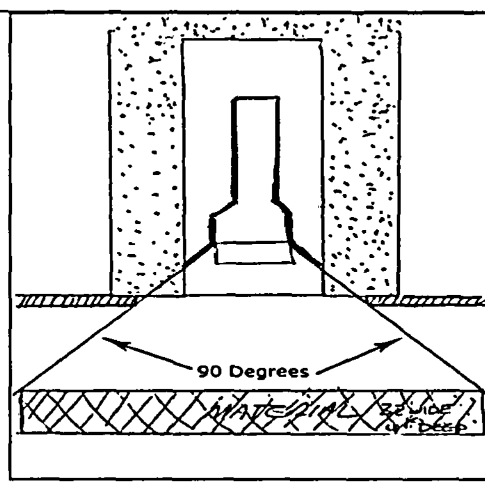

Figure 2-3. Cross-section view of detector and conveyor.

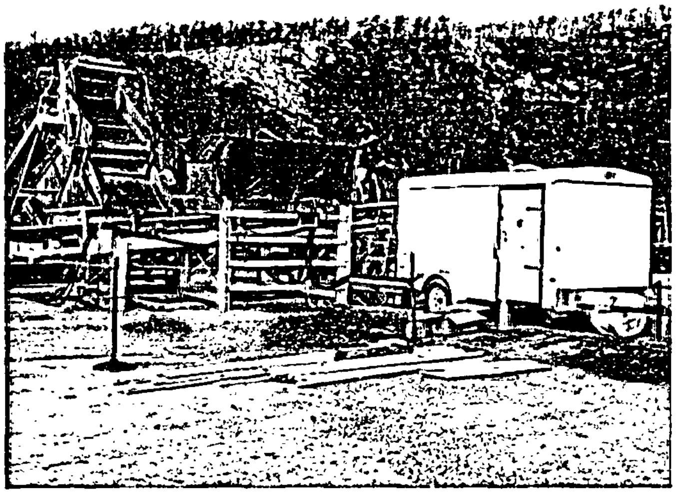

Figure 2-4. Completed monitoring enclosure and mobile command center (MCC).

Prior to deployment, each MCA low level discriminator (LLD) and zero-offset were calibrated. During SR-55 batch 25, two of the four detectors experienced a shift in their zero-offsets of approximately -50 keV. The shift was studied and did not seriously impact the system's real-time detection abilities. The problem is described in Appendix G: Shift in Zero Offset. After the conveyor was relocated to process the soil piles, the MCA calibration was repeated which restored the zero offset to zero.

Appropriate shielding calculations were performed to establish a calibration in an equivalent manner to the method of Helfer and Miller: "Calibration factors for Ge Detectors used for Field Spectrometry (*Health Physics* Vol. 55 No.1 (July), pp 15-29 1988). A full description of the calibration process is included in Appendix B: NaI Detector Calibration Factors.

In addition to the NaI spectrometers, the conveyor mounted SMCM carried a continuous air monitor (CAM) that monitored the levels of radon daughter products in air via a pancake Geiger-Muller (GM) detector. The counts from the CAM were recorded during every acquisition. Analysis of the data from the CAM confirmed that the sand shielded detectors had no inherent response to radon. The CAM detector and data is summarized in Appendix E: Radon Detector.

The monitoring system also included an encoder and wheel, attached to the end of a swing arm that rolled on top of the soil. The encoder was coupled to the wheel via a flexible drive shaft (see Figure 2-5). The encoder generates 2048 pulses per rotation. The pulses were monitored (and the conveyor speed was calculated) every 0.5 seconds. Average conveyor speed was recorded for every 5-second acquisition. The encoder confirmed that the conveyor belt was traveling at 4 inches per second (0.1 meters per second).

The swing arm was also equipped with a level switch. The design of the switch closed a circuit if the swing arm was riding on less than 2 inches of soil (the detector / source model assumed a 4 inch (0.1 m) thick volume of debris). The circuit was monitored every 0.5 seconds and the average position was recorded for every 5-second acquisition. When the feed hopper emptied, the conveyor rapidly emptied in less than the 5-second interval or 19.7 inches (0.5 meters) of travel due to the material level limiter. The material level limiter kept the material at a uniform height of 4 inches (0.1 m) on the survey conveyor as long as the survey belt feed hopper was kept full.

All measurements were recorded to the process computer's hard drive. The survey operator controlled the starting and stopping of the recorded data. All the recorded data between the start and stop is called a "survey strip." Collectively, the encoder, level switch, and computer monitoring were an extremely convenient feature of the conveyor monitoring system. They allowed the system to be run independently of the conveyor. Data collected when the belt was stationary or no debris present was removed. Figure 2-5 is a photo showing the swing arm and wheel encoder.

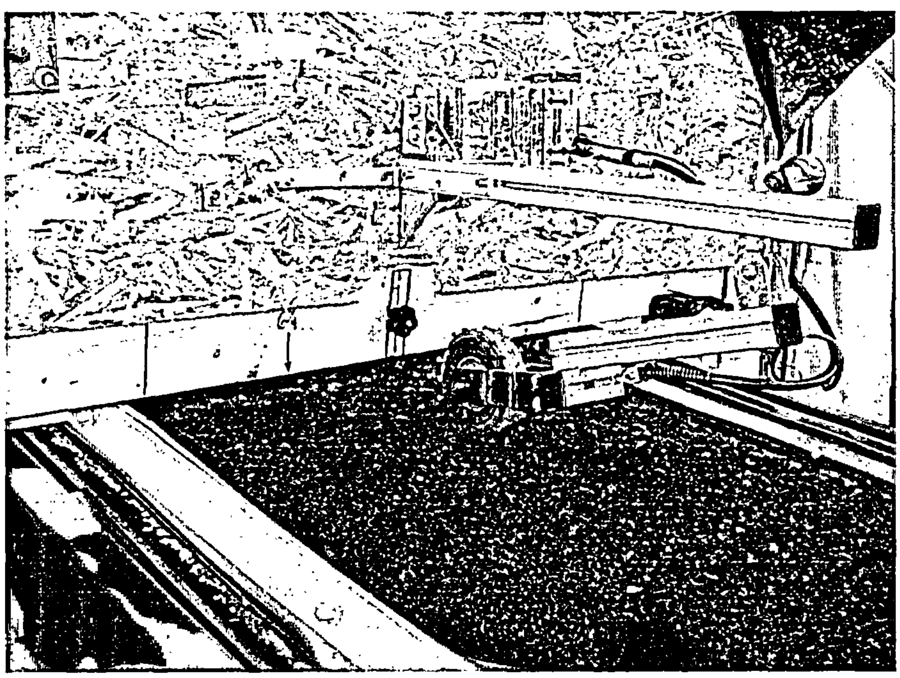

Figure 2-5. Swing arm with level switch and encoder idler wheel. The encoder located inside the enclosure is coupled to the wheel via flexible shaft.

The SMCM was equipped with a number of alarm enunciators. When a source was detected, the operation screen would change color. A remote day light readable monitor was provided for the conveyor operator. The SMCM computer would also activate a radiation alarm light with audio that was mounted at the controls of the conveyor. A wireless network and pocket PC were also utilized to convey alarms and other critical system information when the operator was away from the monitoring station.

The conveyor system consisted of three major sections, each of which is hydraulically powered. A feed conveyor was used to break up any large accumulations and to screen out large rocks. It fed a monitoring conveyor that provided a uniform material 32 inches (0.8 m) wide and 4 inches (0.1 m) deep that traveled at a constant speed of four inches per second (0.1 meters per second) under the radiation detectors. The monitoring conveyor fed a third conveyor, which was a stacker loader. The stacker loader deposited material into dump trucks. Figure 2-6 shows the layout of the conveyor system in use.

Figure 2-6. Layout of conveyor system.

2.2 Establishment of Survey Areas

The debris and soil were separated into approximately 250-ton piles called batches. Although there were a number of different types of materials present among the piles, each individual pile appeared to be a homogeneous mixture of the same type of material.

C05

Each pile was treated as a separate survey area or batch. Each survey area was summarized in a Survey Release Record (SRR) report.

SR-55 batches 1 to 38 consisted of building debris from demolished structures at the Saxton Steam Generating Station (SSGS). The building debris had been crushed to a size of no greater than 4 inches earlier in the year. SR-55 batches 1- 2 consisted of the demolished SSGS garage and warehouse. This debris consisted mostly of brick and mortar. SR-55 batches 3 - 38 were the debris from the SSGS footprint which was excavated to allow survey of the below grade structure. This debris consisted mostly of brick and concrete with minor amounts of tile and grout.

SR-62 batches 1 to 18 (except batch 3) consisted of Multi-Agency Radiation and Site Survey Investigation Manual (MARSSIM) "Impacted Class 1" soil excavated from areas around the Containment Vessel and other impacted surface soils from the site. In SR-62 batch 3, the soil consisted of sediment pumped from the SSGS intake and discharge tunnels. These tunnels were desilted to permit survey under the FSS program. The silt was decanted in a settling basin. The material types and the batches in which they were present are provided in Table 2-1 below. The average lab density and moisture content values were provided by GPU.

Table 2-1. Material types for the various batches.

SR	Batch	Material Type	Average Lab Density (g/cc)	Average Moisture Content (weight %)
55	1-2	Crushed Brick and Mortar	1.42	12.5
55	3-38	Crushed Brick, Concrete, Tile and Grout	1.33	13.1
62	1-2	Red Clay and Soil	1.17	13.9
62	3	Sediment Pumped from the SSGS Tunnels	1.05	39.4
62	4-18	Red Clay and Soil	1.40	12.4

2.3 Survey Methods

The conveyor mounted SMCM collected acquisitions every five seconds as the soil and debris was moved at 4 inches (10 centimeters) per second. During each acquisition, an industrial computer recorded the following: a spectra and live time from each of the four MCAs, the distance traveled by the incremental encoder, the average position of the swing arm, and the count rate from the CAM. Periodically during the operation, the operator recorded temperatures and other system status information. Although all of these signals were collected and monitored during operations, the system's most important function was the real time low-level radiation alarms based on the data analysis. A brief description of the real time data analysis, alarms, and investigative measures are described below.

The spectra were converted from units of counts to count per second (cps) by dividing by the live time. The net values in each region of interest (ROI) were determined for cesium (Cs-137 @ 662 keV), potassium (K-40 @ 1461 keV), uranium (U-238 using Bi-214 @ 1764 keV), and thorium (Th-232 using Tl-208 @ 2614 keV). Calculation of net K-40, U-238, and Th-232 are described in Appendix D: Determination of Cs, K, U, and T Stripping Coefficients. The net Cs-137 was calculated by removing the contribution to the Cs-137 ROI from each of the primordials: K-40, U-238, and Th-232. Calculation of net Cs-137 is also described in Appendix D: Determination of Cs, K, U, and T Stripping Coefficients. To strip a spectrum (window) means to remove the contributions to an energy window from radionuclides emitting gammas of higher energies. Only a fraction of the emitted gamma photons are registered as full energy photons. Scattered photons originating from higher energy photons will be measured in lower energy windows. The contribution from those scattered photons is removed when stripping the spectra.

The diagonal mean is the mean of the 4 detectors for a given sample of material on the moving conveyor. If a source were present in the soil, it would reach detector 1 during acquisition *t*, detector 2 during acquisition *t +1*, and so on. A delayed average or diagonal mean of the net Cs values was calculated to improve the systems detection ability. Monitoring a system with four recounts of the same material doubled the signal to noise ratio. This data was then processed with two types of filters, a point source filter, and a moving average filter. The output of each filter, as well as the summed pCi/g for the current batch, was tested with alarm logic. Different alarm points were utilized for the point source filter, moving average filter, and summed activity. The most conservative alarm limit was applied to the moving average filtered data (uniform moving average filter with a width of 5 acquisitions).

The regulatory limit was 6.6 pCi/g for the 11,200-ton pile for SR-55. Due to the isotopic mix, GPU lowered the limit to 5.6 pCi/g. An administrative conservatism was declared that lowered the limit to 75% or 4.2 pCi/g. To assure the pile would not exceed the 4.2 pCi/g limits, the real-time alarm setpoint was set to a much smaller volume than the pile. The alarm setpoint was set to 2.91 pCi/g Cs-137 assuming a uniformly distributed contamination of 773 pounds (350 kgs) in a volume of 4 inches (0.1 m) by 32 inches (0.8 m) by 8.2 feet (2.5 m). The detection limit is substantially lower for a truckload or entire batch. An example operator screen included a strip chart of the data is shown in Figure 2-7.

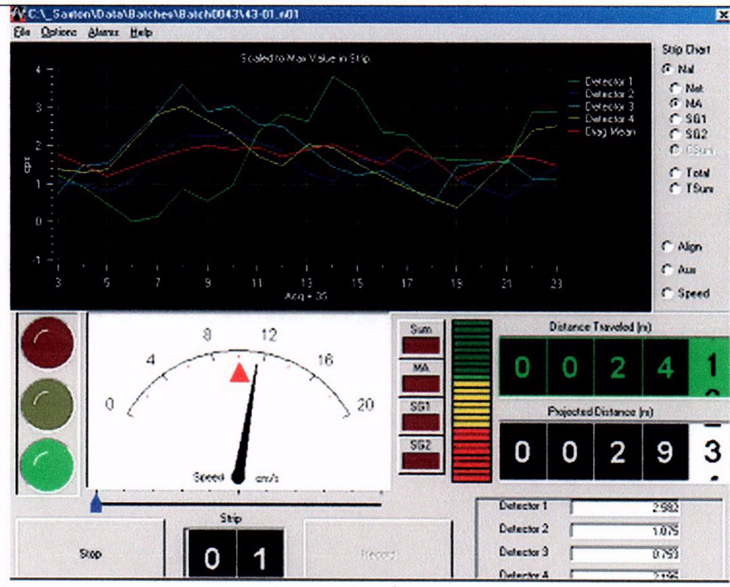

Figure 2-7. SMCM Operation Software.

If an alarm occurred, the conveyor was stopped and the data was investigated. The SMCM operator would review the strip chart on the SMCM process software screen. The strip chart shows the four detectors and the diagonal mean of the 4 detectors. From the strip chart, the operator is able to determine if the alarm is a point source or a distributed source and where along the belt the suspect material is located. The best estimate of the source distribution was then described to GPU for investigation.

GPU utilized 2-inch x 2-inch (5-cm x 5-cm) portable NaI detectors attached to rate meters to investigate alarms. Generally, large source distributions would motivate removing dirt from the entire survey conveyor. If the source were localized to a single acquisition, the affected acquisition and at a minimum the two adjoining acquisitions were removed. Response to alarms and investigations is further outlined in GPU's SR-55 and SR-62 survey documents.

2.4 Quality Control

Quality control (QC) and quality assurance (QA) for the laboratory environment has been studied for some time and is well established in the nuclear industry for radiation detection equipment. However, QC associated with the operation of radiation detectors in the field is not generally established with the same degree of rigor. To attain lab-like stability in the field, rigorous QC and QA measures are required that go beyond common practice. The following text outlines the traditional QC measures for gamma spectrometers when operated in a laboratory environment. The remaining controls that are imperative to proper field operation have been integrated into section 2.5 Data Analysis.

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Prior to deploying for Saxton, the four NaI detectors were calibrated at SRA's laboratory in Marietta, Georgia. The four MCAs were aligned to ensure a linear relationship, with a zero offset, between channels and energy. The internal computer-controlled digital gain in all four MCAs were adjusted to align 1461 keV (K-40 photo peak) into channel 250. This calibration (5.844 keV per channel with 512 channels, or 0 to 3 MeV) was used in order to resolve the 2.614 keV photon from the Tl-208 daughter product in the Th-232 decay chain. Similar calibrations are used in aerial surveys. The detectors were calibrated to determine their intrinsic efficiency. Two National Institute for Standards and Technology (NIST) traceable button sources, Co-60 (nominal 0.5 μCi) and Cs-137 (nominal 9.0 μCi), were placed one meter below the front face of the detector. The NIST traceable source certificates are provided in Appendix F: Source Calibration Certificates. A technical description of the calibration factors is provided in Appendix B: NaI Detector Calibration Factors.

During operation, source response checks (SRCs) were performed at the beginning and end of each day and at least every five hours throughout the day. The SRCs were performed by recording twenty, 5-second SMCM acquisitions while four Cs-137 (~5 μCi) button sources were present. The four sources were mounted to a removable SRCs fixture, which was mounted to the detector enclosure. The Cs-137 sources used for the SRCs were not NIST traceable. The sources were only intended to act as a stable artifact and not a means of calibration. The SRCs are the same checks as are done traditionally with hand-held survey instruments. In the case of the SMCM, the SRCs serve as a measure of the condition of the detectors, preamps, and MCAs. QC charts for the SRCs are provided for each detector in Appendix C: NaI Detector Quality Control.

In addition to the SRCs, performance based checks (PBCs) were performed at the beginning and end of each day and at least every five hours throughout the day. The PBCs consisted of placing a Cs-137 (~9 μCi) button source on the moving conveyor as the SMCM software recorded several acquisitions. The source was placed on the conveyor three times per PBC. The software was operated in a manner identical to real data collection. Although, the source was NIST traceable, the PBCs were not intended to serve as a measure of calibration. The point source (randomly placed on the conveyor) was different from the source geometry that was modeled to establish the detector response. The PBCs were intended to measure the condition and operation of both the conveyor system and detector system, including the process computer and software. The PBCs also are a means to evaluate the conveyor speed and detector height. The SRCs were intended to evaluate the detection system alone. QC charts for the PBCs are provided for each detector in Appendix C: NaI Detector Quality Control. Comparing SRCs and PBCs show that significant added variability occurs when a source is randomly placed on a moving conveyor, as opposed to measurements taken with a source in a source jig.

2.5 Data Analysis

Implementation of laboratory radiation detectors in the field requires that added QC / QA measures be taken. Some of these added measures, as the standard measures described above in section 2.4, can be taken and evaluated *a priori*. However, the source of information for the majority of these measures comes from the survey data itself. The measures can only be evaluated *a posteriori*. The system description and real time data processing are described above in sections 2.1 and 2.3, respectively. The post survey QC measures and data processing are described below; collectively, the two are commonly referred to as post processing.

2.5.1 Recorded Data

In order to achieve the needed detection limit and throughput, a large number of parameters are recorded and analyzed by the SMCM system. For each acquisition, the live time and raw spectra is recorded for each detector. During operation, a summary file is also generated which records virtually every parameter that was collected or calculated for each acquisition. The summary file is summarized Table 2-2.

Table 2-2. Summary file content.

Parameter	Type
Belt Speed	Floating
Live time (each detector)	Floating
CAM count rate	Floating
Material sense	Integer
Condition of all Alarms	Boolean
Operator Response to Alarms	Boolean
Gross ROI (standard IAEA windows)	Floating
Net Cs	Floating
Net Cs Filter outputs	Floating
Diagonal Mean values for each Filter	Floating

The noise-adjusted singular value decomposition NASVD algorithms are performed during the post processing. NASVD is a spectral component analysis procedure for the removal of noise from gamma-ray spectra. The procedure transforms observed spectra into orthogonal spectral components. The lower-order components represent the signal in the original observed spectra, and the higher-order components represent uncorrelated noise. Noise is removed from the observed spectra by rejecting noise components and reconstructing the spectra from lower-order components. The raw spectra files are loaded for a particular survey and the NASVD software determines the principal components. Identification of point sources is one of the tasks for which NASVD is very efficient.

The components are visually inspected for specific shapes. Components with no photo-peak like structure, that is, components that are generated by noise, are discarded and the spectra are re-assembled. Figure 2-8 and Figure 2-9 are examples of components with and without Cs-137 photo-peak structure. The Cs-137 component data was collected by recording a strip of data as the conveyor moved a 110 lb (50 kg) bag of 6.7 pCi/g soil past the detectors. Next, ROIs are calculated and net K-40, U-238, Th-232, and Cs-137 are calculated from the NASVD process data in a manner identical to the real time process. The net Cs-137 is also filtered and the diagonal mean is calculated. Alarm logic is performed and summarized.

The multi-channel analyzer sorts the measured gamma energies in energy intervals (like a histogram) and the distribution of photons of different energies is seen as a spectrum. Figure 2-8 and Figure 2-9 show the first four components. The first component (top graph in Figure 2-8 and Figure 2-9) is the average spectral shape for all logged spectra. The first component if inverted with an expanded scale, represents the average spectra seen in all acquisitions. The second component explains the most dominant spectral change between logged spectra. Each ROI is identified as "Cs", "K, "U" and "T" with the label on the lower channel of the ROI. Comparing the second component in Figure 2-8 and Figure 2-9 show no peak in the Cs-137 window (Figure 2-8) and a relatively large peak in Figure 2-9.

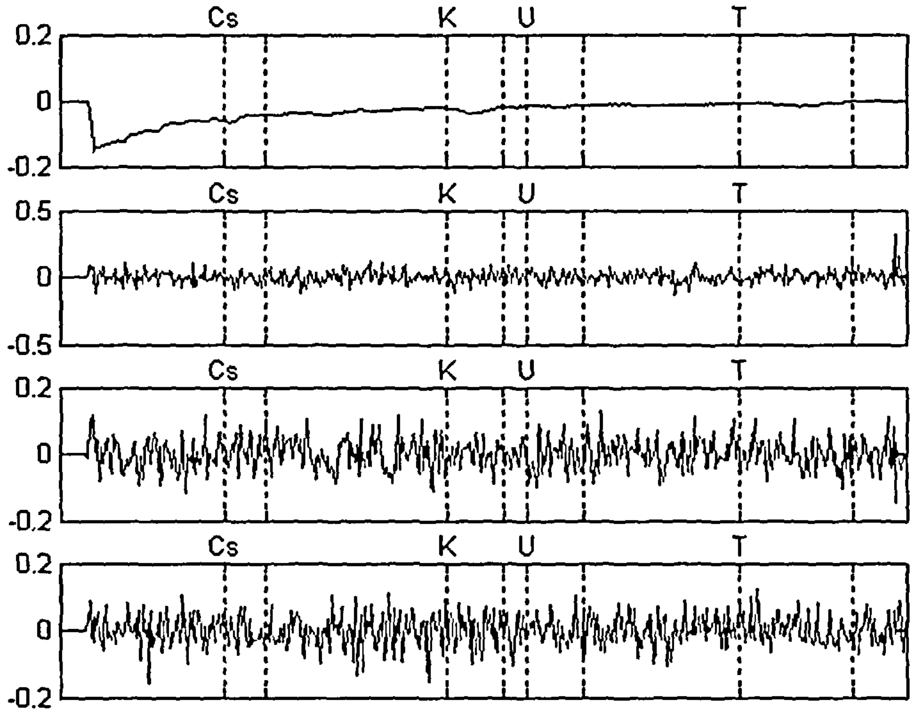

Figure 2-8. Principal components from background data set.

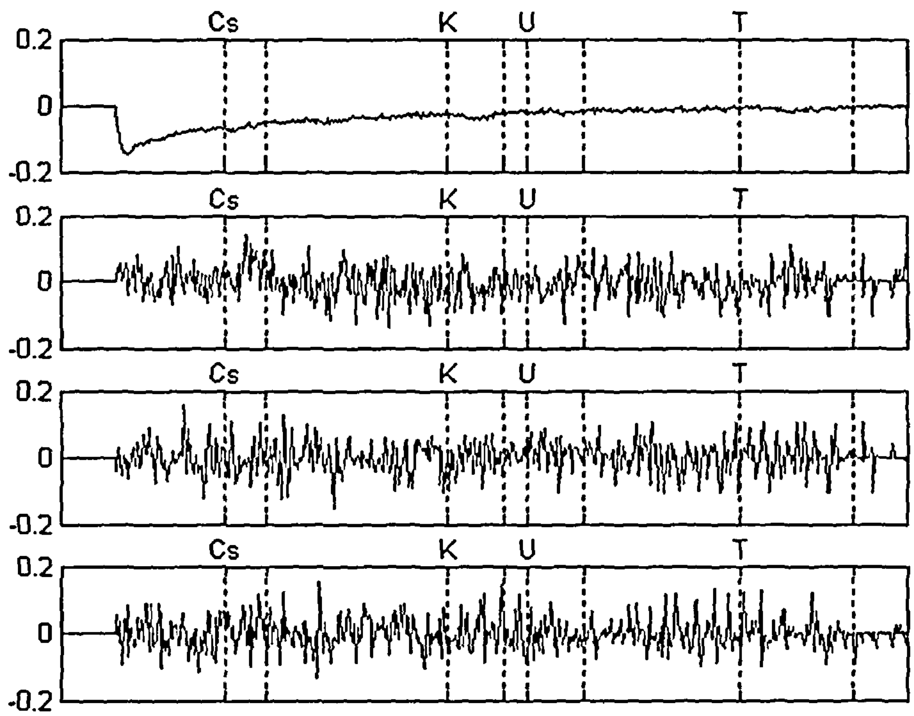

Figure 2-9. Principal components from data set with Cs-137 contaminated soil.

2.5.2 Exploratory Data Analysis

The net Cs-137 data was then assessed using the four-plot methods from exploratory data analysis (EDA) recommended by the NIST in the Engineering Statistics Handbook (*NIST/SEMATECH e-Handbook of Statistical Methods*, http://www.itl.nist.gov/div898/handbook/, 2003.).

The cps in each of the ROIs was plotted using four different plots: 1) a time history plot (strip chart) of the ROI given as cps vs. acquisition number, 2) a cumulative frequency distribution (cfd) of the ROI given as cps vs. standard deviation, 3) a histogram probability density function (PDF) of the ROI, and 4) a lag plot of the ROI. The four-plot method was also used to analyze the conveyor speed and detector acquisition live time for each SAB as well as the data collected from the CAM.

The four-plot method is illustrated in Figure 2-10 and Figure 2-11. Figure 2-10 is an example of four-plot method for data showing a single distribution for the net uranium from SR-55 batch 20 showing in the top-left and moving clockwise: 1) cps vs. acquisition (a time history of a survey area), 2) cfd of the same survey data, 3) histogram of the same data, and 4) lag plot of the same data.

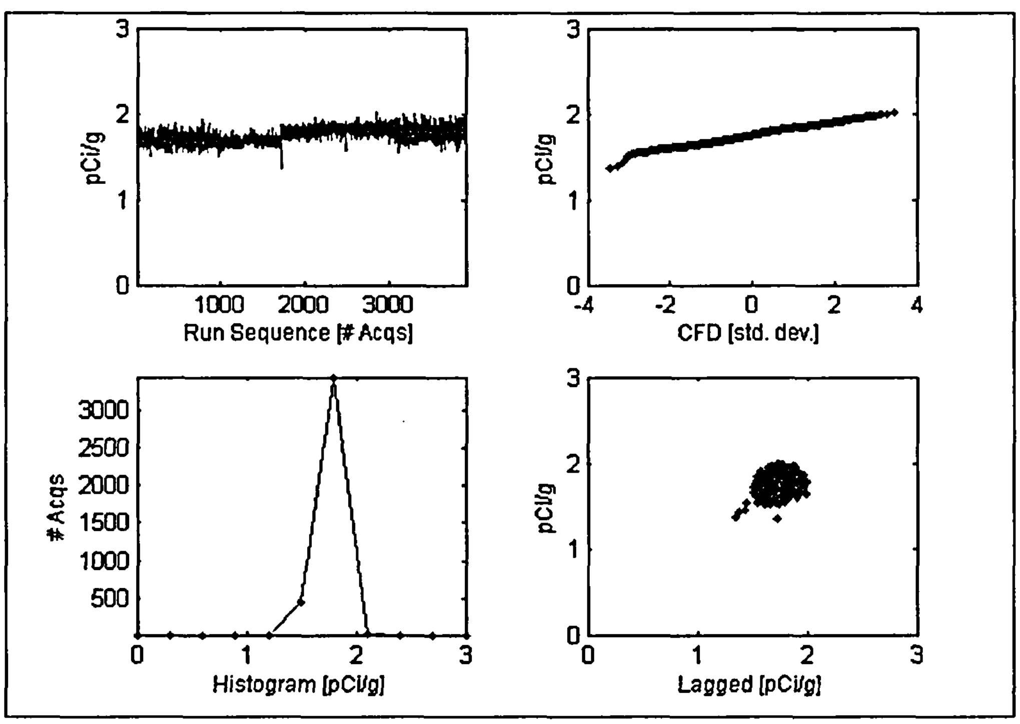

Figure 2-10. Four-plot of uranium for SR-55 Batch 0020.

The interpretation of a four-plot proceeded as follows. In Figure 2-10, the time history showed a slight increase of cps as the survey proceeded. The cfd was well approximated by a straight-line, indicating normal behavior. The histogram resembled a normal distribution and looked symetric, and finally, the lag plot showed a mostly uniform spread of values inside the rectangle defined by the minimum and maximum values of the data on both axes. These behaviors lead to the conclusion that there was no evidence of change in this data, and that this data represents consistent background indicative of one distribution.

In Figure 2-11 data is presented for SR-62 batch 1 truckload 10. This data from batch 1 truckload 10 shows the presence of added and non-uniform uranium in soil. The time history plot revealed a non-uniform history. The cfd was not linear. The histogram was asymmetric. The lag plot showed a non-uniform spread as well as strong clustering of the data. When such behavior was observed, the data were subjected to additional analyses in order to determine the cause of the lack of normality.

In Figure 2-11, the primordial uranium in the debris changed, presumably from a change in the matrix being counted. If this were the Cs-137, the change could be due to added contamination.

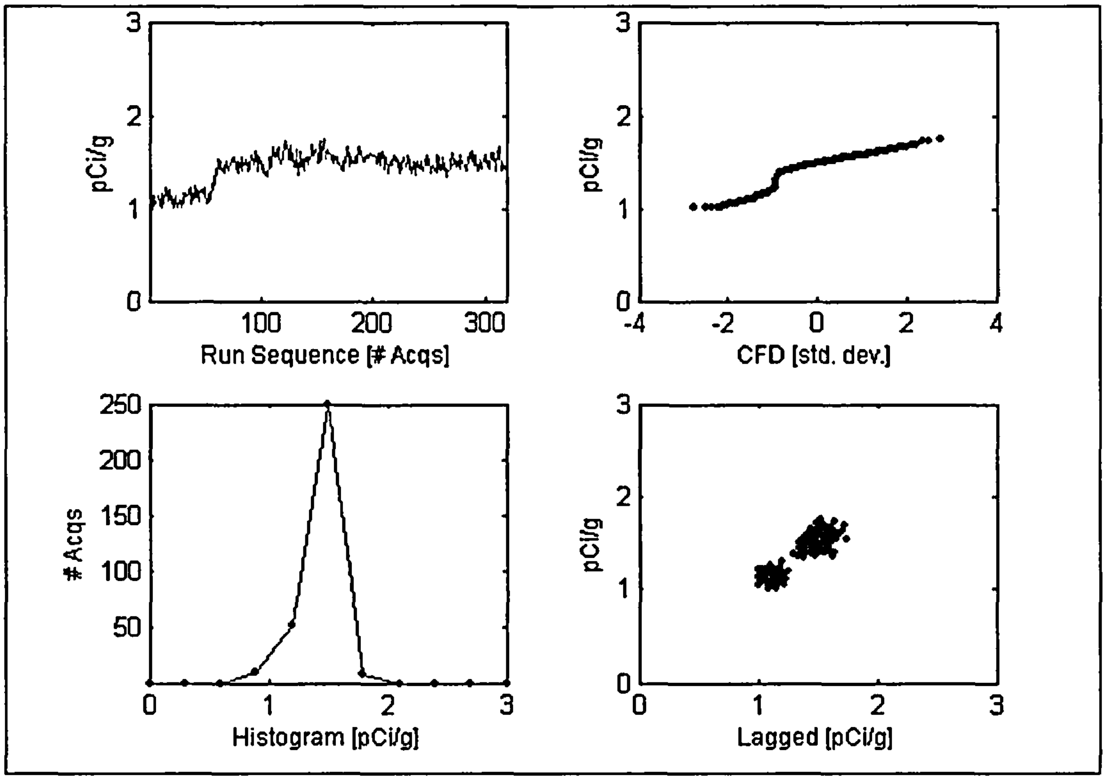

Figure 2-11. Four-plot of uranium for SR-62 Batch 1 Truckload 10.

2.5.3 Waterfall Plots

In addition to the four-plot method, utilization of the waterfall plots of the spectral data gives a more general investigation of all the raw data collected. Waterfall plots are useful because they can illustrate all of the survey data at once. Quantitative conclusions are difficult to draw from a waterfall plot. However, the plots quickly give the user a qualitative understanding of the survey data. Figure 2-12 shows a waterfall plot of a short strip. Figure 2-12 shows the results of running a 110 lb (50 kg) soil sample of approximate size 30 inches x 19 inches (0.75 m x 0.5 m) with 6.7 pCi/g of Cs-137 down the survey conveyor. The waterfall plot shows a Cs-137 signature during acquisitions 4, 5, 6, and 7.

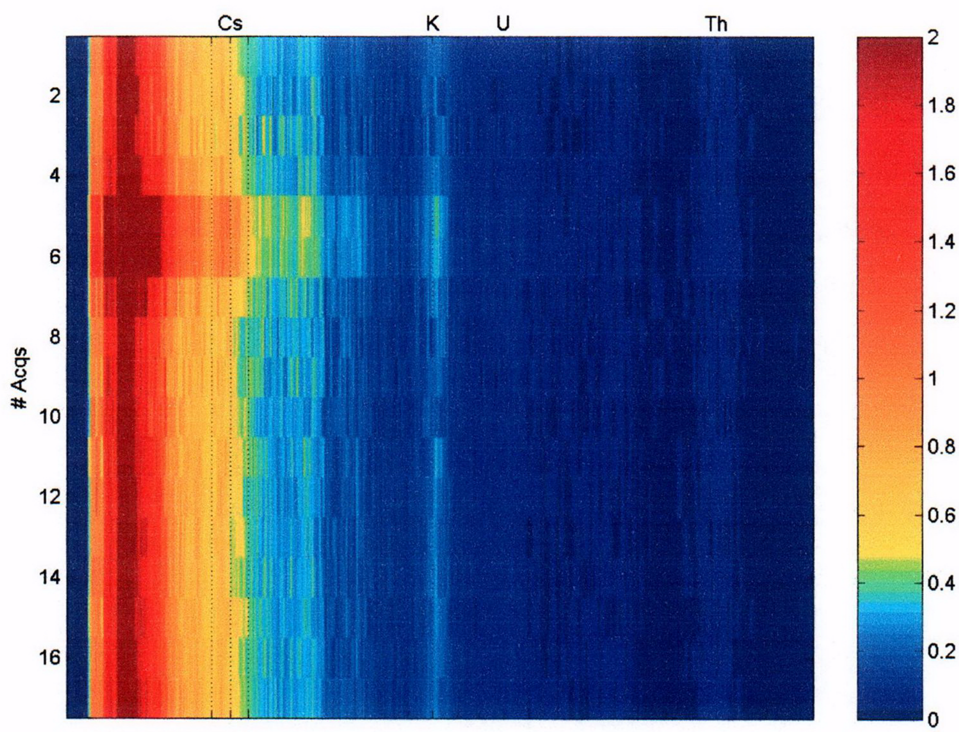

Figure 2-12. Waterfall plot of a short strip with Cs-137. The scale is shown to the right of the waterfall plot and is in units of gross cps.

2.5.4 Correlation Plots

Correlation plots are yet another tool needed in analyzing SMCM data. Correlation plots easily illustrate the presence or absence of covariance between two variables. If an unexpected trend is found in a data set, correlation plots are generally the next step in the data analysis. A correlation plot of Cs-137 vs. KUT and K vs. U from SR-55 batch 20 is provided in Figure 2-13. This type of correlation plot confirms that KUT subtraction method has the correct stripping coefficients and the underlying spectra has not shifted with respect to the ROIs of interest.

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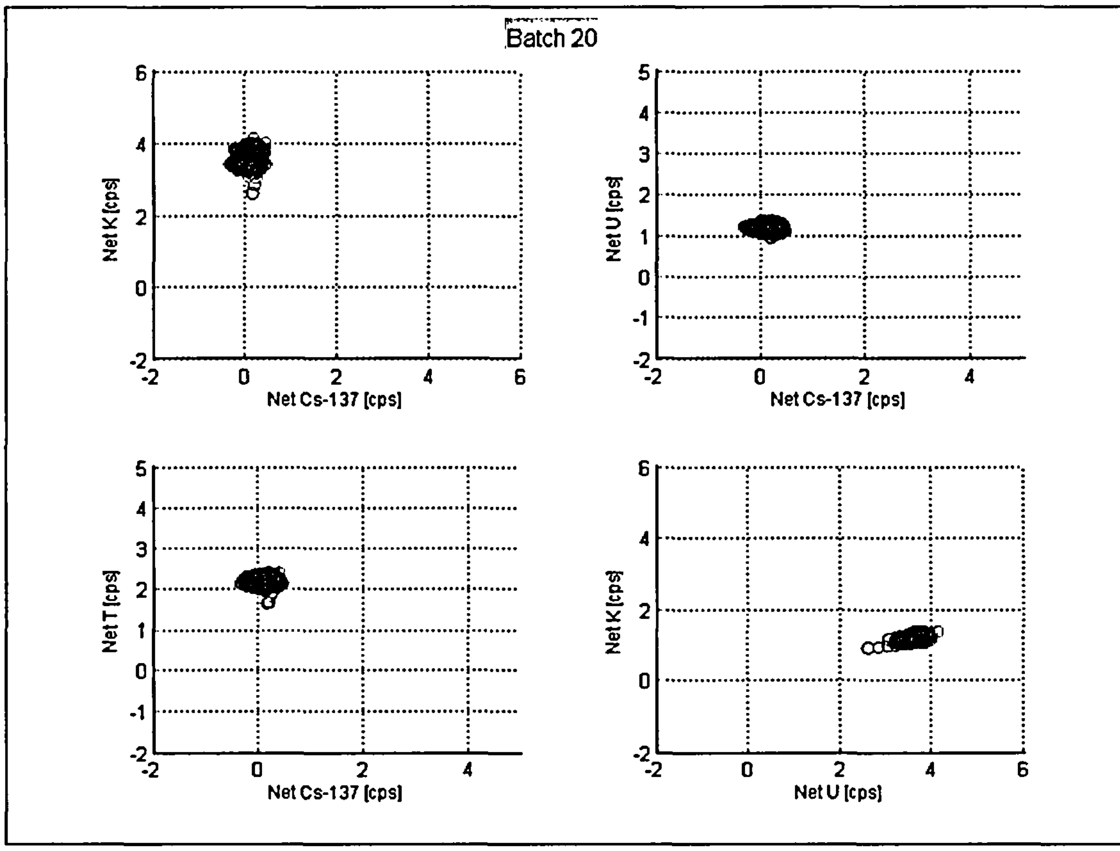

Figure 2-13. Correlation plot of Cs-137 vs. KUT and K vs. U from SR-55 Batch 20.

2.5.5 Post Processing Data Files

As the post processing algorithms processed the data, a number of files were generated. See Table 2-3 for list of data files available. Many of the files were used later in the data analysis. See Table 2-4 for types of data analysis available.

Table 2-3. Data files available for further analysis.

• Filenames and acquisitions
• Net K, U, Th, and Cs-137 summary stats of mean, median, minimum, maximum, and standard deviation.
• Net Cs-137 cps for each acquisition for each detector.
• Net Cs-137 diagonal mean for each acquisition:
o Moving average
o Savitsgy-Golay
o Mean
• Noise adjusted mean spectra for each acquisition.
• Noise adjusted mean for each acquisition for Net K, Net U, Net Th, Gross spectra, Gross Cs-134, Gross Cs-137, and Gross Co-60.
• Noise adjusted mean for each acquisition broken down into 1000 acquisition lots for Net K, Net U, Net Th, Gross spectra, Gross Cs-134, Gross Cs-137, and Gross Co-60.
• Radon versus Net Cs-137 for each acquisition.
• Background count rate data for each acquisition. This is the sum of the K, U, and Th windows with each multiplied by their respective Cs-137 stripping ratio.
• Noise adjusted mean for each acquisition for Net K, Net U, and Net Th.
• Cs-137 factors generated on each of the 1000 acquisition lots.
• Noise adjusted mean broken down into 1000 acquisition lots for Net K, Net U, Net Th, Gross spectra, Gross Cs-134, Gross Cs-137, and Gross Co-60.
• AVI file of all spectra collected.

2.5.6 Review and Analysis Process

Table 2-4. Data Analysis.

Description	Data	Analysis
Review four-plot for the following windows for each detector.	Net K, U, Th. Gross spectra, Gross Cs-134, Gross Cs-137 Gross Co-60.	Look for trends in the run sequence, look for non-normal distributions, look for correlated data.
Review four-plot for the diagonal mean.	Net K, U, Th, and Cs-137	Look for trends in the run sequence, look for non-normal distributions, look for correlated data.
Review run sequence of the diagonal mean for K, U, and Th in a side-by-side graph.	Net K, U, Th	Look for correlation trends between the 3 isotopes.
Review 1st four spectral components for each detector.	All spectra	Review 1st component shape to see it looks normal with no unknown peaks. Look for excursions in the 2nd, 3rd, and 4th components.
Review waterfall plot of gross spectra for each detector.	All spectra	Look for spectral shifting and no unknown peaks exists and all ROIs have uniform count rate data.
Review radon versus net Cs-137.	Net Cs-137 CAM count rate	Look for correlation between radon and Net Cs-137. Review radon gross counts to see if they are in range.
Review four-plot for the background count rate.		Look for trends in the run sequence, look for non-normal distributions, look for correlated data. Is the mean count rate as expected?
Review four-plot of live time for each detector.		Look for trends in the run sequence, look for non-normal distributions, look for correlated data.
Review four-plot of acquisition time.		Look for trends in the run sequence, look for non-normal distributions, look for correlated data.
Review four-plot of material sense.		Look for trends in the run sequence; the CFD should be

Description	**Data**	**Analysis**
		close to a flat straight line.
Review four-plot of belt speed.		Look for trends in the run sequence, look for non-normal distributions, look for correlated data.
Review filename, number of acquisitions in each filename, and total number of acquisitions.		Review filenames for syntax and date/time stamps. Total acquisitions should be about 4000. Individual trucks should be about 240 acquisitions.

3. SURVEY RESULTS

Summary reports for each batch are provided in Appendix A: Survey Release Records reports. The system operated with an alarm setpoint of 2.91 pCi/g Cs-137 on a 5-acquisition (25-second) basis assuming a uniformly distributed contamination.

No alarms occurred during the survey of SR-55 that included 11,717 (includes 5% re-surveyed) tons of debris. Table 3-1 below summarizes the radiological information collected for each batch in SR-55. The data shown in Table 3-1 for SR-55 is simply showing the background and variability of the system. Table 3-2 presents the laboratory radiological information collected by GPU for each batch in SR-55.

Table 3-3 below summarizes the radiological information collected for each batch in SR-62. The data shown in Table 3-3 is actual Cs-137 well above background. Twenty-eight alarms occurred during the survey that included 5,258 (includes 5% re-surveyed) tons of debris. Table 3-4 presents the laboratory radiological information collected by GPU for each batch in SR-62.

Table 3-1. Summary of SMCM radiological information collected for each batch surveyed under GPU SR-55. (The 38 batches comprise 11,183 tons of material.)

	Cs-137 [pCi/g]			
Batch	Mean	Max	StDev	# of Alarms
1	-0.04	0.18	0.10	0
2	0.13	0.52	0.17	0
3	-0.02	0.66	0.09	0
4	0.01	0.19	0.07	0
5	-0.07	0.17	0.06	0
6	-0.06	0.11	0.05	0
7	0.00	0.21	0.08	0
8	0.10	0.31	0.08	0
9	0.02	0.22	0.06	0
10	0.02	0.21	0.06	0
11	0.01	0.20	0.05	0
12	0.05	0.43	0.11	0
13	-0.01	0.24	0.13	0
14	0.04	0.22	0.07	0
15	0.11	0.40	0.07	0
16	0.13	0.41	0.14	0
17	-0.11	0.10	0.07	0

Batch	Cs-137 [pCi/g]			
	Mean	Max	StDev	# of Alarms
18	0.08	0.35	0.06	0
19	0.00	0.29	0.08	0
20	0.07	0.24	0.06	0
21	0.08	0.28	0.08	0
22	0.12	0.35	0.06	0
23	0.11	0.27	0.08	0
24	0.19	0.53	0.08	0
25	0.10	0.52	0.15	0
26	-0.14	0.26	0.08	0
27	-0.12	0.25	0.10	0
28	-0.16	0.07	0.09	0
29	-0.10	0.20	0.07	0
30	-0.02	0.31	0.10	0
31	-0.11	0.19	0.06	0
32	-0.09	0.25	0.08	0
33	-0.17	0.13	0.10	0
34	-0.07	0.19	0.08	0
35	-0.09	0.14	0.07	0
36	-0.08	0.11	0.07	0
37	-0.13	0.16	0.07	0
38	-0.17	0.10	0.11	0

Table 3-2. Summary of laboratory radiological information collected for each batch surveyed under GPU SR-55. (The 38 batches comprise 11,183 tons of material.)

Lab [pCi/g]				
Batch	Value	2 Sigma	Detect	Sample Log Number
1	0.067	0.063	No	513271
2	0.021	0.026	Yes	513274
3	0.090	0.028	Yes	113280
4	0.052	0.026	Yes	513283
5	0.061	0.027	Yes	513285
6	0.047	0.025	Yes	113289
7	0.030	0.033	Yes	113293
8	0.081	0.030	Yes	113296
9	0.062	0.029	Yes	113300
10	0.081	0.031	Yes	113308
11	0.072	0.027	Yes	113331
12	0.057	0.031	Yes	513334
13	0.052	0.028	Yes	113333
14	0.088	0.033	Yes	113342
15	0.104	0.034	Yes	513350
16	0.091	0.022	Yes	113354
17	0.070	0.027	Yes	113357
18	0.101	0.040	Yes	513358

Lab [pCi/g]				
Batch	Value	2 Sigma	Detect	Sample Log Number
19	0.082	0.029	Yes	113365
20	0.068	0.019	Yes	113368
21	0.049	0.034	Yes	513371
22	0.056	0.026	Yes	113370
23	0.054	0.026	Yes	113373
24	0.062	0.029	Yes	113380
25	0.068	0.030	Yes	513386
26	0.092	0.039	Yes	513389
27	0.065	0.030	Yes	113400
28	0.082	0.034	Yes	513413
29	0.103	0.036	Yes	513428
30	0.042	0.026	Yes	113459
31	0.067	0.029	Yes	513456
32	0.083	0.046	Yes	413477
33	0.097	0.031	Yes	513496
34	0.074	0.032	Yes	513510
35	0.070	0.035	Yes	113547
36	0.056	0.027	Yes	113585
37	0.065	0.032	Yes	513584
38	0.060	0.020	Yes	113603

Table 3-3. Summary of SMCM radiological information collected for each batch surveyed under GPU SR-62. (The 18 batches comprise 5,012 tons of material.)

Batch	Cs-137 [pCi/g]			
	Mean	Max	StDev	# of Alarms
1	1.73	2.08	0.12	4
2	1.76	2.32	0.24	1
3	1.36	1.67	0.09	0
4	1.29	1.56	0.07	0
5	1.52	1.83	0.10	2
6	1.64	2.04	0.18	2
7	1.89	2.29	0.18	9
8	1.84	2.21	0.12	1
9	1.83	2.19	0.14	0
10	2.00	2.40	0.11	2
11	1.78	2.39	0.12	1
12	1.80	2.08	0.09	2
13	1.87	2.23	0.11	2
14	1.74	2.62	0.35	0
15	1.63	1.89	0.11	2
16	1.45	1.84	0.21	0
17	1.60	1.89	0.12	0
18	1.68	2.05	0.16	0

Table 3-4. Summary of lab radiological information collected for each batch surveyed under GPU SR-62. (The 18 batches comprise 5,012 tons of material.)

	Lab [pCi/g]							
Batch	Value	2 Sigma	Detect	Sample Log Number	Value	2 Sigma	Detect	Sample Log Number
1	0.699	0.118	Yes	513734	0.572	0.097	Yes	113752
2	1.005	0.124	Yes	513757	0.584	0.088	Yes	113774
3	0.418	0.081	Yes	413809	N/A	N/A	N/A	N/A
4	0.553	0.096	Yes	514128	0.463	0.081	Yes	514143
5	0.556	0.088	Yes	114165	0.607	0.098	Yes	114170
6	0.617	0.094	Yes	114177	0.657	0.082	Yes	114182
7	0.717	0.112	Yes	414197	0.855	0.131	Yes	414207
8	0.704	0.106	Yes	114218	0.733	0.099	Yes	514245
9	0.732	0.099	Yes	514245	0.749	0.129	Yes	414270
10	0.811	0.097	Yes	114269	0.718	0.117	Yes	414283
11	0.768	0.095	Yes	114302	0.906	0.115	Yes	514297
12	0.721	0.089	Yes	114305	1.002	0.111	Yes	114306
13	0.728	0.099	Yes	114317	0.712	0.099	Yes	514319
14	0.768	0.100	Yes	114318	0.817	0.104	Yes	114341
15	0.670	0.889	Yes	114363	0.790	0.101	Yes	514364
16	0.695	0.086	Yes	114370	0.624	0.084	Yes	514371
17	0.641	0.086	Yes	514413	0.661	0.089	Yes	514414
18	0.696	0.087	Yes	114417	0.623	0.080	Yes	514418

3.1 SMCM vs. Lab

The measured data indicates that there is a small bias between the SMCM and lab reported Bi-214 and Tl-208. The possible sources of bias are discussed in Appendix H: Comparison of SMCM Results with Laboratory-Based Measurements.

The Bi-214 and Tl-208 concentration (pCi/g) levels are similar in SR-55 to SR-62. The lab results for K-40 differed as shown in Table 3-5. The average K-40 shown for SR-55 excludes the first 2 batches that had higher K-40 content. Batches 1 and 2 where crushed brick and mortar. Batches 3 to 38 were crushed brick, concrete, tile and grout. For SR-62, two samples where taken per batch. Batch 3 was excluded from the K-40 average because it was sediment pumped from the SSGS tunnels. For K-40, SMCM agreed with the lab on SR-55 but was 23% lower than the lab for SR-62. The lower value for K-40 on SR-62 resulted in higher reported Cs-137 concentrations but well under the site de-rated regulatory limits.

Table 3-5. K-40 comparison between SR-55 and SR-62 based on lab results.

SR	K-40 [pCi/g]	
	Sample 1	Sample 2
55	9.385	.N/A
62	15.666	14.910

In general, for both SR-55 and SR-62, the SMCM consistently over-reported the Bi-214 by a factor of 2 and Tl-208 by about 30%. This over-reporting is attributed to several sources: additional background counts come from the Bi-214 and Tl-208 in the soil underneath and around the conveyor. Another contributing factor is the use of a window that includes some Compton scattered photons as well as the primary photons assumed in the calibration model.

Using the SMCM, SR55 had no detectable Cs-137 and consistently reported measurements near zero.

SR-62 had detectable Cs-137 and the SMCM over-reported the Cs-137 concentration by about 150%. This over-reporting is largely attributed to K-40 being under-reported that results in too little background subtraction. This can also be seen by the fact that K-40 is correlated to Cs-137 (see Figure 3-1).

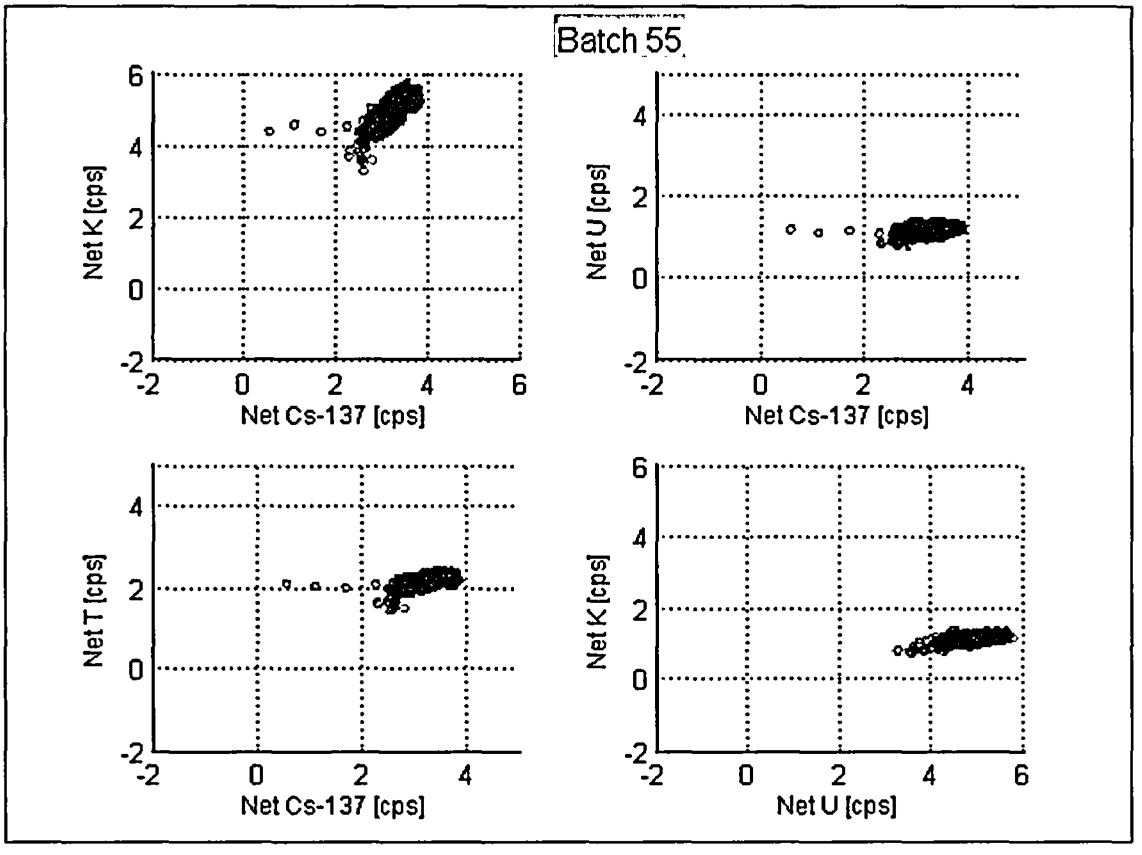

Figure 3-1. Upper left chart shows K -40 is correlated to Cs-137.

For SR-62, the K-40 results agree within 25% of the lab measurements but show greater variability when compared to the lab. This variability is attributed to variability in zero offset through the course of the 5 months of measurements (see Appendix G Shift in Zero Offset). The impact of the zero offset shift is to cause variability in the stripping coefficients that remove Bi-214 and Tl-208 from the K-40 window (see Appendix D Striping Coefficients).

3.1.1 SMCM vs. Lab for SR-55

GPU staff acquired and analyzed a composite soil sample for each batch of debris. A total of 16 one-half liter soil samples were taken, corresponding to the 16 truck loads that made up a batch. The total 8-liter composite sample was dried for 8 hours, mixed, screened with a 0.25-inch (0.6 cm) screen to remove rocks, and used to fill a one-liter Marinelli beaker for counting. The mean concentrations from both the laboratory analysis and the SMCM results are plotted below in Figure 3-2, Figure 3-3, Figure 3-4, and Figure 3-5 for Cs-137, K-40, Bi-214, and Tl-208. The measured data indicates that there is a small bias between the SMCM and lab reported Bi-214 and Tl-208. The possible sources of bias are discussed in Appendix H: Comparison of SMCM Results with Laboratory-Based Measurements.

Since Cs-137 was not present, all SMCM values are below the system's MDC value. The zero offset issue can be observed at batch 26 in Figure 3-2 and is explained in Appendix G Shift in Zero Offset.

The K-40 results agree on average within 2%. Batches 1 and 2 were different material than batches 3 to 38 and showed agreement within 25%.

The Bi-214 results show that the SMCM is over-reporting this value by about 100%. In the data shown in Figure 3-5, the SMCM slightly over-reported Thorium-232 (via Tl-208 which is related to Th-232 by the 36% branching ratio, or 3X the scale indicated). The over-reporting of Th-232 is primarily attributed to failure to subtract the background thorium measured from soil underneath the conveyor system, and to other minor causes, such as the extrapolation from Co-60 (1.33 MeV) to the Tl-208 photon energy of 2.614 MeV. The Tl-208 results show that the SMCM is over-reporting this value by about 40%. These differences were viewed as acceptable with no further study of the issue. See also Appendix H Comparison of SMCM Results.

3.1.2 SMCM vs. Lab for SR-62

GPU staff acquired and analyzed two composite soil samples for each batch of debris. Each sample was comprised of 8 one-half liter soil samples, corresponding to 8 truckloads. Two each 8-liter composite samples per batch was dried for 8 hours, mixed, screened with a 0.25 inch (0.6 cm) screen to remove rocks, and used to fill two one-liter Marinelli beakers for counting. The mean concentrations from both the laboratory analysis and the SMCM results are plotted below in Figure 3-6, Figure 3-7, Figure 3-8, and Figure 3-9 for Cs-137, K-40, Bi-214, and Tl-208. The measured data indicates that there is a small bias between the SMCM and lab reported Bi-214 and Tl-208. The possible sources of bias are discussed in Appendix H: Comparison of SMCM Results with Laboratory-Based Measurements.

The Cs-137 results show that the SMCM is over-reporting this value on average by about 150%. This is attributed to the under-reporting of K-40 that is subtracted to provide net Cs-137 concentrations.

The K-40 results show that the SMCM is under-reporting this value on average by about 25%.

The Bi-214 results show that the SMCM is over-reporting this value on average by about 100%. This result is consistent with SR-55.

The Tl-208 results show that the SMCM is over-reporting this value on average by about 20%. This result is consistent with SR-55.

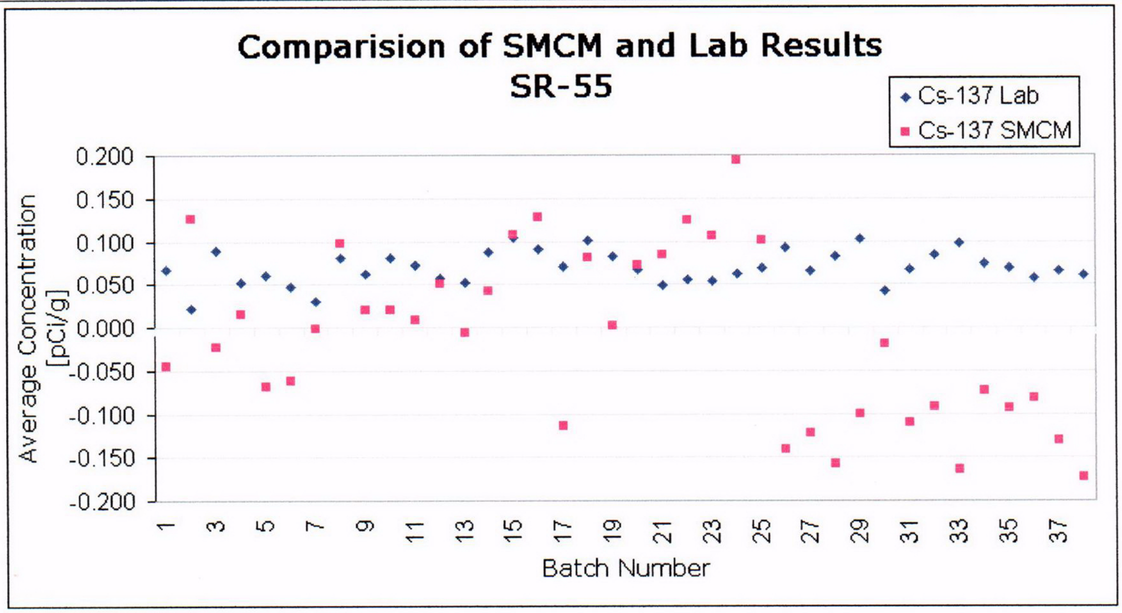

Figure 3-2. SR-55 mean concentration from laboratory analysis and SMCM results for Cs-137.

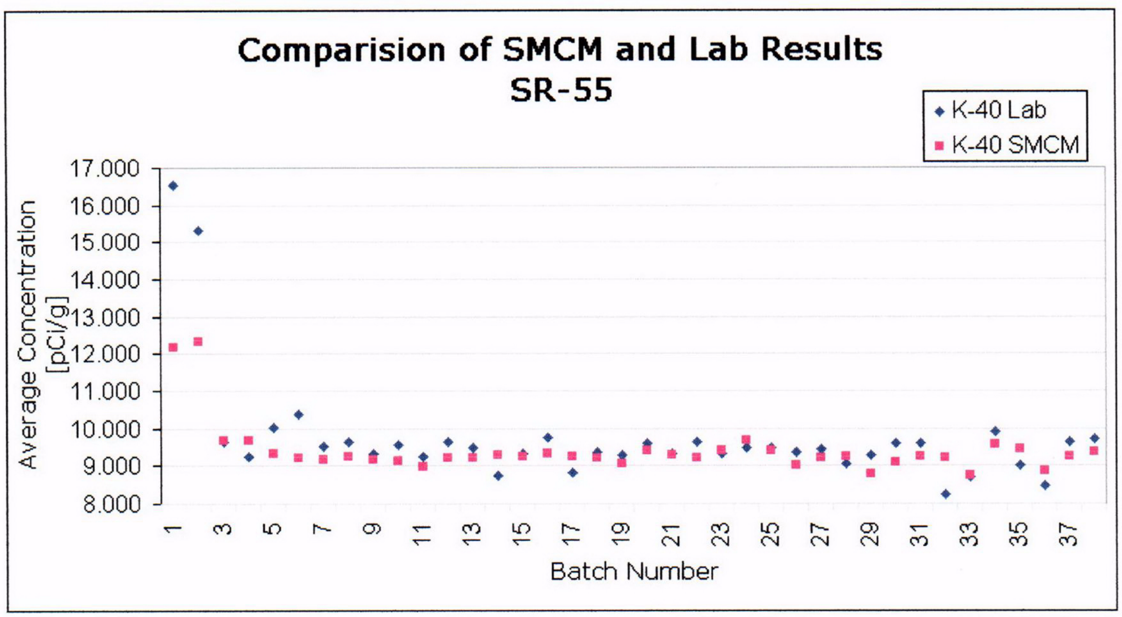

Figure 3-3. SR-55 mean concentration from laboratory analysis and SMCM results for K-40.

C08

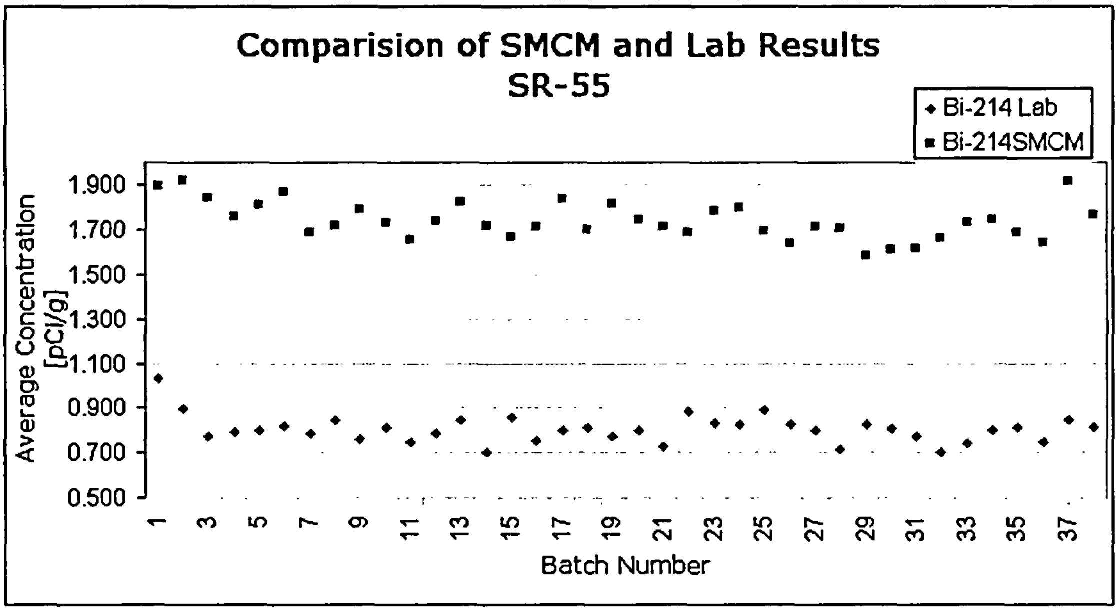

Figure 3-4. SR-55 mean concentration from laboratory analysis and SMCM results for Bi-214.

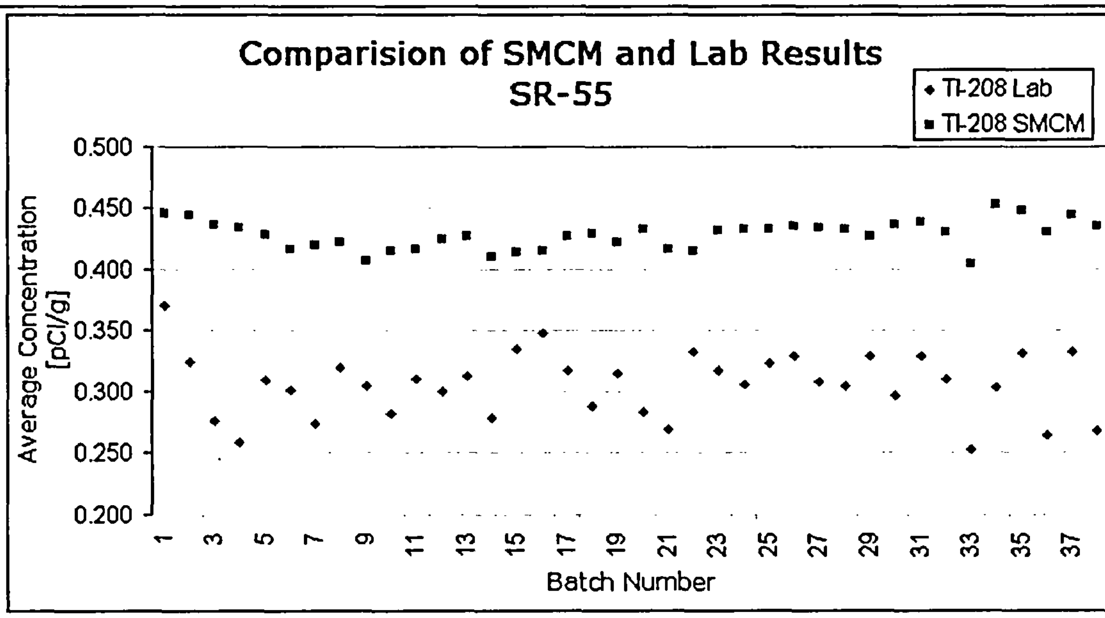

Figure 3-5. SR-55 mean concentration from laboratory analysis and SMCM results for Tl-208.

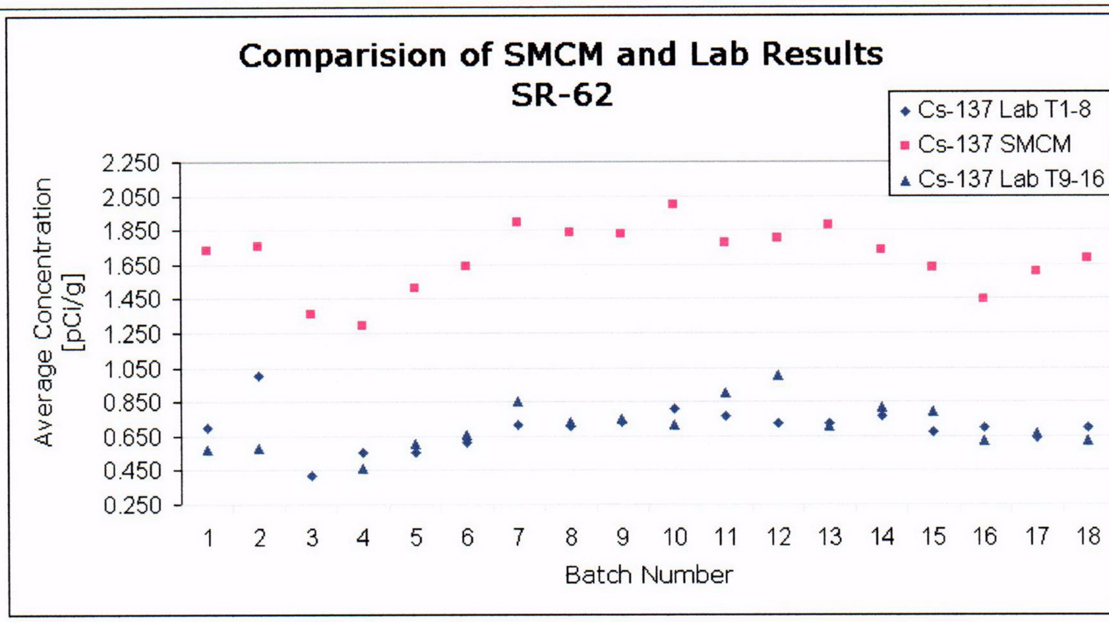

Figure 3-6. SR-62 mean concentration from laboratory analysis and SMCM results for Cs-137.

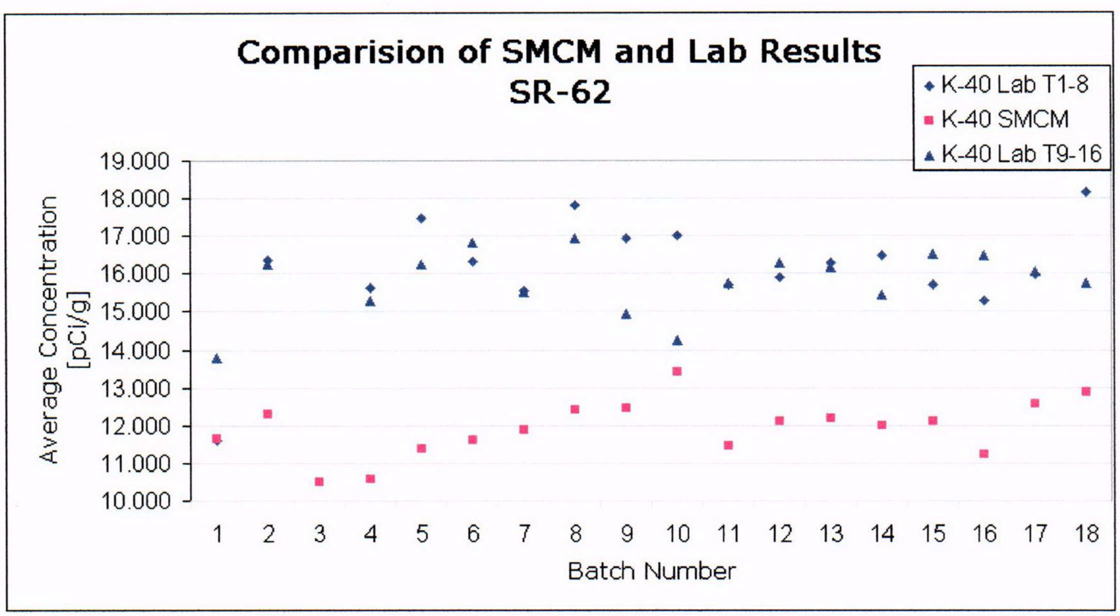

Figure 3-7. SR-62 mean concentration from laboratory analysis and SMCM results for K-40.

C09

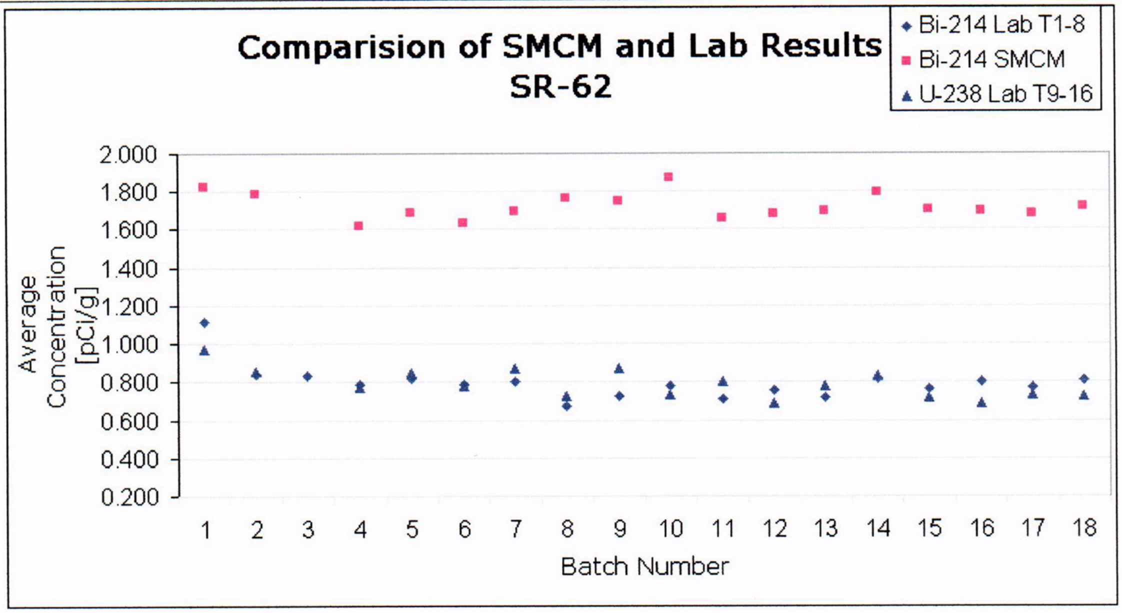

Figure 3-8. Mean concentration from laboratory analysis and SMCM results for Bi-214.

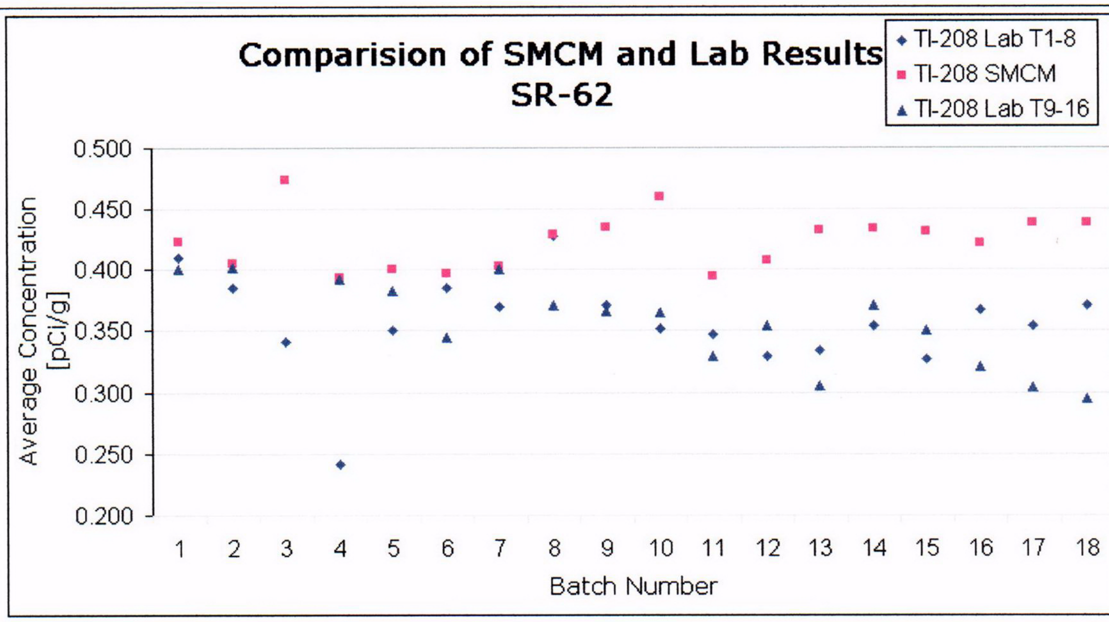

Figure 3-9. Mean concentration from laboratory analysis and SMCM results for Tl-208.

C10

3.2 Productivity for SR-55

The survey of the 11,717 tons (includes 5% re-surveyed) of debris required thirty-one 10-hour shifts to complete. A table summarizing the conveyor productivity in units of tons and piles processed is shown in Figure 3-10.

Table 3-6 also further summarizes the system productivity. Typically, the SMCM was surveying 7.3 hours a day. Actual survey time ranged from 1.8 hours to 7.5 hours. The remaining time was due to administrative activities, e.g., starting conveyors, moving dump trucks, maintaining feed pile, etc. Outside of administrative activities, the SMCM was operated with 99% productivity. The 1% downtime was due to conveyor maintenance or repair and investigating the shift in zero-offset.

3.3 Productivity for SR-62

The survey of the 5,258 tons (includes 5% re-surveyed) of soil required twenty-two 10-hour shifts and four 8-hour shifts to complete. A table summarizing the conveyor productivity in units of tons and piles processed is shown in Figure 3-11. Table 3-7 also further summarizes the system productivity. Typically, the SMCM was surveying 6.5 hours a day in a given 10-hour shift. For the July 4th week only four 8-hour shifts were performed. Actual survey time ranged from 4.1 hours to 7.1 hours. Assuming the same administrative activities, e.g., starting conveyors, moving dump trucks, maintaining feed pile, etc. stayed the same as SR-55, then typically 0.6 hours per shift were spent investigating alarms. Alarms that occurred towards the start of SR-62 took much longer to resolve than alarms towards the end of SR-62. Once the surveying and operating crews became comfortable with the logistics of alarm investigation and material removal, the time reduced to 10 to 15 minutes per event. Outside of administrative activities and alarms, the SMCM was operated with 99% productivity. The 1% downtime was due to conveyor maintenance or repair.

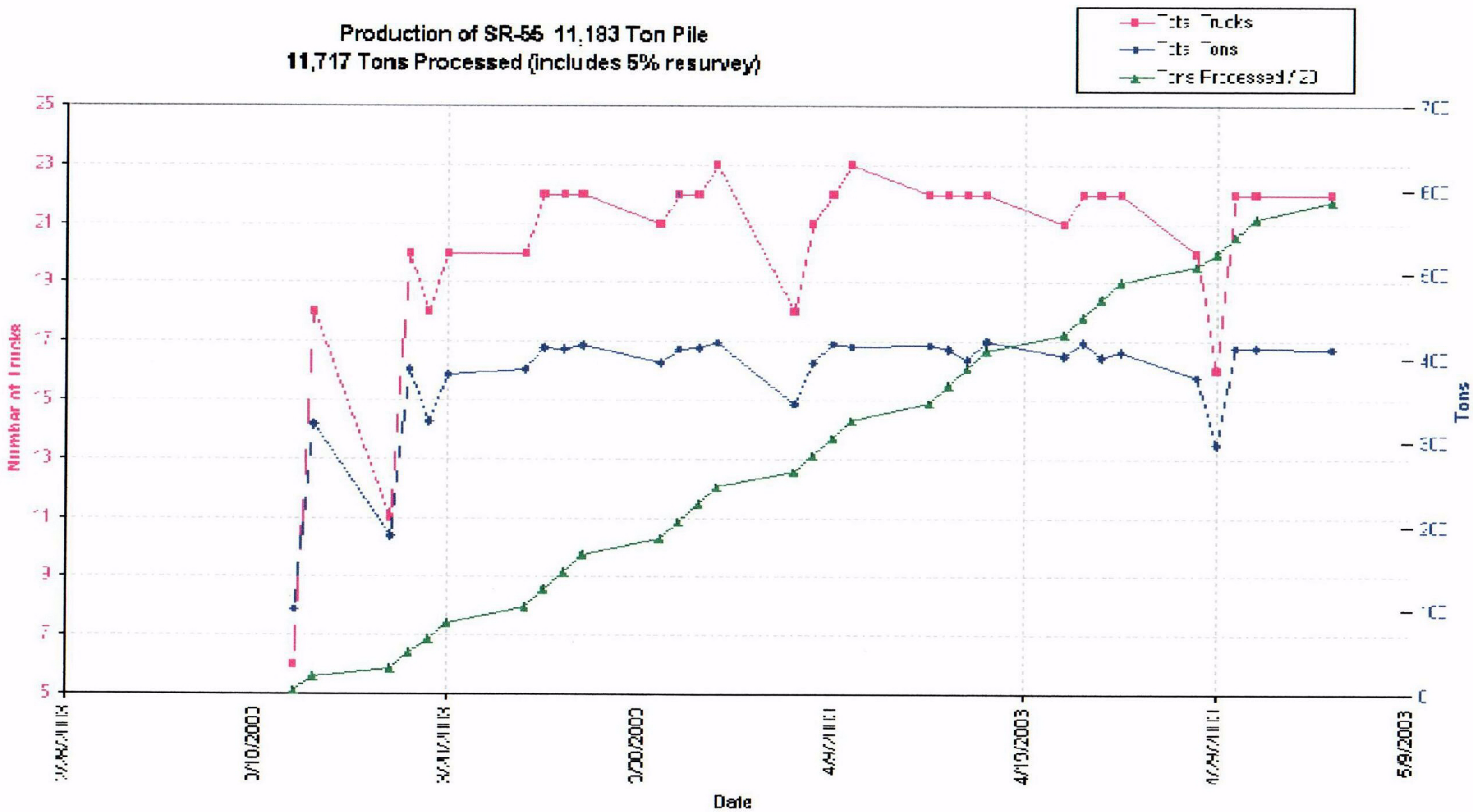

Figure 3-10. Productivity for SR-55 Batches 1 through 38.

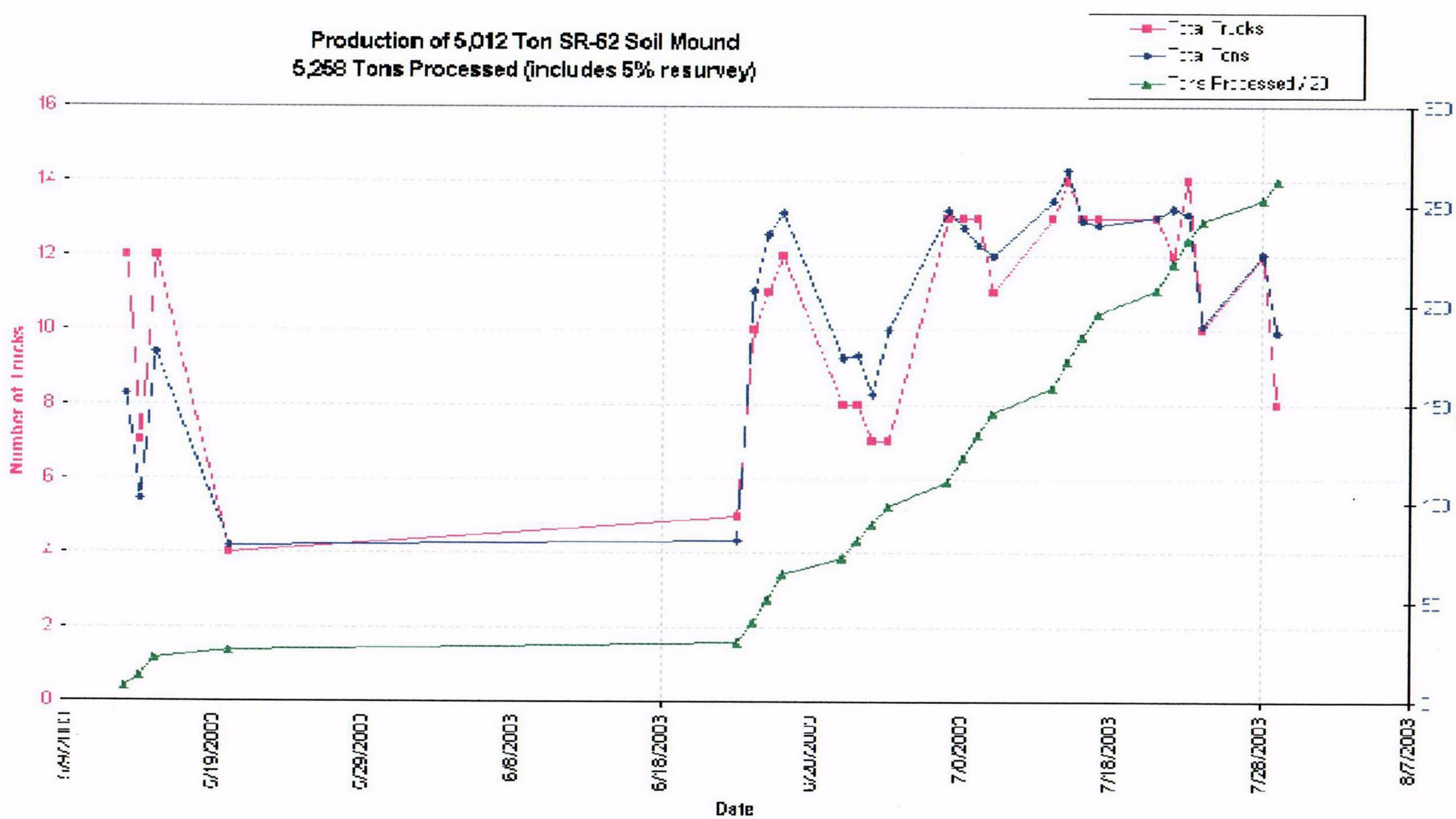

Figure 3-11. Productivity for SR-62 Batches 1 through 18.

Table 3-6. Summary of system productivity for SR-55.

Shift	Date	Acquisitions	Survey Time [hr]	Total Tons	Total Yards^3	Total Trucks	Average Tons / Truck
1	3/12/03	1295	1.8	100	70	6	16.7
2	3/13/03	4147	5.8	320	224	18	17.8
3	3/17/03	2436	3.4	188	132	11	17.1
4	3/18/03	5000	6.9	386	270	20	19.3
5	3/19/03	4192	5.8	324	226	18	18.0
6	3/20/03	4913	6.8	380	265	20	19.0
7	3/24/03	5005	7.0	387	270	20	19.3
8	3/25/03	5343	7.4	413	289	22	18.8
9	3/26/03	5319	7.4	411	287	22	18.7
10	3/27/03	5378	7.5	416	290	22	18.9
11	3/31/03	5103	7.1	394	276	21	18.8
12	4/1/03	5315	7.4	411	287	22	18.7
13	4/2/03	5339	7.4	413	288	22	18.8
14	4/3/03	5410	7.5	418	292	23	18.2
15	4/7/03	4460	6.2	345	241	18	19.1
16	4/8/03	5105	7.1	395	276	21	18.8
17	4/9/03	5397	7.5	417	291	22	19.0
18	4/10/03	5356	7.4	414	289	23	18.0
19	4/14/03	5374	7.5	415	290	22	18.9
20	4/15/03	5312	7.4	411	287	22	18.7
21	4/16/03	5154	7.2	398	278	22	18.1
22	4/17/03	5446	7.6	421	294	22	19.1
23	4/21/03	5203	7.2	402	281	21	19.1
24	4/22/03	5412	7.5	418	292	22	19.0
25	4/23/03	5190	7.2	401	280	22	18.2
26	4/24/03	5281	7.3	408	285	22	18.6
27	4/28/03	4878	6.8	377	263	20	18.8
28	4/29/03	3855	5.4	298	208	16	18.6
29	4/30/03	5330	7.4	412	288	22	18.7
30	5/1/03	5341	7.4	413	288	22	18.8
31	5/5/03	5322	7.4	411	287	22	18.7
Median		5281	7.3	408	285	22	18.8
Total		151,611	210.6	11,717	8,188	628	N/A

Table 3-7. Summary of system productivity for SR-62.

Shift	Date	Acquisitions	Survey Time [hr]	Total Tons	Total Yards^3	Total Trucks	Average Tons / Truck
1	5/13/03	2952	4.1	155	108	12	12.9
2	5/14/03	1946	2.7	102	71	7	14.6
3	5/15/03	3351	4.7	176	123	12	14.7
4	5/20/03	1491	2.1	78	55	4	19.6
5	6/23/03	1547	2.1	81	57	5	16.2
6	6/24/03	3944	5.5	207	145	10	20.7
7	6/25/03	4491	6.2	236	165	11	21.4
8	6/26/03	4692	6.5	246	172	12	20.5
9	6/30/03	3303	4.6	173	121	8	21.7
10	7/1/03	3322	4.6	174	122	8	21.8
11	7/2/03	2952	4.1	155	108	7	22.1
12	7/3/03	3570	5.0	187	131	7	26.8
13	7/7/03	4725	6.6	248	173	13	19.1
14	7/8/03	4559	6.3	239	167	13	18.4
15	7/9/03	4388	6.1	230	161	13	17.7
16	7/10/03	4287	6.0	225	157	11	20.5
17	7/14/03	4816	6.7	253	177	13	19.4
18	7/15/03	5107	7.1	268	187	14	19.1
19	7/16/03	4613	6.4	242	169	13	18.6
20	7/17/03	4580	6.4	240	168	13	18.5
21	7/21/03	4658	6.5	245	171	13	18.8
22	7/22/03	4732	6.6	248	174	12	20.7
23	7/23/03	4683	6.5	246	172	14	17.6
24	7/24/03	3617	5.0	190	133	10	19.0
25	7/28/03	4299	6.0	226	158	12	18.8
26	7/29/03	3542	4.9	186	130	8	23.2
Median		4393	6.0	225	157	12	19.1
Total		100167	139.1	5258	3674	275	N/A

3.4 Re-survey Results

The LTP required that 5% of all survey units be re-surveyed. The requirements were for the results of the original survey and the results of the re-survey to meet the survey performance requirements. The last truck of the day was dumped and re-run through the system the following workday. Table 3-8 and Table 3-9 show that all resurveyed material met the survey performance requirements. As another metric of the SMCM's performance, this re-surveyed data was compared using K-40, since the Cs-137 was often below the detection limit of the SMCM. As shown in Figure 3-12 and Figure 3-13 the re-survey results agreed within 1 standard deviation of the original truck. Only the standard deviation of the original truck is shown in the figure for clarity.

3.4.1 Re-survey Results for SR-55

The re-survey results are shown Table 3-8 and in Figure 3-12.

Table 3-8. SR-55 re-survey results.

Re-Survey Filename	Below 2.2pCi/g	Original Filename	Below 2.2pCi/g
99-01	Yes	02-04	Yes
99-02	Yes	02-06	Yes
99-03	Yes	03-01	Yes
99-04	Yes	04-04	Yes
99-05	Yes	05-04	Yes
99-06	Yes	06-07	Yes
99-07	Yes	07-11	Yes
99-08	Yes	08-16	Yes
99-09	Yes	10-05	Yes
99-10	Yes	11-10	Yes
99-11	Yes	12-14	Yes
99-12	Yes	14-03	Yes
99-13	Yes	15-08	Yes
99-14	Yes	16-13	Yes
99-15	Yes	17-01.N04	Yes
99-16	Yes	19-01.N02	Yes
99-17	Yes	20-02	Yes
99-18	Yes	21-04	Yes
99-19	Yes	23-01	Yes
99-20	Yes	24-02	Yes
99-21	Yes	26-03	Yes
99-22	Yes	28-02	Yes
99-23	Yes	29-03	Yes
99-24	Yes	30-04	Yes
99-25	Yes	32-02	Yes
99-26	Yes	33-03	Yes
99-27	Yes	34-04	Yes
99-28	Yes	35-02	Yes
99-29	Yes	36-03	Yes

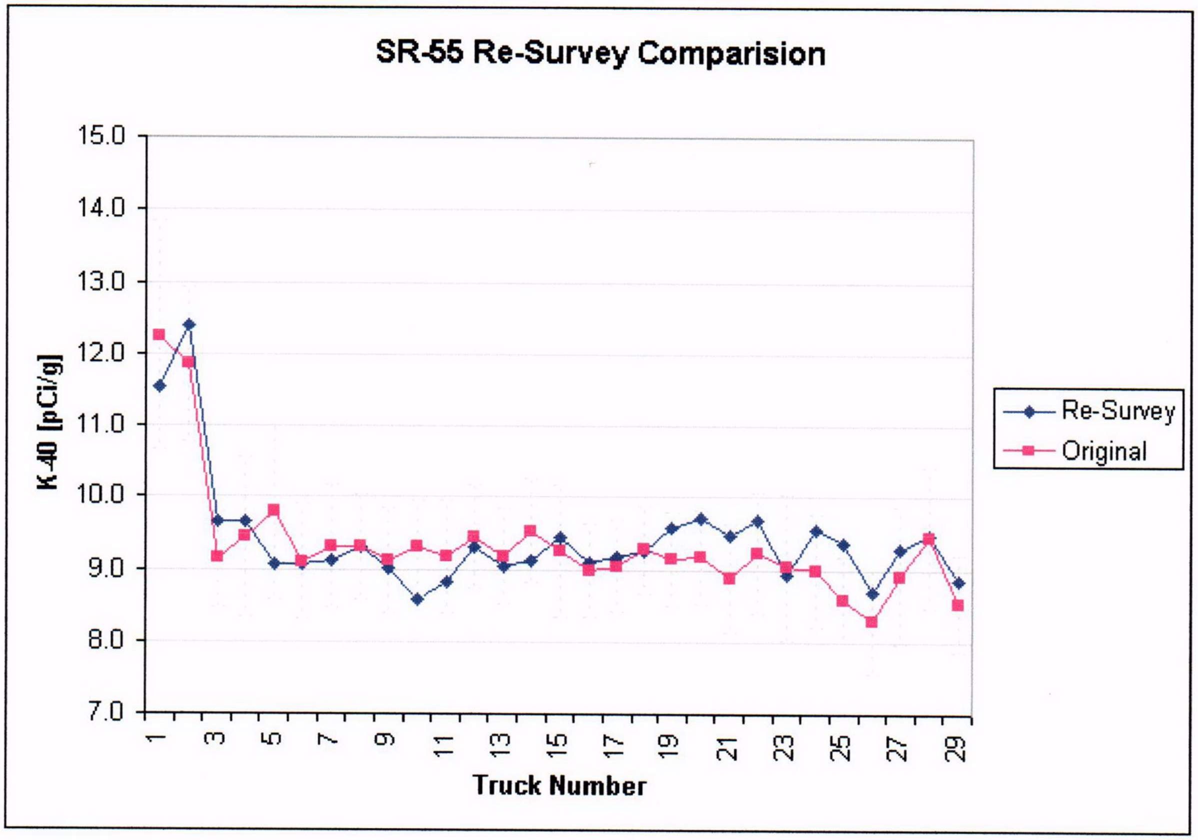

Figure 3-12. SR-55 re-survey results comparison.

C13

3.4.2 Re-survey Results for SR-62

The re-survey results are shown in Table 3-9 and Figure 3-13.

Table 3-9. SR-62 re-survey results.

Resurvey Filename	Below 4.2pCi/g	Truck Filename	Below 4.2pCi/g
99-30	Yes	39-10.N01	Yes
99-31	Yes	40-01.N02	Yes
99-32	Yes	40-06.N01	Yes
99-33	Yes	42-03.N02	Yes
99-34	Yes	42-05.N05	Yes
99-35	Yes	43-04	Yes
99-36	Yes	44-01.N02	Yes
99-37	Yes	44-03.N03	Yes
99-38	Yes	45-04	Yes
99-39	Yes	45-10	Yes
99-40	Yes	46-04	Yes
99-41	Yes	47-02	Yes
99-42	Yes	47-08	Yes
99-43	Yes	48-05	Yes
99-44	Yes	56-02.N04	Yes

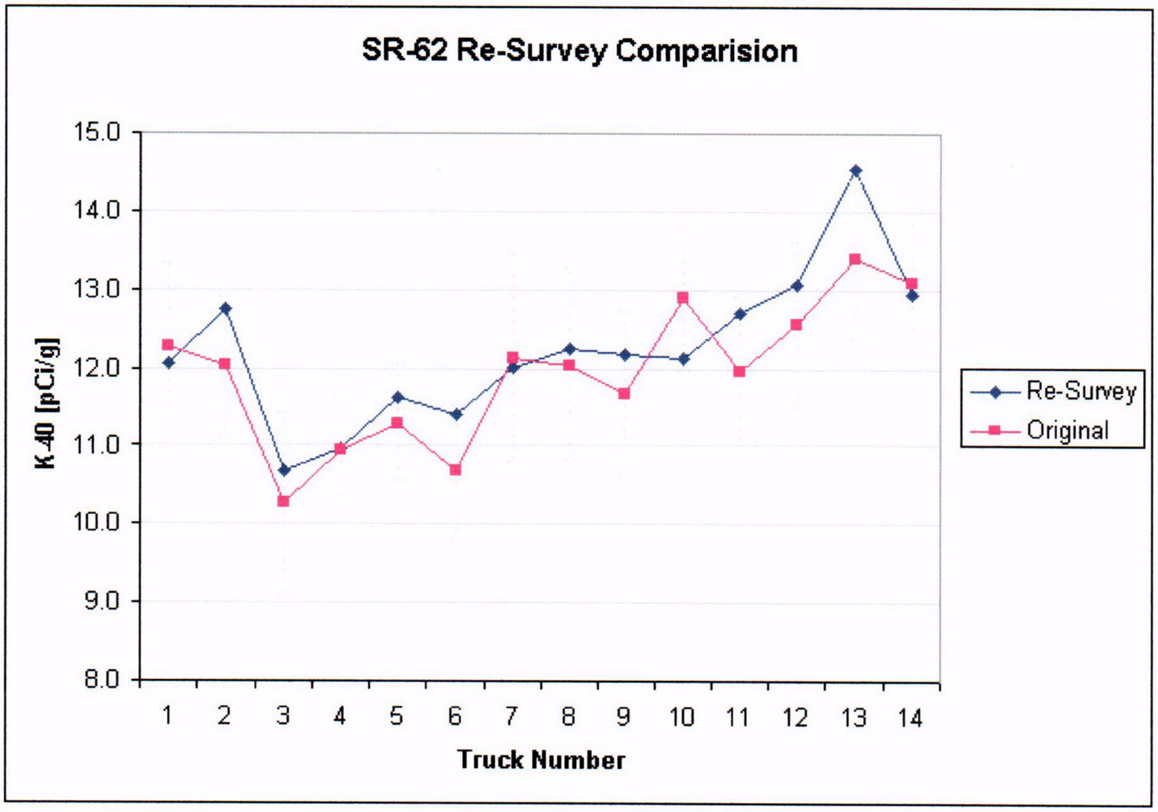

Figure 3-13. SR-62 re-survey results comparison.

3.5 Conclusions

The surveys for SR-55 and SR-62 showed no Cs-137 greater than sites de-rated limit of 4.2 pCi/g (See Table 3-10).

Table 3-10. Best estimate of average pile results.

SR	Mean Cs-137 [pCi/g]	Uncertainty
55	0.069	0.010
62	0.683	0.085

3.5.1 Conclusions for SR-55

The survey of the 11,183 tons of debris had 38 1-liter samples taken and measured by the NIST traceable germanium lab counter. The best estimate of the total pile is the mean of the samples or 0.069 ± 0.010 pCi/g. The sample for batch 1 is not included in the mean due to its value being a non-detect by the lab. All other lab samples detected Cs-137. The SMCM measured 100% of the debris and showed a mean of 0.040 ± 0.067 pCi/g for batches 1 through 24. A zero offset occurred (see Figure 3-2) during batch 25 that moved the Bi-214 609 keV peak mostly out of the Cs-137 window. Thus, reducing the background counts in the Cs-137 window. Therefore, batches 26 through 38 all had negative values with a mean of –0.113 ± 0.042 pCi/g. The SRCs and PBCs showed that if Cs-137 was present the SMCM was operating reliably for all batches 1 through 38.

The SMCM and lab results agree within one standard deviation. For the case of the SR-55 pile, SMCM has verified that the lab sampling methodology is valid and the best estimate of the total pile is 0.069 ± 0.010 pCi/g. The SMCM did not alarm during the SR-55 survey. Therefore, there is no Cs-137 greater than 2.91 pCi/g for a 5-acqusition sample or 773 pounds (350 kgs) of debris. Furthermore, the NASVD data analysis showed no indication that Cs-137 was present when comparing acquisition to acquisition.

3.5.2 Conclusions for SR-62

The survey of the 5,012 tons of soil had 36 1-liter samples taken and measured by the NIST traceable germanium lab counter. The best estimate of the total pile is the mean of the lab samples or 0.683 ± 0.085 pCi/g. The SMCM measured 100% of the soil and showed a mean of 1.689 ± 0.190 pCi/g for batches 1 through 18. The model used to determine the Cs-137 calibration factor used a density of 1.6 g/cc. The average dry density as measured by the on-site lab was 1.285 g/cc. Therefore, the SMCM results may be reduced by 20%.

For the case of the SR-62 pile, SMCM has verified that the lab sampling methodology is valid and the best estimate of the total pile is 0.683 ± 0.085 pCi/g. When the SMCM did alarm during the SR-62 survey, the surrounding material was removed and not placed in the below limits pile. Therefore, there is no localized (hot-spot) volume of Cs-137 greater than 2.91 pCi/g for a 5-acqusition sample or 773 pounds (350 kgs) of soil.