Appendix A

Class 1 Areas
Survey Design

FirstEnergy

SNEC CALCULATION COVER SHEET

CALCULATION DESCRIPTION

Calculation Number	Revision Number	Effective Date	Page Number
E900-04-007	0	5/13/04	1 of 11

Subject

Discharge Tunnel Survey Design for Class 1 Areas

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

ORIGINAL

APPROVAL SIGNATURES

Calculation Originator	B. Brosey/ B. Brosey	Date	5/10/04
Technical Reviewer	P. Donnachie/ P. Donnachie	Date	5/10/04
Additional Review	A. Paynter/	Date	13 May 2004
Additional Review		Date	
SNEC Management Approval		Date	

1.0 PURPOSE

1.1 The purpose of this calculation is to develop a survey design for Class 1 surfaces within the Discharge Tunnel. This is a partial survey that addresses areas bypassed by Shonka Research Associates (SRA) **(Reference 3.1)** during their scan survey of this structure. The entire Class 1 survey areas of the Discharge Tunnel are listed below.

Survey Units	Location	Material Type	Classification	Area (m^2)
SS1	Floor of DT to 150 ft	Concrete	1	109.5
SS4	Ceiling of Discharge Tunnel to 150 ft	Concrete	1	107.7
SS6-1	South Wall of DT to 150 ft	Concrete	1	118
SS6-2	North Wall of DT to 150 ft	Concrete	1	127.5
SS6-2	East Wall (included with the North Wall)	Concrete	1	7.4

NOTE 1: There is very little exposed steel in these survey units (<< 1% of the total area).

NOTE 2: This is the total surface for the Class 1 areas in the Discharge Tunnel. It does not include the transition area between the Discharge Tunnel, the Spray Pump Pit, Seal Chambers or the access area into the Discharge Tunnel.

2.0 SUMMARY OF RESULTS

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

General survey instructions:

- Scan the areas listed on **Attachment 1-1** using a GFPC detector.
- Scan the same areas using a 2" by 2" NaI detector.
- Scan any additional locations within the Class 1 areas as directed by SNEC site management or as deemed appropriate when bounding an area.
- Locate the randomly placed static measurement points for these survey units and make a 1 minute static measurement at each location using a GFPC detector.
- Mark any location for potential sampling determined to be above the action level defined for a NaI detector IAW Section 2.2.

2.1 *Step 1 - GFPC Scanning and Static Measurements*

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

2.1.2 Scanning parameters are as shown in the following Table.

Scan Coverage (%)	Scan Speed (cm/sec)	Detector Geometry
100% of marked areas*	2.2	Contact

*Marked surfaces are identified in Class 1 areas only.

Areas bypassed by SRA are shown on **Attachment 2-1** through **2-5**. Each of these areas have been identified by reviewing the draft SRA survey report for the Discharge Tunnel and then documenting all bypassed areas. In addition, SRA and SNEC personnel have performed walk-downs of the Discharge Tunnel and determined additional locations requiring follow-up survey work. Each of these areas were then assigned a specific label derived from the survey unit where they reside. The total surface area of these bypassed areas is ~112 square meters.

NOTE
Steel components/hardware that exhibit severely corroded surfaces (scaled or bubbled surfaces) should be scanned using a NaI detector. See Section 2.2 for instructions on scanning these components or structures.

2.1.3 Additional surface areas may be scanned IAW site management direction or to more completely bound an elevated area (using NaI or GFPC). If additional areas are scanned:

- locate the area on a diagram and determine the approximate dimensions.
- Ensure the area has been inspected IAW **Reference 3.2** and meets the requirements and general criteria of this survey design. Contact the cognizant GRCS with any questions regarding these criteria.
- Document the addition of this area in the survey results.

2.1.4 The following Table shows the applicable Discharge Tunnel DCGLw values.

Surface GA DCGLw (dpm/100 cm^2)	Volumetric DCGLw (pCi/g-Cs-137)
8968 (A.L.= 6726)	6.52 (A.L.= 4.89)

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

2.1.5 The following is the calculated GFPC detection efficiency for this survey design.

GFPC Detection Efficiency Data

ε_i	ε_s	% Cs-137	Efficiency Loss Factor	counts/disintegration
0.478	0.5	0.982	0.23	0.054

2.1.6 GFPC detectors exhibiting an instrument efficiency (εi) less than 0.478 should not be used for this survey work.

2.1.7 The following is the Compass output values for this survey design.

MDCstatic (dpm/100 cm^2)*	MDCscan (dpm/100 cm^2)*	Action Level Assigned During Phase 1 Scanning (ncpm)
1,251	2,466	300

*As calculated by the Compass computer program assuming a background value of 266 cpm (corrected Williamsburg data).

2.1.8 The number of necessary static measurement points (see **Attachment 3-1** through **3-4**), was determined using the Compass computer program (**Reference 3.3**). Compass output is presented in **Attachment 4-1** through **4-13**. The number of static measurement points per survey unit was determined to be ten (10). VSP (**Reference 3.4**), is then used to plot these points on area diagrams. Five (5) additional points are added so that the total number of points per survey unit for this design is fifteen (15).

2.1.9 The action level during first phase scanning is 300 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 from the elevated location.

2.1.10 Areas greater than the calculated DCGLw (424 ncpm) must be identified, documented, marked, and bounded to include an area estimate.

> ***NOTE***
> ***If remediation actions are taken as a result of this survey, this survey design must be revised or re-written entirely. Review results thoroughly before taking this action.***

2.1.11 Any location or hardware that cannot be adequately surveyed with the GFPC as described in the note below Section 2.1.2, should be identified for NaI scanning IAW Section 2.2.

2.2 *NaI Scanning and Sampling*

2.2.1 The purpose of NaI scanning is to identify elevated measurement locations in difficult to reach areas or on highly corroded steel surfaces and mark them for potential sampling. The following criteria apply:

2.2.1.1 A minimum of ***100% scan*** coverage of the SRA bypassed areas is required.

2.2.1.2 The scan speed is set at ***5 cm/second*** when scanning with a ***2" by 2" NaI*** detector while moving side to side in a serpentine pattern within 2" from the surface. The stand-off distance (2") should be monitored frequently during the scanning process.

2.2.1.3 The action level is ***300 gross cpm***. When an area is thought to be at this level during phase one scanning, the detector should be held stationary for ***at least 15 seconds*** to record the actual count rate. If the area is confirmed to be above the action level, the location should be marked for potential sampling. These areas shall be bounded and documented.

2.2.2 The conversion factor for the NaI used in cpm/mR/h, shall not be less than ***208,000 cpm/mR/h*** (see **Attachment 5-1 to 5-3** for a typical NaI instrument calibration report).

2.2.3 IAW site management instruction, sample concrete at any location above the action level cited is Section 2.2.1.3. A 4" long core bore sample is preferred so that the depth of penetration can be identified. However, when a core bore cannot be taken because of the quality of the concrete, or because of limited access in an area, sampling should remove the first 1" of concrete and yield a volume of at least 200 cc to ensure an adequate counting MDA for Cs-137 (a 4" diameter area by 1" deep = ~200 cc).

2.2.4 For steel surfaces above the action level, scrape the surface to collect a sample for gamma scanning by removing as much material as possible in the suspect area. Document the approximate size of the area where the materials were removed. Whenever possible, obtain a volume of no less then 25 cc's (200 cc's is preferred). Core bore radionuclide concentrations will be averaged and an assessment will be made as to average depth of the contaminant. MicroShield will be used to determine annual dose per radionuclide. LTP Chapter 6, Equation 6-1 will then be used to determine the unity fraction for the surface and volume contaminant fractions.

3.0 REFERENCES

3.1 Shonka Research Associates, Inc., "Final Report for SCM Survey of Saxton Nuclear Experimental Corporation", Revision 0, October 17, 2003.

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

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

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

3.7 SNEC Calculation No. E900-03-016, "Shonka Discharge Tunnel and Intake Tunnels FSS Survey Design", 7-28-03.

3.8 Plan SNEC Facility License Termination Plan.

3.9 GPU Nuclear, SNEC Facility, SSGS Footprint, Drawing, SNECRM-039, 040 & 041.

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

3.11 MicroShield, Computer Radiation Shielding Code, Version 5.05-00121, Grove Engineering.

3.12 NUREG-1507, "Minimum Detectable Concentrations With Typical Radiation Survey Instruments for Various Contaminants and Field Conditions," June 1998.

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

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

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

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

4.0 ASSUMPTIONS AND BASIC DATA

4.1 Remediation History

Remediation of the Discharge Tunnel began with removal of ground water in this semi-isolated below grade structure. Gross decontamination followed to include the removal of contaminated hardware and piping that passed into and through the Seal Chambers. One pipe originating in the SNEC Nuclear facility, terminated in Seal Chamber 1. This is thought to be the main source of contamination entering the Discharge Tunnel. Of interest, is the fact that this pipe did not significantly contaminate Seal Chamber 1 which contained the least amount of radiological contamination of the three chambers. Instead, contaminated water and steam from the SSGS Coal Fired Steam plant passing into and through Seal Chamber 3 appears to have had a more significant impact with regard to contaminating the Discharge Tunnel. Because the Discharge Tunnel is below grade level, surface water in-leakage is a problem and some patching of cracked concrete was necessary to prepare this area for final status survey work.

Surface cleaning of the Discharge Tunnel was performed by removing a thickness of concrete in affected areas. Core bores were then taken to determine the depth of the contamination and to estimate remediation effectiveness. Remaining piping systems were sampled and gamma scanned to determine the existing concentrations. Obstructions were cut off and concrete surfaces were scraped free of scale when necessary. Remediation efforts included combinations of the following cleaning techniques:

- scabbling
- grinding and use of an oxy/acetylene torch to remove metal obstructions and pipe
- surface scraping
- water flushing
- pumping
- hand removal of solids and sediment

4.2 Cs-137's detection efficiency has been checked by SNEC personnel using ISO standard 7503-1 methodology (**Reference 3.5**). The SNEC facility uses only the lowest reported GFPC efficiency for any of the instruments available for the survey work as input to the survey design process. **Attachment 6-1**, is an example of an instrument efficiency check sheet showing an instrument efficiency of 0.509. Detectors with values less then 0.478 for the instrument efficiency should not be used for this work. An ISO standard value of 0.5 is used as the source efficiency.

4.3 A GFPC detector stand-off distance of 2.7" is assumed for all areas to compensate for rough surfaces in each survey unit. This factor corrects the overall efficiency by a factor of 0.23 (**Reference 3.6**), as shown on **Attachment 7-1**. Surface defects (gouges, cracks, etc.), are present in these survey units, but a portion of the surface area is relatively smooth. Thus the average concentration of a residual source term will be overestimated.

4.4 The overall counting efficiency for this survey design assumes a mix ratio as developed in **Attachment 8-1** through **8-6**.

4.5 The instrument and source efficiency is assumed to be as shown in Section 2.1.5. The detection efficiency is based on the instruments response to Cs-137. All other nuclides except Ni-63 are less than 1% of the total mix IAW **Attachment 8**. Ni-63 provides no additional counting efficiency. A rough surface efficiency correction factor is also employed to ensure a representative efficiency is used for weathered, broken or remediated concrete surface. From **Attachment 1-1** a worst case surface gouge depth is listed as 2.7 inches. From **Reference 3.6** and **Attachment 7-1** this gap would reduce the overall efficiency by a factor of ~0.23. The resulting efficiency is then 0.054 cts/dis.

4.6 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 6,726 dpm/100 cm^2 x (126 cm^2 physical probe area/100 cm^2) = 8,475 x (0.982 disintegration of Cs-137/ disintegration in mix) x ε_i (0.478) x ε_s (0.5) x 0.23 (distance factor) which yields ~457 net cpm above background (Compass calculates 424 ncpm as the gross beta DCGLw). The 0.054 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 0.982 disintegration of Cs-137/disintegration in mix x 0.23 (efficiency loss factor due to distance from surface) = ***0.054 cts/disintegration***.

4.7 Badly corroded steel surfaces will be scanned using a 2" x 2" NaI detector. These detectors are set-up and calibrated with a Cs-137 window setting typical to that described in **Attachment 5-1** to **5-3**.

4.8 MicroShield models containing Cs-137 were developed for this survey design when scanning with a NaI detector (**Attachment 9-5** to **9-7**). One slab model was developed for scanning concrete surfaces, and one disk source for surface deposition.

1) Model 1 - a 1" thick slab of concrete 12" in diameter, and

2) Model 2 - a surface deposit (12" diameter), on a corroded surface

4.9 The modeled concentration used was 1 pCi/g Cs-137, and the density of concrete is assumed to be 2.35 g/cc. Then the concentration of Cs-137 in the first model is 2.35g/cc x 1 pCi/g or 2.35E-06 uCi/cc of Cs-137 for the concrete model, and 1.0E-06 uCi/cm^2 for the surface model. The calculated MDCscan for these two models is shown in the following table for a typical windowed 2" by 2" NaI detector.

Material/Model	BKGND (cts/min)	MDC_{SCAN} (pCi/g) or dpm/100 cm^2
Concrete Slab (2.35 g/cc)	100	Attachment 9-1 = 3.74 pCi/g
Surface (0.125" Fe Coating)	100	Attachment 9-3 = 4354

NOTE: Background is assumed to range from about 100 to 200 cpm in the Discharge Tunnel.

4.10 The results of the MicroShield modeling indicate that an exposure rate of approximately 7.865E-05 mR/h is obtained at a distance of 3" from the surface of the slab model, (2" inches from the face of the detector). Exposure rate is measured to the center of the detector and therefore the air gap between the surface of both models is taken to be 2".

4.11 The second MicroShield model of a surface deposition incorporates a Cs-137 concentration of 1 pCi/cm^2 (see **Attachment 9-7**). For this scenario, the modeled area is assumed to be a 12" diameter disk source. The activity is uniformly dispersed over the surface. The source is assumed to be a corroded steel plate. This model incorporates a 0.125" thickness of iron oxide (Fe_2O_3) to simulate a corroded steel surface. The resulting mR/h value was 1.501E-05. Then the calculated pCi/cm^2 MDCscan is 19.6 pCi/cm^2 (4354 dpm/100 cm^2) for a background count rate of 100 cpm (see **Attachment 9-1** to **9-4**).

4.12 These survey units are below grade and are surrounded by concrete walls and therefore the original GFPC related background values have been adjusted to compensate for shielding effects of these walls. This results in a conservative estimate of background.

4.13 The Discharge Tunnel variability results and the Williamsburg background measurements are used to estimate the actual background for a similar below grade concrete surface. The following correction was used to correct the Williamsburg concrete background data:

Mean Williamsburg concrete data = 211 cpm ± 26.9 shielded, and

= 306 cpm ± 34.5 unshielded

Discharge Tunnel concrete data = 171 cpm ± 19.3 shielded, and

= 297 cpm ± 61.1 unshielded

Difference in shielded readings = 211 – 171 = 40 cpm

Mean Williamsburg unshielded data corrected = 306 – 40 cpm = ***266 cpm ± 34.5*** cpm. The background data may be see on **Attachment 10-1**. The Discharge Tunnel variability measurements are shown on **Attachment 11-1**.

4.14 The GFPC 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), 0.054 counts/disintegration and a 126 cm^2 probe area. In all cases, the scan MDC is less than the gross activity DCGLw for these survey units. Therefore, there is no need to add additional survey points to this survey design for purposes of meeting hot spot design criteria.

4.15 The survey units described in this survey design were inspected after remediation efforts were completed. A copy of portions of the SNEC facility post-remediation inspection report are included (see **Attachment 12-1** to **12-9**).

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

4.17 No special measurements are included for this survey design.

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

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

4.20 Diagrams shown in this survey design have been developed from **Reference 3.9**.

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

4.22 The GFPC data will be evaluated IAW the WRS statistical testing criteria.

4.23 The Area Factors for this survey unit is shown below (Co-60). These values (as applicable), were input to the Compass computer program and are the same as those reported in Reference 3.1. The lower limit area factor for areas less than 1 square meter is 10.1. Area factors for values between the values listed in the following table, are interpolated from the data by Compass.

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 complex calculations are performed internal to applicable computer codes or within an Excel spreadsheet previously identified.

6.0 APPENDICES

6.1 **Attachment 1-1**, Areas in the Discharge Tunnel bypassed by SRA, "Difficult to Survey Surface Areas".

6.2 **Attachment 2-1** to **2-5**, Diagrams of the Discharge Tunnel showing the areas requiring scanning.

6.3 **Attachment 3-1** to **3-4**, Diagrams of the Discharge Tunnel showing static measurement locations.

6.4 **Attachment 4-1** to **4-13**, are Compass output results for the Discharge Tunnel.

6.5 **Attachment 5-1** to **5-3**, is typical calibration information for a 2" by 2" NaI detector with a Cs-137 window setting.

6.6 **Attachment 6-1**, is typical calibration information for a GFPC detector.

6.7 **Attachment 7-1**, is a calculation result for used to determine efficiency loss for a GFPC detector as a function of distance from a source.

6.8 **Attachment 8-1** to **8-6**, are DCGL Calculation Logic sheets for the Discharge Tunnel area.

6.9 **Attachment 9-1** to **9-4**, are the calculation sheets for MDCscan values for a concrete slab and a surface deposit.

6.9.1 **Attachment 9-5** to **9-7**, are calculation sheets from MicroShield for both the slab and surface models used for determining the MDCscan values for a NaI detection system.

6.10 **Attachment 10-1**, is background measurements using a GFPC instrument in non-impacted at the old Williamsburg coal fired steam plant site.

6.11 **Attachment 11-1**, is site GFPC variability measurements from the Discharge Tunnel area.

6.12 **Attachment 12-1** to **12-9**, are sections of survey unit inspection reports for the Discharge Tunnel.

Exhibit 1

SNEC Facility Individual Radionuclide DCGL Values [a]

Radionuclide	25 mrem/y Limit Surface Area ($dpm/100cm^2$)	25 mrem/y Limit (All Pathways) Open Land Areas (Surface & Subsurface) (pCi/g)	4 mrem/y Goal (Drinking Water) Open Land Areas [b] (Surface & Subsurface) (pCi/g)
Am-241	2.7E+01	9.9	2.3
C-14	3.7E+06	2	5.4
Co-60	7.1E+03	3.5	67
Cs-137	2.8E+04	6.6	397
Eu-152	1.3E+04	10.1	1440
H-3	1.2E+08	132	31.1
Ni-63	1.8E+06	747	1.9E+04
Pu-238	3.0E+01	1.8	0.41
Pu-239	2.8E+01	1.6	0.37
Pu-241	8.8E+02	86	19.8
Sr-90	8.7E+03	1.2	0.61

NOTES:

(a) While drinking water DCGLs will be used by SNEC to meet the drinking water 4 mrem/y goal, only the DCGL values that constitute the 25 mrem/y regulatory limit will be controlled under this LTP and the NRC's approving license amendment.

(b) Listed values are from the subsurface model. These values are the most conservative values between the two models (i.e., surface & subsurface).

Exhibit 2

Survey Design Checklist (From Reference 3.5)

Calculation No. E900-04-007	SS1, SS4, SS6-1, and SS6-2		
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	JTU 5/10/04
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	JTU 5/10/04

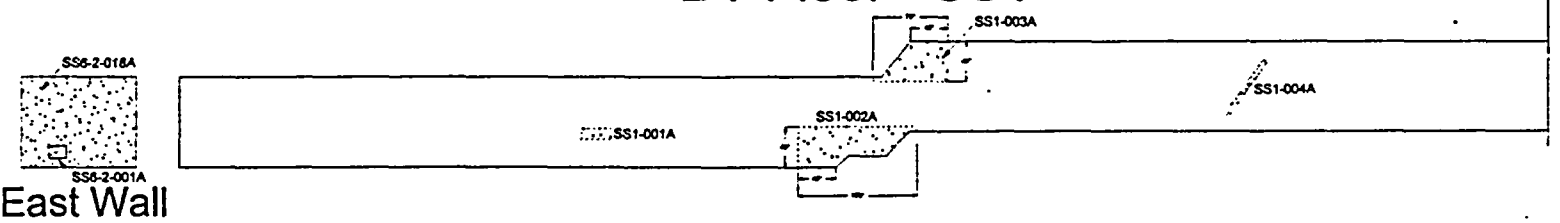
NOTE: a copy of this completed form or equivalent, shall be included within the survey design calculation.

Discharge Tunnel Class 1 Areas Not Surveyed by SRA

ROUGH OR DIFFICULT TO SURVEY SURFACE AREAS						
Location Code	Area (Inches^2)	(Meters^2)	Average Depth (mm)	Inches	Area Fraction	Weighted Depth Correction
SS6-2-001A	234	0.1510	10.2	0.40	0.13%	0.001
SS6-2-002A	361	0.2329	14.2	0.56	0.21%	0.001
SS6-2-003A	52	0.0336	12.1	0.48	0.03%	0.000
SS6-2-004A	105	0.0677	13.3	0.52	0.06%	0.000
SS6-2-005A	280	0.1807	10.7	0.42	0.16%	0.001
SS6-2-006A	56	0.0361	11.2	0.44	0.03%	0.000
SS6-2-007A	308	0.1987	11.3	0.44	0.18%	0.001
SS6-2-008A	66	0.0426	16.6	0.65	0.04%	0.000
SS6-2-009A	66	0.0426	14.9	0.59	0.04%	0.000
SS6-2-010A	13923	8.9831	8.8	0.35	8.02%	0.028
SS6-2-011A	16	0.0103	12.6	0.50	0.01%	0.000
SS6-2-012A	33	0.0213	15.7	0.62	0.02%	0.000
SS6-2-013A	2130	1.3743	9.5	0.37	1.23%	0.005
SS6-2-014A	25	0.0161	7.2	0.28	0.01%	0.000
SS6-2-015A	216	0.1394	15.7	0.62	0.12%	0.001
SS6-2-016A	120	0.0774	10.1	0.40	0.07%	0.000
SS6-2-017A	33865	21.8497	31.75	1.25	19.51%	0.244
SS6-2-018A	11286	7.2817	6.35	0.25	6.50%	0.016
SS6-2-019A	3841	2.4782	6.35	0.25	2.21%	0.006
SS6-1-001A	432	0.2787	16.7	0.66	0.25%	0.002
SS6-1-002A	28	0.0181	11.2	0.44	0.02%	0.000
SS6-1-003A	381	0.2458	21.1	0.83	0.22%	0.002
SS6-1-004A	323	0.2084	7.9	0.31	0.19%	0.001
SS6-1-005A	81	0.0523	10.5	0.41	0.05%	0.000
SS6-1-006A	52	0.0336	30.1	1.19	0.03%	0.000
SS6-1-007A	20	0.0129	13.3	0.52	0.01%	0.000
SS6-1-008A	6	0.0039	18.8	0.74	0.00%	0.000
SS6-1-009A	63	0.0406	13	0.51	0.04%	0.000
SS6-1-010A	238	0.1536	14.6	0.57	0.14%	0.001
SS6-1-011A	162	0.1045	6.3	0.25	0.09%	0.000
SS6-1-012A	7339	4.7351	35.5	1.40	4.23%	0.059
SS6-1-013A	11686	7.5398	9.3	0.37	6.73%	0.025
SS6-1-014A	192	0.1239	10.8	0.43	0.11%	0.000
SS6-1-015A	500	0.3226	9.6	0.38	0.29%	0.001
SS6-1-016A	624	0.4026	12.3	0.48	0.36%	0.002
SS6-1-017A	52	0.0336	8.5	0.33	0.03%	0.000
SS6-1-018A	20	0.0129	15.2	0.60	0.01%	0.000
SS6-1-019A	2133	1.3762	19.1	0.75	1.23%	0.009
SS6-1-020A	1791	1.1556	18.7	0.74	1.03%	0.008
SS6-1-021A	3955	2.5518	22.5	0.89	2.28%	0.020
SS6-1-022A	1751	1.1297	8.7	0.34	1.01%	0.003
SS6-1-023A	1498	0.9665	19.05	0.75	0.86%	0.006
SS6-1-024A	1175	0.7581	6.35	0.25	0.68%	0.002
SS6-1-025A	4775	3.0808	6.35	0.25	2.75%	0.007
SS1-001A	341	0.2200	8.8	0.35	0.20%	0.001
SS1-002A	3916	2.5266	22.4	0.88	2.26%	0.020
SS1-003A	2457	1.5853	68.3	2.69	1.42%	0.038
SS1-004A	350	0.2258	23.4	0.92	0.20%	0.002
SS1-005A	1304	0.8413	27.6	1.09	0.75%	0.008
SS1-006A	14914	9.6225	6.35	0.25	8.59%	0.021
SS4-001A	6203	4.0022	18.5	0.73	3.57%	0.026
SS4-002A	1938	1.2504	11.1	0.44	1.12%	0.005
SS4-003A	252	0.1626	4.3	0.17	0.15%	0.000
SS4-004A	3744	2.4156	18.5	0.73	2.16%	0.016
SS4-005A	1168	0.7536	13.2	0.52	0.67%	0.003
SS4-006A	664	0.4284	0.4	0.02	0.38%	0.000
SS4-007A	840	0.5420	4	0.16	0.48%	0.001
SS4-008A	1393	0.8988	2.3	0.09	0.80%	0.001
SS4-009A	325	0.2097	8.7	0.34	0.19%	0.001
SS4-010A	105	0.0677	2.1	0.08	0.06%	0.000
SS4-011A	6825	4.4035	44.45	1.75	3.93%	0.069
SS4-012A	1495	0.9646	25.4	1.00	0.86%	0.009
SS4-013A	19074	12.3065	6.35	0.25	10.99%	0.027
Total Area=>	173568	112.0			100.00%	0.700
		Mean Depth=>	14.6	0.58		
			Max=>	2.69		
			Min=>	0.02		
			Sigma=>	0.42		
			2 Sigma + Mean=>	1.42		

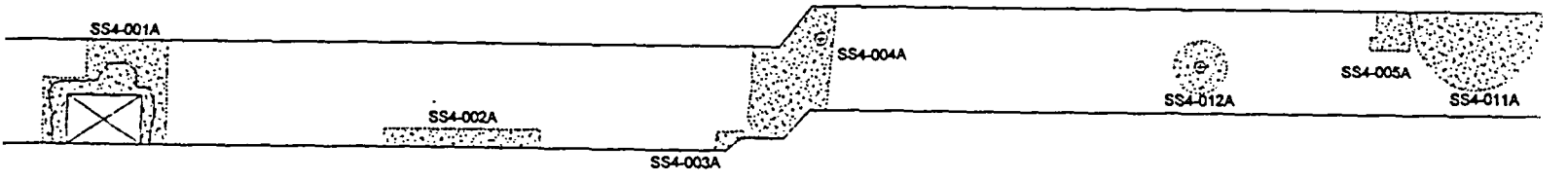
ATTACHMENT 1.1

DT Floor - SS1



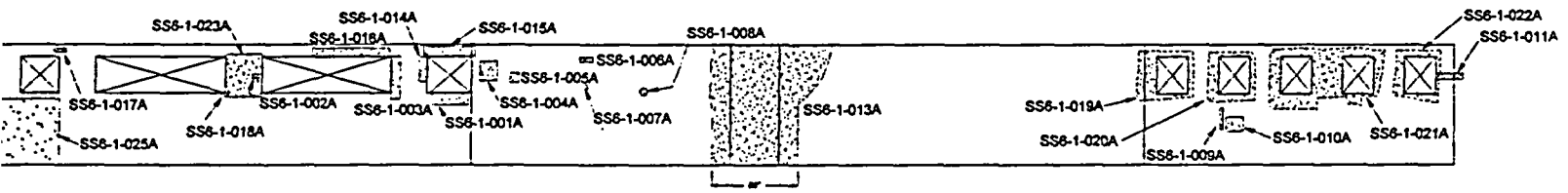
ATTACHMENT 2 . 1

DT Ceiling - SS4



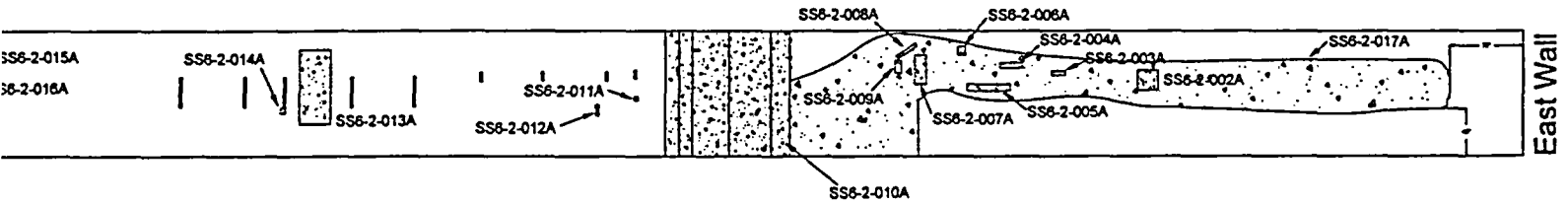
ATTACHMENT 2.2

DT South Wall - SS6-1



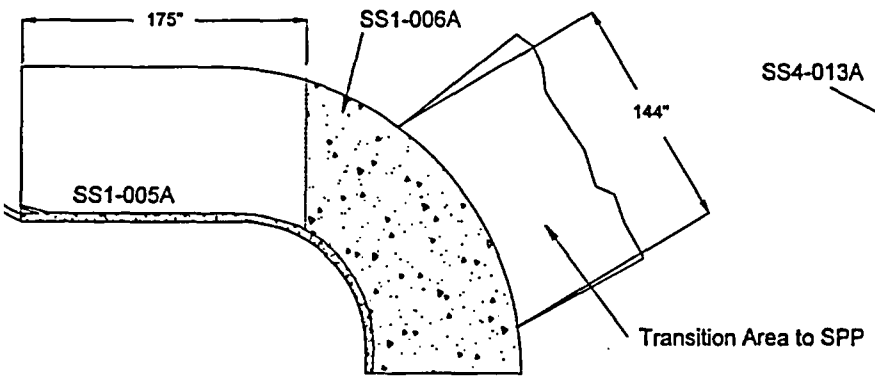
ATTACHMENT 2 . 3

DT North Wall - SS6-2

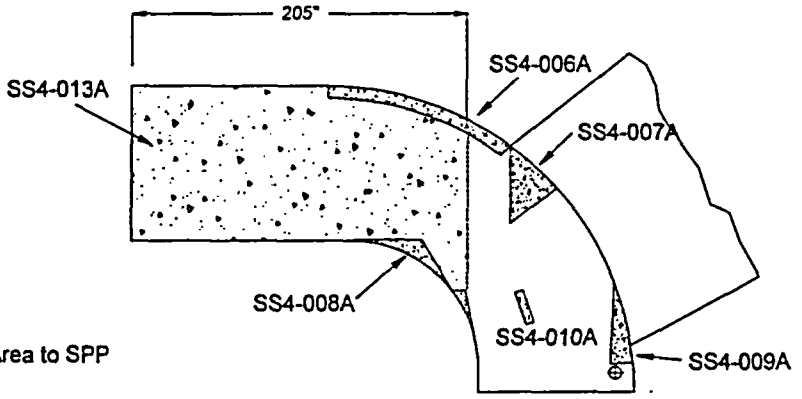


ATTACHMENT 2 . 4

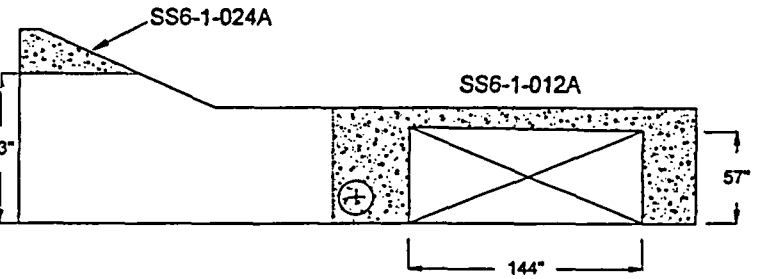
Corner of DT



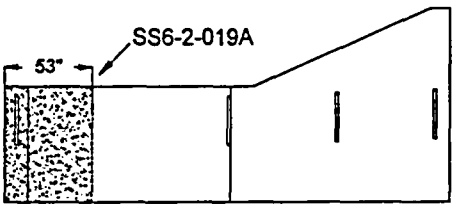
Floor - SS1



Ceiling - SS4



SW Wall - SS6-1

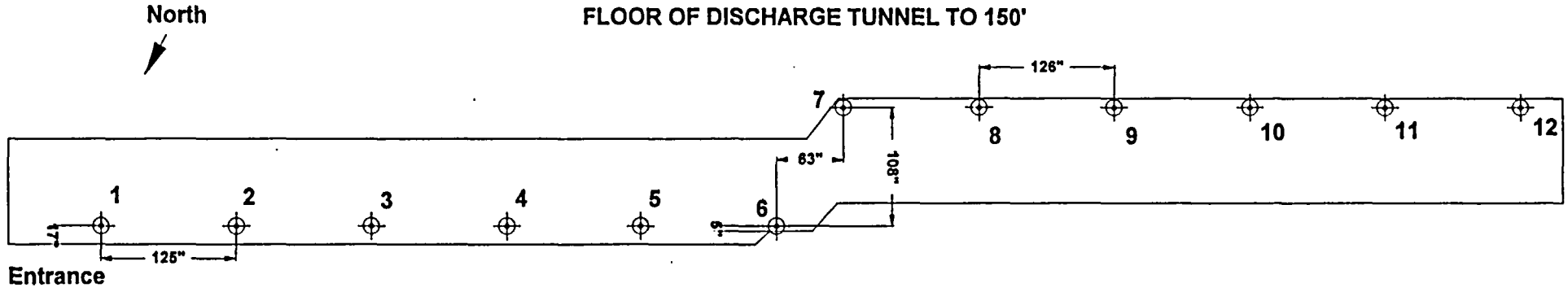


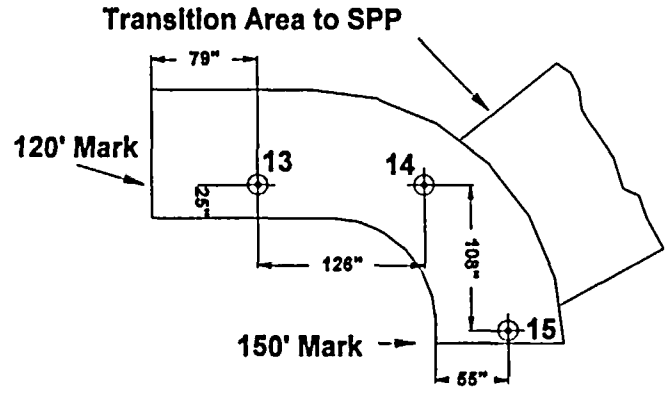
NE Wall - SS6-2

ATTACHMENT 2.5

SS1

FLOOR OF DISCHARGE TUNNEL TO 150'

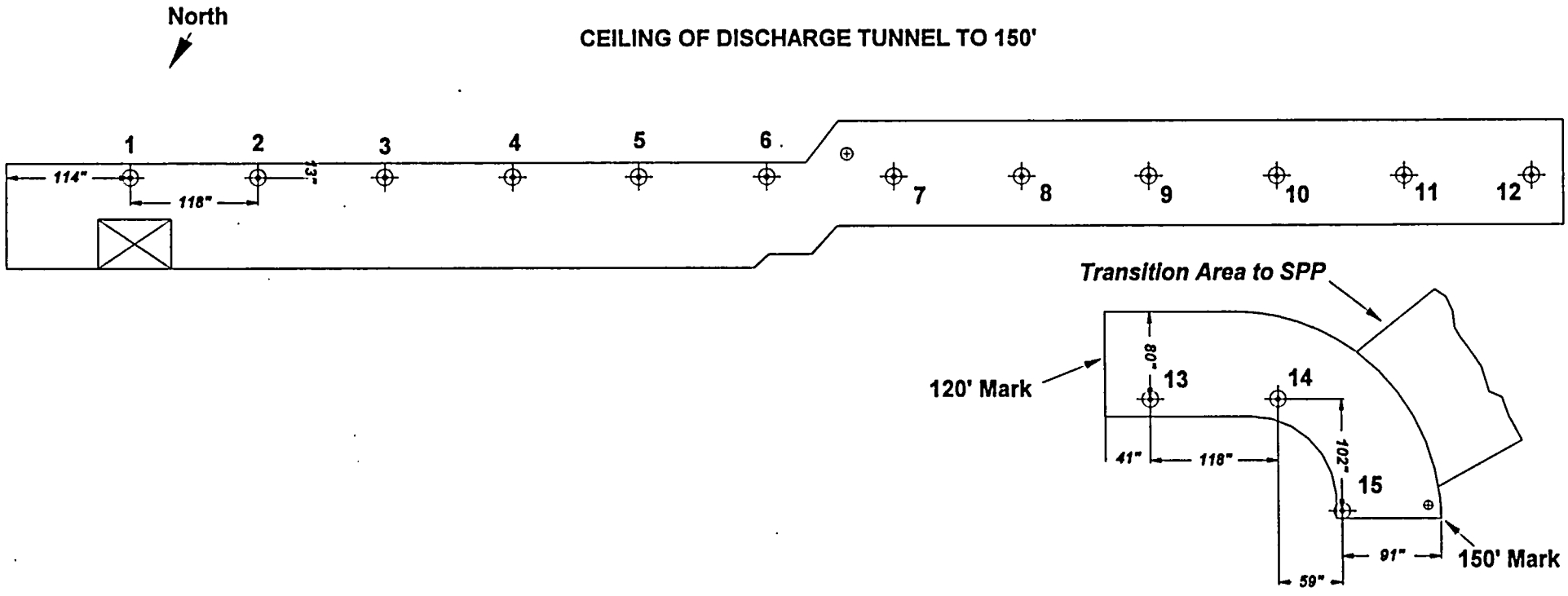




ATTACHMENT 3 . 1

SS4

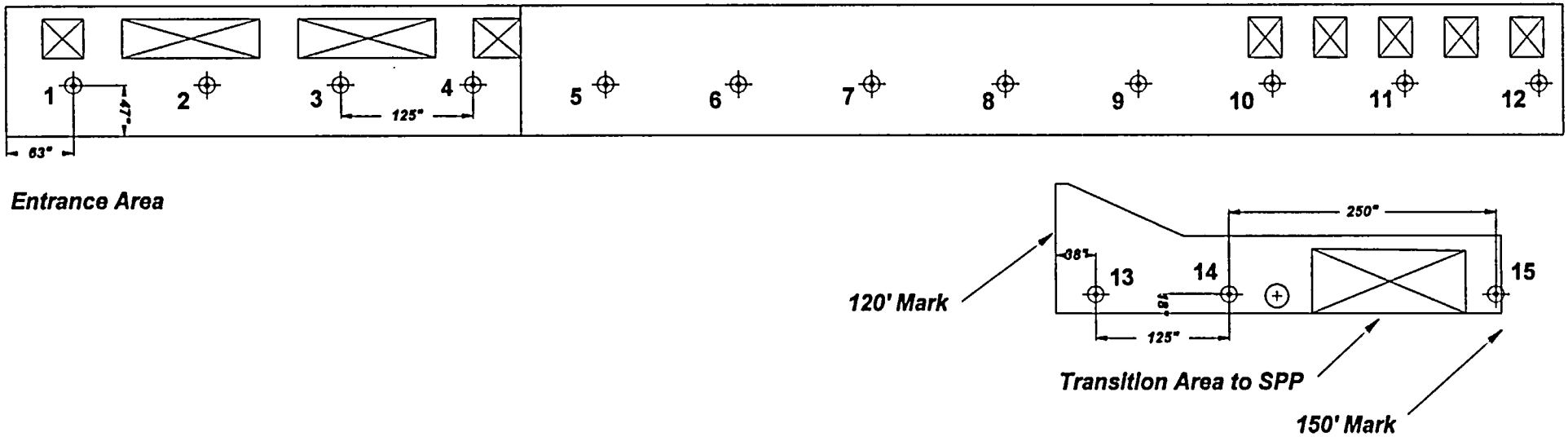
CEILING OF DISCHARGE TUNNEL TO 150'



ATTACHMENT 3.2

SS6-1

SOUTH WALL OF DISCHARGE TUNNEL TO 150'
(Facing South)

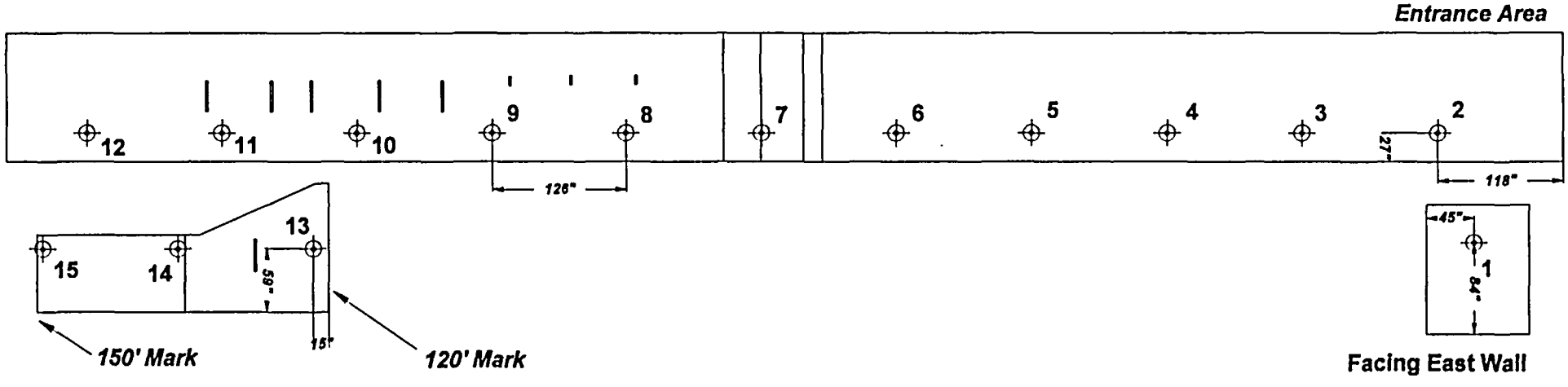


ATTACHMENT 3 . 3

SS6-2

NORTH WALL OF DISCHARGE TUNNEL TO 150'

(Facing North)



ATTACHMENT 3 . 4

Site Report

Site Summary

Site Name: Discharge Tunnel Class 1 Areas

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	6,726	No	0.25	10.1
				1	10.1
				4	3.4
				9	2
				16	1.5
				25	1.2
				36	1

BHB
5/9/04

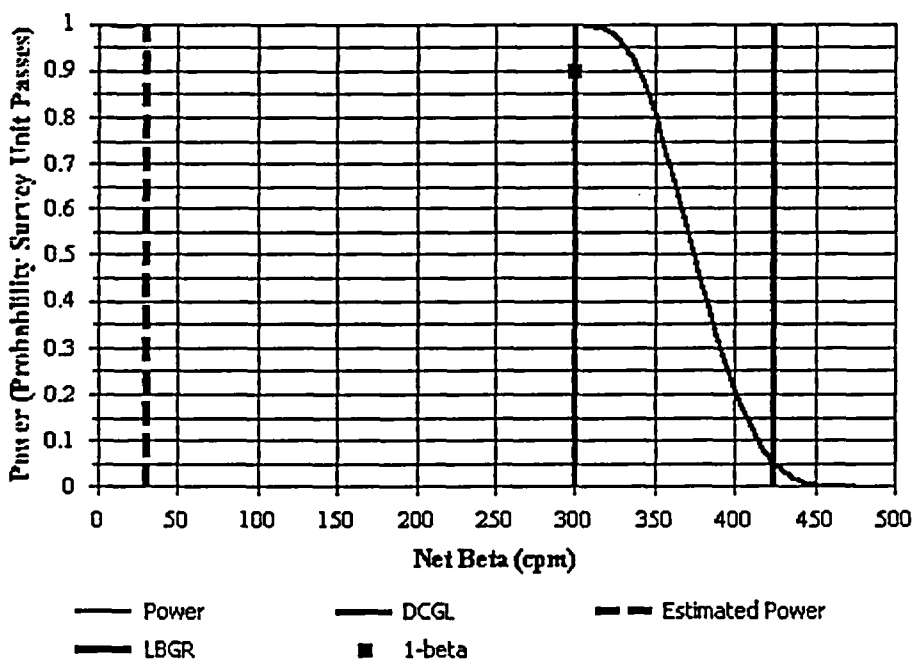
ATTACHMENT 4-1

Building Surface Survey Plan

Survey Plan Summary

Site:	Discharge Tunnel Class 1 Areas		
Planner(s):	BHB		
Survey Unit Name:	Discharge Tunnel SS1		
Comments:	Floor of DT		
Area (m²):	110	Classification:	1
Selected Test:	WRS	Estimated Sigma (cpm):	62.1
DCGL (cpm):	424	Sample Size (N/2):	10
LBGR (cpm):	300	Estimated Conc. (cpm):	31
Alpha:	0.050	Estimated Power:	1.00
Beta:	0.100	EMC Sample Size (N):	10

Prospective Power Curve



ATTACHMENT 4.2

Building Surface Survey Plan

Contaminant Summary

Contaminant	DCGLw (dpm/100 cm²)
Gross Activity	6,726

Beta Instrumentation Summary

Gross Beta DCGLw (dpm/100 cm²): 6,726
Total Efficiency: 0.05
Gross Beta DCGLw (cpm): 424

ID	Type	Mode	Area (cm²)
17	GFPC	Beta	126

Contaminant	Energy[1]	Fraction[2]	Inst. Eff.	Surf. Eff.	Total Eff.
Gross Activity	187.87	1.0000	0.48	0.11	0.0540

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

Gross Survey Unit Mean (cpm): 297 ± 62 (1-sigma)
Count Time (min): 1

Material	Number of BKG Counts	Average (cpm)	Standard Deviation (cpm)	MDC (dpm/100 cm²)
Concrete	31	266	34.5	1,251

ATTACHMENT 4.3

COMPASS - DQO Wizard for Building Surface Assessment

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	6,726	1.86	12,510

Statistical Design		Hot Spot Design	
N/2:	10	Actual Scan MDC*:	2,466
Bounded Area (m²):	11.0	Area Factor:	N/A
Area Factor:	1.86	Bounded Area (m²):	N/A
DCGLw*:	6,726	Post-EMC N/2:	10
Scan MDC Required*:	12,510		

* 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

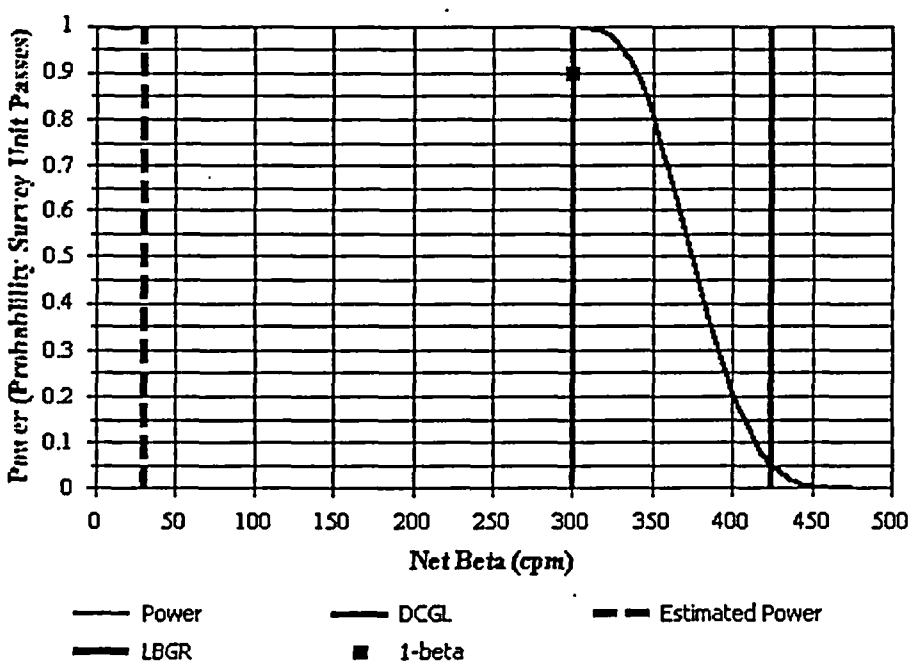
ATTACHMENT 4.4

Building Surface Survey Plan

Survey Plan Summary

Site:	Discharge Tunnel Class 1 Areas		
Planner(s):	BHB		
Survey Unit Name:	Discharge Tunnel SS4		
Comments:	Ceiling of DT		
Area (m²):	108	Classification:	1
Selected Test:	WRS	Estimated Sigma (cpm):	62.1
DCGL (cpm):	424	Sample Size (N/2):	10
LBGR (cpm):	300	Estimated Conc. (cpm):	31
Alpha:	0.050	Estimated Power:	1.00
Beta:	0.100	EMC Sample Size (N):	10

Prospective Power Curve



ATTACHMENT 4.5

Building Surface Survey Plan

Contaminant Summary

Contaminant	DCGLw (dpm/100 cm²)
Gross Activity	6,726

Beta Instrumentation Summary

Gross Beta DCGLw (dpm/100 cm²): 6,726
Total Efficiency: 0.05
Gross Beta DCGLw (cpm): 424

ID	Type	Mode	Area (cm²)
17	GFPC	Beta	126

Contaminant	Energy[1]	Fraction[2]	Inst. Eff.	Surf. Eff.	Total Eff.
Gross Activity	187.87	1.0000	0.48	0.11	0.0540

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

Gross Survey Unit Mean (cpm): 297 ± 62 (1-sigma)
Count Time (min): 1

Material	Number of BKG Counts	Average (cpm)	Standard Deviation (cpm)	MDC (dpm/100 cm²)
Concrete	31	266	34.5	1,251

ATTACHMENT 4.6

COMPASS - DOE Wizard for Building Surface Assessment

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	6,726	1.87	12,578

Statistical Design		Hot Spot Design	
N/2:	10	Actual Scan MDC*:	2,466
Bounded Area (m²):	10.8	Area Factor:	N/A
Area Factor:	1.87	Bounded Area (m²):	N/A
DCGLw*:	6,726	Post-EMC N/2:	10
Scan MDC Required*:	12,578		

* dpm/100 cm²

COMPASS

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

Enable Trainin

v1.0.0

OK

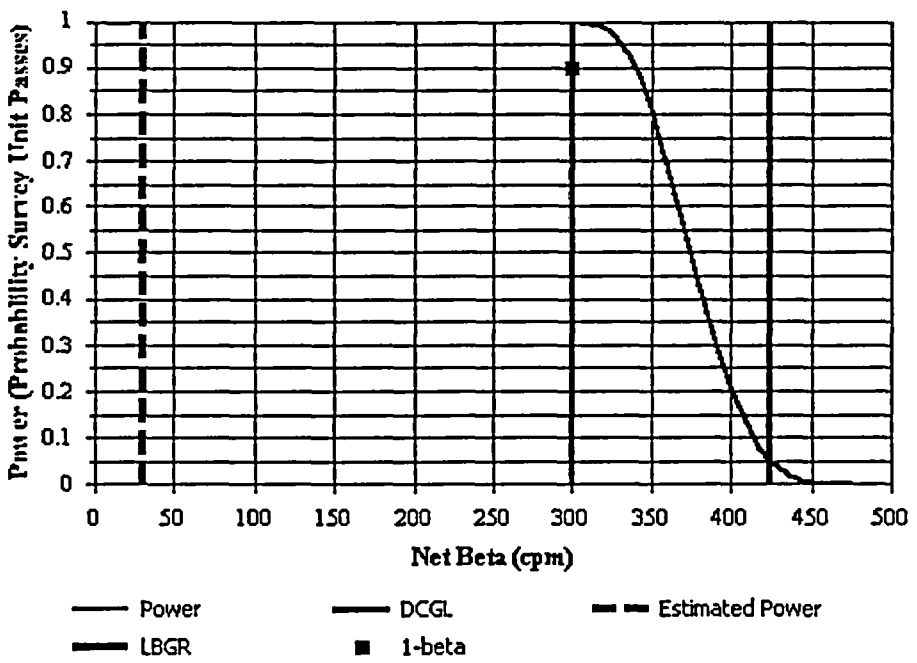
ATTACHMENT 4.7

Building Surface Survey Plan

Survey Plan Summary

Site:	Discharge Tunnel Class 1 Areas		
Planner(s):	BHB		
Survey Unit Name:	Discharge Tunnel SS6-1		
Comments:	South Wall of DT		
Area (m²):	118	Classification:	1
Selected Test:	WRS	Estimated Sigma (cpm):	62.1
DCGL (cpm):	424	Sample Size (N/2):	10
LBGR (cpm):	300	Estimated Conc. (cpm):	31
Alpha:	0.050	Estimated Power:	1.00
Beta:	0.100	EMC Sample Size (N):	10

Prospective Power Curve



ATTACHMENT 4.8

Building Surface Survey Plan

Contaminant Summary

Contaminant	DCGLw (dpm/100 cm²)
Gross Activity	6,726

Beta Instrumentation Summary

Gross Beta DCGLw (dpm/100 cm²): 6,726
Total Efficiency: 0.05
Gross Beta DCGLw (cpm): 424

ID	Type	Mode	Area (cm²)
17	GFPC	Beta	126

Contaminant	Energy[1]	Fraction[2]	Inst. Eff.	Surf. Eff.	Total Eff.
Gross Activity	187.87	1.0000	0.48	0.11	0.0540

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

Gross Survey Unit Mean (cpm): 297 ± 62 (1-sigma)
Count Time (min): 1

Material	Number of BKG Counts	Average (cpm)	Standard Deviation (cpm)	MDC (dpm/100 cm²)
Concrete	31	266	34.5	1,251

ATTACHMENT 4.9

COMPASS - DQO Wizard for Building Surface Assessment

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	6,726	1.80	12,107

Statistical Design		Hot Spot Design	
N/2:	10	Actual Scan MDC*:	2,466
Bounded Area (m²):	11.8	Area Factor:	N/A
Area Factor:	1.80	Bounded Area (m²):	N/A
DCGLw*:	6,726	Post-EMC N/2:	10
Scan MDC Required*:	12,107		

* dpm/100 cm²

COMPASS

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

Enable Trainin

v1.0.0

OK

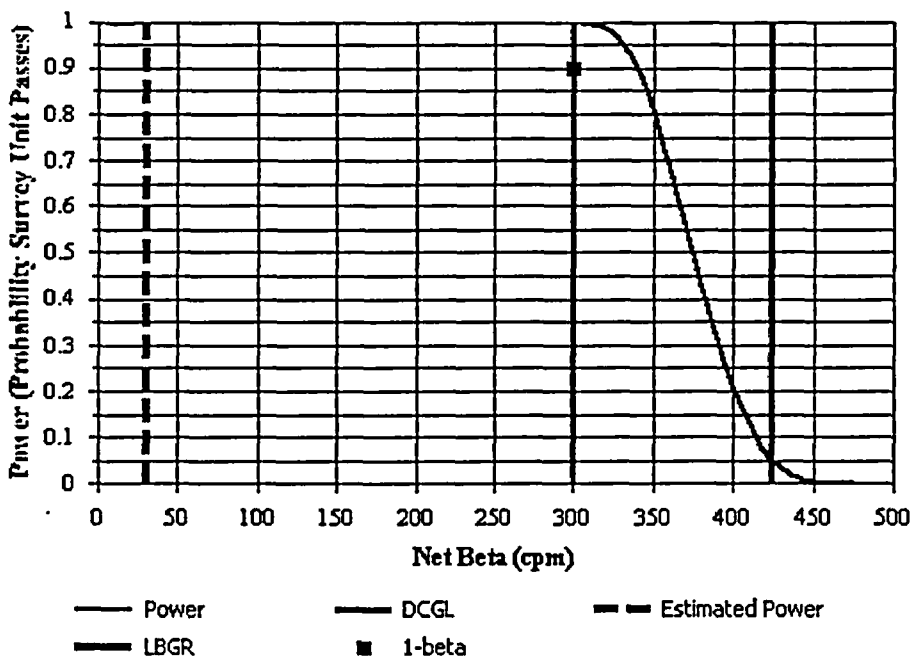
ATTACHMENT 4 . 10

Building Surface Survey Plan

Survey Plan Summary

Site:	Discharge Tunnel Class 1 Areas		
Planner(s):	BHB		
Survey Unit Name:	Discharge Tunnel SS6-2		
Comments:	North Wall of DT		
Area (m²):	135	Classification:	1
Selected Test:	WRS	Estimated Sigma (cpm):	62.1
DCGL (cpm):	424	Sample Size (N/2):	10
LBGR (cpm):	300	Estimated Conc. (cpm):	31
Alpha:	0.050	Estimated Power:	1.00
Beta:	0.100	EMC Sample Size (N):	10

Prospective Power Curve



ATTACHMENT 4 . 11

Building Surface Survey Plan

Contaminant Summary

Contaminant	DCGLw (dpm/100 cm²)
Gross Activity	6,726

Beta Instrumentation Summary

Gross Beta DCGLw (dpm/100 cm²): 6,726
Total Efficiency: 0.05
Gross Beta DCGLw (cpm): 424

ID	Type	Mode	Area (cm²)
17	GFPC	Beta	126

Contaminant	Energy[1]	Fraction[2]	Inst. Eff.	Surf. Eff.	Total Eff.
Gross Activity	187.87	1.0000	0.48	0.11	0.0540

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

Gross Survey Unit Mean (cpm): 297 ± 62 (1-sigma)
Count Time (min): 1

Material	Number of BKG Counts	Average (cpm)	Standard Deviation (cpm)	MDC (dpm/100 cm²)
Concrete	31	266	34.5	1,251

ATTACHMENT 4 . 12

COMPASS - DQO Wizard for Building Surface Assessment

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	6,726	1.68	11,300

Statistical Design

N/2:	10
Bounded Area (m²):	13.5
Area Factor:	1.68
DCGLw*:	6,726
Scan MDC Required*:	11,300

* dpm/100 cm²

Hot Spot Design

Actual Scan MDC*:	2,466
Area Factor:	N/A
Bounded Area (m²):	N/A
Post-EMC N/2:	10

COMPASS

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

OK

Enable Training

v1.0.0

ATTACHMENT 4 . 13

Duratek

Typical

ORIGINAL

CALIBRATION CERTIFICATE

Duratek Instrument Services
628 Gallaher Road
Kingston, TN 37763
Phone: (865) 376-8337
Fax: (865) 376-8331

This Certificate will be accompanied by Calibration Charts or Readings where applicable

CUSTOMER INFORMATION		DETECTOR INFORMATION
Customer Name: Duratek Instrument Services		Manufacturer: Ludlum
Address: 628 Gallaher Rd Kingston, TN 37763		Detector Model: 44-10
Contact Name: Thomas Scott		Serial Number: 196022
Customer Purchase Order Number: N/A	Work Order Number: 2004-01500	Evaluation Method: Source

DETECTOR EFFICIENCY/RESPONSE/PRECISION INFORMATION			
1) Source Nuclide: Cs^{137}	Serial Number: 019454	Activity: 5μCi	Certification Date: N/A (Used for Plateau Only)
2) Source Nuclide: Cs^{137}	Serial Number: 049711	Activity: Variable	Certification Date: 04/09/03

Scaler Information		Precision Test	mR/Hr (Source #2)
2350-1	#126172	Count 1	2.04
Due Date	4/06/2005	Count 2	2.04
Threshold	T=100 (10mV)	Count 3	2.02
Cable Length	5ft.	Average	2.03
N/A	N/A	Tolerance ±10%	All counts within ±10% of Average
N/A	N/A	Pass/Fail	Pass
N/A	N/A		

Low Sample Activity (400uR/hr): Using Source #2 = 73,971	High Sample Activity (2mR/hr) Using Source #2 = 258,839	Dead Time (DT): 1.739467E-05	Calibration Constant (CC): 6.214138E+10

ATTACHMENTS			DETECTOR DATA: DOSE RATE PROBES (mR/Hr)			
Detector Setup Report	YES ✓	NO	Desired Exposure	Tolerance ±10%	As Found	As Left
Barcode Report	YES ✓	NO	0.400	0.360-0.440	0.403	0.403
Voltage Plateau:	YES ✓	NO	1	0.90-1.10	0.956	0.956
High Voltage: 1000V			2	1.8-2.2	2.04	2.04

COMMENTS

Detectors set up with a 2350-1 may be used with any 2350-1 provided that the setup parameters are scanned into the 2350-1 prior to use with that specific detector
Calibrated with 5ft. Cable

STATEMENT OF CERTIFICATION

We Certify that the detector listed above was evaluated for proper operation prior to shipment and that it met all the Manufacturers published operating specifications. We further certify that our Calibration Measurements are traceable to the National Institute of Standards and Technology. (We are not responsible for damage incurred during shipment or use of this detector).

Detector Certified By: Mike Paul	Reviewed By: Thomas G. Scott	Date: 4-6-04
Certification Date: 04/6/04		Certification Due: 04/6/05

ATTACHMENT 5 . 1

Duratek™

ORIGINAL

Typical

CALIBRATION CERTIFICATE

Duratek Instrument Services
628 Gallaher Road
Kingston, TN 37763
Phone: (865) 376-8337
Fax: (865) 376-8331

This Certificate will be accompanied by Calibration Charts or Readings where applicable

CUSTOMER INFORMATION		INSTRUMENT INFORMATION	
Customer Name: Duratek Inc. - Instrument Services Facility		Manufacturer: Ludlum	
Address: 628 Gallaher Road, Kingston, TN 37763		Model: 2350-1	Serial Number: 126172
Contact Name: Thomas Scott		Probe: N/A	Serial Number: N/A
Customer Purchase Order Number: N/A	Work Order Number: 2004-01500	Calibration Method: Electronic and Source	

INSTRUMENT CALIBRATION INFORMATION

Instrument Range (CPM)	Calibration Standard Value (CPM)	Instrument Response		Comments	
		Before Calibration	After Calibration	Calibrated in accordance with IN-WI-239 Rev 0	
400K	400,000	403,896	403,896	Pulser: 101500	Cal Due: 09/18/04
40K	40,000	40,025	40,025	D-814: 2525	Cal Due: 10/22/04
4K	4,000	4,002	4,002	Psychron: 7480	Cal Due: 02/10/05
400	400	401	401	EPPROM Version: 37122N21	
HV Cal Values (M2350 HV Entry)	Desired HV (Voltmeter) (VDC)	As Found (VDC)	As Left (VDC)		
600	600	605	605	Temp:	22.8°C
1,200	1,200	1,203	1,203	Pressure:	745 mmHg
1,800	1,800	1,798	1,798	Humidity:	31%
Parameter	Tolerance (±10%)	As Found	As Left		
Threshold T = 100	10 ± (9 to 11) mVDC	10.2	10.2	Geotropism: SAT	ACK/Scroll: SAT
Threshold T = 500	50 ± (45 to 55) mVDC	48.6	48.6	BAT>4.5: SAT	Volume: SAT
Threshold T = 1000	100 ± (90 to 110) mVDC	98	98	Count: SAT	Audio Divide: SAT
Window Width W = 100	10 ± (9 to 11) mVDC	9.3	9.3	Alarms: SAT	Lamp: SAT
Display-to-mV ratio:	100 to 10 mV			Overload Test: SAT	

STATEMENT OF CERTIFICATION

We Certify that the instrument listed above was calibrated and inspected prior to shipment and that it met all the Manufacturers published operating specifications. We further certify that our Calibration Measurements are traceable to the National Institute of Standards and Technology. (We are not responsible for damage incurred during shipment or use of this instrument).

Instrument Calibrated By: Mike Paul	Reviewed By: Thomas G. Scott	Date: 4-6-04
Calibration Date: 04/06/04	Calibration Due: 04/06/05	

ATTACHMENT 5.2

Typical ORIGINAL

LUDLUM MODEL 44-10 HIGH VOLTAGE PLATEAU DATA SHEET

Serial Number: 196022 .

HIGH VOLTAGE	SOURCE (10 second count)
705	17,537
706	21,507
707	24,743
708	25,998
709	27,826
710 (SET)	28,245
711	28,040
712	26,415
713	25,339
714	22,792

Detector plateau performed using Cs137 #019454 5uCi nominal value button source

Detector Parameters for Peaking

Parameter	Setting	Setting
Threshold (10mV/100)	642	612
Window (On)	40	100
High Voltage	**710**	**710**
CPM/mR/Hr	122,572	208,705
Background CPM	27	63

CPM/mR/Hr conversion performed using Cs137 #049711 Certification Date: 04/09/03

FWHM values performed with Cs137 #019454 (Threshold = 642 and Window = 40)

FWHM = $\frac{679 - 596}{662} \times 100\%$	11.5%

Detector peaked for Cs^{137} using Ludlum peaking procedure and threshold setting of 642 and window setting of 40. As left threshold setting is 612 and window at 100 as requested by John Duskin. 2350-1 #126172 calibration due 04/06/05 used for peaking 44-10 detector.

Performed By: Mike Paul Date: 4/6/04 .

Reviewed By: James T. [illegible] Date: 4-6-04 .

ATTACHMENT 5 3

TYPICAL

ORIGINAL

GFPC Radiation Measurement Instrument Calibration Worksheet

R J Reheard

Performed By:	R. J. Reheard	Date:	6/24/03
Instrument S/N:	95352	Probe S/N:	94818
Instrument Vendor Cal. Date:	12/20/03	Cal. Due Date:	12/20/03

Source No.	ISO 7503-1 Values "Es"	Reference Date	Ao 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

☑ Check if using ISO 7503-1 Value

No.	OW Source Gross CPM	OW Background CPM	OW Source Net CPM
1	1.61E+05	175	1.608E+05
2	1.61E+05	201	1.604E+05
3	1.60E+05	180	1.601E+05
4	1.60E+05	161	1.602E+05
5	1.61E+05	145	1.607E+05
6	1.60E+05	176	1.603E+05
7	1.60E+05	183	1.602E+05
8	1.61E+05	184	1.604E+05
9	1.60E+05	204	1.602E+05
10	1.61E+05	190	1.607E+05
Mean⇒		179.9	1.604E+05

RESULTS
Counts/Emission (εi)
50.9%
2π Emission/Disintigration (εs)
50.0%
Counts/Disintigration (εt)
25.4%

MUST BE AT LEAST 0.478 (47.8%)

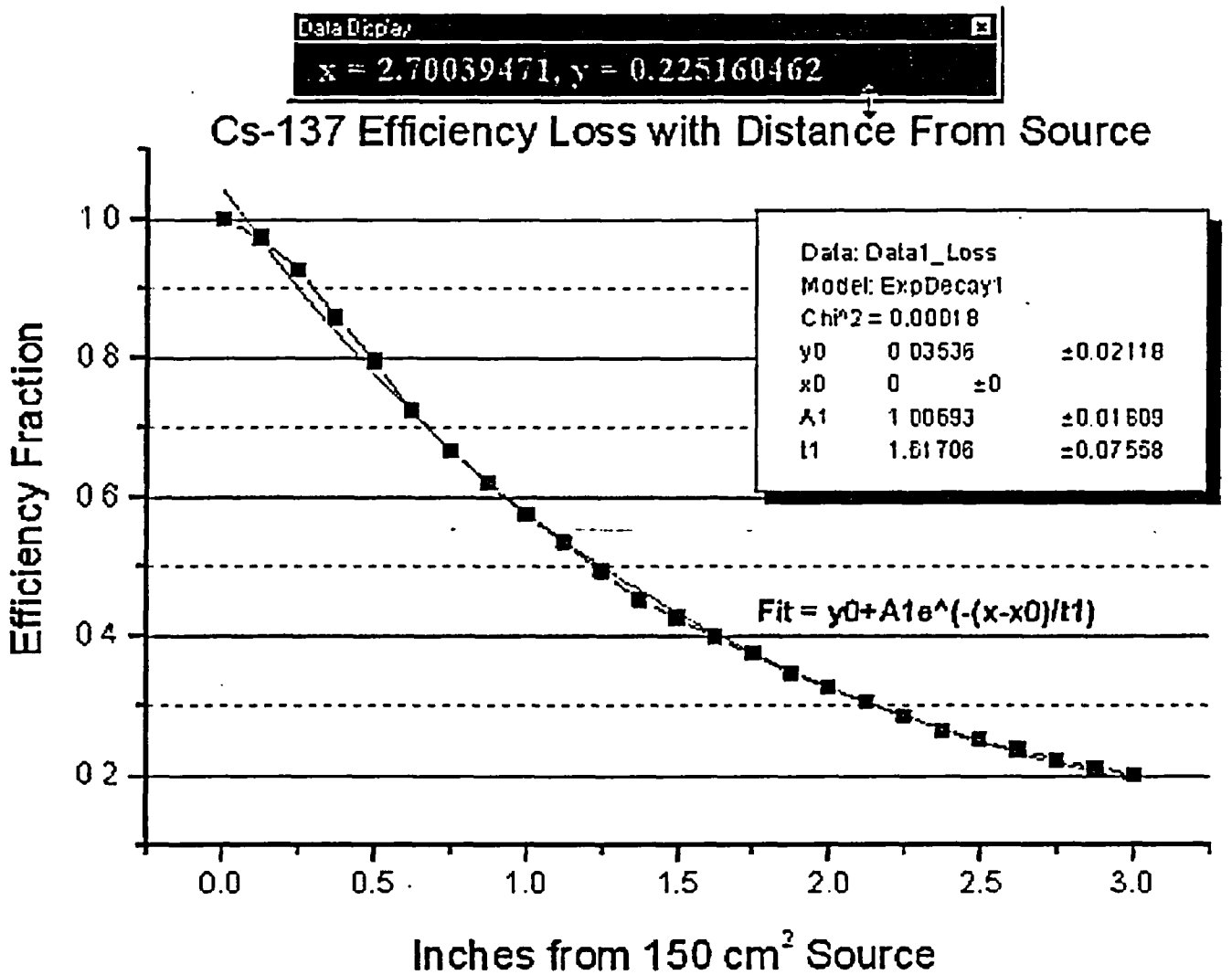
Approved: JWK / JAK

Date: 6/25/03

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

ATTACHMENT 6.1

1



ATTACHMENT 7.1

DCGL Calculation Logic-Discharge Tunnel

I. **Survey Unit:** SNEC Discharge Tunnel

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

III. **Data Selection Logic Tables:** The radionuclide selection logic and subsequent DCGL calculations are provided in seven (7) tables. These tables were developed using Microsoft Excel spreadsheet software. Table explanation is as follows.

Table 1: Data Listing – This table, which has been extracted from a larger database, provides a list of the most representative Discharge Tunnel sample analyses. These results are from scoping, characterization, and pre/post remediation surveys. The samples consist of various sediments, scrapings and concrete cores that were taken in support of the aforementioned surveys. As applicable, a sample number, sample location/description, radionuclide concentration, analysis date are provided for each sample. Positive nuclide concentrations are noted with yellow/shaded background fields while MDAs are noted in the gray shaded fields.

Table 2: Decayed Listing – This table provides the best overall representation of data selected and decayed from Table 1. In Table 1 half-life values (days) are listed above each respective nuclide column. Samples are decayed to the date noted above Table 1 (e.g. January 15, 2004). Positive results are denoted in a yellow background field while MDA values are in a gray background.

Table 3: Decayed Listing of Positive Nuclides & MDAs Removed– This table provides the decayed values of positive nuclides selected in Table 2. In addition MDA values have been removed from this table.

Table 4: Mean Percent of Total for Positive Nuclides – This table provides the calculation methodology for determining the relative fractions of the total activity contributed by each radionuclide. From this information the mean, sigma, and mean % of total are calculated. The mean % of total values is used to calculate the surface gross activity $DCGL_w$ per MARSSIM equation 4-4. See Table 6. Note that the Co-60 mean percents were averaged using only samples 1 & 2. In addition, the mean percents calculated from sample 2 for Am-241, Pu-238, Pu-239 and Ni-63 were not averaged throughout the spreadsheet since there was only one sample where these respective nuclides were positive. This results in higher "mean percent of total" values in the mix, which are conservative.

Table 5: Ratio to Cs-137 for Positive Nuclides – This table provides the calculation methodology for determining the surrogate ratio to Cs-137 for each radionuclide. From this information the mean, sigma, and mean % of total are calculated. The mean % of total values is used to calculate the volumetric $DCGL_w$ per MARSSIM equation I-14. See Table 7. Note that the Co-60 ratios were averaged using only samples 1 & 2. In addition, the ratios calculated from sample 2 for Am-241, Pu-238, Pu-239 and Ni-63 were not averaged throughout the spreadsheet since there was only one sample where these respective nuclides were positive. This results in higher "mean percent of total" values in the mix, which are conservative.

Note: From Tables 4 and 5 only the "mean % of total" values are used as input to the "Effective DCGL Calculation Spreadsheet" as illustrated in Tables 6 and 7.

Table 6: Effective DCGL Calculator for Cs-137 (dpm/100 cm^2) – This table provides the surface gross activity $DCGL_w$ calculation results from data inputted from Table 4.

Table 7: Effective DCGL Calculator for Cs-137 (in pCi/g) – This table provides the surrogate volumetric modified Cs-137 $DCGL_w$ calculation results from data inputted from Table 5.

IV. **Summary** – Since the Discharge Tunnel is a concrete structure the release limit is primarily based on the surface area $DCGL_w$. However, a small portion of the Discharge Tunnel ceiling Class 1 area has volumetric contamination. Using the above data selection logic tables the calculated gross activity $DCGL_w$ for surface area is 8,968 dpm/100 cm^2. The Cs-137 volumetric $DCGL_w$ is 6.52 pCi/g. These values would be reduced by 25% as part of SNEC's requirement to apply an administrative limit as required by the License Termination Plan (LTP).

ATTACHMENT 8.2

TABLE 1 - Data Listing (pCi/g)

														Decay Date	
			T 1/2	T 1/2	T 1/2	T 1/2	T 1/2	T 1/2	T 1/2	T 1/2	T 1/2	T 1/2	T 1/2	January 15, 2004	
			4485.27	10446.15	1925.23275	11019.5925	157861.05	32050.6875	8813847.75	5259.6	2092882.5	36561.525	4967.4		
	SNEC Sample No	Location/Description	H-3	Sr-90	Co-60	Cs-137	Am-241	Pu-238	Pu-239	Pu-241	C-14	Ni-63	Eu-152	Analysis Date	Elapsed Time (d)
1	SX10SD990031	Discharge Tunnel Wall Scraping			0.84	120	0.2	0.04	0.04					July 29, 1999	1631
2	SX10SD990033	Discharge Tunnel 6" Drain Line Scraping	100	8	30	4800	5.4	1.6	2.5	60	6	55	20	July 22, 1999	1638
3	SX5SD99264	SSGS Discharge Tunnel Floor Sediment ~670'			0.2	1.6								November 22, 1999	1515
4	SX5SD99266	SSGS Discharge Tunnel Floor Sediment ~610'			0.3	2.3								November 22, 1999	1515
5	SX5SD99267	SSGS Discharge Tunnel Floor Sediment ~550'			0.16	2								November 22, 1999	1515
6	SXCC4236	SSGS Discharge Tunnel SP-3, Ceiling, Sect 1, Slice 1	0.732	0.0259	0.0237	25.8	0.0181	0.026	0.0159	2.52	0.141	0.54	0.13	October 16, 2003	91
7	SXCW3538	SSGS Discharge Tunnel # 2, Concrete Wall Core - SR-56, Building Structure	2.01	0.0138	0.0663	26.9	0.0876	0.148	0.0119	3.98	0.189	2.43	0.207	May 6, 2003	254
8	SXCW3539	SSGS Discharge, Tunnel # 3, Concrete Wall Core - SR-56, Building Structure	1.99	0.0168	0.13	1.42	0.131	0.26	0.13	4.98	0.17	2.65	0.262	May 6, 2003	254
9	SXCW735	SSGS Tunnel, North Wall - 5'-8" From Floor	10.3	0.03	0.07	22.6	0.044	0.047	0.044	6.57	3.96	7.88	0.33	March 6, 2001	1045
10	SXSD923	SSGS Tunnel, Rubble @ 700', SR-0008	3.69	0.05	0.01	0.15	0.006	0.003	0.003	0.549	0.064	7.02	0.05	May 22, 2001	968

TABLE 2 - Decayed Listing (pCi/g)

	SNEC Sample No	Location/Description	H-3	Sr-90	Co-60	Cs-137	Am-241	Pu-238	Pu-239	Pu-241	C-14	Ni-63	Eu-152	Analysis Date
1	SX10SD990031	Discharge Tunnel Wall Scraping			4.67E-01	1.08E+02	1.99E-01	3.86E-02	4.00E-02					July 29, 1999
2	SX10SD990033	Discharge Tunnel 6" Drain Line Scraping	7.76E+01	7.18E+00	1.66E+01	4.33E+03	5.36E+00	1.54E+00	2.50E+00	4.84E+01	6.00E+00	5.33E+01	1.59E+01	July 22, 1999
3	SX5SD99264	SSGS Discharge Tunnel Floor Sediment ~670'			1.16E-01	1.45E+00								November 22, 1999
4	SX5SD99266	SSGS Discharge Tunnel Floor Sediment ~610'			1.74E-01	2.09E+00								November 22, 1999
5	SX5SD99267	SSGS Discharge Tunnel Floor Sediment ~550'			9.27E-02	1.82E+00								November 22, 1999
6	SXCC4236	SSGS Discharge Tunnel SP-3, Ceiling, Sect 1, Slice 1	7.22E-01	2.57E-02	2.29E-02	2.57E+01	1.81E-02	2.59E-02	1.59E-02	2.49E+00	1.41E-01	5.39E-01	1.28E-01	October 16, 2003
7	SXCW3538	SSGS Discharge Tunnel # 2, Concrete Wall Core - SR-56, Building Structure	1.93E+00	1.36E-02	6.05E-02	2.65E+01	8.75E-02	1.47E-01	1.19E-02	3.85E+00	1.89E-01	2.42E+00	2.00E-01	May 6, 2003
8	SXCW3539	SSGS Discharge, Tunnel # 3, Concrete Wall Core - SR-56, Building Structure	1.91E+00	1.65E-02	1.19E-01	1.40E+00	1.31E-01	0.26	1.30E-01	4.82E+00	1.70E-01	2.64E+00	2.53E-01	May 6, 2003
9	SXCW735	SSGS Tunnel, North Wall - 5'-8" From Floor	8.76E+00	2.80E-02	4.81E-02	2.12E+01	4.38E-02	4.59E-02	4.40E-02	5.72E+00	3.96E+00	7.73E+00	2.85E-01	March 6, 2001
10	SXSD923	SSGS Tunnel, Rubble @ 700', SR-0008	3.18E+00	4.69E-02	7.06E-03	1.41E-01	5.97E-03	2.94E-03	3.00E-03	4.83E-01	6.40E-02	6.89E+00	4.37E-02	May 22, 2001
		Mean⇒	1.57E+01	1.22E+00	1.77E+00	4.52E+02	8.35E-01	2.95E-01	3.92E-01	1.10E+01	1.75E+00	1.23E+01	2.80E+00	499.84
		Sigma⇒	30.481	2.919	5.224	1363.086	1.997	0.558	0.930	18.414	2.580	20.308	6.423	
		Mean % of Total⇒	3.14%	0.24%	0.35%	90.40%	0.17%	0.06%	0.08%	2.19%	0.35%	2.45%	0.56%	100.00%

KEY	
	Yellow Shaded Background = Positive Result
	Gray Shaded Background = MDA

C01

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

	SNEC Sample No	Location/Description	Co-60	Cs-137	Am-241	Pu-238	Pu-239	Ni-63	Total (pCi/g)
1	SX10SD990031	Discharge Tunnel Wall Scraping	4.67E-01	1.08E+02					108.77
2	SX10SD990033	Discharge Tunnel 6" Drain Line Scraping	1.66E+01	4.33E+03	5.36E+00	1.54E+00	2.50E+00	5.33E+01	4409.52
3	SX5SD99264	SSGS Discharge Tunnel Floor Sediment ~670'		1.45E+00					1.45
4	SX5SD99266	SSGS Discharge Tunnel Floor Sediment ~610'		2.09E+00					2.09
5	SX5SD99267	SSGS Discharge Tunnel Floor Sediment ~550'		1.82E+00					1.82
6	SXCC4236	SSGS Discharge Tunnel SP-3, Ceiling, Sect 1, Slice 1		2.57E+01					25.65
7	SXCW3536	SSGS Discharge Tunnel # 2, Concrete Wall Core - SR-56, Building Structure		2.65E+01					26.47
8	SXCW3539	SSGS Discharge, Tunnel # 3, Concrete Wall Core - SR-56, Building Structure		1.40E+00					1.40
9	SXCW735	SSGS Tunnel, North Wall - 5'-8" From Floor		2.12E+01					21.16
10	SXSD923	SSGS Tunnel, Rubble @ 700', SR-0006		1.41E-01					0.14
		Mean⇒	8.55E+00	4.52E+02	5.36E+00	1.54E+00	2.50E+00	5.33E+01	523.14
		Sigma⇒	11.433	1363.086					
		Mean % of Total⇒	1.63%	86.38%	1.02%	0.30%	0.48%	10.19%	100.00%

TABLE 4 - Mean Percent of Total for Positive Nuclides

	SNEC Sample No	Location/Description	Co-60	Cs-137	Am-241	Pu-238	Pu-239	Ni-63	Total
1	SX10SD990031	Discharge Tunnel Wall Scraping	0.43%	99.57%					100.00%
2	SX10SD990033	Discharge Tunnel 6" Drain Line Scraping	0.38%	98.20%	0.12%	0.04%	0.06%	1.21%	100.00%
3	SX5SD99264	SSGS Discharge Tunnel Floor Sediment ~670'		100.00%					100.00%
4	SX5SD99266	SSGS Discharge Tunnel Floor Sediment ~610'		100.00%					100.00%
5	SX5SD99267	SSGS Discharge Tunnel Floor Sediment ~550'		100.00%					100.00%
6	SXCC4236	SSGS Discharge Tunnel SP-3, Ceiling, Sect 1, Slice 1		100.00%					100.00%
7	SXCW3536	SSGS Discharge Tunnel # 2, Concrete Wall Core - SR-56, Building Structure		100.00%					100.00%
8	SXCW3539	SSGS Discharge, Tunnel # 3, Concrete Wall Core - SR-56, Building Structure		100.00%					100.00%
9	SXCW735	SSGS Tunnel, North Wall - 5'-8" From Floor		100.00%					100.00%
10	SXSD923	SSGS Tunnel, Rubble @ 700', SR-0006		100.00%					100.00%
		Mean⇒	4.03E-03	9.98E-01	1.22E-03	3.50E-04	5.67E-04	1.21E-02	1.02
		Sigma⇒	0.0004	0.006					
		Mean % of Total⇒	0.40%	98.20%	0.12%	0.03%	0.06%	1.19%	100.00%

TABLE 5 - Ratio to Cs-137 for Positive Nuclides

	SNEC Sample No	Location/Description	Co-60	Cs-137	Am-241	Pu-238	Pu-239	Ni-63	Total
1	SX10SD990031	Discharge Tunnel Wall Scraping	4.31E-03	1.00E+00					1.00
2	SX10SD990033	Discharge Tunnel 6" Drain Line Scraping	3.84E-03	1.00E+00	1.24E-03	3.57E-04	5.77E-04	1.23E-02	1.02
3	SX5SD99264	SSGS Discharge Tunnel Floor Sediment ~670'		1.00E+00					1.00
4	SX5SD99266	SSGS Discharge Tunnel Floor Sediment ~610'		1.00E+00					1.00
5	SX5SD99267	SSGS Discharge Tunnel Floor Sediment ~550'		1.00E+00					1.00
6	SXCC4236	SSGS Discharge Tunnel SP-3, Ceiling, Sect 1, Slice 1		1.00E+00					1.00
7	SXCW3536	SSGS Discharge Tunnel # 2, Concrete Wall Core - SR-56, Building Structure		1.00E+00					1.00
8	SXCW3539	SSGS Discharge, Tunnel # 3, Concrete Wall Core - SR-56, Building Structure		1.00E+00					1.00
9	SXCW735	SSGS Tunnel, North Wall - 5'-8" From Floor		1.00E+00					1.00
10	SXSD923	SSGS Tunnel, Rubble @ 700', SR-0006		1.00E+00					1.00
		Mean⇒	4.08E-03	1.00E+00	1.24E-03	3.57E-04	5.77E-04	1.23E-02	1.02
		Sigma⇒	0.0003	0.0000					
		Mean % of Total⇒	0.40%	98.18%	0.12%	0.04%	0.06%	1.21%	100.00%

C02

Table 6

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

Gross Activity DCGLw		Gross Activity Administrative Limit	
8968	dpm/100 cm^2	6726	dpm/100 cm^2

25.0 mrem/y TEDE Limit

Cs-137 Limit		Cs-137 Administrative Limit	
8807	dpm/100 cm^2	6605	dpm/100 cm^2

SAMPLE ID(s)⇒ Discharge Tunnel

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	1.22E-03	0.120%	27	10.77	9.97	N/A	10.77	Am-241
2	C-14		0.000%	3,700,000	0.00	0.00	0.00	N/A	C-14
3	Co-60	4.03E-03	0.397%	7,100	35.56	0.13	35.56	N/A	Co-60
4	Cs-137	9.98E-01	98.203%	28,000	8806.99	7.86	8807.0	N/A	Cs-137
5	Eu-152		0.000%	13,000	0.00	0.00	0.00	N/A	Eu-152
6	H-3		0.000%	120,000,000	0.00	0.00	Not Detectable	N/A	H-3
7	Ni-63	1.21E-02	1.191%	1,800,000	106.78	0.00	Not Detectable	N/A	Ni-63
8	Pu-238	3.50E-04	0.034%	30	3.09	2.57	N/A	3.09	Pu-238
9	Pu-239	5.67E-04	0.056%	28	5.00	4.47	N/A	5.00	Pu-239
10	Pu-241		0.000%	880	0.00	0.00	Not Detectable	N/A	Pu-241
11	Sr-90		0.000%	8,700	0.00	0.00	0.00	N/A	Sr-90
			100.000%		8968	25.0	8843	19	
					Maximum Permissible dpm/100 cm^2				

ATTACHMENT 8.5

Table 7

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

SNEC AL	75%	Total Activity Limit DCGLw		Administrative Limit	
		6.64	pCi/g	4.98	pCi/g

Cs-137 Limit		Cs-137 Administrative Limit	
6.52	pCi/g	4.89	pCi/g

SAMPLE NUMBER(s)⇒ Discharge Tunnel

15.34%	25.0	mrem/y TEDE Limit
0.55%	4.0	mrem/y Drinking Water (DW) Limit

☑ Check for 25 mrem/y

	Isotope	Sample Input (pCi/g, uCi, % of Total, etc.)	% of Total	25 mrem/y TEDE Limits (pCi/g)	4 mrem/y DW Limits (pCi/g)	A - Allowed pCi/g for 25 mrem/y TEDE	B - Allowed pCi/g for 4 mrem/y DW	Value Checked from Column A or B	This Sample mrem/y TEDE	This Sample mrem/y DW	
1	Am-241	0.001	0.122%	9.9	2.3	0.01	0.22	0.01	0.00	0.00	Am-241
2	C-14		0.000%	2.0	5.4	0.00	0.00	0.00	0.00	0.00	C-14
3	Co-60	0.0041	0.401%	3.5	67.0	0.03	0.74	0.03	0.03	0.00	Co-60
4	Cs-137	1.0000	98.178%	6.6	397	6.52	180.19	6.52	3.79	0.01	Cs-137
5	Eu-152		0.000%	10.1	1440	0.00	0.00	0.00	0.00	0.00	Eu-152
6	H-3		0.000%	132	31.1	0.00	0.00	0.00	0.00	0.00	H-3
7	Ni-63	0.0123	1.208%	747	19000	0.08	2.22	0.08	0.00	0.00	Ni-63
8	Pu-238	0.0004	0.035%	1.8	0.41	0.00	0.06	0.00	0.00	0.00	Pu-238
9	Pu-239	0.0006	0.057%	1.6	0.37	0.00	0.10	0.00	0.01	0.01	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		0.000%	1.2	0.61	0.00	0.00	0.00	0.00	0.00	Sr-90
		1.02E+00	100.000%			6.64	183.53	6.64	3.835	0.022	
						Maximum Permissible pCi/g (25 mrem/y)	Maximum Permissible pCi/g (4 mrem/y)		To Use This Information, Sample Input Units Must Be In pCi/g *not % of Total.*		

ATTACHMENT 8.6

Nal Scan MDC Calculation - Concrete Surface

$b := 100$ $p := 0.5$ $HS_d := 30.48$ $SR := 5$ $d := 1.38$

$Conv := 208.$ $MS_{output} := 7.865 \cdot 10^{-5}$

$\frac{HS_d}{SR} = 6.096$ *Observation Interval (seconds)*

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

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

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

$MDCR_i = 43.294$ *net counts per minute*

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

$MDCR_{surveyor} = 61.228$ *net counts per minute*

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

$MDER = 0.294$ µR/h

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

$MDC_{scan} = 3.743$ pCi/g

NaI Scan MDC Calculation - Concrete Surface

$b := 200$ $p := 0.5$ $HS_d := 30.48$ $SR := 5$ $d := 1.38$

$Conv := 208.$ $MS_{output} := 7.865 \cdot 10^{-5}$

$\frac{HS_d}{SR} = 6.096$ *Observation Interval (seconds)*

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

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

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

$MDCR_i = 61.228$ *net counts per minute*

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

$MDCR_{surveyor} = 86.589$ *net counts per minute*

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

$MDER = 0.416$ μR/h

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

$MDC_{scan} = 5.293$ pCi/g

Nal Scan MDC Calculation - Surface Deposition

$b := 100$ $p := 0.5$ $HS_d := 30.48$ $SR := 5$ $d := 1.38$

$Conv := 208.$ $MS_{output} := 1.501 \cdot 10^{-5}$ $O_i := \frac{HS_d}{SR}$

$O_i = 6.096$ *Observation Interval (seconds)*

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

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

$MDCR_i = 43.294$ *net counts per minute*

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

$MDCR_{surveyor} = 61.228$ *net counts per minute*

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

$MDER = 0.294$ μR/h

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

$MDC_{scan} = 19.611$ pCi/cm^2

$MDC_{scan} \cdot 222 = 4353.677$ *dpm/100 cm^2*

where:

b = background in counts per minute

b_i = background counts in observation interval

Conv = NaI manufacturers or calibration information 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/cm^2)

$MDCR_i$ = 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/cm^2 of contaminant (mR/h)

O_i = obervation Interval (seconds)

p = human performance factor

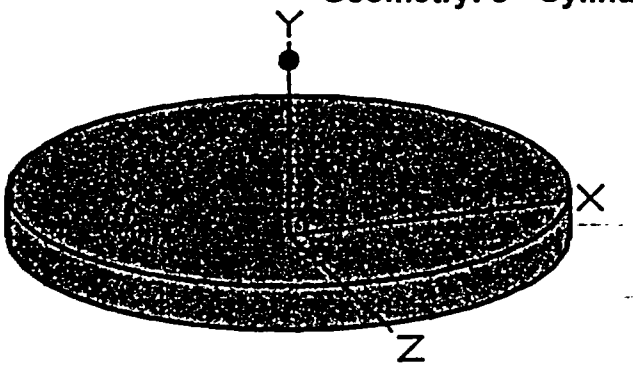
SR = scan rate in centimeters per second

MicroShield v5.05 (5.05-00121)
GPU Nuclear

Page : 1
DOS File : 12SLAB.MS5
Run Date: May 9, 2004
Run Time: 8:06:59 AM
Duration : 00:00:01

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

Case Title: 12" Diameter
Description: Slab - 1" Thick, Cs-137 Source Term
Geometry: 8 - Cylinder Volume - End Shields



Source Dimensions

Height	2.54 cm	1.0 in
Radius	15.24 cm	6.0 in

Dose Points

	X	Y	Z
# 1	0 cm	10.16 cm	0 cm
	0.0 in	4.0 in	0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	1853.333 cm³	Concrete	2.35
Air Gap		Air	0.00122

Source Input
Grouping Method : Actual Photon Energies

Nuclide	curies	becquerels	µCi/cm³	Bq/cm³
Ba-137m	4.1201e-009	1.5245e+002	2.2231e-006	8.2255e-002
Cs-137	4.3553e-009	1.6115e+002	2.3500e-006	8.6950e-002

Buildup
The material reference is : Source

Integration Parameters

Radial	40
Circumferential	40
Y Direction (axial)	40

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0318	3.156e+00	6.355e-06	7.682e-06	5.293e-08	6.399e-08
0.0322	5.823e+00	1.222e-05	1.486e-05	9.832e-08	1.196e-07
0.0364	2.119e+00	6.726e-06	8.749e-06	3.821e-08	4.971e-08
0.6616	1.372e+02	3.202e-02	4.057e-02	6.207e-05	7.865e-05

ATTACHMENT 9 . 5

Page : 2
DOS File : 12SLAB.MS5
Run Date: May 9, 2004
Run Time: 8:06:59 AM
Duration : 00:00:01

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
TOTALS:	1.483e+02	3.204e-02	4.060e-02	6.226e-05	7.888e-05

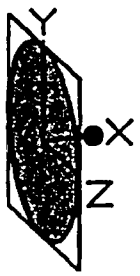
ATTACHMENT 9.6

MicroShield v5.05 (5.05-00121)
GPU Nuclear

Page : 1
DOS File : PLATE.MS5
Run Date: May 10, 2004
Run Time: 11:03:01 AM
Duration : 00:00:00

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

Case Title: Steel Surface
Description: 12 Inch Diameter, 1/8" Layer of Oxide
Geometry: 3 - Disk



Source Dimensions

Radius	15.24 cm	6.0 in

Dose Points

	X	Y	Z
# 1	7.9375 cm	0 cm	0 cm
	3.1 in	0.0 in	0.0 in

Shields

Shield Name	Dimension	Material	Density
Shield 1	.318 cm	Iron Oxide	5.1
Air Gap		Air	0.00122

Source Input
Grouping Method : Actual Photon Energies

Nuclide	curies	becquerels	µCi/cm²	Bq/cm²
Ba-137m	6.9026e-010	2.5540e+001	9.4600e-007	3.5002e-002
Cs-137	7.2966e-010	2.6997e+001	1.0000e-006	3.7000e-002

Buildup
The material reference is : Shield 1

Integration Parameters

Radial	40
Circumferential	40

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0318	5.287e-01	5.790e-10	6.708e-10	4.823e-12	5.588e-12
0.0322	9.755e-01	1.437e-09	1.670e-09	1.157e-11	1.344e-11
0.0364	3.550e-01	7.253e-09	8.719e-09	4.121e-11	4.954e-11
0.6616	2.298e+01	6.714e-03	7.745e-03	1.302e-05	1.501e-05
TOTALS:	2.484e+01	6.714e-03	7.745e-03	1.302e-05	1.501e-05

ATTACHMENT 9.7

Williamsburg Concrete Background Measurements

37122N21	Instrument 95348	RLM6220	Time	Detector	Counts	Count Time (sec)	Mode	Designator		FSS-001	BHB
0	BKGND	1/4/02	08:52	1	7.26E+03	1800	SCL	Inital Background	β	*Correction Factor*	
1	Source Check	1/4/02	09:07	1	1.79E+05	60	SCL	Source	β	40	
2	BKGND	1/4/02	10:05	2	4.40E+01	1800	SCL	Inital Background	α		
14	Source Check	1/4/02	10:39	2	1.51E+05	60	SCL	Source	α	**Shielded**	**Unshielded**
15	CON A1S	1/4/02	13:00	1	2.78E+02	60	SCL	Shielded	β	2.78E+02	
16	CON A1U	1/4/02	13:02	1	3.88E+02	60	SCL	Unshielded	β		3.48E+02
17	CON A2S	1/4/02	13:20	1	2.39E+02	60	SCL	Shielded	β	2.39E+02	
18	CON A2U	1/4/02	13:21	1	2.22E+02	60	SCL	Unshielded	β		1.82E+02
19	CON A3S	1/4/02	13:28	1	2.39E+02	60	SCL	Shielded	β	2.39E+02	
20	CON A3U	1/4/02	13:30	1	2.62E+02	60	SCL	Unshielded	β		2.22E+02
21	CON A4S	1/4/02	13:36	1	2.45E+02	60	SCL	Shielded	β	2.45E+02	
22	CON A4U	1/4/02	13:38	1	2.71E+02	60	SCL	Unshielded	β		2.31E+02
23	CON A5S	1/4/02	13:58	1	2.00E+02	60	SCL	Shielded	β	2.00E+02	
24	CON A5U	1/4/02	14:00	1	2.82E+02	60	SCL	Unshielded	β		2.42E+02
25	CON A6S	1/4/02	14:03	1	1.84E+02	60	SCL	Shielded	β	1.84E+02	
26	CON A6U	1/4/02	14:05	1	3.10E+02	60	SCL	Unshielded	β		2.70E+02
27	CON A7S	1/4/02	14:09	1	1.98E+02	60	SCL	Shielded	β	1.98E+02	
28	CON A7U	1/4/02	14:10	1	3.15E+02	60	SCL	Unshielded	β		2.75E+02
29	CON A8S	1/4/02	14:19	1	2.34E+02	60	SCL	Shielded	β	2.34E+02	
30	CON A8S	1/4/02	14:22	1	2.31E+02	60	SCL	Shielded	β	2.31E+02	
31	CON A8U	1/4/02	14:24	1	2.88E+02	60	SCL	Unshielded	β		2.48E+02
32	CON A9S	1/4/02	14:31	1	2.65E+02	60	SCL	Shielded	β	2.65E+02	
33	CON A9U	1/4/02	14:33	1	2.89E+02	60	SCL	Unshielded	β		2.49E+02
34	CON A10S	1/4/02	14:42	1	2.46E+02	60	SCL	Shielded	β	2.46E+02	
35	CON A10U	1/4/02	14:43	1	3.16E+02	60	SCL	Unshielded	β		2.76E+02
36	CON A11S	1/4/02	15:10	1	1.95E+02	60	SCL	Shielded	β	1.95E+02	
37	CON A11U	1/4/02	15:12	1	2.94E+02	60	SCL	Unshielded	β		2.54E+02
38	CON A12S	1/4/02	15:13	1	2.21E+02	60	SCL	Shielded	β	2.21E+02	
39	CON A12U	1/4/02	15:14	1	2.84E+02	60	SCL	Unshielded	β		2.44E+02
40	CON A13S	1/4/02	15:23	1	1.74E+02	60	SCL	Shielded	β	1.74E+02	
41	CON A13U	1/4/02	15:24	1	2.94E+02	60	SCL	Unshielded	β		2.54E+02
42	CON A14S	1/4/02	15:25	1	1.96E+02	60	SCL	Shielded	β	1.96E+02	
43	CON A14U	1/4/02	15:26	1	3.33E+02	60	SCL	Unshielded	β		2.93E+02
44	CON A15S	1/4/02	15:28	1	2.16E+02	60	SCL	Shielded	β	2.16E+02	
45	CON A15U	1/4/02	15:29	1	3.45E+02	60	SCL	Unshielded	β		3.05E+02
46	CON A16S	1/4/02	15:30	1	1.83E+02	60	SCL	Shielded	β	1.83E+02	
47	CON A16U	1/4/02	15:31	1	3.13E+02	60	SCL	Unshielded	β		2.73E+02
48	CON A17S	1/4/02	15:33	1	1.82E+02	60	SCL	Shielded	β	1.82E+02	
49	CON A17U	1/4/02	15:34	1	3.22E+02	60	SCL	Unshielded	β		2.82E+02
50	CON A18S	1/4/02	15:35	1	1.84E+02	60	SCL	Shielded	β	1.84E+02	
51	CON A18U	1/4/02	15:36	1	3.24E+02	60	SCL	Unshielded	β		2.84E+02
52	CON A19S	1/4/02	15:37	1	1.91E+02	60	SCL	Shielded	β	1.91E+02	
53	CON A19U	1/4/02	15:39	1	3.07E+02	60	SCL	Unshielded	β		2.67E+02
54	CON A20S	1/4/02	15:40	1	1.94E+02	60	SCL	Shielded	β	1.94E+02	
55	CON A20U	1/4/02	15:41	1	3.33E+02	60	SCL	Unshielded	β		2.93E+02
56	CON A21S	1/4/02	15:57	1	2.23E+02	60	SCL	Shielded	β	2.23E+02	
57	CON A21U	1/4/02	15:58	1	2.92E+02	60	SCL	Unshielded	β		2.52E+02
58	CON A22S	1/4/02	15:59	1	1.72E+02	60	SCL	Shielded	β	1.72E+02	
59	CON A22U	1/4/02	16:00	1	2.80E+02	60	SCL	Unshielded	β		2.40E+02
60	CON A23S	1/4/02	16:01	1	1.94E+02	60	SCL	Shielded	β	1.94E+02	
61	CON A23U	1/4/02	16:02	1	3.29E+02	60	SCL	Unshielded	β		2.89E+02
62	CON A24S	1/4/02	16:04	1	1.87E+02	60	SCL	Shielded	β	1.87E+02	
63	CON A24U	1/4/02	16:05	1	3.48E+02	60	SCL	Unshielded	β		3.08E+02
64	CON A25S	1/4/02	16:06	1	2.07E+02	60	SCL	Shielded	β	2.07E+02	
65	CON A25U	1/4/02	16:07	1	3.72E+02	60	SCL	Unshielded	β		3.32E+02
66	CON A26S	1/4/02	16:09	1	2.09E+02	60	SCL	Shielded	β	2.09E+02	
67	CON A26U	1/4/02	16:10	1	3.26E+02	60	SCL	Unshielded	β		2.86E+02
68	CON A27S	1/4/02	16:11	1	2.07E+02	60	SCL	Shielded	β	2.07E+02	
69	CON A27U	1/4/02	16:12	1	3.30E+02	60	SCL	Unshielded	β		2.90E+02
70	CON A28S	1/4/02	16:14	1	2.30E+02	60	SCL	Shielded	β	2.30E+02	
71	CON A28U	1/4/02	16:15	1	3.06E+02	60	SCL	Unshielded	β		2.66E+02
72	CON A29S	1/4/02	16:20	1	2.13E+02	60	SCL	Shielded	β	2.13E+02	
73	CON A29U	1/4/02	16:21	1	2.58E+02	60	SCL	Unshielded	β		2.18E+02
74	CON A30S	1/4/02	16:24	1	2.33E+02	60	SCL	Shielded	β	2.33E+02	
75	CON A30U	1/4/02	16:25	1	2.89E+02	60	SCL	Unshielded	β		2.49E+02
76	CON A31S	1/4/02	16:28	1	1.84E+02	60	SCL	Shielded	β	1.84E+02	
77	CON A31U	1/4/02	16:29	1	2.63E+02	60	SCL	Unshielded	β		2.23E+02
---	Source Check	1/4/02	17:27	1	1.70E+05	60	SCL	---	β		
								Minimum ⇒		1.72E+02	1.82E+02
								Maximum ⇒		2.78E+02	3.48E+02
								Mean ⇒		2.11E+02	2.66E+02
								Sigma ⇒		2.69E+01	3.45E+01

ATTACHMENT 10.1

Discharge Tunnel Concrete Variability Measurements - 2

	Instrument 80500	BB7173	Time	Detector	Counts	Count Time (sec)	Mode	Designator		FSS-178	BHB
2	DTUNL FP1S	7/15/03	08:47	1	1.59E+02	60	SCL	Shielded	β	1.59E+02	
3	DTUNL FP1U	7/15/03	08:48	1	3.97E+02	60	SCL	Unshielded	β		3.97E+02
4	DTUNL FP2S	7/15/03	08:51	1	1.82E+02	60	SCL	Shielded	β	1.82E+02	
5	DTUNL FP2U	7/15/03	08:52	1	2.10E+02	60	SCL	Unshielded	β		2.10E+02
6	DTUNL FP3S	7/15/03	08:55	1	1.73E+02	60	SCL	Shielded	β	1.73E+02	
7	DTUNL FP3U	7/15/03	09:00	1	2.75E+02	60	SCL	Unshielded	β		2.75E+02
8	DTUNL FP4S	7/15/03	09:02	1	1.82E+02	60	SCL	Shielded	β	1.82E+02	
9	DTUNL FP4U	7/15/03	09:03	1	2.87E+02	60	SCL	Unshielded	β		2.87E+02
10	DTUNL FP5S	7/15/03	09:06	1	1.71E+02	60	SCL	Shielded	β	1.71E+02	
11	DTUNL FP5U	7/15/03	09:07	1	2.45E+02	60	SCL	Unshielded	β		2.45E+02
12	DTUNL FP6S	7/15/03	09:09	1	1.69E+02	60	SCL	Shielded	β	1.69E+02	
13	DTUNL FP6U	7/15/03	09:10	1	3.23E+02	60	SCL	Unshielded	β		3.23E+02
14	DTUNL FP7S	7/15/03	09:13	1	1.95E+02	60	SCL	Shielded	β	1.95E+02	
15	DTUNL FP7U	7/15/03	09:14	1	2.90E+02	60	SCL	Unshielded	β		2.90E+02
16	DTUNL FP8S	7/15/03	09:16	1	1.82E+02	60	SCL	Shielded	β	1.82E+02	
17	DTUNL FP8U	7/15/03	09:17	1	2.89E+02	60	SCL	Unshielded	β		2.89E+02
18	DTUNL FP9S	7/15/03	09:20	1	1.63E+02	60	SCL	Shielded	β	1.63E+02	
19	DTUNL FP9U	7/15/03	09:21	1	2.83E+02	60	SCL	Unshielded	β		2.83E+02
20	DTUNL FP10S	7/15/03	09:23	1	1.64E+02	60	SCL	Shielded	β	1.64E+02	
21	DTUNL FP10U	7/15/03	09:24	1	3.09E+02	60	SCL	Unshielded	β		3.09E+02
24	DTUNL FP11S	7/15/03	09:30	1	1.52E+02	60	SCL	Shielded	β	1.52E+02	
25	DTUNL FP11U	7/15/03	09:31	1	1.76E+02	60	SCL	Unshielded	β		1.76E+02
26	DTUNL FP12S	7/15/03	09:33	1	1.26E+02	60	SCL	Shielded	β	1.26E+02	
27	DTUNL FP12U	7/15/03	09:34	1	1.91E+02	60	SCL	Unshielded	β		1.91E+02
28	DTUNL FP13S	7/15/03	09:35	1	1.33E+02	60	SCL	Shielded	β	1.33E+02	
29	DTUNL FP13U	7/15/03	09:36	1	2.30E+02	60	SCL	Unshielded	β		2.30E+02
30	DTUNL FP14S	7/15/03	09:38	1	1.50E+02	60	SCL	Shielded	β	1.50E+02	
31	DTUNL FP14U	7/15/03	09:39	1	1.90E+02	60	SCL	Unshielded	β		1.90E+02
32	DTUNL FP15S	7/15/03	09:41	1	1.47E+02	60	SCL	Shielded	β	1.47E+02	
33	DTUNL FP15U	7/15/03	09:42	1	2.48E+02	60	SCL	Unshielded	β		2.48E+02
34	DTUNL FP16S	7/15/03	09:45	1	1.69E+02	60	SCL	Shielded	β	1.69E+02	
35	DTUNL FP16U	7/15/03	09:47	1	2.39E+02	60	SCL	Unshielded	β		2.39E+02
36	DTUNL FP17S	7/15/03	09:51	1	1.86E+02	60	SCL	Shielded	β	1.86E+02	
37	DTUNL FP17U	7/15/03	09:53	1	3.25E+02	60	SCL	Unshielded	β		3.25E+02
38	DTUNL FP18S	7/15/03	09:55	1	1.81E+02	60	SCL	Shielded	β	1.81E+02	
39	DTUNL FP18U	7/15/03	09:56	1	3.29E+02	60	SCL	Unshielded	β		3.29E+02
40	DTUNL FP19S	7/15/03	09:59	1	1.53E+02	60	SCL	Shielded	β	1.53E+02	
41	DTUNL FP19U	7/15/03	10:00	1	3.15E+02	60	SCL	Unshielded	β		3.15E+02
42	DTUNL FP20S	7/15/03	10:02	1	1.81E+02	60	SCL	Shielded	β	1.81E+02	
43	DTUNL FP20U	7/15/03	10:04	1	3.43E+02	60	SCL	Unshielded	β		3.43E+02
44	DTUNL FP21S	7/15/03	10:07	1	1.94E+02	60	SCL	Shielded	β	1.94E+02	
45	DTUNL FP21U	7/15/03	10:08	1	3.53E+02	60	SCL	Unshielded	β		3.53E+02
46	DTUNL FP22S	7/15/03	10:10	1	1.88E+02	60	SCL	Shielded	β	1.88E+02	
47	DTUNL FP22U	7/15/03	10:11	1	3.53E+02	60	SCL	Unshielded	β		3.53E+02
48	DTUNL FP23S	7/15/03	10:14	1	1.64E+02	60	SCL	Shielded	β	1.64E+02	
49	DTUNL FP23U	7/15/03	10:15	1	3.77E+02	60	SCL	Unshielded	β		3.77E+02
50	DTUNL FP24S	7/15/03	10:17	1	1.54E+02	60	SCL	Shielded	β	1.54E+02	
51	DTUNL FP24U	7/15/03	10:18	1	3.18E+02	60	SCL	Unshielded	β		3.18E+02
52	DTUNL FP25S	7/15/03	10:20	1	1.71E+02	60	SCL	Shielded	β	1.71E+02	
53	DTUNL FP25U	7/15/03	10:22	1	3.24E+02	60	SCL	Unshielded	β		3.24E+02
56	DTUNL FP26S	7/15/03	10:32	1	1.92E+02	60	SCL	Shielded	β	1.92E+02	
57	DTUNL FP26U	7/15/03	10:33	1	2.30E+02	60	SCL	Unshielded	β		2.30E+02
58	DTUNL FP27S	7/15/03	10:35	1	1.93E+02	60	SCL	Shielded	β	1.93E+02	
59	DTUNL FP27U	7/15/03	10:36	1	2.70E+02	60	SCL	Unshielded	β		2.70E+02
60	DTUNL FP28S	7/15/03	10:38	1	2.15E+02	60	SCL	Shielded	β	2.15E+02	
61	DTUNL FP28U	7/15/03	10:39	1	3.85E+02	60	SCL	Unshielded	β		3.85E+02
62	DTUNL FP29S	7/15/03	10:41	1	1.99E+02	60	SCL	Shielded	β	1.99E+02	
63	DTUNL FP29U	7/15/03	10:42	1	3.20E+02	60	SCL	Unshielded	β		3.20E+02
64	DTUNL FP30S	7/15/03	10:44	1	1.80E+02	60	SCL	Shielded	β	1.80E+02	
65	DTUNL FP30U	7/15/03	10:45	1	3.17E+02	60	SCL	Unshielded	β		3.17E+02
66	DTUNL FP31S	7/15/03	10:46	1	1.69E+02	60	SCL	Shielded	β	1.69E+02	
67	DTUNL FP31U	7/15/03	10:48	1	2.91E+02	60	SCL	Unshielded	β		2.91E+02
68	DTUNL FP32S	7/15/03	10:49	1	1.57E+02	60	SCL	Shielded	β	1.57E+02	
69	DTUNL FP32U	7/15/03	10:50	1	3.07E+02	60	SCL	Unshielded	β		3.07E+02
70	DTUNL FP33S	7/15/03	10:52	1	1.55E+02	60	SCL	Shielded	β	1.55E+02	
71	DTUNL FP33U	7/15/03	10:54	1	2.39E+02	60	SCL	Unshielded	β		2.39E+02
72	DTUNL FP34S	7/15/03	10:56	1	1.59E+02	60	SCL	Shielded	β	1.59E+02	
73	DTUNL FP34U	7/15/03	10:57	1	4.12E+02	60	SCL	Unshielded	β		4.12E+02
74	DTUNL FP35S	7/15/03	10:59	1	1.89E+02	60	SCL	Shielded	β	1.89E+02	
75	DTUNL FP35U	7/15/03	11:00	1	4.11E+02	60	SCL	Unshielded	β		4.11E+02
										Shielded	Unshielded
									Minimum ⇒	1.26E+02	1.76E+02
									Maximum ⇒	2.15E+02	4.12E+02
									Mean ⇒	1.71E+02	2.97E+02
									Sigma ⇒	1.93E+01	6.21E+01

ATTACHMENT 11.1

EXHIBIT 1

Survey Unit Inspection Check Sheet

SECTION 1 - SURVEY UNIT INSPECTION DESCRIPTION

Survey Unit #	554			Survey Unit Location	DISCHARGE Tunnel Ceiling, FIRST ISD
Date	7/31/03	Time	1520	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.) (1)	✓		
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) AREA UNDER CONFINED SPACE CONTROLS

Survey Unit Inspector (print/sign)	JDUSKIN / [signature]	Date	7/31/03
Survey Designer (print/sign)	J.P. Donnachie Jr / [signature]	Date	8/6/03

ATTACHMENT 12.1

EXHIBIT 3

Surface Measurement Test Area (SMTA) Data Sheet

SECTION 1 - DESCRIPTION

SMTA Number	SMTA - SS4 -1	Survey Unit Number	SS4		
SMTA Location	DISCHARGE Tunnel CEILING, FIRST 150FT				
Survey Unit Inspector	JDUSKIN	Date	7/31/03	Time	1500

SECTION 2 - CALIPER INFORMATION & PERSONNEL INVOLVED

Caliper Manufacturer	Mitutoyo	Caliper Model Number	CD-6" CS		
Caliper Serial Number	0763897	Calibration Due Date (as applicable)	10/03		
Rad Con Technician	NA	Date	NA	Time	NA
Survey Unit Inspector Approval	JDUSKIN / [signature]	Date	7/31/03		

SECTION 3 - MEASUREMENT RESULTS

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

1 10.4	7 2.6	13 3.2	19 13.7	25 1.9	31 3.3
2 2.6	8 4.2	14 1.5	20 2.3	26 2.1	32 2.4
3 4.9	9 2.8	15 7.8	21 2.4	27 4.1	33 2.8
4 2.3	10 2.7	16 1.3	22 2.6	28 3.1	34 1.3
5 1.8	11 2.0	17 4.4	23 3.3	29 2.3	35 1.9
6 2.0	12 3.4	18 2.1	24 2.9	30 2.7	36 2.5

Average Measurement 4.6 mm

Comments

SMTA TYPICAL of SURVEY UNIT SURFACE ROUGHNESS

ATTACHMENT 12.2

Additional Measurements Required (IN MM)

SS4-001	46.25MM	SS4-001A	(35X121") - (31X72") - (21X52) - (24X9")	18.5MM
SS4-002	28.9MM	SS4-002A	17X114	11.1MM
SS4-003	32.9MM	SS4-003A	(15X24") = (12X18")/2	4.3MM
SS4-004	>128MM	SS4-004A	(48X78"	18.5MM
		SS4-005A	16X47"	13.2MM
		SS4-006A	8X83"	0.4 MM
SS4-005	>128MM	SS4-007A	(35X48")/2	4.0MM
		SS4-008A	(42X61")/2 + (8X28")/2	2.3MM
		SS4-009A	(50"X13")/2	8.7MM
SS4-006	56.1MM	SS4-010A	5X21"	2.1MM

EXHIBIT 1

Survey Unit Inspection Check Sheet

SECTION 1 - SURVEY UNIT INSPECTION DESCRIPTION

Survey Unit #	SS1			Survey Unit Location	DISCHARGE Tunnel FLOOR FIRST 150'
Date	7/31/03	Time	1250	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.)?	✓ (1)		
7. Are the survey surfaces free of all paint, which has the potential to shield radiation?	(2)		
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.) (3)	✓		
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) Removal of residual moisture from the floor must be confirmed immediately prior to survey
(2) Paint remnants have been confirmed by the survey designer to be acceptable
(3) Confined space requirements in effect.

Survey Unit Inspector (print/sign)	JDUSKIN / [signature]	Date	7/31/03
Survey Designer (print/sign)	J.P. Donnachie Jr / [signature]	Date	8/6/03

ATTACHMENT 12.3

EXHIBIT 3

Surface Measurement Test Area (SMTA) Data Sheet

SECTION 1 - DESCRIPTION

SMTA Number	SMTA - SS1-1	Survey Unit Number	SS1
SMTA Location	Discharge Tunnel Floor First 150FT		
Survey Unit Inspector	JDuskin/	Date 7/31/03	Time 1250

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	JDuskin/	Date N/A	Time N/A
Survey Unit Inspector Approval	JDuskin/	Date 7/31/03	

SECTION 3 - MEASUREMENT RESULTS

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

1 4.4	7 1.1	13 0.7	19 4.6	25 1.6	31 0.5
2 0.3	8 5.2	14 0.9	20 0.2	26 0.1	32 1.0
3 0.4	9 0.1	15 2.8	21 3.0	27 0.5	33 1.1
4 0.7	10 2.5	16 2.7	22 1.9	28 0.7	34 3.0
5 1.7	11 3.5	17 0.2	23 1.0	29 1.3	35 1.5
6 1.6	12 2.8	18 0.8	24 1.7	30 6.5	36 1.7

Average Measurement 1.8 mm

Comments

SMTA Exhibits Surface Roughness Typical of Survey Unit

Additional Measurements Required

	Area Dimensions	Area	Avg Depth
SS1-001A	31"x11"	341 in²	8.8mm
SS1-002 8/25/03 A	43"x27"	1161 in²	22.4mm
SS1-003 8/25/03 A	7"x7"	49 in²	68.3mm
SS1-004 A	70"x5"	350 in²	23.4 mm
SS1-005 8-25-03 A	326"x4"	1304 in²	27.6 mm

Floor Core Boxes - 5

ATTACHMENT 12.4

EXHIBIT 1

Survey Unit Inspection Check Sheet

SECTION 1 - SURVEY UNIT INSPECTION DESCRIPTION

Survey Unit #	SS6-2-	Survey Unit Location	DISCHARGE TUNNEL WALL, NORTH, FIRST 15 OFT
Date	7/31/03	Time	14:30
Inspection Team Members	JDUSKIW		

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) (2)	✓		
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.)	(2) ✓		
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) Examination of residual paint by the survey designer determined that residual paint will not impact the survey
(2) confined space controls in effect.

Survey Unit Inspector (print/sign)	JDUSKIW / [signature]	Date	7/31/03
Survey Designer (print/sign)	J.P. Donnachie Jr / [signature]	Date	8/6/03

ATTACHMENT 12.5

EXHIBIT 3

Surface Measurement Test Area (SMTA) Data Sheet

SECTION 1 - DESCRIPTION

SMTA Number	SMTA - SS6-2-002	Survey Unit Number	SS6-2-2
SMTA Location	SS6S NORTH WALL		
Survey Unit Inspector	JDUSLIN	Date 8/25/03	Time 1130

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	JDUSLIN / [illegible]	Date	8/25/03

SECTION 3 - MEASUREMENT RESULTS

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

1: 17.1	7: 13.8	13: 9.8	19: 10.2	25: 0.3	31: 5.7
2: 13.5	8: 12.6	14: 12.8	20: 11.8	26: 6.7	32: 0.1
3: 44.1	9: 11.0	15: 13.7	21: 9.5	27: 8.6	33: 6.8
4: 8.9	10: 16.2	16: 9.1	22: 8.7	28: 6.6	34: 0.6
5: 14.0	11: 5.7	17: 1.6	23: 1.8	29: 1.0	35: 6.8
6: 15.6	12: 2.1	18: 5.1	24: 0.8	30: 2.4	36: 0.4

Average Measurement 8.8 mm

Comments

SMTA REPRESENTS ROUGHNESS OF SURFACE ON 'Dog Leg AREA' OF NORTH WALL.

SS6-2-015A 24"x9"(216in²) 15.7mm
SS6-2-016A 20"x6"(120in²) 10.1mm
~~SS6-2-017A~~ 8-25-03 JD

Additional Measurements Required

SS6-2-001A 7"x1"(7in²), 10.2mm Deep
SS6-2-002A 19"x19"(361in²), 14.2mm
SS6-2-003A 4"x13"(52in²) 12.1 mm
SS6-2-004A 5"x21" (105in²) 13.3mm
SS6-2-005A 40"x7" (280in²) 10.7mm
SS6-2-006A 7"x8" (56in²) 11.2mm
SS6-2-007A 28"x11" (308in²) 11.3mm
SS6-2-008A 6"x11" (66in²), 14.9mm
SS6-2-009A 3"x22" (66in²), 16.6mm
SS6-2-010A 117"x119 (13,923in²), 8.8mm
SS6-2-011A 4"x4" (16in²), 12.6mm
SS6-2-012A 11"x3" (33in²) 15.7mm
SS6-2-013A 71"x30" (2130in²) 9.5mm
SS6-2-014A 5"x5" (25in²) 7.2mm

ATTACHMENT 12.6

EXHIBIT 1

Survey Unit Inspection Check Sheet

SECTION 1 - SURVEY UNIT INSPECTION DESCRIPTION

Survey Unit #	SS6-1			Survey Unit Location	Discharge Tunnel Southwall, First 150 FT
Date	7/31/03	Time	1330	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.)	(2) ✓		
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) Residual paint on the surface was confirmed to be acceptable by survey designer
(2) Area will be controlled as confined space

Survey Unit Inspector (print/sign)	JDuskin / [signature]	Date	7/31/03
Survey Designer (print/sign)	J.P. Donnachie, Jr / [signature]	Date	8/6/03

ATTACHMENT 12.7

EXHIBIT 3

Surface Measurement Test Area (SMTA) Data Sheet

SECTION 1 - DESCRIPTION

SMTA Number	SMTA - SS6-1 -1	Survey Unit Number	SS6-1
SMTA Location	DISCHARGE Tunnel South WALL, FIRST 150 FT		
Survey Unit Inspector	JDUSKIN/[illegible]	Date 7/31/03	Time 1330

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	JDUSKIN/[illegible]	Date	7/31/03

SECTION 3 - MEASUREMENT RESULTS

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

1 4.5	7 16.1	13 1.1	19 3.5	25 5.7	31 12.0
2 6.4	8 13.2	14 2.3	20 3.0	26 7.4	32 4.0
3 0.7	9 0.4	15 6.4	21 4.4	27 2.2	33 1.1
4 2.2	10 11.7	16 8.0	22 2.8	28 4.9	34 1.7
5 4.2	11 2.3	17 11.7	23 3.4	29 3.8	35 0.2
6 1.6	12 2.9	18 4.1	24 3.8	30 2.5	36 3.4

Average Measurement 4.7 mm

Comments

SMTA SURFACE Roughness IS TYPICAL OF SURVEY UNIT AREA

NO PICTURE FOR SS6-1-011

ATTACHMENT 12.8

Additional Measurements Required

SS6-1-001 19.4 mm
SS6-1-002 25.9 mm
SS6-1-003 65.8 mm
SS6-1-004 37.1 mm
SS6-1-005 26.2 mm
SS6-1-006 30.0 mm
SS6-1-007 >128 mm
SS6-1-008 >128 mm
SS6-1-009 >128 mm
SS6-1-010 63.2 mm
SS6-1-011 >128 mm

Exhibit 1
Survey Unit Inspection Check Sheet

SECTION 1 - SURVEY UNIT INSPECTION DESCRIPTION

Survey Unit #	SS1, SS4, SS6-1, SS6-2			Survey Unit Location	SSGS Discharge Tunnel (Entrance to 150 ft)
Date	5/10/04	Time	1400	Inspection Team Members	D. Sarge

SECTION 2 - SURVEY UNIT INSPECTION SCOPE

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

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

Comments:

Response to Question 6 - Water present on majority of floor areas. Must be removed prior to performance of survey.

Response to Question 10 – Scaffolding will be installed to allow access to higher elevations of the walls and ceiling.

Response to Question 11 – Lighting will be improved prior to start of survey.

Response to Question 12 – Discharge Tunnel access is controlled under the Confined Space Program.

Survey Unit Inspector (print/sign)	David Sarge / [signature]	Date	5/11/04
Survey Designer (print/sign)	D. Sarge / [signature] for B. Brosey	Date	5/11/04

ATTACHMENT 12.9