Appendix B

Upper Spray Pump Area
And Discharge Tunnel Entrance
Survey Design

FirstEnergy Corp.

SNEC CALCULATION COVER SHEET

CALCULATION DESCRIPTION

Calculation Number	Revision Number	Effective Date	Page Number
E900-04-017	0	8/31/04	1 of 9

Subject

Upper Spray Pump Area & DT Entrance - Survey Design

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

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

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

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

DESCRIPTION OF REVISION

APPROVAL SIGNATURES

Calculation Originator	B. Brosey/	Date	8/30/04
Technical Reviewer	P. Donnachie/	Date	8/31/04
Additional Review	A. Paynter/	Date	31Aug04
Additional Review		Date	
SNEC Management Approval		Date	

1.0 PURPOSE

1.1 The purpose of this calculation is to develop a survey design for the upper Spray Pump building and the Discharge Tunnel entrance area. These survey units are listed in Table 1 and are shown in **Attachments 1-1** to **1-2.**

Table 1, Survey Unit Information

Survey Units	Location	Material Types	Area Classification	Area (m^2)
SS9-2	Spray Pump Bldg. Floor at El. 795'	Concrete	2	30.2
SS11-1	Walls of Spray Pump Bldg. To El. ~802'	Concrete	2	59.7
SS11-2	Walls of Spray Pump Bldg. Above El. ~802'	Concrete	3	58.2
SS23-1	Entrance to Discharge Tunnel	Concrete	2	65.9
SS23-2	Entrance to Discharge Tunnel	Soil/Stone	2	31

2.0 SUMMARY OF RESULTS

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

2.1 GFPC Scanning Criteria

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

2.1.2 All GFPC instruments used shall demonstrate an efficiency (ε_t) at or above ***23.9%*** (value used for planning). Detector efficiency factors are presented in the following Table.

Table 2, GFPC Detection Efficiency Results Used for Planning

Material Type	ε_i	ε_s	ε_t (as %)*	ECF	% Cs-137	Resulting counts/disintegration
Concrete	0.478	0.5	23.9%	0.31	0.982	0.0728

*Typical SNEC GFPC detector efficiency factors (as of 7/1/04) are provided in **Attachment 2-1.**

NOTE 1: Total efficiency should not be less than ε_t value for any instrument used during this survey effort.
NOTE 2: ECF is efficiency correction factor.

2.1.3 An efficiency correction factor (ECF) is applied to compensate for efficiency loss over rough surface areas based on **Reference 3.1** criteria and **Attachment 3-1.** An applicable ECF has been determined for both survey areas listed in Table 2. This value corrects detection efficiency based on the average depth of the worst rough surface area in either location. Use of this factor for all concrete surfaces will underestimate the detection efficiency for the majority of surfaces in these two areas.

2.1.4 The amount of detectable beta emitter is dependant on the amount of Cs-137 present in the radionuclide mix. From **Reference 3.2** the mix is determined to be 98.2% Cs-137. No other radionuclides are credited with providing any additional (detectable) beta emissions.

Table 3, Summary Of GFPC Scanning Parameters

Area or Structure	Material Type	Scan Speed	Surface to Detector Face	Minimum Coverage*	MDCscan
SS9-2, SS11-1, SS23-1	Concrete	0.9" per sec (2.2 cm/sec)	Contact	25%	1,817 dpm/100 cm^2
SS11-2	Concrete	0.9" per sec (2.2 cm/sec)	Contact	10%	1,817 dpm/100 cm^2

Table 4, Summary Of GFPC Action Levels

Area or Structure	First Phase (gcpm)	DCGLw (ncpm)
All Concrete	500	593

2.1.5 The action levels during first phase scanning is provided above. If this level is reached, the surveyor should stop and perform a count of at least 1/2 minute duration to identify the actual second phase count rate from the elevated area. If the second phase count rate is equal to or greater than the DCGLw cpm, the area must be identified, bounded and documented to include an area estimate.

2.2 Nal Scanning Criteria

2.2.1 A 2" by 2" diameter Nal detector with a Cs-137 window setting shall be used for gamma scanning these survey units IAW Table 5 parameters.

2.2.2 The conversion factor for Nal survey instruments used shall not be less than ***208,302 cpm/mR/h*** (see **Attachment 2-1** for current Nal instrument conversion factors as of 7-1-04).

Table 5, Summary Of Scanning Parameters

Instrument Type Used	Area or Structure	Material Type	Scan Speed	Surface to Detector Face	Coverage	MDCscan*
Nal (2" by 2" Cs-137 Window)	SS23-2	Soil/Stone	10" per sec (25 cm/sec)	4" (5.08 cm)	100% of accessible surfaces	2 – 2.84 pCi/g

*See Attachment 4-1 to 4-4 for calculation results using an assumed 100–200 cpm background values and MicroShield output for modeled survey areas. The soil model assumes a 6" thick source term and is ~56.4 cm in diameter with a density of loose lime stone (~2/3 of 3 g/cc = 2 g/cc).

2.2.3 The action level during first phase scanning using a Nal instrument is ***300 gross cpm***. If this level is reached, the surveyor should stop and perform a count of at least 15 seconds duration to identify the actual count rate of the elevated area.

2.2.4 Based on Nal scanning work, sample areas IAW the following criteria:

2.2.4.1 When an area is confirmed to be above the action level sited in Section 2.2.3, the location should be marked for sampling (see Section 2.5) These areas shall be bounded and documented.

2.3 *DCGLw Values*

The following Table shows the DCGLw values that were used to plan surveys in these areas. Soil volumetric DCGLw values are used as a planning tool.

Areas above the action level should be sampled to determine the actual concentration and fraction of Table 6 values.

Table 6, Summary Of DCGLw Values

Surface DCGLw (dpm/100 cm^2)	Volumetric DCGLw (pCi/g)
GA = 8,968 (6,726 A.L.)	6.52 (4.89 A.L.) for Cs-137

DCGLw values from Reference 3.2.
A.L. = the administrative limit.

2.4 *Fixed Point GFPC Static Measurements*

2.4.1 The minimum required number of static survey points for each area is provided in Table 7 (see **Attachment 5-1** to **5-10** for the calculations yielding the minimum No. of random start systematic grid survey points – Compass output, **Reference 3.3**).

Table 7, Minimum No. Random Start Systematic Grid Survey Points (GFPC)

Survey Units	Location	Static Points
SS9-2	Spray Pump Bldg. Floor at El. 795'	9
SS11-1	Walls of Spray Pump Bldg. to El. ~802'	9
SS11-2	Walls of Spray Pump Bldg. Above El. ~802'	9
SS23-1	Entrance to Discharge Tunnel - Concrete	9
SS23-2	Entrance to Discharge Tunnel – Stone/Soil	8

See Attachment 6-1 to 6-2 for locations of fixed point measurements.

2.4.2 VSP (**Reference 3.4**) is used to plot all measurement points on **Attachment 6-1** and **6-2**. The actual number of random start systematically spaced measurement points may be greater than that required by the Compass computer code because of any of the following:

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

2.5 *Sampling of Soil/Loose Stone*

2.6.1 Obtain a sample volume IAW **Reference 3.5**.

3.0 REFERENCES

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

3.2 SNEC Calculation No. E900-04-015, Spray Pump Pit – Survey 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 SNEC Procedure E900-IMP-4520.04, "Survey Methodology to Support SNEC License Termination".

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

3.7 Plan SNEC Facility License Termination Plan.

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

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

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

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

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

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

4.0 ASSUMPTIONS AND BASIC DATA

4.1 Remediation History

Since the Spray Pump moved water from the Discharge Tunnel, the same radionuclide mix is assumed for this area as was used inside the Discharge Tunnel. The Discharge Tunnel access area has been used during remediation efforts in the Discharge Tunnel. No remediation was necessary in either of these areas, but materials that could hinder survey work were removed prior to performing these surveys. Some potential safety issues with regard to collapsing loose stone side walls exist in the Discharge Tunnel access area and thus only the accessible exposed stone wall surfaces will be surveyed.

4.2 Cs-137's detection efficiency has been checked by SNEC personnel using ISO standard 7503-1 methodology (**Reference 3.6**). The SNEC facility uses a conservatively low GFPC efficiency as input to the survey design process.

4.3 Survey unit variability (GFPC only) used to plan the number of fixed point measurement locations is shown on **Attachment 7-1** and **7-2**. **Attachment 8-1** is the Williamsburg concrete background results. From the SNEC LTP (**Reference 3.7**), the off-site background soil samples yielded a mean concentration for Cs-137 of 0.28 ± 0.39 pCi/g. This background values variability was used as input to the Compass computer program.

4.4 A GFPC detector stand-off distance of ~2.1" is assumed for all survey areas. This value is used to compensate for rough surfaces in each survey unit. These survey units were inspected IAW **Reference 3.8**. A copy of portions of the SNEC facility post-remediation inspection reports are included (see **Attachment 9-1** to **9-8**). Surface defects (gouges, cracks, etc.), are present within these survey units, yielding a efficiency correction factor (ECF). Thus the average concentration of the source term will be overestimated for all surfaces (GFPC only).

4.5 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 0.31 (distance factor) which yields ~617 net cpm above background (Compass calculates 593 ncpm as the gross beta DCGLw). The 0.0728 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 0.31 (efficiency correction factor due to distance from surface) = ***0.0728 cts/disintegration***.

4.6 A MicroShield soil slab model was used to develop NaI scan MDC value for the soil/stone in the Discharge Tunnel access area (see **Attachment 4-1**). The model is a 6" thick slab of soil/stone 56.4 cm in diameter with a density of 2 g/cc model assumes that the majority of the activity resides in no more than the first 6 inches of exposed materials. The modeled concentration used was 1 pCi/g Cs-137. Then the concentration of Cs-137 in the model is 2.0 g/cc x 1 pCi/g = 2.0E-06 uCi/cc of Cs-137. The calculated MDCscan is shown in Table 5.

4.7 The results of the MicroShield modeling indicate that an exposure rate of approximately 2.41E-04 mR/h is obtained at a distance of 5" (4" inches from the face of the detector). Exposure rate is measured to the center of the detector and therefore the air gap is taken to be 4".

4.8 The majority of the structural surface area is concrete. GFPC measurements of structural concrete are compared to concrete background values (see Williamsburg concrete background values – **Attachment 8-1**).

4.9 The scan MDC calculation is determined based on a 1.38 index of sensitivity at a 95% correct detection probability and 60% false positive rate. In all cases, the scan MDC is less than the gross and volumetric activity DCGLw values for these survey units. A surveyor efficiency factor of 0.5 is assumed.

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

4.11 No special measurements are included for this survey design.

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

4.13 The survey design checklist is listed in Exhibit 2.

4.14 Area factors are not applicable for Class 2 and 3 areas.

4.15 The decision errors and other Data Quality Objectives for this survey design are listed within **Attachment 5-1** through **5-10**, and are justified IAW **Reference 3.9** criteria.

4.16 Analysis results (MDA requirements, etc.) will be IAW **Reference 3.5** criteria.

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** to **1-2**, diagrams of Spray Pump and Discharge Tunnel areas.

6.2 **Attachment 2-1**, is typical calibration information for NaI and GFPC detection systems used at the SNEC facility as of 7-1-04.

6.3 **Attachment 3-1**, is a calculation result for determining efficiency loss for a GFPC detector as a function of distance from a calibration source.

6.4 **Attachment 4-1** to **4-4**, is the MicroShield output and MDCscan calculation results for a NaI detector.

6.4.1 **Attachment 4-5** and **4-6**, are the GFPC MDCscan results.

6.5 **Attachment 5-1** to **5-10**, are Compass output results for all areas.

6.6 **Attachment 6-1** to **6-2**, are the random start, systematic grid diagrams for GFPC fixed point survey locations.

6.7 **Attachment 7-1** and **7-2**, are the GFPC variability measurements from these survey units.

6.8 **Attachment 8-1**, is the Williamsburg background measurements of concrete using a GFPC instrument (an non-impacted area).

6.9 **Attachment 9-1** to **9-8**, are sections of survey unit inspection reports for the Spray Pump and Discharge Tunnel areas.

Exhibit 1

SNEC Facility Individual 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 3.7)

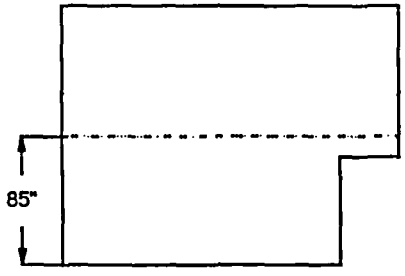
Calculation No.	
E900-04-017	SS9-1 & SS11-1, SS11-2, SS23-1 & SS23-2

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	AT 8/31/04
2	Are drawings/diagrams adequate for the subject area (drawings should have compass headings)?	(Yes), N/A	AT 8/31/04
3	Are boundaries properly identified and is the survey area classification clearly indicated?	(Yes), N/A	AT 8/31/04
4	Has the survey area(s) been properly divided into survey units IAW EXHIBIT 10	(Yes), N/A	AT 8/31/04
5	Are physical characteristics of the area/location or system documented?	(Yes), N/A	AT 8/31/04
6	Is a remediation effectiveness discussion included?	(Yes), N/A	AT 8/31/04
7	Have characterization survey and/or sampling results been converted to units that are comparable to applicable DCGL values?	(Yes), N/A	AT 8/31/04
8	Is survey and/or sampling data that was used for determining survey unit variance included?	(Yes), N/A	AT 8/31/04
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	AT 8/31/04
10	Are applicable survey and/or sampling data that was used to determine variability included?	(Yes), N/A	AT 8/31/04
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)	AT 8/31/04
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)	AT 8/31/04
13	Are all necessary supporting calculations and/or site procedures referenced or included?	(Yes) N/A	AT 8/31/04
14	Has an effective DCGLw been identified for the survey unit(s)?	(Yes), N/A	AT 8/31/04
15	Was the appropriate $DCGL_{EMC}$ included in the survey design calculation?	(Yes), N/A	AT 8/31/04
16	Has the statistical tests that will be used to evaluate the data been identified?	(Yes), N/A	AT 8/31/04
17	Has an elevated measurement comparison been performed (Class 1 Area)?	Yes (N/A)	AT 8/31/04
18	Has the decision error levels been identified and are the necessary justifications provided?	(Yes) N/A	AT 8/31/04
19	Has scan instrumentation been identified along with the assigned scanning methodology?	(Yes), N/A	AT 8/31/04
20	Has the scan rate been identified, and is the MDCscan adequate for the survey design?	(Yes), N/A	AT 8/31/04
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)	AT 8/31/04
22	Is survey instrumentation calibration data included and are detection sensitivities adequate?	(Yes), N/A	AT 8/31/04
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	AT 8/31/04
24	Are investigation levels and administrative limits adequate, and are any associated actions clearly indicated?	(Yes) N/A	AT 8/31/04
25	For sample analysis, have the required MDA values been determined.?	Yes (N/A)	AT 8/31/04
26	Has any special sampling methodology been identified other than provided in Reference 6.3?	Yes, (N/A)	AT 8/31/04

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

SPRAY PUMP ROOM, 795' El & ABOVE

SS9-2, SS11-1 & SS11-2



North Wall

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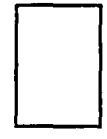

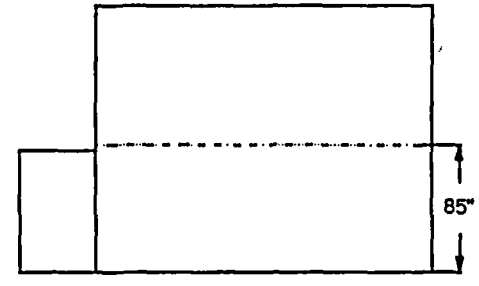

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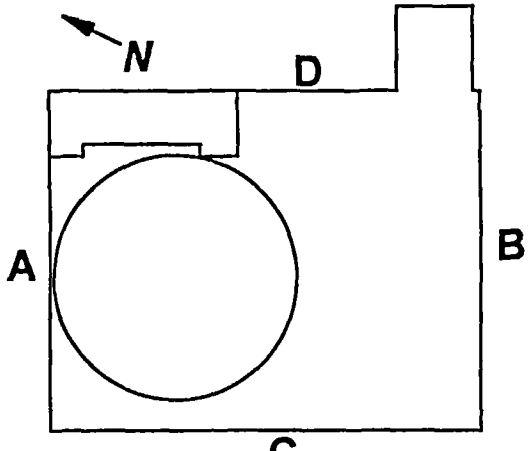
South Wall



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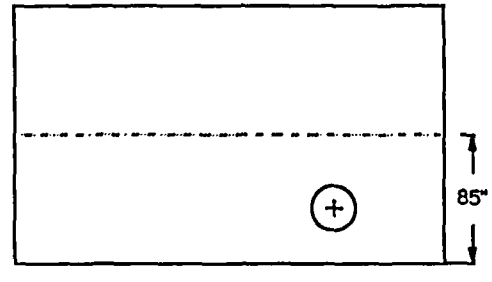
795' El Floor



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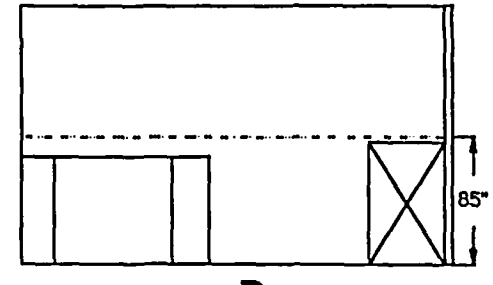

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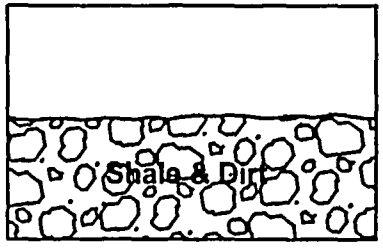
East Wall

ATTACHMENT 1 . 1

ENTRANCE TO DISCHARGE TUNNEL

SS23-1 & SS23-2



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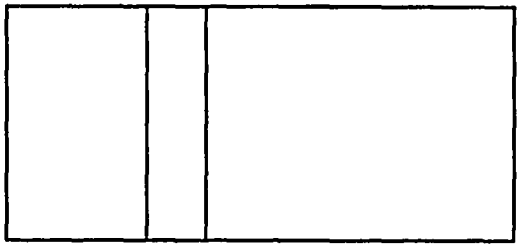

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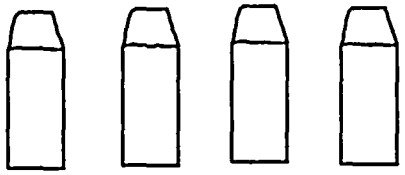

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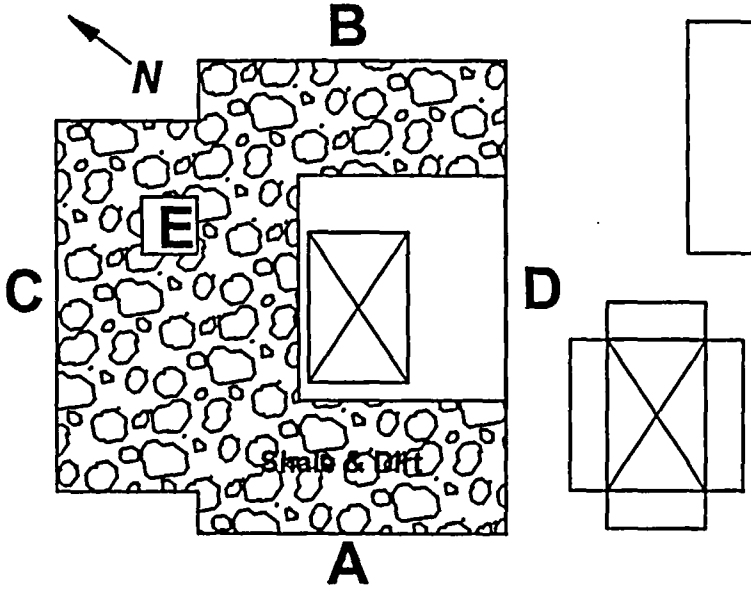

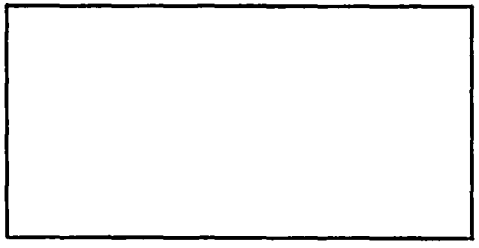

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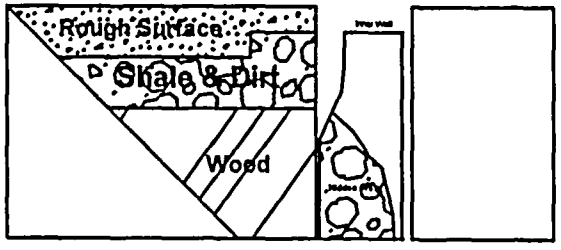


Some of this area is not accessible

A

ATTACHMENT 1 . 2

2350 INSTRUMENT AND PROBE EFFICIENCY CHART
7/01/04 (Typical 2" by 2" Nal (Cs-137 W) Conversion Factors)

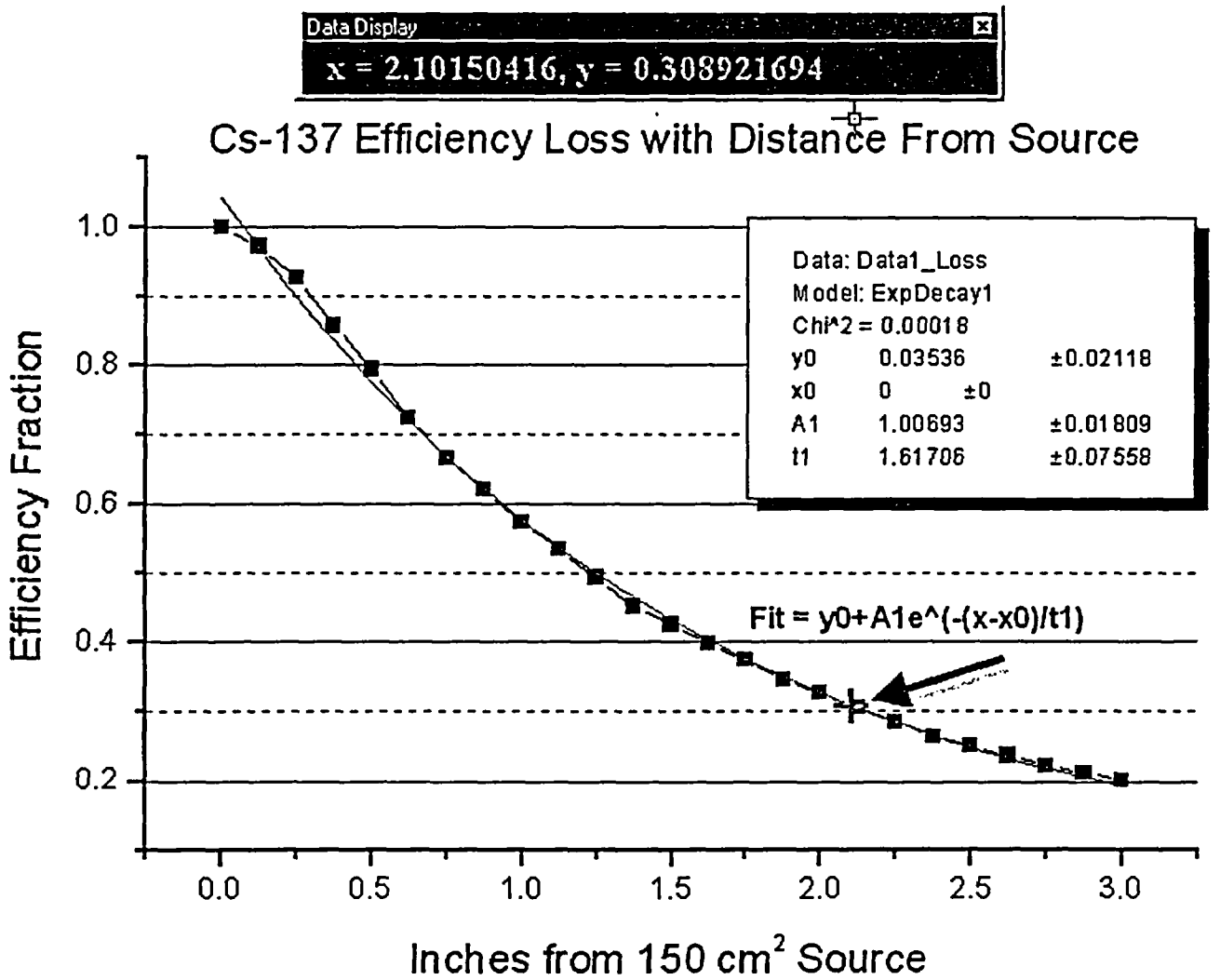
Inst.#	Cal Due	AP #		Probe #	Cal Due	cpm/mR/h
98625	5/18/05	R & Y		211680 Pk	5/18/05	214.882
98647	5/18/05	G &Y		211667 Pk	5/18/05	218.807
129423	5/18/05	P &Y		211687 Pk	5/18/05	213.539
117573	5/18/05	O &Y		211674 Pk	5/18/05	212.173
117566	4/9/05	G&R		185852 Pk	4/13/05	209.862
126183	11/19/04	B&R		206280 Pk	12/12/04	190,907
129429	11/3/04	Y&W		206283 Pk	10/31/04	177185
126198	11/03/04	R&W		196021Pk	5/25/05	209.194
126172	6/07/05	G&W		196022	6/07/05	208.302
129440	4/09/05	O&W		210938 Pk	4/14/05	205.603
120588	6/08/05	B&W		185844 Pk	6/09/05	216.654
95361	6/25/05	P&W		025686	6/28/05	211.799

ATTACHMENT 2 - 1

2350 INSTRUMENT AND PROBE EFFICIENCY CHART
7/01/04 (Typical 43-68 Beta Efficiency Factors)

Different Instrument/Probe Cal. Due	Cesium only instruments (10mV to 100)

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



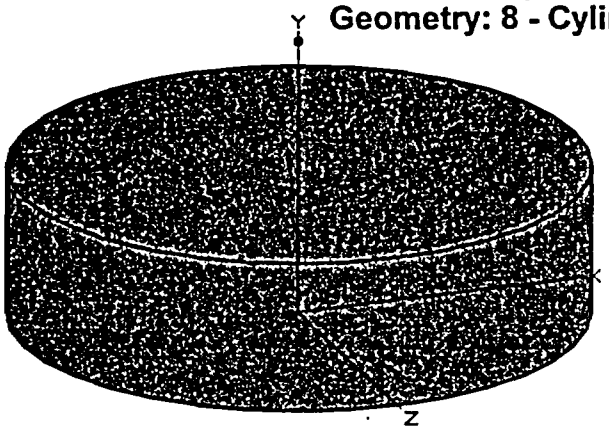
ATTACHMENT 3.1

MicroShield v5.05 (5.05-00121)
GPU Nuclear

Page : 1
DOS File : DTEA.MS5
Run Date: August 30, 2004
Run Time: 10:21:06 AM
Duration : 00:00:01

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

Case Title: Stone/Soil
Description: Density 2 g/cc, 6" Cylinder @ 5" from Surface
Geometry: 8 - Cylinder Volume - End Shields



Source Dimensions

Height	15.24 cm	6.0 in
Radius	28.21 cm	11.1 in

Dose Points

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

Shields

Shield Name	Dimension	Material	Density
Source	2325.091 in³	Concrete	2
Air Gap		Air	0.00122

Source Input
Grouping Method : Actual Photon Energies

Nuclide	curies	becquerels	µCi/cm³	Bq/cm³
Ba-137m	7.2088e-008	2.6673e+003	1.8920e-006	7.0004e-002
Cs-137	7.6203e-008	2.8195e+003	2.0000e-006	7.4000e-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	5.522e+01	6.811e-06	8.245e-06	5.673e-08	6.868e-08
0.0322	1.019e+02	1.310e-05	1.595e-05	1.054e-07	1.284e-07
0.0364	3.707e+01	7.262e-06	9.488e-06	4.126e-08	5.391e-08
0.6616	2.400e+03	6.601e-02	1.243e-01	1.280e-04	2.410e-04
TOTALS:	2.594e+03	6.604e-02	1.244e-01	1.282e-04	2.413e-04

ATTACHMENT 4 . 1

NaI Scan MDC Calculation

$b := 100$ $p := 0.5$ $HS_d := 56.4$ $SR := 25$ $d := 1.38$

$Conv := 208.302$ $MS_{output} := 2.41\ 10^{-4}$ $O_i := \frac{HS_d}{SR}$

$O_i = 2.256$ *Observation Interval (seconds)*

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

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

$MDCR_i = 71.168$ *net counts per minute*

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

$MDCR_{surveyor} = 100.647$ *net counts per minute*

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

$MDER = 0.483$ µR/h

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

$MDC_{scan} = 2.005$ pCi/g C_s-137

BHS 8/30/04

NaI Scan MDC Calculation

$b := 200$ $p := 0.5$ $HS_d := 56.4$ $SR := 25$ $d := 1.38$

$Conv := 208.302$ $MS_{output} := 2.41 \cdot 10^{-4}$ $O_i := \frac{HS_d}{SR}$

$O_i = 2.256$ *Observation Interval (seconds)*

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

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

$MDCR_i = 100.647$ *net counts per minute*

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

$MDCR_{surveyor} = 142.336$ *net counts per minute*

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

$MDER = 0.683$ µR/h

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

$MDC_{scan} = 2.835$ pCi/g C_s-137

RHB 8/29/04

where:

b = *background in counts per minute*

b_i = *background counts in observation interval*

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

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

HS_d = *hot spot diameter (in centimeters)*

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

$MDCR_i$ = *Minimum Detectable Count Rate (ncpm)*

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

MDER = Minimum Detectable Exposure Rate (uR/h)

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

O_i = *obervation Interval (seconds)*

p = *human performance factor*

SR = *scan rate in centimeters per second*

Beta Scan Measurement MDC Calculation

Concrete Surface in Upper SPR & DTEA

$\varepsilon_i := .478$ $\varepsilon_s := .5 \cdot .31 \cdot .982$ $b := 306$ $p := 0.5$ $W_d := 8.8$ $S_r := 2.2$ $d := 1.38$ $A := 100$

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

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

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

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

$\varepsilon_i = 0.0728$

$b_i = 20.4$ *Counts in observation Interval*

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

$C = 19.438$

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

$MDCR_i = 93.5$ *net counts per minute*

$MDCR_i + b = 399.494$ *gross counts per minute*

$\frac{MDCR_i}{O_i} = 23.4$ *net counts per minute in observation interval*

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

$MDC_{scan} = 1.817 \cdot 10^3$ *dpm per 100 cm^2*

where:

b = *background counts per minute*

b_i = *background counts in observation interval*

p = *human performance factor*

W_d = *detector width in centimeters*

S_r = *scan rate in centimeters per second*

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

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

C = *constant used to convert MDCR to MDC*

ε_i = *instrument efficiency (counts/emission)*

ε_s = *source efficiency (emissions/disintegration)*

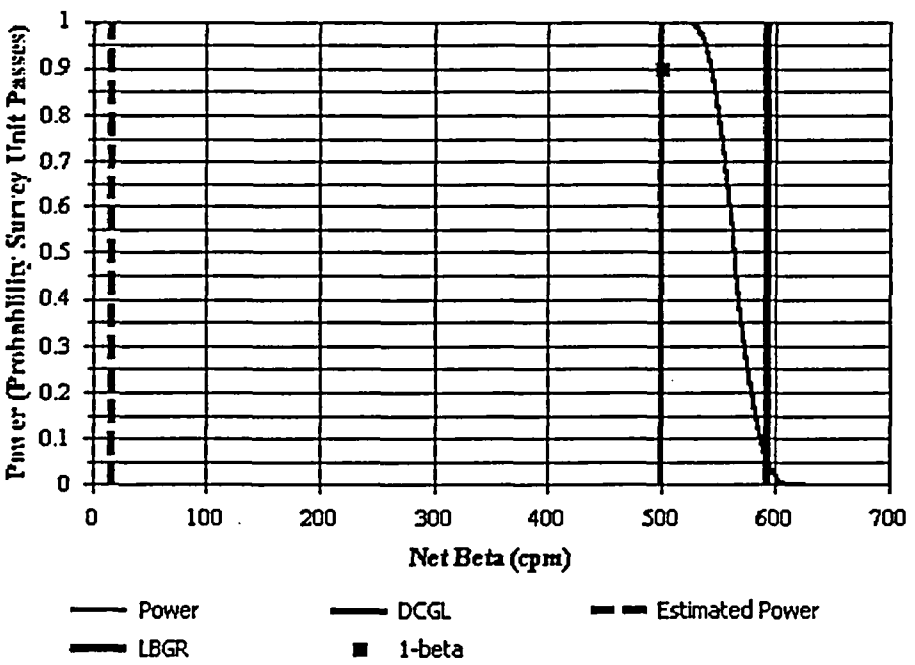
A = *instrument physical probe area (in square centimeters)*

Building Surface Survey Plan

Survey Plan Summary

Site:	Upper Spray Pump Bldg.		
Planner(s):	BHB		
Survey Unit Name:	Spray Pump Bldg. Floor @ El. 785' SS9-2 BHB 9/24/04		
Comments:			
Area (m²):	30	Classification:	2
Selected Test:	WRS	Estimated Sigma (cpm):	34.5
DCGL (cpm):	593	Sample Size (N/2):	9
LBGR (cpm):	500	Estimated Conc. (cpm):	17
Alpha:	0.050	Estimated Power:	1.00
Beta:	0.100		

Prospective Power Curve



ATTACHMENT 5.1

Building Surface Survey Plan

Contaminant Summary

559-2 BWB 8/26/04

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

Beta Instrumentation Summary

Gross Beta DCGLw (dpm/100 cm²): 6,726
Total Efficiency: 0.07
Gross Beta DCGLw (cpm): 593

ID	Type	Mode	Area (cm²)
26	GFPC	Beta	126

Contaminant	Energy[1]	Fraction[2]	Inst. Eff.	Surf. Eff.	Total Eff.
Gross Activity	187.87	1.0000	0.48	0.15	0.0728

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

Gross Survey Unit Mean (cpm): 323 ± 34 (1-sigma)
Count Time (min): 1

Material	Number of BKG Counts	Average (cpm)	Standard Deviation (cpm)	MDC (dpm/100 cm²)
Concrete	31	306	34.5	956

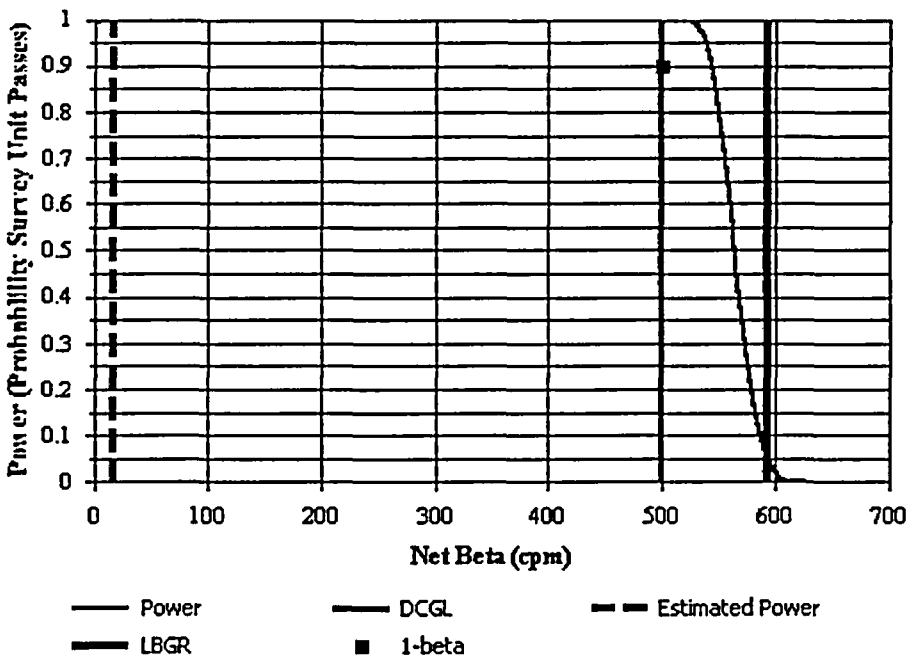
ATTACHMENT 5 - 2

Building Surface Survey Plan

Survey Plan Summary

Site:	Upper Spray Pump Bldg.		
Planner(s):	BHB		
Survey Unit Name:	Walls of Spray Pump Bldg. to El. ~802'		
Comments:	SS11-1		
Area (m²):	60	Classification:	2
Selected Test:	WRS	Estimated Sigma (cpm):	34.5
DCGL (cpm):	593	Sample Size (N/2):	9
LBGR (cpm):	500	Estimated Conc. (cpm):	17
Alpha:	0.050	Estimated Power:	1.00
Beta:	0.100		

Prospective Power Curve



ATTACHMENT 5.3

Building Surface Survey Plan

Contaminant Summary

5511-1 BJB 8/26/04

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

Beta Instrumentation Summary

Gross Beta DCGLw (dpm/100 cm²): 6,726
Total Efficiency: 0.07
Gross Beta DCGLw (cpm): 593

ID	Type	Mode	Area (cm²)
26	GFPC	Beta	126

Contaminant	Energy[1]	Fraction[2]	Inst. Eff.	Surf. Eff.	Total Eff.
Gross Activity	187.87	1.0000	0.48	0.15	0.0728

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

Gross Survey Unit Mean (cpm): 323 ± 34 (1-sigma)
Count Time (min): 1

Material	Number of BKG Counts	Average (cpm)	Standard Deviation (cpm)	MDC (dpm/100 cm²)
Concrete	31	306	34.5	956

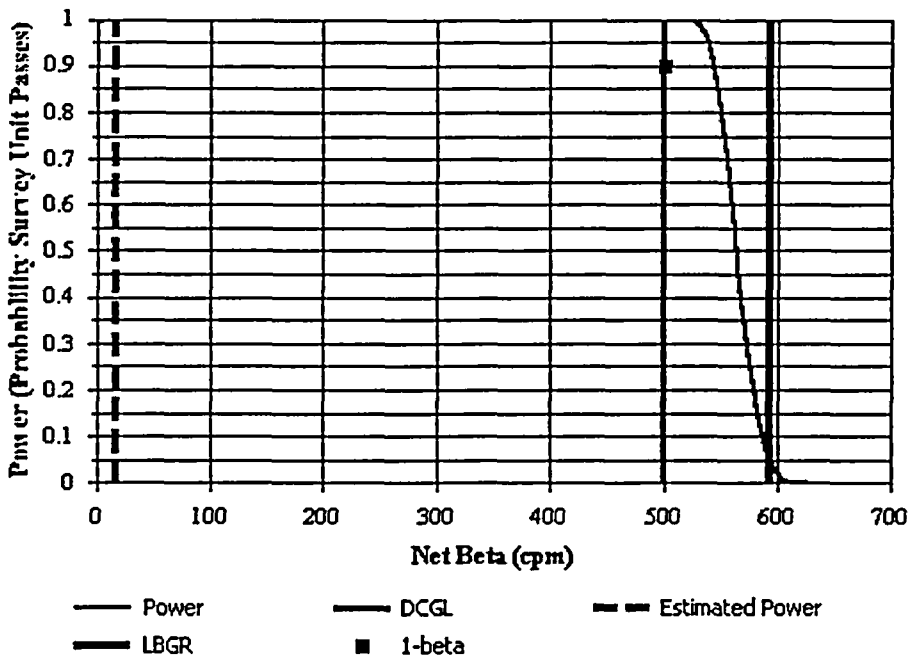
ATTACHMENT 5 - 4

Building Surface Survey Plan

Survey Plan Summary

Site:	Upper Spray Pump Bldg.		
Planner(s):	BHB		
Survey Unit Name:	Walls of Spray Pump Bldg. Above El. ~802'		
Comments:	SS11-2		
Area (m²):	58	Classification:	3
Selected Test:	WRS	Estimated Sigma (cpm):	34.5
DCGL (cpm):	593	Sample Size (N/2):	9
LBGR (cpm):	500	Estimated Conc. (cpm):	17
Alpha:	0.050	Estimated Power:	1.00
Beta:	0.100		

Prospective Power Curve



Building Surface Survey Plan

Contaminant Summary

5511-2 BHS 8/26/04

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

Beta Instrumentation Summary

Gross Beta DCGLw (dpm/100 cm²): 6,726
Total Efficiency: 0.07
Gross Beta DCGLw (cpm): 593

ID	Type	Mode	Area (cm²)
26	GFPC	Beta	126

Contaminant	Energy[1]	Fraction[2]	Inst. Eff.	Surf. Eff.	Total Eff.
Gross Activity	187.87	1.0000	0.48	0.15	0.0728

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

Gross Survey Unit Mean (cpm): 323 ± 34 (1-sigma)
Count Time (min): 1

Material	Number of BKG Counts	Average (cpm)	Standard Deviation (cpm)	MDC (dpm/100 cm²)
Concrete	31	306	34.5	956

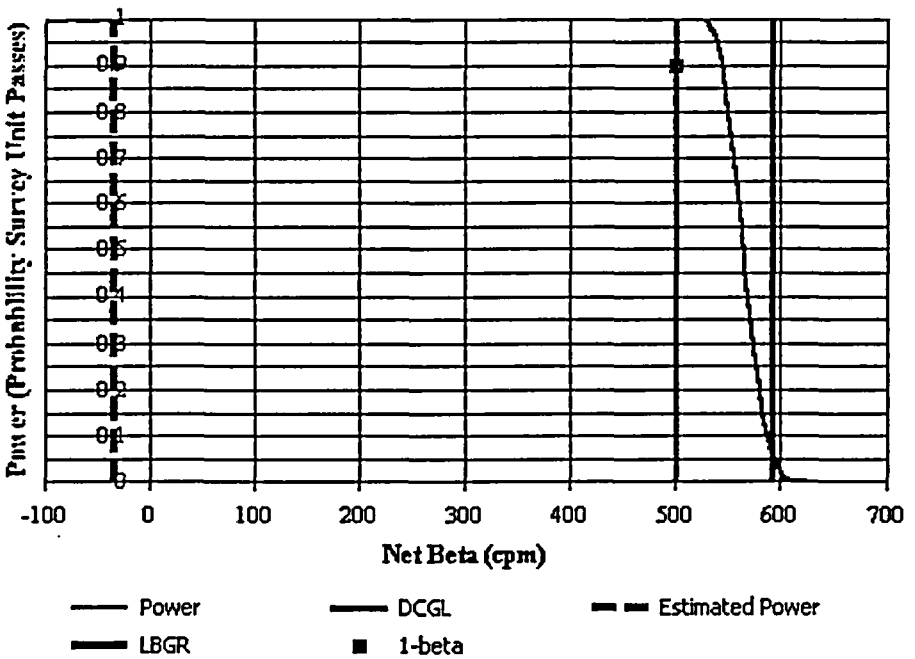
ATTACHMENT 5.6

Building Surface Survey Plan

Survey Plan Summary

Site:	DT Entrance		
Planner(s):	BHB		
Survey Unit Name:	Entrance to Discharge Tunnel - Concrete		
Comments:	SS23-1		
Area (m²):	66	Classification:	2
Selected Test:	WRS	Estimated Sigma (cpm):	34.5
DCGL (cpm):	593	Sample Size (N/2):	9
LBGR (cpm):	500	Estimated Conc. (cpm):	-35
Alpha:	0.050	Estimated Power:	1.00
Beta:	0.100		

Prospective Power Curve



ATTACHMENT 5 - 7

Building Surface Survey Plan

Contaminant Summary

5523-1 BNB
8/26/04

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

Beta Instrumentation Summary

Gross Beta DCGLw (dpm/100 cm²): 6,726
Total Efficiency: 0.07
Gross Beta DCGLw (cpm): 593

ID	Type	Mode	Area (cm²)
27	GFPC	Beta	126

Contaminant	Energy[1]	Fraction[2]	Inst. Eff.	Surf. Eff.	Total Eff.
Gross Activity	187.87	1.0000	0.48	0.15	0.0728

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

Gross Survey Unit Mean (cpm): 271 ± 29 (1-sigma)
Count Time (min): 1

Material	Number of BKG Counts	Average (cpm)	Standard Deviation (cpm)	MDC (dpm/100 cm²)
Concrete	31	306	34.5	956

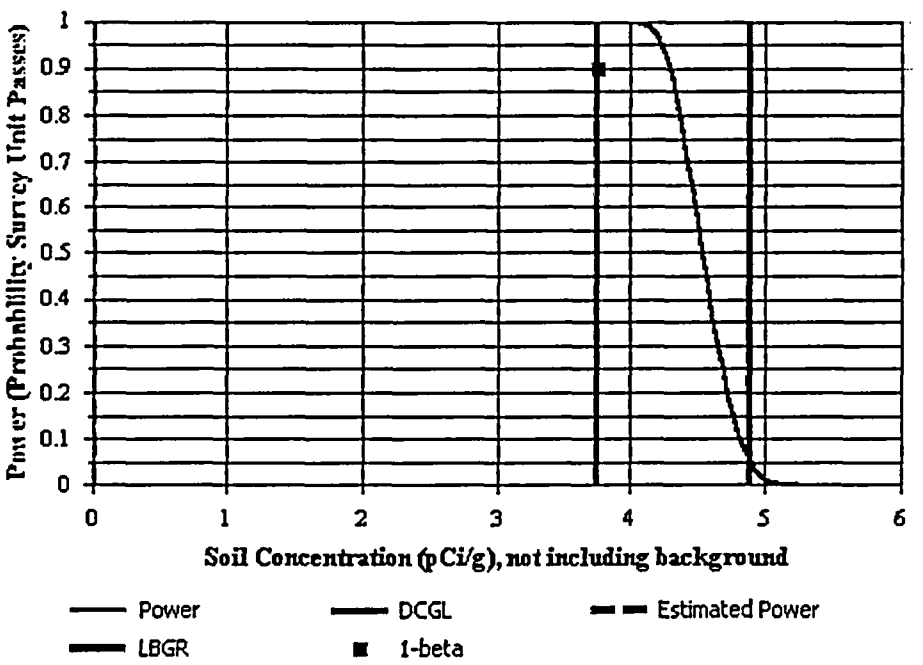
ATTACHMENT 5 - 8

Surface Soil Survey Plan

Survey Plan Summary

Site:	Entrance to Discharge Tunnel - Stone/Soil		
Planner(s):	BHB		
Survey Unit Name:	Entrance to Discharge Tunnel - Stone/Soil		
Comments:	SS23-2		
Area (m²):	31	Classification:	2
Selected Test:	WRS	Estimated Sigma (pCi/g):	0.39
DCGL (pCi/g):	4.89	Sample Size (N/2):	8
LBGR (pCi/g):	3.75	Estimated Conc. (pCi/g):	0
Alpha:	0.050	Estimated Power:	1
Beta:	0.100		

Prospective Power Curve



ATTACHMENT 5.9

Surface Soil Survey Plan

Contaminant Summary

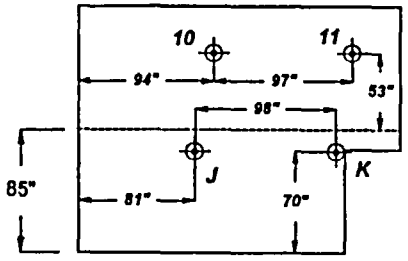
Contaminant	DCGLw (pCi/g)	Inferred Contaminant	Ratio	Modified DCGLw (pCi/g)	Scan MDC (pCi/g)
Cs-137	4.89	N/A	N/A	N/A	N/A

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

ATTACHMENT 5 . 10

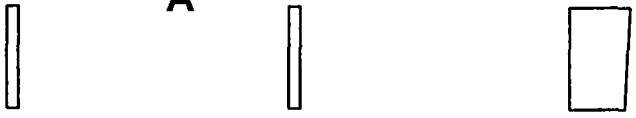
SPRAY PUMP ROOM, 795' El & ABOVE

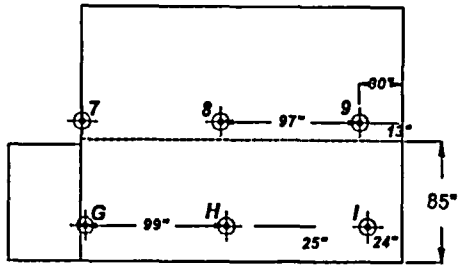
SS9-2, SS11-1 & SS11-2



North Wall

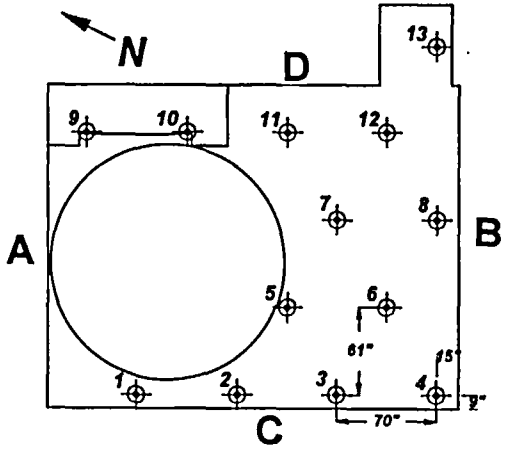
A





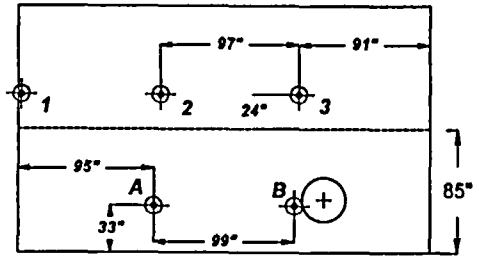
B

South Wall



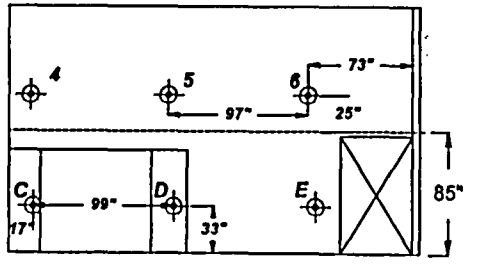
C

795' El Floor



C

West Wall



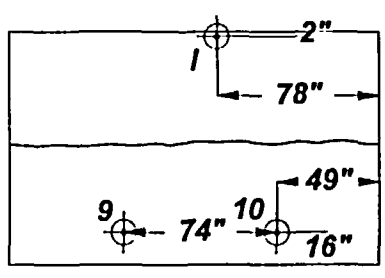
D

East Wall

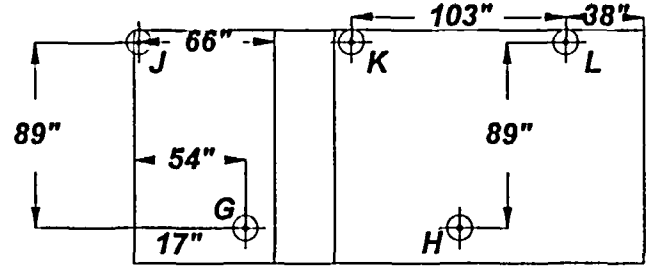
ATTACHMENT 6 . 1

ENTRANCE TO DISCHARGE TUNNEL

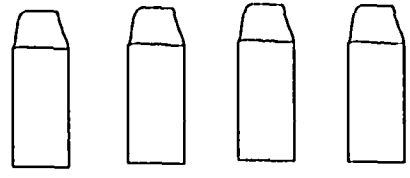
SS23-1 & SS23-2



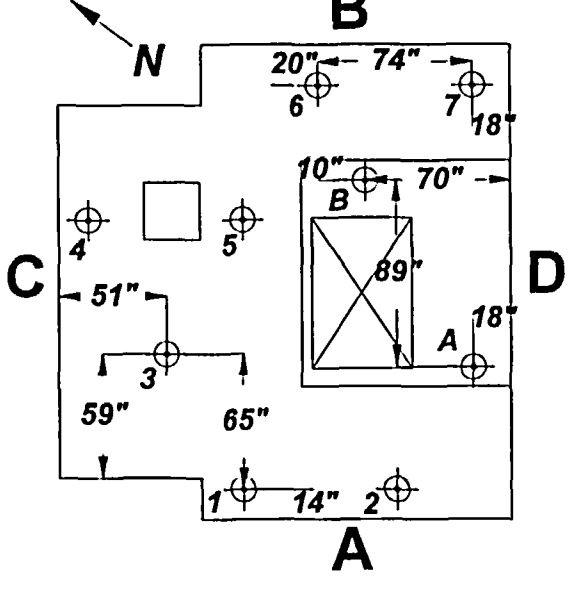
C



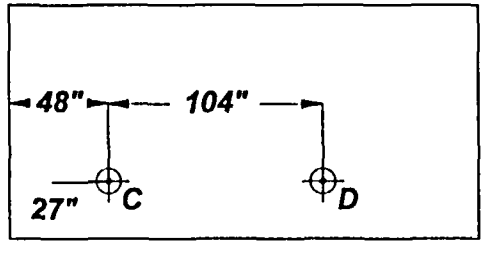
B



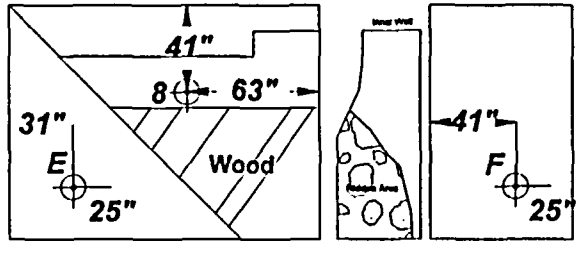
E



A



D



Some of this area is not accessible

A

ATTACHMENT 6.2

SPRAY PUMP BLDG. 795' El. FLOOR & ABOVE - CONCRETE

	Instrument 126188	Lane/Graham						SR-108		FSS-491	BHB
No.	Location	Date	Time	Detector	Counts	Count Time (sec)	Mode	Designator		Shielded	Unshielded
4	SS9 FP1S	3/31/2004	13:47	1	2.56E+02	60	SCL	Shielded	β	2.56E+02	
5	SS9 FP1U	3/31/2004	13:48	1	3.43E+02	60	SCL	Unshielded	β		3.43E+02
6	SS9 FP2S	3/31/2004	14:03	1	2.61E+02	60	SCL	Shielded	β	2.61E+02	
7	SS9 FP2U	3/31/2004	14:05	1	3.36E+02	60	SCL	Unshielded	β		3.36E+02
8	SS9 FP3S	3/31/2004	14:07	1	2.60E+02	60	SCL	Shielded	β	2.60E+02	
10	SS9 FP3U	3/31/2004	14:10	1	3.78E+02	60	SCL	Unshielded	β		3.78E+02
11	SS9 FP4S	3/31/2004	14:12	1	2.55E+02	60	SCL	Shielded	β	2.55E+02	
12	SS9 FP4U	3/31/2004	14:15	1	3.64E+02	60	SCL	Unshielded	β		3.64E+02
13	SS9 FP5S	3/31/2004	14:17	1	2.60E+02	60	SCL	Shielded	β	2.60E+02	
14	SS9 FP5U	3/31/2004	14:19	1	3.34E+02	60	SCL	Unshielded	β		3.34E+02
15	SS11 FP6S	3/31/2004	14:21	1	2.07E+02	60	SCL	Shielded	β	2.07E+02	
16	SS11 FP6U	3/31/2004	14:24	1	3.07E+02	60	SCL	Unshielded	β		3.07E+02
17	SS11 FP7S	3/31/2004	14:26	1	2.08E+02	60	SCL	Shielded	β	2.08E+02	
18	SS11 FP7U	3/31/2004	14:27	1	2.85E+02	60	SCL	Unshielded	β		2.85E+02
19	SS11 FP8S	3/31/2004	14:29	1	2.10E+02	60	SCL	Shielded	β	2.10E+02	
20	SS11 FP8U	3/31/2004	14:31	1	3.05E+02	60	SCL	Unshielded	β		3.05E+02
21	SS11 FP9S	3/31/2004	14:32	1	2.07E+02	60	SCL	Shielded	β	2.07E+02	
22	SS11 FP9U	3/31/2004	14:34	1	2.75E+02	60	SCL	Unshielded	β		2.75E+02
23	SS9 FP10S	3/31/2004	14:36	1	1.95E+02	60	SCL	Shielded	β	1.95E+02	
24	SS9 FP10U	3/31/2004	14:37	1	3.00E+02	60	SCL	Unshielded	β		3.00E+02
								Minimum ⇒		1.95E+02	2.75E+02
								Maximum ⇒		2.61E+02	3.78E+02
								Mean ⇒		2.32E+02	3.23E+02
								Sigma ⇒		2.83E+01	3.38E+01

ATTACHMENT 7.1

ENTRANCE TO DISCHARGE TUNNEL CONCRETE

37122N21	Instrument 126188	BH4008								FSS-912	BHB
No.	Location	Date	Time	Detector	Counts	Count Time (sec)	Mode	Designator		Shielded	Unshielded
2	SS23 EW1S	8/12/2004	10:56	1	1.99E+02	60	SCL	Shielded	β	1.99E+02	
3	SS23 EW1U	8/12/2004	10:58	1	2.56E+02	60	SCL	Unshielded	β		2.56E+02
4	SS23EW2S	8/12/2004	11:00	1	2.23E+02	60	SCL	Shielded	β	2.23E+02	
5	SS23EW2U	8/12/2004	11:01	1	3.06E+02	60	SCL	Unshielded	β		3.06E+02
6	SS23EW3S	8/12/2004	11:03	1	1.89E+02	60	SCL	Shielded	β	1.89E+02	
7	SS23EW3U	8/12/2004	11:04	1	2.61E+02	60	SCL	Unshielded	β		2.61E+02
8	SS23EW4S	8/12/2004	11:06	1	1.86E+02	60	SCL	Shielded	β	1.86E+02	
9	SS23EW4U	8/12/2004	11:07	1	2.53E+02	60	SCL	Unshielded	β		2.53E+02
10	SS23EW5S	8/12/2004	11:08	1	2.05E+02	60	SCL	Shielded	β	2.05E+02	
11	SS23EW5U	8/12/2004	11:12	1	2.40E+02	60	SCL	Unshielded	β		2.40E+02
15	SS23EW6S	8/12/2004	11:21	1	2.06E+02	60	SCL	Shielded	β	2.06E+02	
16	SS23EW6U	8/12/2004	11:23	1	2.23E+02	60	SCL	Unshielded	β		2.23E+02
17	SS23EW7S	8/12/2004	11:24	1	2.08E+02	60	SCL	Shielded	β	2.08E+02	
18	SS23EW7U	8/12/2004	11:26	1	2.38E+02	60	SCL	Unshielded	β		2.38E+02
19	SS23EW8S	8/12/2004	11:28	1	1.92E+02	60	SCL	Shielded	β	1.92E+02	
20	SS23EW8U	8/12/2004	11:29	1	2.52E+02	60	SCL	Unshielded	β		2.52E+02
24	SS23SW1S	8/12/2004	13:02	1	1.73E+02	60	SCL	Shielded	β	1.73E+02	
25	SS23SW1U	8/12/2004	13:03	1	2.31E+02	60	SCL	Unshielded	β		2.31E+02
26	SS23SW2S	8/12/2004	13:04	1	2.13E+02	60	SCL	Shielded	β	2.13E+02	
27	SS23SW2U	8/12/2004	13:06	1	2.50E+02	60	SCL	Unshielded	β		2.50E+02
28	SS23SW3S	8/12/2004	13:08	1	2.04E+02	60	SCL	Shielded	β	2.04E+02	
29	SS23SW3U	8/12/2004	13:09	1	2.50E+02	60	SCL	Unshielded	β		2.50E+02
30	SS23SW4S	8/12/2004	13:10	1	1.98E+02	60	SCL	Shielded	β	1.98E+02	
31	SS23SW4U	8/12/2004	13:12	1	2.70E+02	60	SCL	Unshielded	β		2.70E+02
32	SS23SW5S	8/12/2004	13:13	1	1.97E+02	60	SCL	Shielded	β	1.97E+02	
33	SS23SW5U	8/12/2004	13:14	1	2.87E+02	60	SCL	Unshielded	β		2.87E+02
34	SS23SW6S	8/12/2004	13:16	1	1.95E+02	60	SCL	Shielded	β	1.95E+02	
35	SS23SW6U	8/12/2004	13:17	1	2.81E+02	60	SCL	Unshielded	β		2.81E+02
36	SS23SW7S	8/12/2004	13:18	1	2.19E+02	60	SCL	Shielded	β	2.19E+02	
37	SS23SW7U	8/12/2004	13:19	1	2.73E+02	60	SCL	Unshielded	β		2.73E+02
38	SS23SW8S	8/12/2004	13:22	1	2.07E+02	60	SCL	Shielded	β	2.07E+02	
39	SS23SW8U	8/12/2004	13:23	1	2.79E+02	60	SCL	Unshielded	β		2.79E+02
40	SS23SW9S	8/12/2004	13:24	1	2.14E+02	60	SCL	Shielded	β	2.14E+02	
41	SS23SW9U	8/12/2004	13:26	1	2.54E+02	60	SCL	Unshielded	β		2.54E+02
42	SS23SW10S	8/12/2004	13:27	1	2.18E+02	60	SCL	Shielded	β	2.18E+02	
43	SS23SW10U	8/12/2004	13:28	1	2.88E+02	60	SCL	Unshielded	β		2.88E+02
47	SS23WW1S	8/12/2004	13:39	1	1.88E+02	60	SCL	Shielded	β	1.88E+02	
48	SS23WW1U	8/12/2004	13:40	1	2.75E+02	60	SCL	Unshielded	β		2.75E+02
49	SS23WW2S	8/12/2004	13:41	1	2.04E+02	60	SCL	Shielded	β	2.04E+02	
50	SS23WW2U	8/12/2004	13:43	1	3.03E+02	60	SCL	Unshielded	β		3.03E+02
51	SS23WW3S	8/12/2004	13:44	1	2.60E+02	60	SCL	Shielded	β	2.60E+02	
52	SS23WW3U	8/12/2004	13:45	1	3.29E+02	60	SCL	Unshielded	β		3.29E+02
53	SS23WW4S	8/12/2004	13:47	1	2.80E+02	60	SCL	Shielded	β	2.80E+02	
54	SS23WW4U	8/12/2004	13:48	1	3.12E+02	60	SCL	Unshielded	β		3.12E+02
55	SS23WW5S	8/12/2004	13:49	1	2.26E+02	60	SCL	Shielded	β	2.26E+02	
56	SS23WW5U	8/12/2004	13:51	1	3.13E+02	60	SCL	Unshielded	β		3.13E+02
57	SS23WW6S	8/12/2004	13:52	1	2.55E+02	60	SCL	Shielded	β	2.55E+02	
58	SS23WW6U	8/12/2004	13:53	1	2.95E+02	60	SCL	Unshielded	β		2.95E+02
63	SS-23 NW1S	8/16/2004	9:02	1	1.83E+02	60	SCL	Shielded	β	1.83E+02	
64	SS-23 NW1U	8/16/2004	9:04	1	2.32E+02	60	SCL	Unshielded	β		2.32E+02
65	SS-23 NW2S	8/16/2004	9:06	1	1.87E+02	60	SCL	Shielded	β	1.87E+02	
66	SS-23 NW2U	8/16/2004	9:07	1	2.76E+02	60	SCL	Unshielded	β		2.76E+02
67	SS-23 NW3S	8/16/2004	9:08	1	2.06E+02	60	SCL	Shielded	β	2.06E+02	
68	SS-23 NW3U	8/16/2004	9:10	1	2.91E+02	60	SCL	Unshielded	β		2.91E+02
69	SS-23 NW4S	8/16/2004	9:11	1	2.01E+02	60	SCL	Shielded	β	2.01E+02	
70	SS-23 NW4U	8/16/2004	9:13	1	2.29E+02	60	SCL	Unshielded	β		2.29E+02
71	SS-23 NW5S	8/16/2004	9:14	1	2.44E+02	60	SCL	Shielded	β	2.44E+02	
72	SS-23 NW5U	8/16/2004	9:15	1	3.20E+02	60	SCL	Unshielded	β		3.20E+02
73	SS-23 NW6S	8/16/2004	9:17	1	2.14E+02	60	SCL	Shielded	β	2.14E+02	
74	SS-23 NW6U	8/16/2004	9:18	1	2.77E+02	60	SCL	Unshielded	β		2.77E+02
								Minimum ⇒		1.73E+02	2.23E+02
								Maximum ⇒		2.80E+02	3.29E+02
								Mean ⇒		2.10E+02	2.71E+02
								Sigma ⇒		2.39E+01	2.91E+01

ATTACHMENT 7.2

Williamsburg Concrete Background Measurements

37122N21	Instrument 95348	RLM6220	Time	Detector	Counts	Count Time (sec)	Mode	Designator		FSS-001	BHB
0	BKGND	1/4/2002	8:52	1	7.26E+03	1800	SCL	Inital Background	β		
1	Source Check	1/4/2002	9:07	1	1.79E+05	60	SCL	Source	β		
2	BKGND	1/4/2002	10:05	2	4.40E+01	1800	SCL	Inital Background	α	*Concrete CF(com)* ⇒	0
14	Source Check	1/4/2002	10:39	2	1.51E+05	60	SCL	Source	α	Shielded	Unshielded
15	CON A1S	1/4/2002	13:00	1	2.78E+02	60	SCL	Shielded	β	2.78E+02	
16	CON A1U	1/4/2002	13:02	1	3.88E+02	60	SCL	Unshielded	β		3.88E+02
17	CON A2S	1/4/2002	13:20	1	2.39E+02	60	SCL	Shielded	β	2.39E+02	
18	CON A2U	1/4/2002	13:21	1	2.22E+02	60	SCL	Unshielded	β		2.22E+02
19	CON A3S	1/4/2002	13:28	1	2.39E+02	60	SCL	Shielded	β	2.39E+02	
20	CON A3U	1/4/2002	13:30	1	2.62E+02	60	SCL	Unshielded	β		2.62E+02
21	CON A4S	1/4/2002	13:36	1	2.45E+02	60	SCL	Shielded	β	2.45E+02	
22	CON A4U	1/4/2002	13:38	1	2.71E+02	60	SCL	Unshielded	β		2.71E+02
23	CON A5S	1/4/2002	13:58	1	2.00E+02	60	SCL	Shielded	β	2.00E+02	
24	CON A5U	1/4/2002	14:00	1	2.82E+02	60	SCL	Unshielded	β		2.82E+02
25	CON A6S	1/4/2002	14:03	1	1.84E+02	60	SCL	Shielded	β	1.84E+02	
26	CON A6U	1/4/2002	14:05	1	3.10E+02	60	SCL	Unshielded	β		3.10E+02
27	CON A7S	1/4/2002	14:09	1	1.98E+02	60	SCL	Shielded	β	1.98E+02	
28	CON A7U	1/4/2002	14:10	1	3.15E+02	60	SCL	Unshielded	β		3.15E+02
29	CON A8S	1/4/2002	14:19	1	2.34E+02	60	SCL	Shielded	β	2.34E+02	
30	CON A8S	1/4/2002	14:22	1	2.31E+02	60	SCL	Shielded	β	2.31E+02	
31	CON A8U	1/4/2002	14:24	1	2.88E+02	60	SCL	Unshielded	β		2.88E+02
32	CON A9S	1/4/2002	14:31	1	2.65E+02	60	SCL	Shielded	β	2.65E+02	
33	CON A9U	1/4/2002	14:33	1	2.89E+02	60	SCL	Unshielded	β		2.89E+02
34	CON A10S	1/4/2002	14:42	1	2.46E+02	60	SCL	Shielded	β	2.46E+02	
35	CON A10U	1/4/2002	14:43	1	3.16E+02	60	SCL	Unshielded	β		3.16E+02
36	CON A11S	1/4/2002	15:10	1	1.95E+02	60	SCL	Shielded	β	1.95E+02	
37	CON A11U	1/4/2002	15:12	1	2.94E+02	60	SCL	Unshielded	β		2.94E+02
38	CON A12S	1/4/2002	15:13	1	2.21E+02	60	SCL	Shielded	β	2.21E+02	
39	CON A12U	1/4/2002	15:14	1	2.84E+02	60	SCL	Unshielded	β		2.84E+02
40	CON A13S	1/4/2002	15:23	1	1.74E+02	60	SCL	Shielded	β	1.74E+02	
41	CON A13U	1/4/2002	15:24	1	2.94E+02	60	SCL	Unshielded	β		2.94E+02
42	CON A14S	1/4/2002	15:25	1	1.96E+02	60	SCL	Shielded	β	1.96E+02	
43	CON A14U	1/4/2002	15:26	1	3.33E+02	60	SCL	Unshielded	β		3.33E+02
44	CON A15S	1/4/2002	15:28	1	2.16E+02	60	SCL	Shielded	β	2.16E+02	
45	CON A15U	1/4/2002	15:29	1	3.45E+02	60	SCL	Unshielded	β		3.45E+02
46	CON A16S	1/4/2002	15:30	1	1.83E+02	60	SCL	Shielded	β	1.83E+02	
47	CON A16U	1/4/2002	15:31	1	3.13E+02	60	SCL	Unshielded	β		3.13E+02
48	CON A17S	1/4/2002	15:33	1	1.82E+02	60	SCL	Shielded	β	1.82E+02	
49	CON A17U	1/4/2002	15:34	1	3.22E+02	60	SCL	Unshielded	β		3.22E+02
50	CON A18S	1/4/2002	15:35	1	1.84E+02	60	SCL	Shielded	β	1.84E+02	
51	CON A18U	1/4/2002	15:36	1	3.24E+02	60	SCL	Unshielded	β		3.24E+02
52	CON A19S	1/4/2002	15:37	1	1.91E+02	60	SCL	Shielded	β	1.91E+02	
53	CON A19U	1/4/2002	15:39	1	3.07E+02	60	SCL	Unshielded	β		3.07E+02
54	CON A20S	1/4/2002	15:40	1	1.94E+02	60	SCL	Shielded	β	1.94E+02	
55	CON A20U	1/4/2002	15:41	1	3.33E+02	60	SCL	Unshielded	β		3.33E+02
56	CON A21S	1/4/2002	15:57	1	2.23E+02	60	SCL	Shielded	β	2.23E+02	
57	CON A21U	1/4/2002	15:58	1	2.92E+02	60	SCL	Unshielded	β		2.92E+02
58	CON A22S	1/4/2002	15:59	1	1.72E+02	60	SCL	Shielded	β	1.72E+02	
59	CON A22U	1/4/2002	16:00	1	2.80E+02	60	SCL	Unshielded	β		2.80E+02
60	CON A23S	1/4/2002	16:01	1	1.94E+02	60	SCL	Shielded	β	1.94E+02	
61	CON A23U	1/4/2002	16:02	1	3.29E+02	60	SCL	Unshielded	β		3.29E+02
62	CON A24S	1/4/2002	16:04	1	1.87E+02	60	SCL	Shielded	β	1.87E+02	
63	CON A24U	1/4/2002	16:05	1	3.48E+02	60	SCL	Unshielded	β		3.48E+02
64	CON A25S	1/4/2002	16:06	1	2.07E+02	60	SCL	Shielded	β	2.07E+02	
65	CON A25U	1/4/2002	16:07	1	3.72E+02	60	SCL	Unshielded	β		3.72E+02
66	CON A26S	1/4/2002	16:09	1	2.09E+02	60	SCL	Shielded	β	2.09E+02	
67	CON A26U	1/4/2002	16:10	1	3.26E+02	60	SCL	Unshielded	β		3.26E+02
68	CON A27S	1/4/2002	16:11	1	2.07E+02	60	SCL	Shielded	β	2.07E+02	
69	CON A27U	1/4/2002	16:12	1	3.30E+02	60	SCL	Unshielded	β		3.30E+02
70	CON A28S	1/4/2002	16:14	1	2.30E+02	60	SCL	Shielded	β	2.30E+02	
71	CON A28U	1/4/2002	16:15	1	3.06E+02	60	SCL	Unshielded	β		3.06E+02
72	CON A29S	1/4/2002	16:20	1	2.13E+02	60	SCL	Shielded	β	2.13E+02	
73	CON A29U	1/4/2002	16:21	1	2.58E+02	60	SCL	Unshielded	β		2.58E+02
74	CON A30S	1/4/2002	16:24	1	2.33E+02	60	SCL	Shielded	β	2.33E+02	
75	CON A30U	1/4/2002	16:25	1	2.89E+02	60	SCL	Unshielded	β		2.89E+02
76	CON A31S	1/4/2002	16:28	1	1.84E+02	60	SCL	Shielded	β	1.84E+02	
77	CON A31U	1/4/2002	16:29	1	2.63E+02	60	SCL	Unshielded	β		2.63E+02
—	Source Check	1/4/2002	17:27	1	1.70E+05	60	SCL	—	β		
										Minimum ⇒	1.72E+02	2.22E+02
										Maximum ⇒	2.78E+02	3.88E+02
										Mean ⇒	2.11E+02	3.06E+02
										Sigma ⇒	2.69E+01	3.45E+01

ATTACHMENT 6 : 1

Exhibit 1
Survey Unit Inspection Check Sheet

ORIGINAL

SECTION 1 - SURVEY UNIT INSPECTION DESCRIPTION

Survey Unit #	SS23-1/2	Survey Unit Location	Discharge Tunnel Access Area – Floor and Walls
Date	8/25/04	Time	1300
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 #3: Miscellaneous rope, supplies, sock filters, trash, herculite remains in area.

Response to Question #4: Scaffolding, "A" Frame hoist, stairway remain in area.

Survey Unit Inspector (print/sign)	David Sarge /	Date	8/25/04
Survey Designer (print/sign)	B. BROSEN / B. Brosen	Date	8/25/04

ATTACHMENT 9.1

ORIGINAL

EXHIBIT 3

Surface Measurement Test Area (SMTA) Data Sheet

SECTION 1 - DESCRIPTION					
SMTA Number	SMTA-SS23-2-1	Survey Unit Number	SS23-2		
SMTA Location	Discharge Tunnel Access Area – South Wall				
Survey Unit Inspector	D. Sarge	Date	8/25/04	Time	1245

SECTION 2 - CALIPER INFORMATION & PERSONNEL INVOLVED					
Caliper Manufacturer	Mitotoyo	Caliper Model Number	CD-6" CS		
Caliper Serial Number	763893	Calibration Due Date (as applicable)	N/A		
Rad Con Technician	D.Sarge	Date	8/25/04	Time	1245
Survey Unit Inspector Approval	D. Sarge /		Date	8/25/04	

SECTION 3 - MEASUREMENT RESULTS

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

1 3.6	7 4.0	13 3.5	19 3.8	25 1.5	31 1.1
2 2.3	8 7.4	14 0.6	20 1.7	26 0.5	32 0.4
3 1.2	9 0.3	15 1.3	21 3.0	27 2.3	33 1.9
4 3.7	10 0.4	16 2.7	22 5.5	28 10.8	34 2.8
5 3.0	11 3.0	17 3.4	23 3.5	29 2.8	35 5.2
6 3.0	12 1.5	18 2.2	24 4.5	30 2.1	36 6.3

Average Measurement - 3.3 mm

Comments

Concrete surfaces throughout the survey unit were formed in the same fashion and exhibit similar surface characteristics. Therefore these readings are representative of the typical range of concrete surfaces to be surveyed during FSS.

Additional Measurements Required

ATTACHMENT 9.2

ORIGINAL

EXHIBIT 3
Surface Measurement Test Area (SMTA) Data Sheet

SECTION 1 - DESCRIPTION					
SMTA Number	SMTA-SS23-1-1	Survey Unit Number	SS23-1		
SMTA Location	Discharge Tunnel Access Area – Pillar				
Survey Unit Inspector	D. Sarge	Date	8/25/04	Time	1300

SECTION 2 - CALIPER INFORMATION & PERSONNEL INVOLVED					
Caliper Manufacturer	Mitotoyo	Caliper Model Number	CD-6" CS		
Caliper Serial Number	763893	Calibration Due Date (as applicable)	N/A		
Rad Con Technician	D.Sarge	Date	8/25/04	Time	1245
Survey Unit Inspector Approval	D. Sarge /	Date	8/25/04		

SECTION 3 - MEASUREMENT RESULTS

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

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

Average Measurement - mm

Comments

- Readings taken with caliper without the use of plastic grid template in various surfaces throughout the pillar.
- Eleven readings obtained throughout concrete surfaces, as follows (in mm): 16, 10, 15, 27, 42, 35, 1.5, 2.0, 14, 12, and 28.

  Average depth: 18.4 mm.

Additional Measurements Required

ATTACHMENT 9.3

ORIGINAL

EXHIBIT 3
Surface Measurement Test Area (SMTA) Data Sheet

SECTION 1 - DESCRIPTION					
SMTA Number	SMTA-SS23-2-2	Survey Unit Number	SS23-2		
SMTA Location	Discharge Tunnel Access Area – West Wall –North Side				
Survey Unit Inspector	D. Sarge	Date	8/25/04	Time	1215

SECTION 2 - CALIPER INFORMATION & PERSONNEL INVOLVED					
Caliper Manufacturer		Caliper Model Number			
Caliper Serial Number		Calibration Due Date (as applicable)			
Rad Con Technician	D.Sarge	Date	8/25/04	Time	1215
Survey Unit Inspector Approval	D. Sarge / Daf	Date	8/25/04		

SECTION 3 - MEASUREMENT RESULTS

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

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

Average Measurement - mm

Comments

- Readings taken with a tape measure using a detector template to simulate actual radiation survey distances.
- Ten readings obtained throughout concrete surfaces, as follows (in inches): 2.0, 2.5, 2.0, 1.25, 1.0, 1.0, 0.75, 1.25, 2.0, 1.25

  Average depth = 1.5 inches.
- Concrete has imbedded metal.

Additional Measurements Required

ATTACHMENT 9.4

ORIGINAL

EXHIBIT 3
Surface Measurement Test Area (SMTA) Data Sheet

SECTION 1 - DESCRIPTION					
SMTA Number	SMTA-SS23-2-3	Survey Unit Number	SS23-2		
SMTA Location	Discharge Tunnel Access Area – West Wall -South Side				
Survey Unit Inspector	D. Sarge	Date	8/25/04	Time	1200

SECTION 2 - CALIPER INFORMATION & PERSONNEL INVOLVED					
Caliper Manufacturer		Caliper Model Number			
Caliper Serial Number		Calibration Due Date (as applicable)			
Rad Con Technician	D.Sarge	Date	8/25/04	Time	1200
Survey Unit Inspector Approval	D. Sarge /	Date	8/25/04		

SECTION 3 - MEASUREMENT RESULTS

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

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

Average Measurement - mm

Comments

- Readings taken with a tape measure using a detector template to simulate actual radiation survey distances.
- Twelve readings obtained throughout concrete surfaces, as follows (in inches):

  2.5, 2.0, 2.25, 2.0, 2.0, 1.75, 2.25, 3.0, 1.0, 1.75

  2.0, 2.25. Average depth = 2.1 inches.
- Concrete has imbedded metal.

Additional Measurements Required

ATTACHMENT 9.5

ORIGINAL

Exhibit 1
Survey Unit Inspection Check Sheet

SECTION 1 - SURVEY UNIT INSPECTION DESCRIPTION

Survey Unit #	SS9-1, SS10, SS11	Survey Unit Location	Spray Pump Pit Floor, Walls Below & Above 795' el

Date	7/29/04	Time	0800	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:

Survey Unit Inspector (print/sign)	D. Sarge / Daf	Date	7/29/04
Survey Designer (print/sign)	P. BROSEY / B. Brosey	Date	8/3/04

ATTACHMENT 9.6

EXHIBIT 3
Surface Measurement Test Area (SMTA) Data Sheet

SECTION 1 - DESCRIPTION						
SMTA Number	SMTA-SS11-1	Survey Unit Number	SS11			
SMTA Location	Spray Pump House Floor					
Survey Unit Inspector	D. Sarge	Date	7/29/04	Time	0800	

SECTION 2 - CALIPER INFORMATION & PERSONNEL INVOLVED			
Caliper Manufacturer	Mitotoyo	Caliper Model Number	CD-6" CS
Caliper Serial Number	763893	Calibration Due Date (as applicable)	N/A
Rad Con Technician	D. Sarge	Date	7/29/04 Time 0800
Survey Unit Inspector Approval	D. Sarge	Date	0800

SECTION 3 - MEASUREMENT RESULTS

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

1 0.8	7 0.1	13 0.6	19 0.4	25 3.7	31 4.4
2 1.0	8 3.2	14 1.0	20 1.9	26 10.3	32 17.3
3 0.9	9 1.0	15 3.0	21 6.3	27 0.9	33 16.2
4 1.2	10 0.9	16 1.5	22 1.1	28 10.0	34 0.9
5 1.4	11 1.0	17 2.6	23 1.0	29 1.0	25 0.5
6 4.6	12 7.1	18 5.9	24 6.2	30 4.0	36 0.6

Average Measurement – 3.5 mm

Comments

- Floor surfaces indicate similar depth irregularity similar to these readings.
- Two ground straps for equipment protrude from floor surface. These areas will pose survey obstructions. Notified D & D to remove exposed wires.

Additional Measurements Required

1) **Pump Pedestal has been chiseled causing surface irregularities:**
   10 depth readings using a tape measure were obtained throughout surface. Results ranged from 0.4 – 2.0 inches with an average of 1 inch.
2) **Drain Trough is cut across outside edge of floor:**
   Trough is approx. 3 inches wide and varies in depth between 1.375 to 1.75 inches deep.
3) **Core Bores Holes are present in floor.**
   Three 3-inch holes vary in depth between 4.75 to 6.5 inches. One 4-inch hole is approx. 5.5 inches deep.

ATTACHMENT 9.7

EXHIBIT 3
Surface Measurement Test Area (SMTA) Data Sheet

SECTION 1 - DESCRIPTION

SMTA Number	SMTA-SS11-2	Survey Unit Number	SS11		
SMTA Location	Spray Pump House West Wall (Southwest corner)				
Survey Unit Inspector	D. Sarge	Date	7/29/04	Time	0815

SECTION 2 - CALIPER INFORMATION & PERSONNEL INVOLVED

Caliper Manufacturer	Mitotoyo	Caliper Model Number	CD-6" CS		
Caliper Serial Number	763893	Calibration Due Date (as applicable)	N/A		
Rad Con Technician	D. Sarge	Date	7/29/04	Time	0815
Survey Unit Inspector Approval	D. Sarge	Date	0815		

SECTION 3 - MEASUREMENT RESULTS

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

1 1.3	7 2.6	13 1.1	19 0.6	25 4.1	31 0.7
2 1.0	8 4.8	14 0.5	20 0.6	26 1.4	32 1.0
3 7.2	9 15.6	15 0.3	21 0.3	27 2.6	33 3.6
4 5.7	10 25.4	16 1.3	22 0.8	28 4.6	34 0.3
5 11.6	11 15.4	17 3.0	23 2.3	29 7.5	25 0
6 11.3	12 11.1	18 8.8	24 2.6	30 12.5	36 1.2

Average Measurement – 4.9 mm

Comments

- Wall surfaces indicate similar depth irregularity similar to these readings.
- Steel Bolts/Mounting Brackets are protruding from the wall in various areas.
- Pump Discharge Line (30-inch diameter) indicates surface flaking.

Additional Measurements Required

ATTACHMENT 9.8