June 8, 2005
E910-05-019

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

Gentlemen,

Subject Saxton Nuclear Experimental Corporation (SNEC)
Operating License No., DPR-4
Docket No. 50-146
FSS Report for East Yard Excavation OL1-7

The purpose of this letter is to submit for your review the attached FSS Report for East Yard Excavation OL1-7. One CD-ROM is included in this submission. The CD-ROM labeled: FSS Report for East Yard Excavation OL1-7 – Publicly Available" contains the following 6 files:

Document Title	File Name	File Size (Mbytes)
Main Report	001 FSS Report – OL1-7.pdf	0.33
Appendix A (pages 1-8)	002 OL1-7 – Appendix A (1-8).pdf	44.7
Appendix A (pages 9-11	003 OL1-7 – Appendix A (9-11).pdf	14.9
Appendix A (attachments 1-1 to 2-4)	004 OL1-7 – Appendix A (attachments 1-1 to 2-4).pdf	32.0
Appendix A (attachments 3-1 to 9-1)	005 OL1-7 – Appendix A (attachments 3-1 to 9-1).pdf	28.6
Appendix A (attachments 9-2 to 9-3, Appendix B to Appendix D	006 OL1-7 – Appendix A (attachments 9-2 to 9-3), Appendix B to Appendix D,pdf	26.5

If you have any questions on this information, please contact Mr. Art Paynter at (814) 635-4384.

Sincerely,

G. A. Kuehn
Program Director, SNEC

cc: NRC Project Manager
NRC Project Scientist, Region 1
Mr. Tim Bauer, ORISE Project Leader

A020

Final Status Survey Report

For

Saxton Nuclear Experimental Corporation
East Yard Excavation OL1-7

Prepared by GPU Nuclear, Inc.

May 2005

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Executive Summary

This report presents the results and conclusions of the final status survey (FSS) of the Class 1 East Yard Excavation at the Saxton Nuclear Experimental Corporation (SNEC) facility designated as OL1-7. This FSS report includes only surveys of the east yard excavation. The excavation is in the original SNEC site area between the locations of the Containment Vessel (CV) and the RadWaste Disposal Facility (RWDF) and is just north of the pipe tunnel. The survey was conducted in April and May of 2005.

The FSS was performed in accordance with the SNEC License Termination Plan (LTP, reference 9.3). The survey area (OL1-7) was a single survey unit subdivision of the OL1 area. The survey unit consisted of a large excavation up to about 20 feet deep. Data was collected in accordance with the specific survey design data collection requirements. The following is a summary of the measurements performed:

1) Direct NaI(Tl) scans of 100 percent of the accessible floor and wall surfaces of the excavation covering about 99.7% of the actual total surface area.
2) Eleven samples (soil / rock / backfill) collected and then analyzed by laboratory gamma spectroscopy

The yard tank excavation consists of an approximately 20 foot deep excavation that includes four separate areas, the gas decay tank excavation on the east side, the storage tank excavation in the center, the decon tank excavation on the west, and a trench northwest of the decon tank excavation. These are contiguous, and thus are treated as one survey unit, but have differing dimensions and depths. The total area of the unit is about 1066 square meters and includes the floors, walls, and side ramps of the entire excavation area. The bottom of the excavation is substantially below the groundwater level. Water intrusion was controlled to improve the survey of the pit floors.

The collected FSS survey data demonstrate that the 1066 square meters of the OL1-7 survey area meets the radiological release criteria for unrestricted use specified in 10CFR20.1402. Therefore GPU Nuclear, Inc. concludes that the area meets the NRC requirements and may be released for unrestricted use.

1.0 Purpose and Scope

This report presents the results and conclusions of the final status survey of the east yard excavation designated OL1-7 in the original yard area of the SNEC facility. It provides the information required by 10CFR50.82(a)(11) and the SNEC license termination plan (LTP, reference 9.3) to demonstrate that this area meets the radiological criteria for unrestricted use specified in 10CFR20.1402.

This report describes the radiological data collected in the Class 1 survey unit consisting of the exposed excavation surfaces. This report only addresses the FSS performed on this specific survey unit of the larger area designated as OL1 on reference 9.1. The format of this report follows the guidance contained in reference 9.2.

2.0 Survey Area Description

Survey Unit OL1-7 is Class 1 impacted land consisting of an approximately 20 foot deep excavation that includes four separate areas, the gas decay tank excavation, the storage tank excavation, the decon tank excavation and a trench northwest of the decon tank excavation. These four regions are contiguous, and thus are treated as one survey unit, but have differing dimensions and depths. The total area of the unit is about 1066 square meters (post-survey estimate) and includes the floors, walls, and side ramps of the entire excavation area.

The excavation has vertical walls consisting of fractured rock, residual concrete from the RWDF and pipe tunnel, natural soil, and unconsolidated fill. Therefore, there is concern about personnel safety and OSHA requirements for personnel access into the excavation. The bottom of the excavation is substantially below the groundwater level. Immediately prior to the survey, the excavation contained groundwater to within about 6 feet of grade level. Water intrusion was controlled by using submersible pumps to dewater the excavation to provide access to the excavation and to maximize the accessible floor area for survey of the pits.

Since the area is less than the size guidance in the SNEC LTP for Class 1 survey units (2000 square meters recommended maximum), the survey area has been designated a single survey unit. Layout of the survey unit relative to the site layout are shown in Attachment 1-1 of Appendix A. The OL1 designation of the overall survey area that the east yard excavation is a part of is taken from the drawing, reference 9.1 and table 5-2 of the SNEC LTP.

3.0 Operating History

3.1 Plant Operation

The Saxton Nuclear Experimental Corporation (SNEC) facility included a pressurized water reactor (PWR), which was licensed to operate at 23.5 megawatts thermal (23.5 MWTh). The reactor, containment vessel and support buildings have all been removed. The facility is owned by the Saxton Nuclear Experimental Corporation and is licensed by GPU Nuclear, Inc. The SNEC facility is maintained under a Title 10 Part 50 license and associated Technical Specifications. In 1972, the license was amended to possess but not operate the SNEC reactor.

The facility was built from 1960 to 1962 and operated from 1962 to 1972 primarily as a research and training reactor. After shutdown in 1972, the facility was placed in a condition equivalent to the current SAFSTOR status. Since then, it has been maintained in a monitored condition. The fuel was removed in 1972 and shipped to a (now DOE) facility at Savannah River, SC, who is now the owner of the fuel. As a result of this, neither SNEC nor GPU Nuclear, Inc. has any further responsibility for the spent fuel from the SNEC facility. The building and structures that supported reactor operation were partially decontaminated by 1974.

In the late 1980s and through the 1990s, additional decontamination and disassembly of the containment vessel and support buildings and final equipment and large component removal was completed. Final decontamination and dismantlement of the reactor support structures and buildings was completed in 1992. Large component structures, pressurizer, steam generator, and reactor vessel were removed in late 1998. Containment vessel removal (to below grade) and backfill was completed in late 2003. Currently, decontamination, disassembly and demolition of the SNEC facility buildings and equipment has been completed and the facility is in the process of Final Status Survey for unrestricted release and license termination.

3.2 Survey Area Remediation Status

The OL1 area has a history of extensive remediation over the duration of the project. This specific survey unit consists of the remaining excavation hole after radwaste process tanks were removed following plant shutdown. This excavation was backfilled after tank removal during the initial decontamination and dismantlement phase that was completed in 1974. In the current license termination phase, the 1974 backfill was removed and processed though an automated belt scanning system and stored on site for reuse as backfill. The excavation was left open awaiting final status survey of the excavation surfaces.

4.0 Site Release Criteria

The site release criteria applied to the east yard excavation OL1-7 correspond to the radiological dose criteria for unrestricted use per 10CFR20.1402. The dose

criteria is met "if the residual radioactivity that is distinguishable from background radiation results in a Total Effective Dose Equivalent (TEDE) to an average member of the critical group that does not exceed 25 mrem/yr, including that from groundwater sources of drinking water, and that the residual radioactivity has been reduced to levels that are as low as reasonably achievable (ALARA)".

Levels of residual radioactivity that correspond to the allowable dose to meet the site or survey unit release criteria for open land were derived by analyses using a resident farmer family scenario. The dose modeling for this scenario is explained in the SNEC LTP (reference 9.3). The derived concentration guideline levels (DCGL) shown in Table 5-1 of the SNEC LTP form the basis for satisfying the site release criteria.

Because of the unique nature of this survey unit, some residual concrete in the deep portion of the excavation is treated the same as soil for purposes of the scanning. This is conservative since the concrete surface DCGL (28000 dpm /100cm2 for the surrogate isotope Cs137) is higher activity than the effective DCGL based on the surface soil (see appendix D).In addition, the concrete is either 20 feet down in the excavation and a building reuse scenario is unlikely, or is residual from the plant outbuilding foundations that were previously released.

Residual radioactivity sample results for the soils showing the mix of hard to detect isotopes were used to calculate a surrogate Cs137 DCGL. The adjusted surrogate DCGL was developed using the methodology described in the SNEC LTP section 5.2.3.2.3 based on nuclide specific DCGLs from Table 5-1 of the LTP.

An adjustment was made to the surrogate Cs137 DCGL to address the de-listed radionuclides as described in the LTP section 6.2.2.3. SNEC has instituted an administrative limit of 75% of the DCGL for all measurement results. The de-listed radionuclides are conservatively accounted for in this 25% reduction since the de-listed radionuclides were only 4.7% of the dose contribution. These adjustment factors are discussed in section 6 of the SNEC LTP.

The east yard excavation is a large open hole up to about 20 feet deep. MARSSIM (reference 9.4) and the SNEC LTP (reference 9.3) do not specifically address surveys of deep subsurface material. Nevertheless, it was assumed that the existing MARSSIM based requirements for open land would be applied to the excavation. The fundamental design parameters used for surface open land at SNEC, such as area factors and DCGL, are conservative for the excavation and significantly overestimate the actual impact of any residual activity that may be in the excavation as discussed below.

The area factors for the surrogate isotope, Cs-137, are based on the relative total direct dose rates from small sources compared to the direct dose rate of a large area source (up to 10000 square meters). This, the area factor is essentially a correction for total activity and source to dose point geometry.

The depth of the excavation would reduce the effective direct dose rate for smaller area sources not only from the thick shielding of the overburden / backfill, but also because of the additional distance from the source.

Using only air between the dose point and the source, and only a 10 foot (3 meter) depth, the dose rate from the assumed 1 square meter elevated area is reduced by a factor of about 150 due primarily to the source-to-dose point geometry change (compare uncollided dose rate shown on Attachment 5-1 and that on Attachment 5-2 in Appendix A) which is essentially dependent on the secant of the subtended angle between the dose point and the center and the edge of the source.

The backfill of the excavation will place a thick layer of material between the surface and the lower portions of the excavation. This would provide substantially more shielding than the standard SNEC surface dose model assumes.

Both of these factors (geometry and overburden / backfill shielding) contribute significant conservatism to the dose consequences of residual activity in small areas at depth in the excavation and therefore the surface based area factors and DCGLs when applied to deep activity are highly conservative. Since the 25 mrem/yr DCGLs from the SNEC LTP apply to surface and subsurface, other dose model factors such as drinking water transfer would be equivalent, while others, such as vegetation transfer, would be highly conservative. Generally, therefore, the use of the existing DCGLs from the SNEC LTP are conservative for application to the excavation.

Therefore, although the SNEC LTP (reference 9.3) does not address deep dose area factors, and the Table 5-1 DCGLs apply the same values to 'surface and subsurface' the use of the surface DCGLs and area factors for activity in the excavation would significantly overestimate the actual direct dose to the average member of the critical group and therefore can be conservatively applied in the survey of the OL1-7 Yard Storage Tank Excavation.

5.0 Final Status Survey Design and DQO

The SNEC calculation providing the design of the survey for these survey units is provided in Appendix A. Since the survey unit is Class 1, scan measurements were conducted over 100% of the accessible surface. Approximately 0.3% of the surface of the survey unit was not accessible for scanning due to groundwater intrusion. Scans were conducted using a narrow window optimized for Cs137 to reduce background.

The number of sample points was determined by using the COMPASS computer program (reference 9.6 and attachment 7 of appendix A)). These points were located on survey maps using the Visual Sample Plan program (reference 9.7

and attachment 6 of appendix A). Samples are collected to a depth of 1 meter to match the site surface dose model used in the SNEC LTP (reference 9.3).

The survey design uses a surrogate Cs137 effective DCGL developed from radionuclide mix analyses from soil samples collected before the Final Status Survey in the vicinity of the survey unit. For OL1-7 the mix was based on radionuclide mix data (including the hard-to-detects listed in Table 5-1 of the LTP) from the OL1 and OL2 area (attachment 2 of appendix A). Cs137, Co60, H3, and Sr90 were positively detected in one or more of these soil samples and are accounted for in the adjusted surrogate DCGL. The following table (Table 1) presents the Data Quality Objectives (DQO) and other relevant information from the survey design package.

Table 1 DQO / Design

DQO/Design Parameter	OL1-7
SNEC Design Calc. #	E900-05-012
MARSSIM Classification	1
Survey Unit Area (m^2)	1018***
Statistical Test	Sign
Type 1 decision error (α)	0.05
Type 2 decision error (β)	0.1
LBGR (pCi/gm)	3.55*
Estimated σ (pCi/gm)	0.37
Relative Shift (Δ/σ)	3.0
Number of static points	11
DCGLw (Cs137 pCi/gm)	5.73
75% Action Level (pCi/gm)	4.3
Scan MDC (pCi/gm)	6.2 / 7.7**
SNEC Survey Request #	SR220
Scan Survey Instrument	L2350-1 w/ 44-10

* - LBGR was raised from 50% of the DCGL to lower the relative shift to 3
** - The design MDCscan was 6.2. Accounting for the saturated soil and thin water film in the deep pit results in a MDCscan of 7.7
*** - Design area estimate. Post-survey area estimate was 1066 m^2

6.0 Final Status Survey Results

The following sections provide the survey summary results for each survey unit as required by the respective design. Summary data was taken from reference 9.10 which is filed in the SNEC history files.

6.1 Survey Unit OL1-7

6.1.1 OL1-7 Scan survey

Scan measurements were made in the four regions of the excavation (gas tank pit, decon tank pit, storage tank pit, and trench) using a 2 inch by 2 inch NaI detector with an MDCscan of 6.2 pCi/gm (attachment 4 of appendix A). The Action Level was 4.3 pCi/gm and the adjusted surrogate Cs137 DCGLw for this survey unit was 5.73 pCi/gm (table 1 on page 2 of appendix A). The area factor can be used to compare the MDCscan to the DCGLw. In this case, the MDCscan was below the DCGL times the effective area factor so no sample number adjustment was needed.

A portion of the survey unit, the bottom of the deepest part of the excavation (the storage tank pit), had saturated soil and in some areas a thin (estimated at 1/8 inch) layer of water. This saturation and water layer will slightly affect the MDCscan. With the saturation and water film, the MDCscan is estimated to be 7.7 pCi/gm, slightly higher than the design value of 6.2 pCi/gm. This MDCscan is also below the DCGL times the effective area factor so no sample number adjustment was needed. A calculation showing the impact of the water is provided as Appendix C.

Of the four excavation regions scanned, a small portion was inaccessible due to groundwater intrusion. A total of about 3 square meters was not scanned due to groundwater in the deepest part of the excavation. This results in approximately 1063 square meters actually scanned in the 1066 square meter survey unit, or about 99.7 percent.

The scans conducted identified two areas with activity greater than the scan action level. The action level was >175 net cpm (table 2 on page 3 of appendix A). One Alarm Point (AP) was on the south wall of the excavation under an overhang of rock. The second was in the northwest bottom corner of the deepest part of the excavation.

6.1.2 soil samples

Eleven random start triangular grid systematic soil sample locations were defined for the survey unit, based on a conservative relative shift of about 3.0. No biased samples were required.

None of the design fixed point soil samples in OL1-7 had results in excess of the adjusted surrogate DCGLw. The table below (Table 2) shows the Cs137 results

(no other licensed isotopes were detected) for each sample, along with the mean, standard deviation and range of the soil sample data. Results that are less than MDA are assumed to be positive at the MDA value for the statistics in the table. This will overestimate the mean.

The standard deviation of the samples collected from the survey unit was greater than the variability assumed in the survey design. However, the LBGR used in the design was much higher than 50% of the DCGL. The observed sample variability and an LBGR greater than 50% of the DCGL would still result in a relative shift of three. Therefore, the relative shift and number of samples required is consistent between the survey design and the survey results. Based on this, no changes to the survey design or additional samples are required.

Table 2 - Soil sample results for OL1-7

Sample Number	Cs137 pCi/gm
1	<0.09
2	1.07
3	0.13
4	0.80
5	0.50
6	1.65
7	0.27
8	<0.06
9	1.80
10	<0.08
11	0.06
Mean	0.59
Std Dev	0.65
Min	0.06
Max	1.80

6.1.3 Elevated measurement investigation

During scan measurements in OL1-7 two alarm points (AP) (in excess of the action level of 175 net cpm) were identified. One AP was on the south wall of the excavation under an overhang of rock and was 208 cpm above background. The second was in the northwest bottom corner of the deepest part of the excavation and was 176 cpm above background. An area of about one square foot (0.1 square meters) was defined around each of the alarm points to the edge where the count rate was back down to normal background.

In order to assess the residual radioactivity in the AP areas, a sample was collected exactly at each AP location. In addition, in order to demonstrate that the

elevated area was adequately bounded by the 0.1 square meter area, One sample was collected at the edge of the area boundary at each AP. The table below (Table 3) shows the Cs137 results (no other licensed isotopes were detected) of these samples.

Table 3 – OL1-7 elevated area investigation sampling

Sample location	Activity (pCi/gm)
South AP	5.31
South AP Boundary	2.51
North AP	<0.08
North AP Boundary	<0.10

The edge samples show that the elevated area is clearly delineated by the defined boundary. The edge sample results are also consistent with the variability and range of the rest of the survey unit.

Because the samples collected at the AP locations are both less than the DCGLw, no additional action is required and no Elevated Measurements Comparison (EMC) Test is performed. The Action Level is used to screen sample results and initiate investigation. In the case of these two APs, the investigation is the additional samples collected based on the scans. The DCGLw is used for the EMC test. The 5.3 pCi/gm collected at the South AP is less than the adjusted surrogate Cs137 DCGLw of 5.73. Even accounting for the 4.7% contribution from de-listed radionuclides (5.73*95.3=5.46) the AP sample results are less than the DCGLw.

The result for the South AP is consistent with expected activity based on the observed count rate. The North AP result is lower than the count rate would have indicated. This AP, however, is probably a result of the unusual geometry of being in a floor / wall / wall corner junction contributing to background.

7.0 Data Assessment

7.1 Assessment Criteria

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

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

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

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

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

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

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

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

8) The custody of samples that were sent for off-site analysis were tracked from the point of collection until final results were provided.

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

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

The statistical test does not need to be performed for this final status survey since the data clearly show that the survey unit meets the release criteria because all measurements in the survey units are less than or equal to the DCGLw.

7.2 Summary of Overall Results

OL1-7 had two alarm points during scan surveys of 99.7% of the surface: one under an overhang of rock on the south wall, and one in a bottom corner of the deepest part of the excavation. Both were investigated, sampled, and shown to be less than the DCGLw. Scan MDCs were adequate. Eleven soil samples were all less than the DCGLw. Scan fraction, scan MDC, and number of soil samples all meet LTP and MARSSIM requirements.

7.3 Survey Variations (design, Survey Request, LTP)

7.3.1 Approximately 3 square meters total of OL1-7 was inaccessible. The remaining scanned portion constituted 99.7 percent of the survey unit area.

7.3.2 An alarm point was found by scanning the south wall at an overhang of rock. Subsequent investigation showed the area to contain activity but less than the DCGLw.

7.3.3 An alarm point was found by scanning in the bottom northwest corner of the deepest part of the excavation. Subsequent investigation showed the area to contain no measurable licensed activity.

7.3.4 Of the 150 square meters in the bottom of the storage tank pit (the deepest part), about 50% was covered by a thin layer of water up to about 1/8 inch thick, and the rest was saturated. The MDCscan was re-evaluated for this condition and estimated to be 7.7 pCi/gm. This MDCscan is still well within requirements of DCGLw times the Area Factor for elevated area detection requirements.

7.4 QC comparisons

7.4.1 Scan surveys

Numerous areas were partially rescanned as QC duplicates. The QC rescans did not identify any activity above alarm points except at the previously known AP. Results at the AP were similar and so are in agreement with the primary scans. Approximately 95 square meters were QC scanned out of the 1063 square meters in the primary scans. This exceeds the minimum 5% QC requirement.

Table 4 - OL1-7 QC Scan comparison

Sample Point	Sample Result (cpm)	QC Result (cpm)
South AP	516	531

7.4.2 Soil Samples

One sample from OL1-7 received a QC split gamma spectroscopy analyses on the soil sample. The duplicates had good agreement as shown in the table below (Table 5). One QC split out of eleven samples exceeds the minimum 5% QC requirement.

Table 5 - OL1-7 QC Split comparison

Sample Point	Sample Result (pCi/gm)	QC Result (pCi/gm)
OL1-7 SP6	1.65	2.34

8.0 Final Survey Conclusions

The East Yard Excavation OL1-7 final status survey was performed in accordance with the SNEC LTP (reference 9.3), site procedures, design calculations, and Survey Request requirements. FSS data was collected to meet and/or exceed the quantity specified or required for each survey unit design. The survey data for each survey unit meets the following conditions:

1) The average residual radioactivity in the soils is less than the derived surrogate DCGLw in the survey unit.

2) All measurements were less than the DCGLw in the survey unit.

These conditions satisfy the release criteria established in the SNEC LTP and the radiological criteria for unrestricted use given in 10CFR20.1402. Therefore it is concluded that the SNEC East Yard Excavation survey unit designated OL1-7 is suitable for unrestricted release.

9.0 References

9.1 SNEC Facility Site area grid map Drawing number SNECRM-020
9.2 SNEC procedure E900-ADM-4500.60 "Final Status Survey Report"
9.3 SNEC License Termination Plan
9.4 NUREG 1575 "Multi-Agency Radiation Survey and Site Investigation Manual" (MARSSIM), Revision 1 August 2000
9.5 SNEC Calculation E900-05-012 "Yard Storage Tank Excavation - OL1-7 – Survey Design"
9.6 COMPASS computer program, Version 1.0.0, Oak Ridge Institute for Science and Education
9.7 VISUAL SAMPLE PLAN computer program, Version 3.0, Battelle Memorial Institute
9.8 SNEC procedure E900-IMP-4500.59, "Final Site Survey Planning and DQA"
9.9 SNEC procedure E900-IMP-4520.04, "Survey Methodology to Support SNEC License Termination"
9.10 SNEC Survey Request (SR) # SR220 for FSS of OL1-7

10.0 Appendices

Appendix A - SNEC Calculation E900-05-012 "Yard Storage Tank Excavation - OL1-7 – Survey Design" (11 pages plus numerous attachments)

Appendix B - COMPASS DQA report for OL1-7 (2 pages)
Appendix C – Microshield output and MDCscan calculation for saturated soil with water film (2 pages)
Appendix D – Comparison of Concrete surface DCGL to soil DCGL

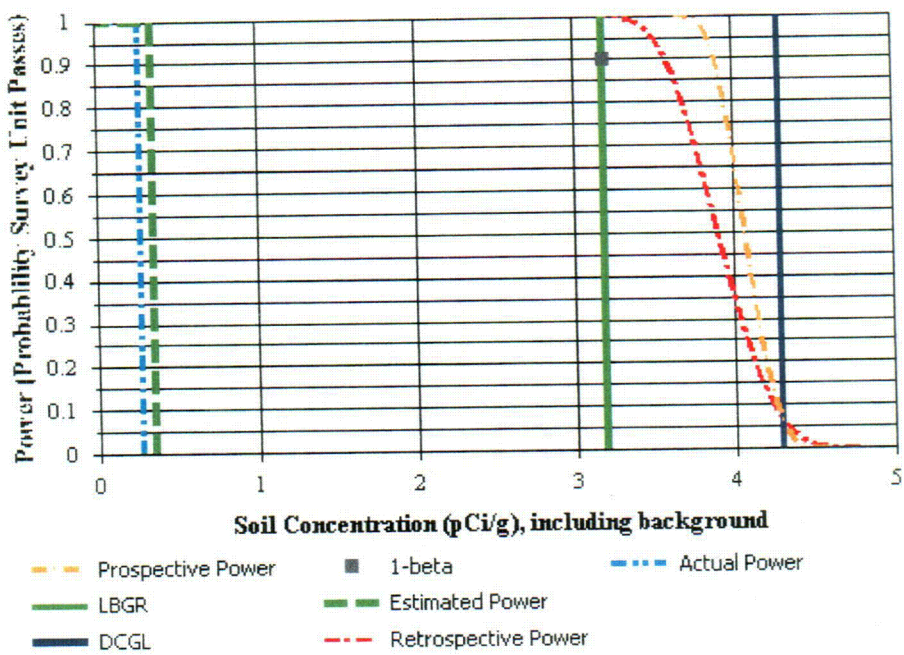
Appendix B, C, D

DQA Surface Soil Report

Assessment Summary

Site:	EYE		
Planner(s):	WJCooper		
Survey Unit Name:	East Yard Tank Excavation		
Report Number:	2		
Survey Unit Samples:	11		
Reference Area Samples:	0		
Test Performed:	Sign	Test Result:	Not Performed
Judgmental Samples:	0	EMC Result:	Not Performed
Assessment Conclusion:	***Reject Null Hypothesis (Survey Unit PASSES)***		

Retrospective Power Curve



Appendix B
OL1-7

C01

DQA Surface Soil Report

Survey Unit Data

NOTE: Type = "S" indicates survey unit sample.
Type = "R" indicates reference area sample.

Sample Number	Type	Cs-137 (pCi/g)
1	S	0.09
2	S	1.07
3	S	0.13
4	S	0.8
5	S	0.5
6	S	1.65
7	S	0.27
8	S	0.06
9	S	1.8
10	S	0.08
11	S	0.06

Basic Statistical Quantities Summary

Statistic	Survey Unit	Background	DQO Results
Sample Number	11	N/A	N=11
Mean (pCi/g)	0.59	N/A	0.35
Median (pCi/g)	0.27	N/A	N/A
Std Dev (pCi/g)	0.65	N/A	0.37
High Value (pCi/g)	1.80	N/A	N/A
Low Value (pCi/g)	0.06	N/A	N/A

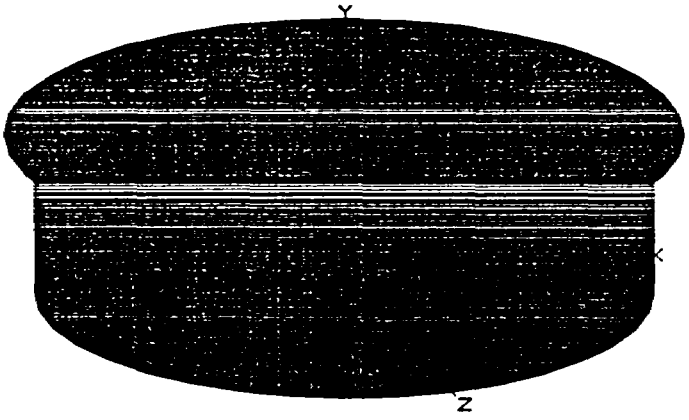
Appendix B
OL1-7

MicroShield v5.05 (5.05-00121)
GPU Nuclear

Page : 1
DOS File: EYEHOLE.MS5
Run Date: May 16, 2005
Run Time: 12:20:44 PM
Duration: 00:00:02

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

Case Title: Cs137 Soil
Description: Model for Scanning with thin water layer
Geometry: 8 - Cylinder Volume - End Shields



Source Dimensions

Height	15.24 cm	6.0 in
Radius	28.0 cm	11.0 in

Dose Points

	X	Y	Z
# 1	0 cm	25.4 cm	0 cm
	0.0 in	10.0 in	0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	3.75e+04 cm³	Mixed ->	2
		Concrete	1.6
		Water	0.4
Shield 1	.3 cm	Water	1
Air Gap		Air	0.00122

Source Input
Grouping Method : Actual Photon Energies

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Ba-137m	5.6815e-008	2.1022e+003	1.5136e-006	5.6003e-002
Cs-137	6.0058e-008	2.2221e+003	1.6000e-006	5.9200e-002

Buildup
The material reference is : Source

Integration Parameters

Radial	50
Circumferential	50
Y Direction (axial)	50

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0318	4.352e+01	6.047e-06	1.675e-05	5.037e-08	1.395e-07
0.0322	8.030e+01	1.164e-05	3.289e-05	9.370e-08	2.647e-07
0.0364	2.922e+01	6.499e-06	2.261e-05	3.692e-08	1.285e-07
0.6616	1.892e+03	5.689e-02	1.219e-01	1.103e-04	2.363e-04
TOTALS:	2.045e+03	5.692e-02	1.220e-01	1.105e-04	2.368e-04

NaI Scan MDC Calculation

MDCscan =	7.7	pCi / g

b = background in counts per minute
bi = background counts in observation interval
Conv = NaI Detector / meter calibrated response in cpm/uR/hr
d = Index of sensitivity from MARSSIM Table 6.5 based on 95% detection, 60% false positive
HSd = Elevated measurement spot diameter in centimeters
MDCscan = MinimumDetectable Concentration for scanning in pCi/g
MDCRi = Minimum Detectable Count Rate in net counts per minute
MDCRsurv = MDCRi adjusted for the human performance factor p - in net counts per minute
MDER = Minimum Detectable Exposure Rate in uR / hr
MSoutput = MicroShield derived exposure rate for 1 pCi/g contaminant in mR/hr
Oi = Observation interval in seconds
p = human performance adjustment factor - unitless
SR = Scanning movement rate in centimeters per second
DCGLeq = Net count rate equivalent to the Adjusted DCGL

b = 300 cpm p = 0.5 HSd = 56 cm

SR = 25 cm d = 1.38 Conv = 205.6 cpm/uR/hr

Msoutput = 1.10E-04 mR/hr / pCi/g DCGL = 4.3 pCi/g

$\frac{HSd}{SR}$ = 2.24 = Oi (sec) $\frac{b*Oi}{60\ (sec/min)}$ = 11.2 = bi (counts)

$\frac{d*sqrt(bi)*60}{Oi}$ = 123.7 = MDCRi (net counts per minute)

$\frac{MDCRi}{sqrt(p)}$ = 174.9 = MDCRsurv (net counts per minute)

$\frac{MDCRsurveyor}{Conv}$ = 0.851 = MDER (uR/hr)

$\frac{MDER}{MSoutput*1000(uR/mR)}$ = **7.71** = MDCscan pCi/g

Evaluation of concrete surface activity compared to the soil DCGL.

Cs137 surface DCGL – 28000 dpm/100cm^2

Cs137 soil DCGL – 6.6 pCi/g

Action Level for excavation – 4.3 pCi/g

AL / DCGL ratio: 4.3 /6.6 = 0.65

Adjusted surface DCDL: 28000*0.65 = 18200 dpm/100cm^2

18200 dpm/100cm2 = 182 dpm /cm2 = 82 pCi/cm^2

soil MDC model uses 15 cm thick layer (see appendix A)

15cm*4.3 pCi/g = 64.5 pCi/cm^2

Therefore, surface activity DCGL is larger than the activity present for the action Level defined in the survey design.