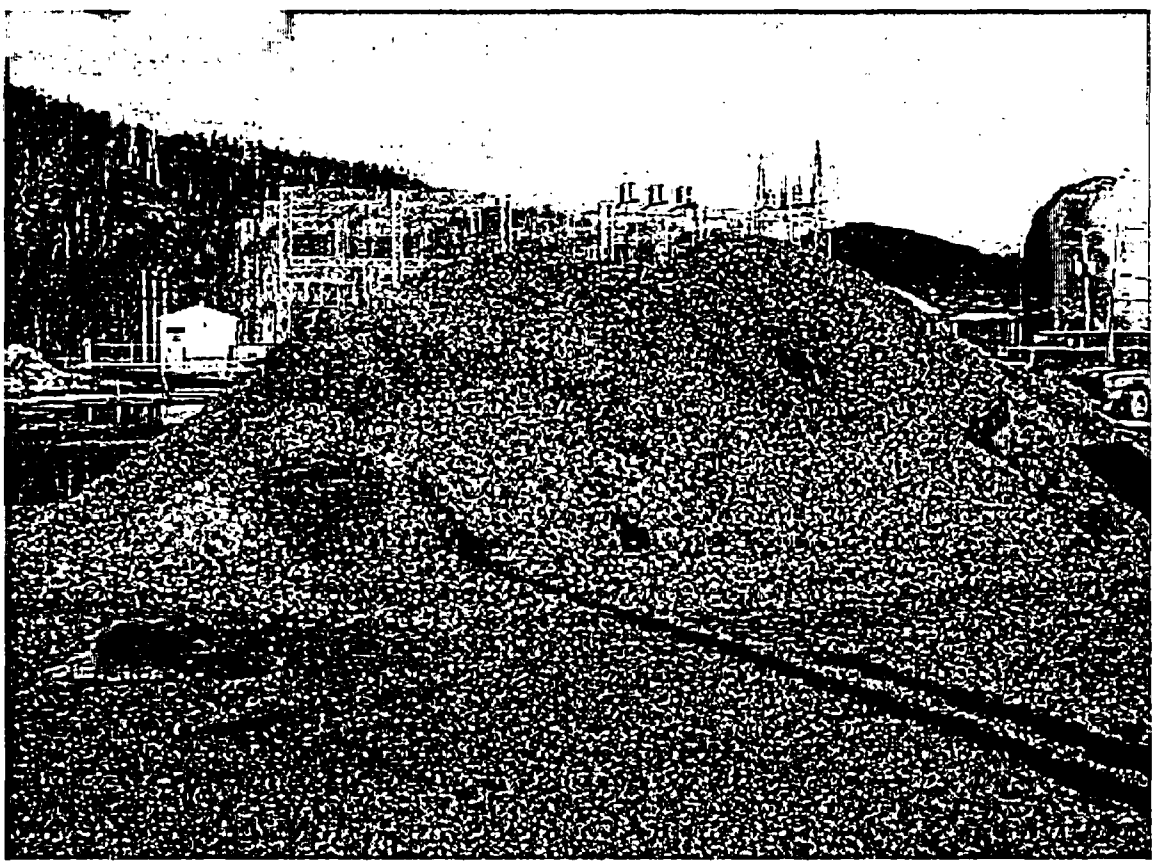
Final Status Survey Report

For

Saxton Nuclear Experimental Corporation

Final Report for Survey of Remediated Soils



Prepared by GPU Nuclear, Inc.

July 2005

Table of Contents

Final Status Survey – Survey of Remediated Soils

Executive Summary

This report presents the results and conclusions of the FSS soil monitoring campaign conducted by Shonka Research Associates, Inc. (SRA) and GPU Nuclear, Inc. on the SNEC Facility Excavated Soils. This survey work was performed on site from December 2004 to February 2005. This FSS Report provides the summary of survey/sampling results taken from this campaign.

The survey work was performed in accordance with the SNEC License Termination Plan (LTP) (Reference 9.1), using procedures reviewed and approved by SNEC Management. Survey Design 03-031 (Appendix A) provided the calculations to ensure the survey methodology would meet the site release criteria. The survey work was performed under Survey Requests SR-186 (Appendix C) and SR-190 (Appendix D).

The composition of the soil was a mixture of dirt and flyash accumulated from various Class 1 characterization/remediation efforts. The following types of measurements were performed:

1. Scan measurements were performed in 57 batches covering approximately 8,150 tons.
2. Alarm response scans were performed on three suspect sections of soil. This material was removed from the conveyor system.
3. 136 soil samples were obtained throughout the SRA scanning phase.

Scan results indicated residual activity less than 75% of the administrative $DCGL_w$. The sample results indicated a maximum activity of 1.0 pCi/g for Cs-137, which is less than 25% of the administrative $DCGL_w$. These results meet the requirements stated in the LTP and the NRC requirements for release for unrestricted use. SNEC Management plans to use this soil as fill material for re-grading of open land areas following the performance of FSS.

1.0 Purpose and Scope

This report presents the results and conclusions of the surveys and sampling performed under SR-186 and SR-190. The results provide the information required by 10 CFR 50.82(a)(11) (Reference 9.2) and the SNEC LTP to demonstrate that this material meets the radiological criteria for unrestricted use specified in 10 CFR 20.1402 (Reference 9.3).

2.0 SRA Survey Methodology / SMCM Monitoring Enclosure

2.1 Description

The radiation monitoring system used for this soil campaign was virtually the same as the system used in the previous monitoring campaign documented in the SRA report, "Final Report for Survey of Debris Piles" Rev. 3, Jan 11, 2005. This system, as seen as Figure 1, utilizes the Subsurface Multispectral Contamination Monitor (SMCM) technology developed by SRA. Although the conveyor fill height was increased from 4 to 6 inches for this campaign, the detector's collimated view of the material surface was unchanged from the first deployment. The detectors, sand collimators, and vertical spacing (relative to the soil surface) were all identical to the original deployment. The belt speed was again four inches per second and the distance encoder and material level switch were deployed and calibrated in a similar manner as the original system.

During SR-186, the conveyor system was filled by front-end loaders moving dirt from a single pile of material. Post-monitored material was then dumped onto a concrete pad where the loaders would continuously carry the soil over to a single processed storage pile. Typically 2 batches of material were processed per day. The size of batches ranged from 67 to 257 tons with an average of 150 tons. The system's real-time alarm capabilities allowed accelerated processing of material.

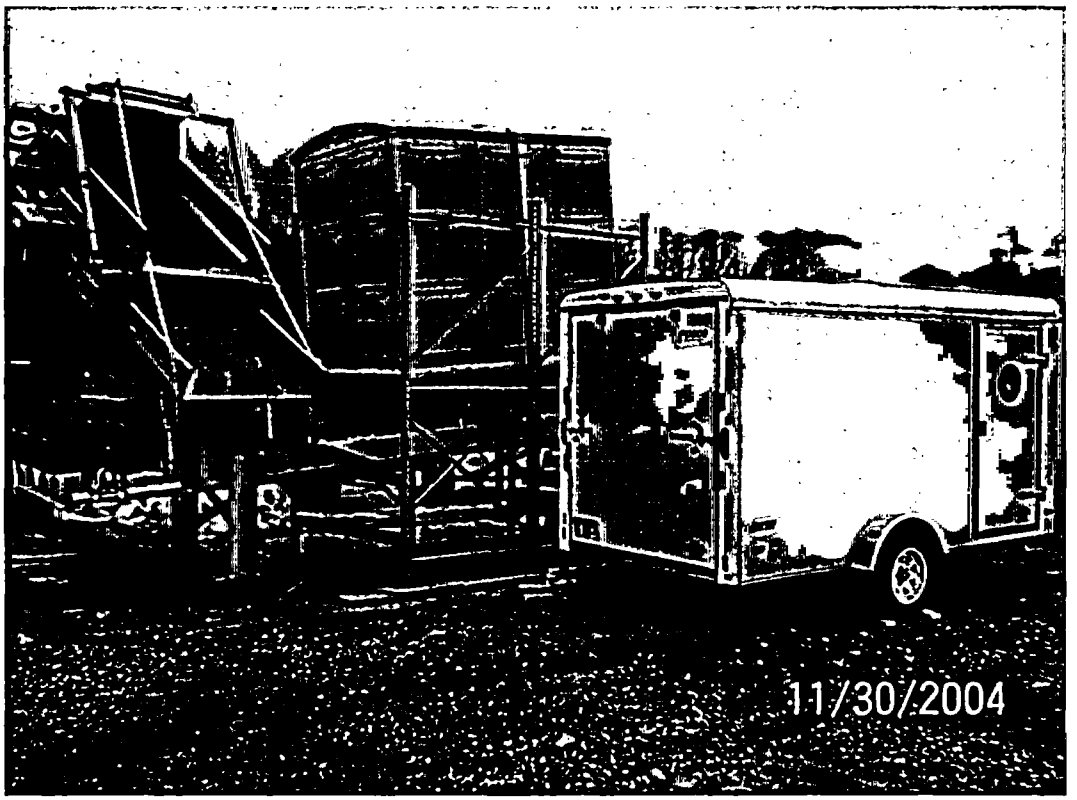


Figure 1, SRA Monitoring Enclosure, Mobile Control Center and conveyor system.

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 permit SNEC to possess but not to 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 permanent cessation of operation in 1972, the facility was placed in a condition equivalent to the current SAFSTOR status. Since then, it had 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, the 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 have been completed and the facility is in the process of Final Status Survey for unrestricted release and license termination.

3.2 Soil History

The soil surveyed by SRA originated from various remediation efforts performed throughout the decommissioning process at the SNEC property. Sampling of the soil was performed at the time of remediation to monitor the radiological composition. Soil indicating contamination levels at or below the $DCGL_w$ were scanned by SRA.

4.0 Site Release Criteria

The site release criteria that is applied to backfill materials corresponds 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 the resident farmer scenario. Levels of residual radioactivity that correspond to the allowable dose to meet the site or survey unit release criteria for the building structures were derived by analyses using the building occupancy (surface area) scenario. The dose modeling for both scenarios is explained in the LTP, Chapter 6. The derived concentration guideline levels (DCGLs) determined in the LTP form the basis for satisfying the site release criteria.

Residual radioactivity sample results from the appropriate media were used to calculate a surrogate Cs-137 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 DCGLw from Table 5-1 of the LTP. An adjustment was made to the surrogate Cs-137 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 (Reference 9.1).

5.0 Survey Designs/ Data Quality Objectives (DQO) Process

The DQO Process is a series of planning steps based on the scientific method for establishing criteria for data quality and developing survey designs. Planning radiation surveys using the DQO Process improves the survey effectiveness and efficiency, and thereby, the defensibility of decisions.

The Survey Design covering this survey work is provided in Appendix A. The modified Cs-137 concentration developed for this survey work was derived from the median concentration of each radionuclide in the sample data set. The survey designer chose a data set that was specific for the Saxton Steam Generating Station (SSGS) area building debris materials. The sample mix provided the following percentages of individual radionuclides:

Table 1

Radionuclide	Mix Percent
Am-241	0.47
Co-60	0.97
Cs-137	28.6
Ni-63	69.4
Pu-238	0.09
Pu-239	0.13
Sr-90	0.26
Total	100%

The median is not used to develop $DCGL_w$ values in more recent FSS survey designs. However, in this survey design the resulting surrogate Cs-137 $DCGL_w$ was determined to be 4.2 pCi/g (the Administrative Limit – 75% of the calculated value). Thus the $DCGL_w$ value used in this design is more conservative than a similar mix taken from the OL1/OL2 area (adjacent to the SSGS area)

that yields a surrogate Cs-137 concentration of 4.3 pCi/g, and is one of the most highly sampled areas on-site. Consequently, the actual mix used is conservatively determined. Table 2 presents other data quality objectives (DQO's) as calculated in the survey design. Scan coverage requirements were set at 100% of the available surface area.

Table 2

DQO Listings	
DQO/Design Parameter	Remediated Soil
SNEC Design Calculation No.	E900-03-031
SNEC Survey Request No.	186, 190
Survey Area Classification	1
Material Quantity	Approx. 6,150 tons
Scanning Goal (%)	100
Wet Density Range (g/cc)	0.98 to 1.66
Material Moisture Content Range	11 to 20%
$DCGL_w$ (Cs-137 -administrative) pCi/g	4.2
Scan MDC (pCi/g)	2.91 (see note 1)
Alarm setpoint (SMCM) (pCi/g)	2.91
44-10 scan alarm setpoints	300 gross cpm
Calibration Constant (Cesium-137)	1.7 cps per pCi/g
Range of Uncertainty (2-sigma)	0.83 to 1.04 pCi/g
Conveyor Belt Speed	4 inches per second
Survey Instrument Type	(4) SMCM (5" by 2" NaI detectors)
Measurement Type	Scan

Note 1: Based on the data recorded during the SRA scanning, the system operated with a minimum detectable concentration of much less than 2.91 pCi/g Cs-137 on a batch basis (assuming a uniform distribution).

6.0 Final Status Survey Results

6.1 Summary of Survey Results of Remediated Soils

Scan surveys and sampling was performed on soil from two locations: debris pile on the west side of the site and secondly, accumulated soils from numerous site remediation efforts. The FSS was performed in accordance with the requirements specified in SR-186 and SR-190. Scan measurements were performed by SRA utilizing the Sub-surface Multispectral Contamination Monitor (SMCM) technology, (described in detail in section 2.0 of this report).

SRA survey performance details are specified in the "Final Report for Survey of Remediated Soils", (Reference 9.4). The required scan coverage was 100%. Additionally, alarm response scans using a Ludlum 2350-1 "datalogger" system with a 4" by 4" NaI Detector were performed on sections of soil. This detector uses a narrow window optimized for Cs-137 to lower background and increase efficiency. Soil sampling was also performed on each batch of material. The administrative Cs-137 $DCGL_w$ was 4.2 pCi/g (found on page 2 of Appendix A).

6.1.1 Scanning Results

SRA scans were performed on the soil (approximately 6,150 tons of material). The required MDC_{scan} was 2.91 pCi/g, Cs-137 (found on page 1 of Reference 9.6) using a conservative calibration constant of 1.7 cps / pCi/g (Cs-137). All scans met the release criteria with the exception of three alarms that occurred during the survey performance. The suspect material was removed from the belt and the associated monitoring data expunged to not improperly bias the results reported for the remaining material.

Results: 57 batches of material were scanned indicating residual Cs-137 maximum concentrations ranging from 1.53 to 2.89 pCi/g. The residual Cs-137 concentration averaged over each batch ranged from 0.13 to 1.32 pCi/g.

Manual scans were performed by site radcon technicians in response to three SMCM alarms. The established action level was 300 gross cpm (found on pages 3 and 4 of Appendices C and D).

Results: Following the automatic shutdown of the conveyor system, scans were performed on the suspect material in batches 44 and 54. Activity was identified ranging from 300 to 2430 gross cpm. All suspect material was removed from the conveyor.

6.1.2 Soil Sampling

Batch samples: 136 samples were obtained to cover the batched material. The Survey Requests required each least two samples to be obtained for each batch of scanned material.

Results: The highest identified Cs-137 concentration was 1.0 ± 0.18 pCi/g. The range of positive Cs-137 was from 0.13 to 1.0 pCi/g. Cobalt-60 was not identified (typical achieved MDA 0.13 pCi/g). The following table lists the samples:

Table 3

Batch Samples								
Batch Sample Number	Cesium-137 Results (pCi/g)		Batch Sample Number	Cesium-137 Results (pCi/g)		Batch Sample Number	Cesium-137 Results (pCi/g)
SRA-04-001-1	0.4		SRA-04-023-1	0.25		SRA-05-044-3	0.13
SRA-04-001-2	0.3		SRA-04-023-2	0.3		SRA-05-044-4	0.18
SRA-04-002-1	0.32		SRA-04-024-1	0.4		SRA-05-045-1	0.27
SRA-04-002-2	0.33		SRA-04-024-2	0.35		SRA-05-045-2	0.20
SRA-04-002-3	0.36		SRA-04-025-1	0.27		SRA-05-046-1	0.23
SRA-04-003-1	0.30		SRA-04-025-2	0.28		SRA-05-046-2	0.29
SRA-04-003-2	0.35		SRA-04-026-1	0.28		SRA-05-046-3	0.24
SRA-04-004-1	0.27		SRA-04-026-2	0.33		SRA-05-046-4	0.29
SRA-04-004-2	0.42		SRA-05-027-1	0.26		SRA-05-047-1	0.27
SRA-04-005-1	0.33		SRA-05-027-2	0.3		SRA-05-047-2	0.30
SRA-04-005-2	0.28		SRA-05-028-1	0.3		SRA-05-047-3	0.40
SRA-04-006-1	0.24		SRA-05-028-2	0.3		SRA-05-048-1	0.35
SRA-04-006-2	0.28		SRA-05-029-1	0.24		SRA-05-048-2	0.46
SRA-04-007-1	0.4		SRA-05-029-2	0.3		SRA-05-049-1	0.35
SRA-04-007-2	0.4		SRA-05-030-1	0.34		SRA-05-049-2	0.38
SRA-04-007-3	0.34		SRA-05-030-2	0.3		SRA-05-049-3	0.44
SRA-04-008-1	0.3		SRA-05-031-1	0.33		SRA-05-049-4	0.40
SRA-04-008-2	0.3		SRA-05-031-2	0.3		SRA-05-050-1	0.30
SRA-04-009-1	0.4		SRA-05-032-1	0.25		SRA-05-050-2	0.38
SRA-04-009-2	0.33		SRA-05-032-2	0.33		SRA-05-050-3	0.30
SRA-04-010-1	0.26		SRA-05-033-1	0.15		SRA-05-051-1	0.40
SRA-04-010-2	0.3		SRA-05-033-2	0.30		SRA-05-051-2	0.43
SRA-04-011-1	0.3		SRA-05-034-1	0.3		SRA-05-051-3	0.40
SRA-04-011-2	0.27		SRA-05-034-2	0.27		SRA-05-051-4	0.34
SRA-04-012-1	0.2		SRA-05-035-1	0.40		SRA-05-052-1	0.32
SRA-04-012-2	0.3		SRA-05-035-2	0.4		SRA-05-052-2	0.34
SRA-04-013-1	0.25		SRA-05-036-1	0.3		SRA-05-052-3	0.35

Table 3 (Cont.)

Batch Samples					
Batch Sample Number	**Cesium-137 Results (pCi/g)**	**Batch Sample Number**	**Cesium-137 Results (pCi/g)**	**Batch Sample Number**	**Cesium-137 Results (pCi/g)**
SRA-04-013-2	0.25	SRA-05-036-2	0.4	SRA-05-053-1	0.33
SRA-04-014-1	<0.2	SRA-05-037-1	0.33	SRA-05-053-2	0.34
SRA-04-014-2	0.3	SRA-05-037-2	0.28	SRA-05-054-1	0.8
SRA-04-015-1	0.3	SRA-05-038-1	<0.16	SRA-05-054-2	1.0
SRA-04-015-2	0.3	SRA-05-038-2	<0.16	SRA-05-054-3	0.97
SRA-04-016-1	0.3	SRA-05-039-1	0.27	SRA-05-054-4	0.7
SRA-04-016-2	0.3	SRA-05-039-2	0.23	SRA-05-054-5	1.0
SRA-04-017-1	0.24	SRA-05-039-3	0.33	SRA-05-055-1	0.39
SRA-04-017-2	0.24	SRA-05-040-1	0.27	SRA-05-055-2	0.40
SRA-04-018-1	0.2	SRA-05-040-2	0.30	SRA-05-055-3	0.44
SRA-04-018-2	0.2	SRA-05-041-1	0.22	SRA-05-055-4	0.40
SRA-04-019-1	0.3	SRA-05-041-2	0.30	SRA-05-056-1	0.35
SRA-04-019-2	0.22	SRA-05-042-1	0.30	SRA-05-056-2	0.32
SRA-04-020-1	0.2	SRA-05-042-2	0.31	SRA-05-056-3	0.30
SRA-04-020-2	0.23	SRA-05-043-1	0.25	SRA-05-056-4	0.84
SRA-04-021-1	0.24	SRA-05-043-2	0.25	SRA-05-057-1	0.26
SRA-04-021-2	0.3	SRA-05-044-1	0.25	SRA-05-057-2	0.4
SRA-04-022-1	0.24	SRA-05-044-2	0.15	SRA-05-057-3	0.4
SRA-04-022-2	0.3			**Mean**	0.33
				2 sigma	0.28
				Max	1.0
				Min	0.13

Post-alarm samples: six samples were obtained from suspect material removed from the conveyor system.

Results: All samples were unprocessed. The highest identified Cs-137 concentration was 0.62 ± 0.12 pCi/g. The range of positive Cs-137 was from 0.19 to 0.62 pCi/g. Cobalt-60 was not identified (typical achieved MDA was 0.1 pCi/g).

Results Conclusion

The survey and sample results for the soil piles indicate residual Cs-137 concentrations are below the applicable $DCGL_w$ and therefore meet the requirements of the SNEC LTP release criteria.

7.0 Data Assessment

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

- Instruments used to collect the data were capable of detecting the radiation of interest at or below the investigation level.

- 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.

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

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

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

- Survey methods used to collect the data were appropriate for the media and types of radiation being measured.

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

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

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

- Discrepancies were reviewed and corrective actions taken (as appropriate) in accordance with site procedures.

The statistical test does not need to be performed for this final status survey since the data clearly show that the material meets the site release criteria. All measurements are less than the $DCGL_w$.

8.0 Final Survey Conclusions

The SRA survey work on the remediated soils was performed in accordance with the requirements of the SNEC LTP, SRA procedures, and site implementing procedures. Final status survey data was collected to meet and/or exceed the quantity and quality required of material specified in section 5.5.3.4.4 (Re-fill Materials). The results of the conducted surveys/sampling met the following conditions:

1. The average residual radioactivity in the soil surveyed was less than the assigned DCGLw.

2 Since all measurements were either less than the $DCGL_w$, or the suspect material discarded from the batch, no $DCGL_{EMC}$ criteria needed to be applied.

3 Remediation of soils prior to FSS, reduced levels of residual radioactivity to below the concentrations necessary to meet the applicable $DCGL_w$.

These conditions satisfy the release criteria established in the SNEC LTP and the radiological criteria for unrestricted use given in 10 CFR 20.1402. Therefore, it is concluded that the material that passed the SRA SMCM scanning criteria, as described in this report, are suitable for unrestricted release.

9.0 References

9.1 SNEC License Termination Plan (Rev. 3).

9.2 10 CFR 50.82(a)(11).

9.3 10 CFR 20.1402.

9.4 Shonka Research Associates, Inc. "Final Report for Survey of Remediated Soils".

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

10.0 Appendices

Appendix A - SNEC Calculation #E900-03-031, "Shonka Survey of Debris and Soil Piles Design"

Appendix B - "CV Yard Soil and Boulders (Decay Update)"

Appendix C - SNEC Survey Request 186, "SNEC Site: Soils Scanned by SRA"

Appendix D - SNEC Survey Request 190, "SNEC Site: Soils from Intermodals and B-25 Boxes"