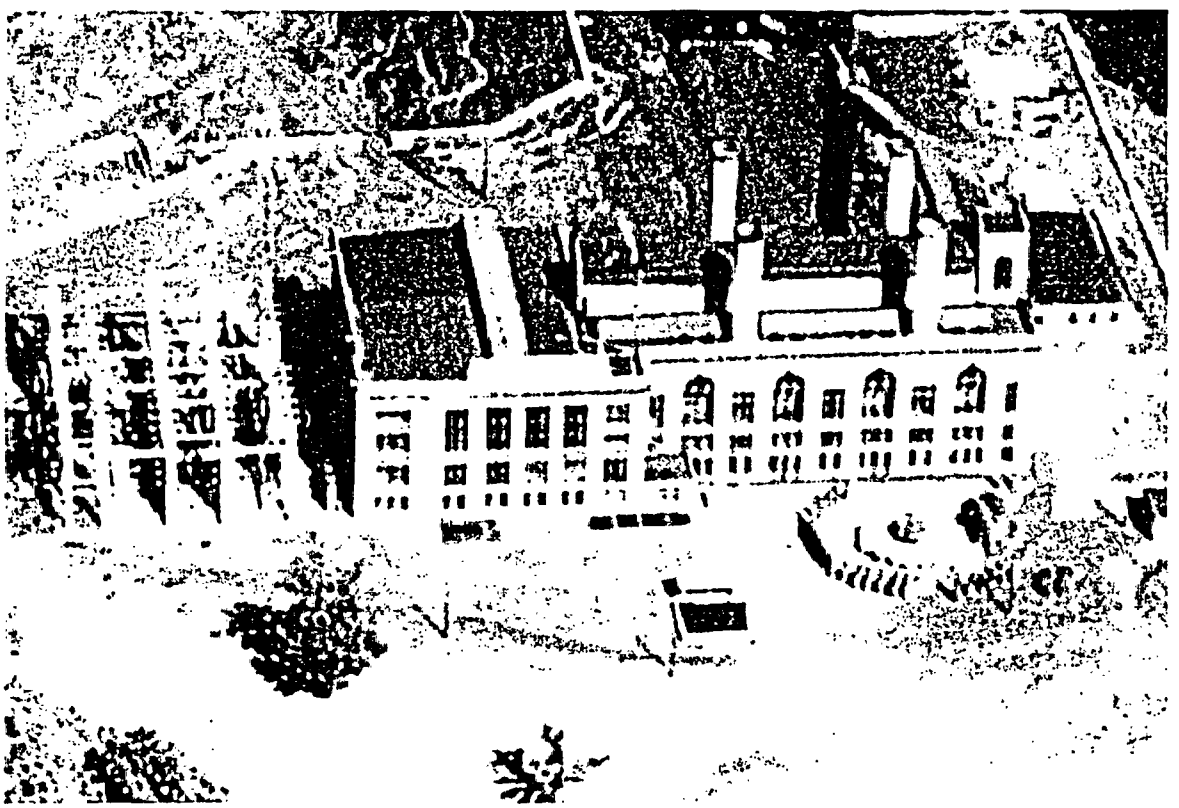
# Final Status Survey Report

For

Saxton Nuclear Experimental Corporation
Saxton Steam Generating Station
Structural Surfaces –Discharge Tunnel
SS1, SS2, SS3, SS4, SS5, SS6, SS7



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# Executive Summary

This report presents the results and conclusions of the final status survey (FSS) of the Class 1, 2, and 3 structural surfaces of the Saxton Nuclear Experimental Corporation (SNEC) facility designated as SS1, SS2, SS3, SS4, SS5, SS6-1, SS6-2, SS7-1, and SS7-2. This FSS includes surveys of residual structural surfaces (e.g. concrete) in the discharge tunnel of the Saxton Steam Generating Station of the SNEC site and was conducted in the fall of 2003.

The FSS was performed in accordance with the SNEC License Termination Plan (LTP). The Discharge Tunnel survey area was divided into nine survey units. Each unit consisted of relatively flat residual structural surfaces. Data was collected from each survey unit in accordance with the specific survey design data collection requirements. The following is a summary of the measurements performed:

1) Automated position sensitive large area detector surface contamination monitor (SCM) scans of about 40% of the surface area.
2) Direct Gas Flow Proportional Counter (GFPC) and NaI detector scans of small portions of four survey units covering about 5.7% of the actual surface area.
3) Sixty fixed point static GFPC measurements.

The SCM surveys were conducted by a contractor utilizing a large area position sensitive gas flow proportional counter. Portions of the survey units could not be surveyed with this equipment because of the large size of this detector and surface irregularity. Subsequent hand-help GFPC and NaI scans were conducted of areas not SCM scanned.

The collected FSS survey data demonstrate that the 1939 square meters of the SSGS Discharge Tunnel 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 residual structural surfaces in the SSGS Discharge Tunnel (nine survey units designated SS1, SS2, SS3, SS4, SS5, SS6-1, SS6-2, SS7-1, and SS7-2) north and west of the SNEC facility. It provides the information required by 10CFR50.82(a)(11) and the SNEC license termination plan (LTP) to demonstrate that this area meets the radiological criteria for unrestricted use specified in 10CFR20.1402.

This report describes the radiological data collected in nine survey units consisting of four Class1, one Class 2, and four Class 3 survey units of residual structural surface in the SSGS Discharge Tunnel. This report only addresses the FSS performed on this specific area . The format of this report follows the guidance contained in reference 9.2.

## 2.0 Survey Area Description

The SSGS Discharge Tunnel is Class 1, 2, or 3 impacted structural surface located underground to the north and west of the SNEC facility. The survey unit encompasses about 1940 square meters of concrete. Because the area exceeds the size guidance in the SNEC LTP for Class 1 survey units (up to 100 square meters recommended), and the classification varies spatially in the tunnel, the survey area has been divided into nine survey units. Layout of the survey area and individual units are shown in Attachment 2 of Appendix A and Appendix F. The nine survey units are discussed below. The individual survey unit designations are derived from table 5-2 of the SNEC LTP (reference 9.3).

Approximately 1000 square meters of the tunnel was not included in the survey units. This area was Class 3, so adequate Class 3 survey coverage fraction of the entire Class 3 portion was performed on the portion that was included in the survey units. This area was not accessed due to personnel safety reasons. It was between the Class 3 portions of the tunnel and the Class 3 outfall area reported separately as MA2 in GPU Nuclear Letter E910-05-016 dated June 8, 2005.

Survey unit SS1 is a Class 1 residual concrete surface in the SSGS Discharge Tunnel. It consists of the floor of the first 150 feet of the underground tunnel from the SSGS toward the river outfall point. The survey unit is approximately 120 square meters. Attachment 2 of appendix A contains drawings showing the layout of the survey unit.

Survey unit SS2 is a Class 2 residual concrete surface in the SSGS Discharge Tunnel. It consists of the 235 feet of the floor downstream of SS1 of the underground tunnel from the SSGS toward the river outfall point. The survey unit

is approximately 175 square meters. Appendix F shows the layout of the survey unit.

Survey unit SS3 is a Class 3 residual concrete surface in the SSGS Discharge Tunnel. It consists of the last 315 feet of the floor of the underground tunnel from the SSGS at the river outfall point end of the tunnel. The survey unit is approximately 234 square meters. Appendix F shows the layout of the survey unit.

Survey unit SS4 is a Class 1 residual concrete surface in the SSGS Discharge Tunnel. It consists of the ceiling of the first 150 feet of the underground tunnel from the SSGS toward the river outfall point. The survey unit is approximately 120 square meters. Attachment 2 of appendix A contains drawings showing the layout of the survey unit.

Survey unit SS5 is a Class 3 residual concrete surface in the SSGS Discharge Tunnel. It consists of the last 550 feet of the ceiling of the underground tunnel from the SSGS toward the river outfall point. The survey unit is approximately 400 square meters. Appendix F shows the layout of the survey unit.

Survey unit SS6-1 is a Class 1 residual concrete surface in the SSGS Discharge Tunnel. It consists of the first 150 feet of the south wall of the underground tunnel from the SSGS toward the river outfall point. The survey unit is approximately 145 square meters. Attachment 2 of appendix A contains drawings showing the layout of the survey unit.

Survey unit SS6-2 is a Class 1 residual concrete surface in the SSGS Discharge Tunnel. It consists of the first 150 feet of the north wall of the underground tunnel from the SSGS toward the river outfall point. The survey unit is approximately 145 square meters. Attachment 2 of appendix A contains drawings showing the layout of the survey unit.

Survey unit SS7-1 is a Class 3 residual concrete surface in the SSGS Discharge Tunnel. It consists of the last 550 feet of the west wall of the underground tunnel from the SSGS toward the river outfall point. The survey unit is approximately 300 square meters. Appendix F shows the layout of the survey unit.

Survey unit SS7-2 is a Class 3 residual concrete surface in the SSGS Discharge Tunnel. It consists of the last 550 feet of the east wall of the underground tunnel from the SSGS toward the river outfall point. The survey unit is approximately 300 square meters. Appendix F shows the layout of the survey unit.

## 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. Steam from the SNEC reactor was directed to the adjacent Saxton Steam Generating Station (SSGS) to generate electricity. Other shared systems also introduced SNEC activity into the SSGS and the main SNEC discharge entered the SSGS discharge tunnel. After shutdown in 1972, the SNEC 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. The SSGS was dismantled circa 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 Discharge Tunnel was contaminated as a result of radioactive liquid effluent discharges from the SNEC Facility in two pathways: (1) a 6" pipe entering the #1 Seal Chamber through the south wall above the water line and discharged into the Discharge Tunnel, and (2) shared water systems introduced contamination into the SSGS and discharged into #3 Seal Chamber and impinged on the opposite wall in the Discharge Tunnel. Groundwater, several inches of silt on the floor and sections of pipe were removed to facilitate the survey process. In addition, the North wall opposite Seal Chamber #3 was remediated by scabbling.

## 4.0 Site Release Criteria

The site release criteria applied to the structural surface areas of the SSGS discharge tunnel 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 structural surfaces were derived by analyses using a building re-use 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.

Residual radioactivity sample results for the surfaces 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.

## 5.0 Final Status Survey Design and DQO

The SNEC calculations providing the design of the survey for these survey units are attached as Appendices A, B, C, D, and E. Scan measurements were conducted over approximately 100% of the surface of each of the four Class 1 survey units. Scan coverage of the Class 2 survey unit was approximately 62%. Scans of the four Class 3 survey units covered from 9.7% to 28% depending on the survey unit Scans were conducted using an automated position sensitive large area gas flow proportional counter ("Surface Contamination Monitor" - SCM) with follow-up scans in the Class 1 survey units using a hand-held Gas Flow Proportional Counter (GFPC) and / or Nal detector.

The number of fixed measurement points was determined by using the COMPASS computer program (reference 9.5, attachment 4 of appendix A). These points were located on survey maps using the Visual Sample Plan

program (reference 9.6, attachment 3 of appendix A). Measurements were collected In the Class 1 survey units with the GFPC using a long fixed count at each point.

No fixed point measurements were performed. Because of the manner in which the SCM measures continuously and collects position information as well, SCM scanning is equivalent to continuous, full coverage static measurements. Section 5.4.3 of the SNEC LTP provides for use of such positionally sensitive scanning in lieu of fixed point measurements when the scanning system has a detection limit a small fraction of the DCGL (e.g. 10%). MARSSIM section 6.7.1 requires that fixed point measurements be capable of detecting the DCGL. In addition, section 6.4.1 of MARSSIM briefly discusses the potential use of modern, positionally referenced survey instrumentation. The maximum MDC observed for a $100cm^2$ area in the SCM scanning was less than 50% of the DCGL. Although the LTP recommends lower detection limits for use of the SCM as fixed point measurements, the use of the SCM results for direct measurements is acceptable because the detection limits meets the MARSSIM requirements. Therefore, no static measurements are required.

The survey design uses a surrogate Cs137/gross beta effective DCGL developed from radionuclide mix analyses from samples collected before the Final Status Survey in the vicinity of the survey unit. The mix was based on radionuclide mix data (including the hard-to-detects listed in Table 5-1 of the LTP) from the discharge tunnel itself (attachment 8 of appendix A).

Cs137, Co60, Am241, Ni63, Pu238, and Pu239 were positively detected in one or more of these samples and are accounted for in the adjusted surrogate DCGL. Additional sample results obtained later were used to modify the mix after the survey. The following table (Table 5.0-1) presents the Data Quality Objectives (DQO) and other relevant information from the survey design package.

## Table 5.0-1 – DQO/Design

| DQO/Design Parameter | SS1,SS4, SS6-1,SS6-2 | SS1,SS4, SS6-1,SS6-2 | SS2 | SS3,SS5, SS7-1,SS7-2 |
|---|---|---|---|---|
| SNEC Design Calc. # | E900-04-007 | E900-03-016 | E900-03-016 | E900-03-016 |
| MARSSIM Classification | 1 | 1 | 2 | 3 |
| Survey Unit Area ($m^2$) | 120,120,145,145 | 120,120,145,145 | 175 | 234,400,300,300 |
| Statistical Test | WRS | N/A | N/A | N/A |
| Type 1 decision error ($\alpha$) | 0.05 | N/A | N/A | N/A |
| Type 2 decision error ($\beta$) | 0.1 | N/A | N/A | N/A |
| LBGR (cpm) | 300 | N/A | N/A | N/A |
| Estimated $\sigma$ ($dpm/100cm^2$) | 62.1 | N/A | N/A | N/A |
| Relative Shift ($\Delta/\sigma$) | 2.0 | N/A | N/A | N/A |
| Number of static points | 15 | N/A | N/A | N/A |
| DCGLw* (Cs137 $dpm/100cm^2$) | 8807 | 8807 | 8807 | 8807 |
| Action Level* (Cs137 $dpm/100cm^2$) | 6605 | 6605 | 6605 | 6605 |
| DCGLw *(Cs137 cpm) | 424 | N/A | N/A | N/A |
| Action Level* (cpm) | 300** | N/A | N/A | N/A |
| Scan MDC ($dpm/100cm^2$) | 2466 | 3087 | 3087 | 3087 |
| SNEC Survey Request # | SR96,SR119 | SR83 | SR83 | SR83 |
| Scan Survey Instrument | L2350-1 w/43-68B or 44-10 | SCM*** | SCM*** | SCM*** |

* this table presents final design DCGL and action level values - these were revised based on new mix ratio logic processes

** GFPC action level. NaI action level is 300 gross cpm

*** because the SCM performs continuous scans with positional information that are equivalent to full coverage fixed point surveys, some MARSSIM design parameters are not applicable (e.g. LBGR, number of static points, etc.). The SCM produces results directly in $dpm/100cm^2$ so cpm based factors are not used.

# 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 references 9.9, 9.10, 9.11, and 9.12 which are filed in the SNEC history files.

## 6.1 Survey Unit SS1

### 6.1.1 Scan survey

Scan measurements were made in SS1, primarily of those areas not scanned using the SCM, using a hand-held GFPC detector with an MDCscan of 2466 dpm/100cm$^2$ (section 2.1.7 on page 3 of appendix A). The scan action level was 300 net cpm (section 2.1.7 on page 3 of appendix A).The adjusted surrogate gross beta DCGLw for this survey unit was 8807 dpm/100cm$^2$ and the 75% administrative limit was 6605 dpm/100cm$^2$ (table 6 on page 15 of appendix D). No fixed point number adjustment was needed in this case because the MDCscan was below the 75% administrative limit.

Scan measurements were made in SS1 using the automated SCM system with an MDCscan of 3087 dpm/100cm$^2$ (section 4.6 on page 5 of appendix B). The adjusted surrogate Cs137 beta DCGLw for this survey unit for the SCM scans was 8807 dpm/100cm$^2$ and the 75% administrative limit was 6605 dpm/100cm$^2$ (table 6 on page 15 of appendix D).

Of the 120 square meters of this survey unit, portions were inaccessible to the SCM scanning for various reasons, particularly uneven surfaces not amenable to large probe automated scanning. Follow-up hand-held scanning was conducted on those portions not SCM scanned using GFPC and NaI detectors. Of the 120 square meters, all were actually scanned, with about 15 square meters scanned using the hand-held detectors. Therefore essentially 100 percent of the survey unit was scanned.

All SCM surveys indicated activity less than the 75% administrative limit for a minimum 1 square meter grid averaging. One square meter averages are applied to the SCM data since this is the minimum size of an area for emc testing per the SNEC LTP. All 43-68 scans were less than the 300 net cpm action level.

6.1.2 Fixed point measurements

Although a majority of the survey unit was scanned using the automated SCM system and Section 5.0 indicates that static measurements are not required under certain conditions when using these position sensitive large detectors, 15 random start triangular grid systematic fixed point measurement locations were defined for the survey unit. Based on a conservative relative shift of about 2.0 a minimum of 10 fixed points were required.

None of the design fixed point measurements in SS1 had results in excess of the action level of 424 net cpm. The table below (Table 6.1-1) shows the gross beta results for each fixed point measurement, along with the mean, standard deviation and range of the fixed point measurement data.

The standard deviation of the measurements collected from the survey unit was less than the variability assumed in the survey design. Therefore, the assessment of variability, relative shift , and number of fixed point measurements required is consistent between the survey design and the survey results. Based

on this, no changes to the survey design or additional measurements are required.

## Table 6.1-1 – Fixed point results for SS1

| Point Number | Unshielded cpm |
|---|---|
| 1 | 238 |
| 2 | 202 |
| 3 | 211 |
| 4 | 189 |
| 5 | 236 |
| 6 | 224 |
| 7 | 198 |
| 8 | 275 |
| 9 | 255 |
| 10 | 213 |
| 11 | 237 |
| 12 | 201 |
| 13 | 251 |
| 14 | 254 |
| 15 | 213 |
| Mean | 226 |
| Std Dev | 25 |
| Min | 189 |
| Max | 275 |

### 6.2 Survey Unit SS2

6.2.1 Scan survey

Scan measurements were made in SS2 using the automated SCM system with an MDCscan of 3087 dpm/100cm$^2$ (section 4.6 on page 5 of appendix B). The adjusted surrogate Cs137 beta DCGLw for this survey unit for the SCM scans was 8807 dpm/100cm$^2$ and the 75% administrative limit was 6605 dpm/100cm$^2$ (table 6 on page 15 of appendix D).

Of the 175 square meters of this survey unit, portions were inaccessible for various reasons, particularly uneven surfaces not amenable to large probe automated scanning. Of the 175 square meters, a total of about 109 square meters were actually scanned. This results in approximately 66 square meters not scanned due to interferences in the survey unit. Therefore about 62 percent

of the survey unit was scanned, which is consistent with coverage requirements for Class 2 survey units.

The scans conducted did not identify any activity greater than the MDCscan in SS2.

6.2.2 Fixed point measurements

This survey unit was scanned using an automated position sensitive proportional counter. This survey unit did not receive fixed point direct static measurements. As discussed in Section 5.0, the SCM is equivalent to continuous static measurements of the entire surface scanned.

**6.3 Survey Unit SS3**

6.3.1 Scan survey

Scan measurements were made in SS3 using the automated SCM system with an MDCscan of 3087 dpm/100cm$^2$ (section 4.6 on page 5 of appendix B). The adjusted surrogate Cs137 beta DCGLw for this survey unit for the SCM scans was 8807 dpm/100cm$^2$ and the 75% administrative limit was 6605 dpm/100cm$^2$ (table 6 on page 15 of appendix D).

Of the 234 square meters of this survey unit, portions were inaccessible for various reasons, particularly uneven surfaces not amenable to large probe automated scanning. Of the 234 square meters, a total of about 33 square meters were actually scanned. This results in approximately 201 square meters not scanned due to interferences in the survey unit. Therefore about 14 percent of the survey unit was scanned, which is consistent with coverage requirements for Class 3 survey units.

The scans conducted did not identify any activity greater than the MDCscan in SS3.

6.3.2 Fixed point measurements

This survey unit was scanned using an automated position sensitive proportional counter. This survey unit did not receive fixed point direct static measurements. As discussed in Section 5.0, the SCM is equivalent to continuous static measurements of the entire surface scanned.

**6.4 Survey Unit SS4**

6.4.1 Scan survey

Scan measurements were made in SS4, primarily of areas not accessible to the SCM, using a hand-held GFPC detector with an MDCscan of 2466 dpm/100cm$^2$ (section 2.1.7 on page 3 of appendix A) The scan action level was 300 net cpm (section 2.1.7 on page 3 of appendix A).The adjusted surrogate Cs137 beta DCGLw for this survey unit was 8807 dpm/100cm$^2$ and the 75% administrative limit was 6605 dpm/100cm$^2$ (table 6 on page 15 of appendix D). No fixed point number adjustment was needed in this case because the MDCscan was below the 75% administrative limit.

Scan measurements were made in SS4 using the automated SCM system with an MDCscan of 3087 dpm/100cm$^2$ (section 4.6 on page 5 of appendix B). The adjusted surrogate Cs137 beta DCGLw for this survey unit for the SCM scans was 8807 dpm/100cm$^2$ and the 75% administrative limit was 6605 dpm/100cm$^2$ (table 6 on page 15 of appendix D).

Of the 120 square meters of this survey unit, portions were inaccessible to the SCM scanning for various reasons, particularly uneven surfaces not amenable to large probe automated scanning. Follow-up hand-held scanning was conducted on those portions not SCM scanned using GFPC and NaI detectors. Of the 120 square meters, all were actually scanned, with about 28 square meters scanned using the hand-held detectors. Therefore essentially 100 percent of the survey unit was scanned.

All SCM surveys indicated activity less than the 75% administrative limit for a minimum 1 square meter grid averaging. One square meter averages are applied to the SCM data since this is the minimum size of an area for emc testing per the SNEC LTP.

Scans using the 43-68 GFPC and the 44-10 NaI hand-held detectors identified four alarm points in two areas. Each alarm area was initially estimated to be about 2 square feet. Activity in excess of the action level was identified using the GFPC at two points. Action level for the GFPC detector was 300 net cpm. Readings of 561 and 882 net cpm were obtained from area 11a of SS4 (see attachment 2-2 of Appendix A). Activity in excess of the action level was identified using the NaI at four points, two of which were the same as the alarm points from the GFPC. Action level for the NaI detector was 300 gross cpm. Readings of 404 and 381 gross cpm were obtained from area 5A, 903 and 874 gross cpm from 11A.

6.4.2 Fixed point measurements

Although a majority of the survey unit was scanned using the automated SCM system and Section 5.0 indicates that static measurements are not required under certain conditions when using these position sensitive large detectors, 15 random start triangular grid systematic fixed point measurement locations were

defined for the survey unit. Based on a conservative relative shift of about 2.0 a minimum of 10 fixed points were required.

None of the design fixed point measurements in SS4 had results in excess of the action level of 424 net cpm. The table below (Table 6.4-1) shows the gross beta results for each fixed point measurement, along with the mean, standard deviation and range of the fixed point measurement data.

The standard deviation of the measurements collected from the survey unit was higher than the variability assumed in the survey design. Since a conservative LBGR of 70% of the action level was initially used for the survey design, using the actual variability and 50% of the DCGL results in a relative shift higher than the 2 initially used. Therefore, the assessment of variability, relative shift , and number of fixed point measurements required is consistent between the survey design and the survey results. Based on this, no changes to the survey design or additional measurements are required.

**Table 6.4-1 – Fixed point results for SS4**

| Point Number | Unshielded cpm |
|---|---|
| 1 | 237 |
| 2 | 239 |
| 3 | 206 |
| 4 | 254 |
| 5 | 205 |
| 6 | 171 |
| 7 | 220 |
| 8 | 292 |
| 9 | 232 |
| 10 | 232 |
| 11 | 355 |
| 12 | 246 |
| 13 | 230 |
| 14 | 457 |
| 15 | 604 |
| Mean | 279 |
| Std Dev | 114 |
| Min | 171 |
| Max | 604 |

* shielded background at point 14 was 194 cpm and at point 15 was 200 cpm, for net of 263 cpm and 404 cpm which are less than the action level of 424

6.4.3 Elevated measurement investigation

Scans using the 43-68 GFPC and the 44-10 NaI hand-held detectors identified four alarm points in two areas. Each alarm area was about 2 square feet. Activity in excess of the action level was identified using the GFPC at two points. Action level for the GFPC detector was 300 net cpm. Readings of 561 and 882 net cpm were obtained from area 11a of SS4 (see attachment 2-2 of Appendix A).

Activity in excess of the action level was identified using the NaI at four points, two of which were the same as the alarm points from the GFPC. Action level for the NaI detector was 300 gross cpm. Readings of 404 and 381 gross cpm from area 5A and 903 and 874 gross cpm from 11A of SS4 (see attachment 2-2 of Appendix A) were obtained.

## Table 6.4-2 SS4 elevated area investigation measurements

| Location in SS4 | GFPC Activity (net cpm) | NaI Activity (gross cpm) |
|---|---|---|
| 5A AP1 | NT* | 404 |
| 5A AP2 | NT | 381 |
| 11A AP1 | 882 | 903 |
| 11A AP2 | 561 | 874 |

* NT – Not Taken

These alarm points were investigated by determining the area of each (initially estimated to be 2 square feet each). The concrete at the location of the alarm points in area 5A and 11A was then sampled and analyzed by gamma spectroscopy. The results of these samples, combined with a conservative estimate of the gross residual activity from the SCM data was used to directly determine a dose contribution for comparison to the unrestricted release criteria.

Using very conservative assumptions and combining the dose from the entire survey unit and that from the elevated measurement area, the SS4 survey unit is shown to be no more than 61% of the dose limit. This shows that the survey unit meets the elevated measurement criteria (section 2.2.3.3 page 5 in Appendix E ).

### 6.5 Survey Unit SS5

#### 6.5.1 Scan survey

Scan measurements were made in SS5 using the automated SCM system with an MDCscan of 3087 dpm/100cm$^2$ (section 4.6 on page 5 of appendix B). The adjusted surrogate Cs137 beta DCGLw for this survey unit for the SCM scans was 8807 dpm/100cm$^2$ and the 75% administrative limit was 6605 dpm/100cm$^2$ (table 6 on page 15 of appendix D).

Of the 400 square meters of this survey unit, portions were inaccessible for various reasons, particularly uneven surfaces not amenable to large probe automated scanning. Of the 400 square meters, a total of about 39 square meters were actually scanned. This results in approximately 361 square meters not scanned due to interferences in the survey unit. Therefore about 9.7 percent of the survey unit was scanned, which is consistent with coverage requirements for Class 3 survey units.

The scans conducted did not identify any activity greater than the MDCscan in SS5.

6.5.2 Fixed point measurements

This survey unit was scanned using an automated position sensitive proportional counter. This survey unit did not receive fixed point direct static measurements. As discussed in Section 5.0, the SCM is equivalent to continuous static measurements of the entire surface scanned.

**6.6 Survey Unit SS6-1**

6.6.1 Scan survey

Scan measurements were made in SS6-1, primarily on areas not accessible to the SCM, using a hand-held GFPC detector with an MDCscan of 2466 dpm/100cm$^2$ (section 2.1.7 on page 3 of appendix A) The scan action level was 300 net cpm (section 2.1.7 on page 3 of appendix A).The adjusted surrogate Cs137 beta DCGLw for this survey unit was 8807 dpm/100cm$^2$ and the 75% administrative limit was 6605 dpm/100cm$^2$ (table 6 on page 15 of appendix D). No fixed point number adjustment was needed in this case because the MDCscan was below the 75% administrative limit.

Scan measurements were made in SS6-1 using the automated SCM system with an MDCscan of 3087 dpm/100cm$^2$ (section 4.6 on page 5 of appendix B). The adjusted surrogate Cs137 beta DCGLw for this survey unit for the SCM scans was 8807 dpm/100cm$^2$ and the 75% administrative limit was 6605 dpm/100cm$^2$ (table 6 on page 15 of appendix D).

Of the 145 square meters of this survey unit, portions were inaccessible to the SCM scanning for various reasons, particularly uneven surfaces not amenable to large probe automated scanning. Follow-up hand-held scanning was conducted on those portions not SCM scanned using GFPC and NaI detectors. Of the 145 square meters, all were actually scanned, with about 25 square meters scanned using the hand-held detectors. Therefore essentially 100 percent of the survey unit was scanned.

All SCM surveys indicated activity less than the 75% administrative limt for a minimum 1 square meter grid averaging. One square meter averages are applied to the SCM data since this is the minimum size of an area for emc testing per the SNEC LTP.

Scans using the 44-10 hand-held detector identified one alarm at 350 gross cpm from area 11a of SS6-1 (see attachment 2-3 of Appendix A). The action level was 300 gross cpm for the 44-10 Nal scan.

6.6.2 Fixed point measurements

Although a majority of the survey unit was scanned using the automated SCM system and Section 5.0 indicates that static measurements are not required under certain conditions when using these position sensitive large detectors, 15 random start triangular grid systematic fixed point measurement locations were defined for the survey unit. Based on a conservative relative shift of about 2.0 a minimum of 10 fixed points were required.

None of the design fixed point measurements in SS6-1 had results in excess of the action level of 424 net cpm. The table below (Table 6.6-1) shows the gross beta results for each fixed point measurement, along with the mean, standard deviation and range of the fixed point measurement data.

The standard deviation of the measurements collected from the survey unit was less than the variability assumed in the survey design. Therefore, the assessment of variability, relative shift , and number of fixed point measurements required is consistent between the survey design and the survey results. Based on this, no changes to the survey design or additional measurements are required.

## Table 6.6-1 – Fixed point results for SS6-1

| Point Number | Unshielded cpm |
|---|---|
| 1 | 183 |
| 2 | 185 |
| 3 | 187 |
| 4 | 185 |
| 5 | 171 |
| 6 | 161 |
| 7 | 239 |
| 8 | 264 |
| 9 | 226 |
| 10 | 260 |
| 11 | 321 |
| 12 | 184 |
| 13 | 223 |
| 14 | 205 |
| 15 | 252 |
| Mean | 216 |
| Std Dev | 44 |
| Min | 161 |
| Max | 321 |

6.6.3 Elevated measurement investigation

The NaI measurement result from the single alarm point from the NaI scans is shown in table 6.6-2 below. The area of this alarm point is included in the dose assessment in Appendix E. Since the activity is less than that from the elevated measurement assessment from SS4 (6.4.3 above), the conclusion (section 2.2.3.3 page 5 in Appendix E) that the elevated measurement test passes for SS4 bounds the same conclusion for SS6-1.

## Table 6.6-2 SS6-1 elevated area investigation measurements

| Location in SS6-1 | NaI Activity (gross cpm) |
|---|---|
| 10A AP1 | 350 |

### 6.7 Survey Unit SS6-2

6.7.1 Scan survey

Scan measurements were made in SS6-2, primarily in areas not accessible to the SCM, using a hand-held GFPC detector with an MDCscan of 2466 dpm/100cm$^2$ (section 2.1.7 on page 3 of appendix A) The scan action level was 300 net cpm (section 2.1.7 on page 3 of appendix A).The adjusted surrogate Cs137 beta DCGLw for this survey unit was 88 dpm/100cm$^2$ and the 75% administrative limit was 6605 dpm/100cm$^2$ (table 6 on page 15 of appendix D). No fixed point number adjustment was needed in this case because the MDCscan was below the 75% administrative limit.

Scan measurements were made in SS6-2 using the automated SCM system with an MDCscan of 3087 dpm/100cm$^2$ (section 4.6 on page 5 of appendix B). The adjusted surrogate Cs137 beta DCGLw for this survey unit for the SCM scans was 8807 dpm/100cm$^2$ and the 75% administrative limit was 6605 dpm/100cm$^2$ (table 6 on page 15 of appendix D).

Of the 145 square meters of this survey unit, portions were inaccessible to the SCM scanning for various reasons, particularly uneven surfaces not amenable to large probe automated scanning. Follow-up hand-held scanning was conducted on those portions not SCM scanned using GFPC and NaI detectors. Of the 145 square meters, all were actually scanned, with about 43 square meters scanned using the hand-held detectors. Therefore essentially 100 percent of the survey unit was scanned.

All SCM surveys indicated activity less than the 75% administrative limit for a minimum 1 square meter grid averaging. One square meter averages are applied to the SCM data since this is the minimum size of an area for emc testing per the SNEC LTP. All 43-68 scans were less than the 300 net cpm action level. All 44-10 scans were less than the action level of 300 gross cpm.

6.7.2 Fixed point measurements

Although a majority of the survey unit was scanned using the automated SCM system and Section 5.0 indicates that static measurements are not required under certain conditions when using these position sensitive large detectors, 15 random start triangular grid systematic fixed point measurement locations were defined for the survey unit. Based on a conservative relative shift of about 2.0 a minimum of 10 fixed points were required.

None of the design fixed point measurements in SS6-2 had results in excess of the action level of 424 net cpm. The table below (Table 6.7-1) shows the gross beta results for each fixed point measurement, along with the mean, standard deviation and range of the fixed point measurement data.

The standard deviation of the measurements collected from the survey unit was less than the variability assumed in the survey design. Therefore, the assessment of variability, relative shift , and number of fixed point measurements

required is consistent between the survey design and the survey results. Based on this, no changes to the survey design or additional measurements are required.

## Table 6.7-1 – Fixed point results for SS6-2

| Point Number | Unshielded cpm |
|---|---|
| 1 | 180 |
| 2 | 171 |
| 3 | 155 |
| 4 | 182 |
| 5 | 162 |
| 6 | 163 |
| 7 | 193 |
| 8 | 236 |
| 9 | 214 |
| 10 | 210 |
| 11 | 363 |
| 12 | 224 |
| 13 | 243 |
| 14 | 208 |
| 15 | 203 |
| Mean | 207 |
| Std Dev | 51 |
| Min | 155 |
| Max | 363 |

### 6.8 Survey Unit SS7-1

6.8.1 Scan survey

Scan measurements were made in SS7-1 using the automated SCM system with an MDCscan of 3087 dpm/100cm$^2$ (section 4.6 on page 5 of appendix B). The adjusted surrogate Cs137 beta DCGLw for this survey unit for the SCM scans was 8807 dpm/100cm$^2$ and the 75% administrative limit was 6605 dpm/100cm$^2$ (table 6 on page 15 of appendix D).

Of the 300 square meters of this survey unit, portions were inaccessible for various reasons, particularly uneven surfaces not amenable to large probe automated scanning. Of the 300 square meters, a total of about 85 square meters were actually scanned. This results in approximately 215 square meters not scanned due to interferences in the survey unit. Therefore about 28 percent

of the survey unit was scanned, which is consistent with coverage requirements for Class 3 survey units.

The scans conducted did not identify any activity greater than the MDCscan in SS7-1.

6.8.2 Fixed point measurements

This survey unit was scanned using an automated position sensitive proportional counter. This survey unit did not receive fixed point direct static measurements. As discussed in Section 5.0, the SCM is equivalent to continuous static measurements of the entire surface scanned.

### 6.9 Survey Unit SS7-2

6.9.1 Scan survey

Scan measurements were made in SS7-2 using the automated SCM system with an MDCscan of 3087 dpm/100cm$^2$ (section 4.6 on page 5 of appendix B). The adjusted surrogate Cs137 beta DCGLw for this survey unit for the SCM scans was 8807 dpm/100cm$^2$ and the 75% administrative limit was 6605 dpm/100cm$^2$ (table 6 on page 15 of appendix D).

Of the 300 square meters of this survey unit, portions were inaccessible for various reasons, particularly uneven surfaces not amenable to large probe automated scanning. Of the 300 square meters, a total of about 43 square meters were actually scanned. This results in approximately 257 square meters not scanned due to interferences in the survey unit. Therefore about 14 percent of the survey unit was scanned, which is consistent with coverage requirements for Class 3 survey units.

The scans conducted did not identify any activity greater than the MDCscan in SS7-2.

6.9.2 Fixed point measurements

This survey unit was scanned using an automated position sensitive proportional counter. This survey unit did not receive fixed point direct static measurements. As discussed in Section 5.0, the SCM is equivalent to continuous static measurements of the entire surface scanned.

## 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**

SS1 had no alarm points during scan surveys of approximately 100% of the surface. Scan MDCs were adequate. Fifteen fixed point measurements were all less than the DCGLw. Scan fraction and number of fixed point measurements meets LTP and MARSSIM requirements.

SS2 had no alarm points during scan surveys of approximately 62% of the surface. Scan MDCs were adequate. No fixed point measurements were collected because of the use of the automated position sensitive detector (see SCM fixed point discussion in section 5.0). Scan fraction and number of fixed point measurements meets LTP and MARSSIM requirements.

SS3 had no alarm points during scan surveys of approximately 14% of the surface. Scan MDCs were adequate. No fixed point measurements were collected because of the use of the automated position sensitive detector (see SCM fixed point discussion in section 5.0). Scan fraction and number of fixed point measurements meets LTP and MARSSIM requirements.

SS4 had four alarm points identified with either GFPC or NaI detectors. These points were small and were determined to meet elevated measurement test criteria at 61% of the emc test limit. The survey unit area had scan surveys of approximately 100% of the surface. Scan MDCs were adequate. Fifteen fixed point measurements were all less than the DCGLw. Scan fraction and number of fixed point measurements meets LTP and MARSSIM requirements.

SS5 had no alarm points during scan surveys of approximately 9.7% of the surface. Scan MDCs were adequate. No fixed point measurements were collected because of the use of the automated position sensitive detector (see SCM fixed point discussion in section 5.0). Scan fraction and number of fixed point measurements meets LTP and MARSSIM requirements.

SS6-1 had one alarm point identified with a NaI detector. This point was small and was determined to meet elevated measurement test criteria at 61% of the emc test limit by bounding limits to the results from SS4. The survey unit area had scan surveys of approximately 100% of the surface. Scan MDCs were adequate. Fifteen fixed point measurements were all less than the DCGLw. Scan fraction and number of fixed point measurements meets LTP and MARSSIM requirements.

SS6-2 had no alarm points during scan surveys of approximately 100% of the surface. Scan MDCs were adequate. Fifteen fixed point measurements were all less than the DCGL. Scan fraction and number of fixed point measurements meets LTP and MARSSIM requirements.

SS7-1 had no alarm points during scan surveys of approximately 28% of the surface. Scan MDCs were adequate. No fixed point measurements were collected because of the use of the automated position sensitive detector (see

SCM fixed point discussion in section 5.0). Scan fraction and number of fixed point measurements meets LTP and MARSSIM requirements.

SS7-2 had no alarm points during scan surveys of approximately 14% of the surface. Scan MDCs were adequate. No fixed point measurements were collected because of the use of the automated position sensitive detector (see SCM fixed point discussion in section 5.0). Scan fraction and number of fixed point measurements meets LTP and MARSSIM requirements.

**7.3 Survey Variations** (Design, survey request, LTP)

7.3.1 Portions of the four Class 1 survey units could not be scanned using the SCM automated detector system. These areas were follow-up scanned using either 43-68 GFPC or 44-10 NaI detectors.

**7.4 QC comparisons**

7.4.1 Scan surveys

Numerous areas were rescanned as QC duplicates with the hand-held detectors. The QC hand-held rescans did not identify any activity above alarm points and so are in agreement with the primary scans because the conclusion that the survey unit passes is supported by both the initial and QC results (reference 9.8). QC scans were conducted on 16.5 $m^2$ of the survey area, which represents about 11 percent of the 111 $m^2$ originally scanned by hand. This exceeds the minimum 5% required.

Numerous areas were rescanned as QC duplicates with the SCM. The QC SCM rescans did not identify any activity above alarm points and so are in agreement with the primary scans because the conclusion that the survey unit passes is supported by both the initial and QC results (reference 9.8). QC scans were conducted on 98 $m^2$ of the survey area, which represents about 13 percent of the 764 $m^2$ originally scanned by hand. This exceeds the minimum 5% required.

7.4.2 Fixed Point measurements

Two fixed point measurements from SS1, three from SS4, and one from SS6-2 received QC duplicate GFPC measurements. These duplicates had good agreement as shown in the table below (Table 7.4-1) because the conclusion that the survey unit passes is supported by both the initial and QC results (reference 9.8) . Six QC splits out of 60 measurements represents 10 percent of the measurements. This exceeds the 5% minimum criterion.

## Table 7.4-1 Discharge Tunnel QC Duplicate comparison

| Fixed Point | Result (cpm) | QC Result (cpm) |
|---|---|---|
| SS1 07 | 198 | 248 |
| SS1 08 | 275 | 236 |
| SS4 06 | 171 | 179 |
| SS4 07 | 220 | 224 |
| SS4 13 | 230 | 193 |
| SS6-2 06 | 163 | 125 |

## 8.0 Final Survey Conclusions

The Structural Surfaces of the SSGS Discharge Tunnel survey units SS1, SS2, SS3, SS4, SS5, SS6-1, SS6-2, SS7-1, and SS7-2 final status survey was performed in accordance with the SNEC LTP, 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 on the surfaces is less than the derived surrogate DCGLw in all of the survey units.

2) All measurements were less than the DCGLw in units SS1, SS2, SS3, SS5, SS6-2, SS7-1, and SS7-2. Units SS4 and SS6-1 were shown by calculation to meet the elevated measurement criteria.

**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 Structural Surface Areas of the SSGS Discharge Tunnel designated SS1, SS2, SS3, SS4, SS5, SS6-1, SS6-2, SS7-1 and SS7-2 are 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 COMPASS computer program, Version 1.0.0, Oak Ridge Institute for Science and Education
9.6 VISUAL SAMPLE PLAN computer program, Version 3.0, Battelle Memorial Institute
9.7 SNEC procedure E900-IMP-4500.59, "Final Site Survey Planning and DQA"
9.8 SNEC procedure E900-IMP-4520.04, "Survey Methodology to Support SNEC License Termination"
9.9 SNEC Survey Request (SR) # SR083
9.10 SNEC Survey Request (SR) # SR096
9.11 SNEC Survey Request (SR) # SR119
9.12 Shonka Research Associates, Inc. "Final Report for SCM Survey of Saxton Nuclear Experimental Corporation", March 3, 2005


## 10.0 Appendices

Appendix A - SNEC Calculation E900-04-007 – Discharge Tunnel Survey Design for Class 1 Areas" (11 pages plus numerous attachments)
Appendix B - SNEC Calculation E900-03-016 – "Shonka Discharge and Intake Tunnels FSS Survey Design" (9 pages plus numerous attachments)
Appendix C - SNEC Calculation E900-03-016 – "Shonka Discharge and Intake Tunnels FSS Survey Design" (9 pages) Revision 1
Appendix D - SNEC Calculation E900-03-016 – "Shonka Discharge and Intake Tunnels FSS Survey Design" (16 pages) Revision 2
Appendix E - SNEC Calculation E900-04-021 –"Assessment of Survey Results for Discharge Tunnel Class 1 Areas" (7 pages plus numerous attachments)
Appendix F – Discharge Tunnel Drawing SNECRM-018