

# Final Status Survey Report

For

Saxton Nuclear Experimental Corporation  
Residual Macadam in OL1



Prepared by GPU Nuclear, Inc.

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## **Executive Summary**

This report presents the results and conclusions of the final status survey (FSS) of the Class 1 macadam surfaces of the Saxton Nuclear Experimental Corporation (SNEC) facility designated as numerous units in the OL1 area. This FSS includes surveys of residual macadam surfaces throughout the OL1 area of the SNEC site. The survey was conducted in June of 2005.

The FSS was performed in accordance with the SNEC License Termination Plan (LTP). The macadam portions of the survey area were divided into ten survey units. Each of these units consisted of relatively flat residual macadam pavement 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) Direct Gas Flow Proportional Counter (GFPC) scans of all of the macadam surfaces in 18 grids covering about 42% of the actual surface area
- 2) One hundred and eleven fixed point static GFPC measurements.

The collected FSS survey data demonstrate that the approximately 760 square meters of the macadam surfaces in the OL1 survey area meet 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 macadam pavement throughout the OL1 area of SNEC facility. Survey units MA8-6, MA8-7, MA8-8, MA8-9, MA8-10, MA8-11, MA8-12, MA8-13, MA8-16, and MA8-17 are included. This report 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 ten Class 1 survey units of residual macadam. This report only addresses the FSS performed on this specific portion of the area designated as OL1. The format of this report follows the guidance contained in reference 9.2.

## **2.0 Survey Area Description**

Survey Area OL1 is primarily the area including and surrounding the original SNEC facility, surrounding the Penelec line building (the 'line shack'), and the northern half of the Saxton Steam Generating Station (SSGS) footprint. The ten macadam survey units are all designated as Class 1. The reference 9.1 map shows the designations of the soil areas of the OL1 survey area. The survey unit encompasses about 760 square meters of macadam surface within 18 grids of the larger OL1 area. Most OL1 grids did not contain any macadam surfaces and some grids contained parts of more than one survey unit due to the layout of the discrete macadam sections. Layout of the survey area and individual units relative to the site layout are shown in Attachment 1 of Appendix A. The ten survey units are discussed below. The survey unit designations are derived from the sequence provided in table 5-2 of the SNEC LTP (reference 9.3).

Survey unit MA8-6 is residual macadam in the Class 1 soil areas south of the original SNEC facility area. It has been designated Class 1 conservatively based on the proximity to the SNEC facility. The survey unit is approximately 96 square meters in 3 grids. The initial survey design estimated 76 square meters and 20 square meters of small adjacent macadam areas was added. Appendix A attachments 1-1 and 6-17 are drawings showing the layout of the survey area and attachment 6-1 of appendix A shows the layout of the macadam in this specific survey unit.

Survey unit MA8-7 is residual macadam in the Class 1 soil areas south of the original SNEC facility area. It has been designated Class 1 conservatively based on the proximity to the SNEC facility. The survey unit is approximately 81 square meters in 2 grids. The initial survey design estimated 76 square meters and 5 square meters of small adjacent macadam areas was added. Appendix A

attachments 1-1 and 6-17 are drawings showing the layout of the survey area and attachment 6-3 of appendix A shows the layout of the macadam in this specific survey unit.

Survey unit MA8-8 is residual macadam in the Class 1 soil areas south of the original SNEC facility area. It has been designated Class 1 conservatively based on the proximity to the SNEC facility. The survey unit is approximately 100 square meters in 2 grids. The initial survey design estimated 76 square meters. The area was estimated to be 95 square meters during the survey and 5 square meters of small adjacent macadam areas was added. Appendix A attachments 1-1 and 6-17 are drawings showing the layout of the survey area and attachment 6-5 of appendix A shows the layout of the macadam in this specific survey unit.

Survey unit MA8-9 is residual macadam in the Class 1 soil areas south of the original SNEC facility area. It has been designated Class 1 conservatively based on the proximity to the SNEC facility. The survey unit is approximately 52 square meters in 2 grids. The initial survey design estimated 76 square meters but the area was estimated at 48 square meters during the survey and 4 square meters of small adjacent macadam areas was added. Appendix A attachments 1-1 and 6-17 are drawings showing the layout of the survey area and attachment 6-7 of appendix A shows the layout of the macadam in this specific survey unit.

Survey unit MA8-10 is residual macadam in the Class 1 soil areas south of the original SNEC facility area. It has been designated Class 1 conservatively based on the proximity to the SNEC facility. The survey unit is approximately 76 square meters in 3 grids. The initial survey design estimated 102 square meters but 26 square meters was not scanned because it was patches of soil within the macadam area. Appendix A attachments 1-1 and 6-17 are drawings showing the layout of the survey area and attachment 6-9 of appendix A shows the layout of the macadam in this specific survey unit.

Survey unit MA8-11 is residual macadam in the Class 1 soil areas south of the original SNEC facility area. It has been designated Class 1 conservatively based on the proximity to the SNEC facility. The survey unit is approximately 42 square meters in 1 grid. Appendix A attachments 1-1 and 6-17 are drawings showing the layout of the survey area and attachment 6-11 of appendix A shows the layout of the macadam in this specific survey unit.

Survey unit MA8-12 is residual macadam in the Class 1 soil areas south of the original SNEC facility area. It has been designated Class 1 conservatively based on the proximity to the SNEC facility. The survey unit is approximately 82 square meters in 4 grids. The initial survey design estimated 73 square meters but additional area was added based on the survey and about 7 square meters was not surveyed because it was patches of soil within the macadam area. Appendix A attachments 1-1 and 6-17 are drawings showing the layout of the survey area

and attachment 6-13 of appendix A shows the layout of the macadam in this specific survey unit.

Survey unit MA8-13 is residual macadam in the Class 1 soil areas south of the original SNEC facility area. It has been designated Class 1 conservatively based on the proximity to the SNEC facility. The survey unit is approximately 83 square meters in 1 grid. The survey unit was estimated to be 100 square meters during the design, but the survey estimated the area to be about 83 square meters. Appendix A attachments 1-1 and 6-17 are drawings showing the layout of the survey area and attachment 6-15 of appendix A shows the layout of the macadam in this specific survey unit.

Survey unit MA8-16 is residual macadam in the Class 1 soil areas west of the original SNEC facility area. It has been designated Class 1 conservatively based on the proximity to the SNEC facility. The survey unit is approximately 93 square meters in 3 grids. Appendix A attachments 1-1 and 6-17 are drawings showing the layout of the survey area and attachment 6-22 of appendix A shows the layout of the macadam in this specific survey unit.

Survey unit MA8-17 is residual macadam in the Class 1 soil areas west of the original SNEC facility area. It has been designated Class 1 conservatively based on the proximity to the SNEC facility. The survey unit is approximately 58 square meters in 2 grids. Appendix A attachments 1-1 and 6-17 are drawings showing the layout of the survey area and attachment 6-24 of appendix A shows the layout of the macadam in this specific 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. 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**

No known remediation activities have been conducted on the residual macadam surfaces discussed here. Surface cleaning to permit the survey was performed and portions of the macadam were removed in order to remove materials that were underground (pipe tunnels, drain lines etc.).

### **4.0 Site Release Criteria**

The site release criteria applied to the macadam surface areas of OL1 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 from the original SNEC yard area 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 calculation providing the design of the survey for these survey units is provided in Appendices A and B. Scan measurements were conducted over approximately 100% of the Class 1 survey units. Scans were planned to be conducted using two different types of large Gas Flow Proportional Counter (GFPC). Most FSS surveys have been conducted using a model 43-68 GFPC which is about 126 square centimeters. Because of the large area of fairly flat macadam, an additional detector, a 43-37 'extra large' GFPC was used. Setpoints for the 43-37 were conservatively determined and then the detector was used only for surface scanning in a screening process. If any alarm points were found with the 43-37, follow-up would be conducted with the more 'traditional' 43-68 detector. Appendix B section 2.1.11 explains the 43-37 detector and conditions of use. Although considered in the design if needed, no 43-68 scans were required for this survey unit group.

The number of fixed measurement points was determined by using the COMPASS computer program (reference 9.5, attachment 7 of appendix A). These points were located on survey maps using the Visual Sample Plan program (reference 9.6 and attachment 6 of appendices A and B). One survey units had more fixed point measurements than the minimum COMPASS indicated. This was due to layout on the shape of the survey unit.

The survey design uses a surrogate Cs137 effective DCGL developed from radionuclide mix analyses from samples collected before the Final Status Survey in the vicinity of the survey unit. For OL1 the mix was based on radionuclide mix data (including the hard-to-detects listed in Table 5-1 of the LTP) from soil samples from the areas of the original SNEC site in OL1 and OL2 (attachment 2 of appendix A).

Cs137, Co60, H3, and Sr90 were positively detected in one or more of these 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	MA8-6, MA8-7, MA8-8, MA8-9, MA8-10, MA8-11, MA8-12, MA8-13, MA8-16, MA8-17
SNEC Design Calc. #	E900-05-015
MARSSIM Classification	1
Survey Unit Area (m <sup>2</sup> )	96, 81, 100, 52, 76, 42, 82, 83, 93, 58
Statistical Test	Sign
Type 1 decision error ( $\alpha$ )	0.05
Type 2 decision error ( $\beta$ )	0.1
LBGR (cpm)	1175
Estimated $\sigma$ (cpm)	25.4
Relative Shift ( $\Delta/\sigma$ )	3.0
Number of static points*	11, 11, 11, 11, 11, 12, 11, 11, 11, 11
DCGLw (Cs137 dpm/100cm <sup>2</sup> )	26445
Action Level (Cs137 dpm/100cm <sup>2</sup> )	19834
Scan MDC (dpm/100cm <sup>2</sup> )	4634 (43-68) 7311 (43-37)
SNEC Survey Request #	SR234, SR235, SR236
Scan Survey Instrument	L2350-1 w/ 43-68B L2350-1 w/ 43-37

\* minimum per design was 11 in each unit

## **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, and 9.11 which are filed in the SNEC history files.

### **6.1 Survey Unit MA8-6**

#### **6.1.1 Scan survey**

Scan measurements were made on the residual macadam in part of 3 grids using a 43-37 GFPC detector with an MDCscan of 7311 dpm/100cm<sup>2</sup> (table 3 on page 5 of appendix B). The 75 % administrative limit was 19834 dpm/100cm<sup>2</sup>

(table 1 on page 3 of appendix A), and the adjusted surrogate Cs137 DCGLw for this survey unit was 26445 dpm/100cm<sup>2</sup> (table 1 on page 3 of appendix A). In this case, the MDCscan was below the DCGLw so no fixed point number adjustment was needed.

Initial design estimate of surface area was 76 square meters. The final estimate of the area from the survey was 96 square meters including about 20 square meters of adjacent macadam added to this unit to ensure complete coverage of the macadam. All of the 96 square meters of macadam as found during the survey was scanned. This results in approximately 96 square meters actually scanned in the 96 square meter survey unit, or 100 percent, which is consistent with coverage requirements for Class 1 survey units. The scans conducted in all 96 square meters did not identify any activity greater than the action level. The action level was >2900 gross cpm (table 3 on page 5 of appendix B). No area greater than 2900 gross cpm was found in MA8-6.

#### 6.1.2 Fixed point measurements

Eleven randomly selected fixed point measurement locations were defined for the survey unit, based on a conservative relative shift of about 3.0. None of the design fixed point measurements in MA8-6 had results in excess of the adjusted surrogate DCGLw. The table below (Table 2) 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 greater than the variability assumed in the survey design. However, since the LBGR used for the design was higher than the typical 50% of the DCGL, a relative shift of three would still result from the observed variability and a slightly less conservative LBGR. 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 2 – Fixed point results for MA8-6**

Point Number	Gross beta cpm
1	337
2	411
3	387
4	472
5	396
6	358
7	394
8	332
9	355
10	403
11	390
Mean	385
Std Dev	39.4
Min	332
Max	472

## **6.2 Survey Unit MA8-7**

### **6.2.1 Scan survey**

Scan measurements were made on the residual macadam in part of 2 grids using a 43-37 GFPC detector with an MDCscan of 7311 dpm/100cm<sup>2</sup> (table 3 on page 5 of appendix B). The 75 % administrative limit was 19834 dpm/100cm<sup>2</sup> (table 1 on page 3 of appendix A), and the adjusted surrogate Cs137 DCGLw for this survey unit was 26445 dpm/100cm<sup>2</sup> (table 1 on page 3 of appendix A). In this case, the MDCscan was below the DCGLw so no fixed point number adjustment was needed.

Initial design estimate of surface area was 76 square meters. The final estimate of the area from the survey was 81 square meters including about 5 square meters of adjacent macadam added to this survey unit for completeness of coverage. All of the 81 square meters of macadam was scanned. This results in approximately 81 square meters actually scanned in the 81 square meter survey unit, or 100 percent, which is consistent with coverage requirements for Class 1 survey units. The scans conducted in all 81 square meters did not identify any activity greater than the action level. The action level was >2900 gross cpm (table 3 on page 5 of appendix B). No area greater than 2900 gross cpm was found in MA8-7.

### **6.2.2 Fixed point measurements**

Eleven randomly selected fixed point measurement locations were defined for the survey unit, based on a conservative relative shift of about 3.0. None of the design fixed point measurements in MA8-7 had results in excess of the adjusted surrogate DCGLw. The table below (Table 3) 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 greater than the variability assumed in the survey design. However, since the LBGR used for the design was higher than the typical 50% of the DCGL, a relative shift of three would still result from the observed variability and a slightly less conservative LBGR. 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 3 – Fixed point results for MA8-7**

Point Number	Gross beta cpm
1	364
2	343
3	372
4	362
5	349
6	359
7	364
8	460
9	288
10	512
11	429
Mean	382
Std Dev	61.9
Min	288
Max	512

### **6.3 Survey Unit MA8-8**

#### **6.3.1 Scan survey**

Scan measurements were made on the residual macadam in part of 2 grids using the 43-37 GFPC detector with an MDCscan of 7311 dpm/100cm<sup>2</sup> (table 3 on page 5 of appendix B). The 75 % administrative limit was 19834 dpm/100cm<sup>2</sup> (table 1 on page 3 of appendix B), and the adjusted surrogate Cs137 DCGLw for this survey unit was 26445 dpm/100cm<sup>2</sup> (table 1 on page 3 of appendix B). In

this case, the MDCscan was below the DCGLw so no fixed point number adjustment was needed.

Initial design estimate of surface area was 76 square meters. The final estimate of the area from the survey was 100 square meters including about 5 square meters of adjacent macadam added to this survey unit for completeness of coverage. All of the 100 square meters of macadam was scanned. This results in approximately 100 square meters actually scanned in the 100 square meter survey unit, or 100 percent, which is consistent with coverage requirements for Class 1 survey units. The scans conducted in all 100 square meters did not identify any activity greater than the action level. The action level was >2900 gross cpm for the 43-37 (table 3 on page 5 of appendix B). No area greater than 2900 gross cpm was found in MA8-8.

### 6.3.2 Fixed point measurements

Eleven randomly selected fixed point measurement locations were defined for the survey unit, based on a conservative relative shift of about 3.0. None of the design fixed point measurements in MA8-8 had results in excess of the adjusted surrogate DCGLw. The table below (Table 4) 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 greater than the variability assumed in the survey design. However, since the LBGR used for the design was higher than the typical 50% of the DCGL, a relative shift of three would still result from the observed variability and a slightly less conservative LBGR. 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 4 – Fixed point results for MA8-8**

Point Number	Gross beta cpm
1	381
2	357
3	310
4	322
5	386
6	353
7	346
8	432
9	410
10	424
11	424
Mean	377
Std Dev	42.5
Min	310
Max	432

#### **6.4 Survey Unit MA8-9**

##### 6.4.1 Scan survey

Scan measurements were made on the residual macadam in part of 2 grids using the 43-37 detector with an MDCscan of 7311 dpm/100cm<sup>2</sup> (table 3 on page 5 of appendix B). The 75 % administrative limit was 19834 dpm/100cm<sup>2</sup> (table 1 on page 3 of appendix B), and the adjusted surrogate Cs137 DCGLw for this survey unit was 26445 dpm/100cm<sup>2</sup> (table 1 on page 3 of appendix B). In this case, the MDCscan was below the DCGLw so no fixed point number adjustment was needed.

Design estimate of the area of the survey unit was 76 square meters. The estimate of the area from the survey was 52 square meters. All of the 52 square meters of macadam was scanned. This results in approximately 52 square meters actually scanned in the 52 square meter survey unit, or 100 percent, which is consistent with coverage requirements for Class 1 survey units. The scans conducted in all 52 square meters did not identify any activity greater than the action level. The action level was >2900 gross cpm for the 43-37 (table 3 on page 5 of appendix B). No area greater than 2900 gross cpm was found with the 43-37 in MA8-9.

##### 6.4.2 Fixed point measurements

Eleven randomly selected fixed point measurement locations were defined for the survey unit based on a conservative relative shift of about 3.0. None of the design fixed point measurements in MA8-9 had results in excess of the adjusted surrogate DCGLw. The table below (Table 5) 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 greater than the variability assumed in the survey design. However, since the LBGR used for the design was higher than the typical 50% of the DCGL, a relative shift of three would still result from the observed variability and a slightly less conservative LBGR. 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 5 – Fixed point results for MA8-9**

Point Number	Gross beta cpm
1	384
2	510
3	370
4	435
5	358
6	430
7	446
8	402
9	423
10	399
11	379
Mean	412
Std Dev	43.1
Min	358
Max	510

## 6.5 Survey Unit MA8-10

### 6.5.1 Scan survey

Scan measurements were made on the residual macadam in part of 3 grids using the 43-37 detector with an MDCscan of 7311 dpm/100cm<sup>2</sup> (table 3 on page 5 of appendix B). The 75 % administrative limit was 19834 dpm/100cm<sup>2</sup> (table 1 on page 3 of appendix B), and the adjusted surrogate Cs137 DCGLw for this survey unit was 26445 dpm/100cm<sup>2</sup> (table 1 on page 3 of appendix B). In this

case, the MDCscan was below the DCGLw so no fixed point number adjustment was needed.

Design estimate of the area of the survey unit was 102 square meters. The estimate of the area from the survey was 76 square meters. This includes about 4 square meters of adjacent macadam added to this survey unit for completeness in coverage and not including about 22 square meters of surface that was holes in the surface filled with soil. All of the 76 square meters of macadam was scanned. This results in approximately 76 square meters actually scanned in the 76 square meter survey unit, or 100 percent, which is consistent with coverage requirements for Class 1 survey units. The scans conducted in all 76 square meters did not identify any activity greater than the action level. The action level was >2900 gross cpm for the 43-37 (table 3 on page 5 of appendix B). No area greater than 2900 gross cpm was found with the 43-37 in MA8-10.

#### 6.5.2 Fixed point measurements

Eleven randomly selected fixed point measurement locations were defined for the survey unit based on a conservative relative shift of about 3.0. None of the design fixed point measurements in MA8-10 had results in excess of the adjusted surrogate DCGLw. The table below (Table 6) 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 greater than the variability assumed in the survey design. However, since the LBGR used for the design was higher than the typical 50% of the DCGL, a relative shift of three would still result from the observed variability and a slightly less conservative LBGR. 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 – Fixed point results for MA8-10**

Point Number	Gross beta cpm
1	430
2	364
3	329
4	317
5	353
6	331
7	426
8	385
9	377
10	373
11	362
Mean	368
Std Dev	36.6
Min	317
Max	430

## **6.6 Survey Unit MA8-11**

### **6.6.1 Scan survey**

Scan measurements were made on the residual macadam in part of 1 grid using the 43-37 detector with an MDCscan of 7311 dpm/100cm<sup>2</sup> (table 3 on page 5 of appendix B). The 75 % administrative limit was 19834 dpm/100cm<sup>2</sup> (table 1 on page 3 of appendix B), and the adjusted surrogate Cs137 DCGLw for this survey unit was 26445 dpm/100cm<sup>2</sup> (table 1 on page 3 of appendix B). In this case, the MDCscan was below the DCGLw so no fixed point number adjustment was needed.

Design estimate of the area of the survey unit was 42 square meters. All of the 42 square meters of macadam was scanned. This results in approximately 42 square meters actually scanned in the 42 square meter survey unit, or 100 percent, which is consistent with coverage requirements for Class 1 survey units. The scans conducted in all 42 square meters did not identify any activity greater than the action level. The action level was >2900 gross cpm for the 43-37 (table 3 on page 5 of appendix B). No area greater than 2900 cpm was found with the 43-37 in MA8-11.

### **6.6.2 Fixed point measurements**

Twelve randomly selected fixed point measurement locations were defined for the survey unit, based on a conservative relative shift of about 3.0. The minimum number required was eleven, but twelve fit on the survey unit when the grid was applied. None of the design fixed point measurements in MA8-11 had results in excess of the adjusted surrogate DCGLw. The table below (Table 7) 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 greater than the variability assumed in the survey design. However, since the LBGR used for the design was higher than the typical 50% of the DCGL, a relative shift of three would still result from the observed variability and a slightly less conservative LBGR. 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 7 – Fixed point results for MA8-11**

Point Number	Gross beta cpm
1	371
2	346
3	387
4	431
5	353
6	376
7	341
8	311
9	440
10	374
11	350
12	407
Mean	374
Std Dev	37.8
Min	311
Max	440

## 6.7 Survey Unit MA8-12

### 6.7.1 Scan survey

Scan measurements were made on the residual macadam in part of 4 grids using the 43-37 detector with an MDCscan of 7311 dpm/100cm<sup>2</sup> (table 3 on page 5 of appendix B). The 75 % administrative limit was 19834 dpm/100cm<sup>2</sup> (table 1 on page 3 of appendix B), and the adjusted surrogate Cs137 DCGLw for this

survey unit was 26445 dpm/100cm<sup>2</sup> (table 1 on page 3 of appendix B). In this case, the MDCscan was below the DCGLw so no fixed point number adjustment was needed.

Design estimate of the area of the survey unit was 73 square meters. The estimate of the area from the survey was 82 square meters. This includes about 30 square meters of adjacent macadam added to this survey unit for completeness in coverage and not including about 7 square meters of surface that was holes in the surface filled with soil. All of the 82 square meters of macadam was scanned. This results in approximately 82 square meters actually scanned in the 82 square meter survey unit, or 100 percent, which is consistent with coverage requirements for Class 1 survey units. The scans conducted in all 82 square meters did not identify any activity greater than the action level. The action level was >2900 gross cpm for the 43-37 (table 3 on page 5 of appendix B). No area greater than 2900 gross cpm was found with the 43-37 in MA8-12.

#### 6.7.2 Fixed point measurements

Eleven randomly selected fixed point measurement locations were defined for the survey unit, based on a conservative relative shift of about 3.0. None of the design fixed point measurements in MA8-12 had results in excess of the adjusted surrogate DCGLw. The table below (Table 8) 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 greater than the variability assumed in the survey design. However, since the LBGR used for the design was higher than the typical 50% of the DCGL, a relative shift of three would still result from the observed variability and a slightly less conservative LBGR. 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 8 – Fixed point results for MA8-12**

Point Number	Gross beta cpm
1	408
2	344
3	450
4	296
5	369
6	419
7	369
8	399
9	326
10	387
11	381
Mean	377
Std Dev	43.6
Min	296
Max	450

## **6.8 Survey Unit MA8-13**

### **6.8.1 Scan survey**

Scan measurements were made on the residual macadam in part of 1 grid using the 43-37 detector with an MDCscan of 7311 dpm/100cm<sup>2</sup> (table 3 on page 5 of appendix B). The 75 % administrative limit was 19834 dpm/100cm<sup>2</sup> (table 1 on page 3 of appendix B), and the adjusted surrogate Cs137 DCGLw for this survey unit was 26445 dpm/100cm<sup>2</sup> (table 1 on page 3 of appendix B). In this case, the MDCscan was below the DCGLw so no fixed point number adjustment was needed.

Design estimate of the area of the survey unit was 100 square meters. The estimate of the area from the survey was 83 square meters, not including about 4 square meters of surface that was holes in the surface filled with soil. All of the 83 square meters of macadam was scanned. This results in approximately 83 square meters actually scanned in the 83 square meter survey unit, or 100 percent, which is consistent with coverage requirements for Class 1 survey units. The scans conducted in all 83 square meters did not identify any activity greater than the action level. The action level was >2900 gross cpm for the 43-37 (table 3 on page 5 of appendix B). No area greater than 2900 gross cpm was found with the 43-37 in MA8-13.

### **6.8.2 Fixed point measurements**

Eleven randomly selected fixed point measurement locations were defined for the survey unit, based on a conservative relative shift of about 3.0. None of the design fixed point measurements in MA8-13 had results in excess of the adjusted surrogate DCGLw. The table below (Table 9) 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 greater than the variability assumed in the survey design. However, since the LBGR used for the design was higher than the typical 50% of the DCGL, a relative shift of three would still result from the observed variability and a slightly less conservative LBGR. 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 9 – Fixed point results for MA8-13**

Point Number	Gross beta cpm
1	450
2	343
3	313
4	318
5	371
6	370
7	370
8	313
9	366
10	390
11	358
Mean	360
Std Dev	39.8
Min	313
Max	450

## 6.9 Survey Unit MA8-16

### 6.9.1 Scan survey

Scan measurements were made on the residual macadam in part of 3 grids using the 43-37 GFPC detector with an MDCscan of 7311 dpm/100cm<sup>2</sup> (table 3 on page 5 of appendix B). The 75 % administrative limit was 19834 dpm/100cm<sup>2</sup> (table 1 on page 3 of appendix B), and the adjusted surrogate Cs137 DCGLw for this survey unit was 26445 dpm/100cm<sup>2</sup> (table 1 on page 3 of appendix B). In

this case, the MDCscan was below the DCGLw so no fixed point number adjustment was needed.

The area of the survey unit was 93 square meters. All of the 93 square meters was actually scanned in the 93 square meter survey unit, or 100 percent, which is consistent with coverage requirements for Class 1 survey units. The scans conducted in all 93 square meters did not identify any activity greater than the action level. The action level was >2900 gross cpm for the 43-37 (table 3 on page 5 of appendix B). No area greater than 2900 gross cpm was found with the 43-37 in MA8-16.

#### 6.9.2 Fixed point measurements

Eleven randomly selected fixed point measurement locations were defined for the survey unit, based on a conservative relative shift of about 3.0. None of the design fixed point measurements in MA8-16 had results in excess of the adjusted surrogate DCGLw. The table below (Table 10) 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 greater than the variability assumed in the survey design. However, since the LBGR used for the design was higher than the typical 50% of the DCGL, a relative shift of three would still result from the observed variability and a slightly less conservative LBGR. 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 10 – Fixed point results for MA8-16**

Point Number	Gross beta cpm
1	327
2	352
3	389
4	343
5	342
6	350
7	337
8	496
9	376
10	411
11	346
Mean	370
Std Dev	48.7
Min	327
Max	496

## **6.10 Survey Unit MA8-17**

### **6.10.1 Scan survey**

Scan measurements were made on the residual macadam in part of 2 grids using the 43-37 GFPC detector with an MDCscan of 7311 dpm/100cm<sup>2</sup> (table 3 on page 5 of appendix B). The 75 % administrative limit was 19834 dpm/100cm<sup>2</sup> (table 1 on page 3 of appendix B), and the adjusted surrogate Cs137 DCGLw for this survey unit was 26445 dpm/100cm<sup>2</sup> (table 1 on page 3 of appendix B). In this case, the MDCscan was below the DCGLw so no fixed point number adjustment was needed.

The area of the survey unit was 58 square meters. All of the 58 square meters was actually scanned in the 58 square meter survey unit, or 100 percent, which is consistent with coverage requirements for Class 1 survey units. The scans conducted in all 58 square meters did not identify any activity greater than the action level. The action level was >2900 gross cpm for the 43-37 (table 3 on page 5 of appendix B). No area greater than 2900 gross cpm was found with the 43-37 in MA8-17.

### **6.10.2 Fixed point measurements**

Eleven randomly selected fixed point measurement locations were defined for the survey unit, based on a conservative relative shift of about 3.0. None of the

design fixed point measurements in MA8-17 had results in excess of the adjusted surrogate DCGLw. The table below (Table 11) 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 greater than the variability assumed in the survey design. However, since the LBGR used for the design was higher than the typical 50% of the DCGL, a relative shift of three would still result from the observed variability and a slightly less conservative LBGR. 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 11 – Fixed point results for MA8-17**

Point Number	Gross beta cpm
1	344
2	360
3	365
4	376
5	489
6	375
7	334
8	384
9	431
10	386
11	327
Mean	379
Std Dev	46.3
Min	327
Max	489

## **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**

MA8-6 had no alarm points during scan surveys of 100% of the surface. Scan MDCs were adequate. Eleven fixed point measurements were all less than the DCGLw. Scan fraction and number of fixed point measurements meets LTP and MARSSIM requirements.

MA8-7 had no alarm points during scan surveys of 100% of the surface. Scan MDCs were adequate. Eleven fixed point measurements were all less than the DCGLw. Scan fraction and number of fixed point measurements meets LTP and MARSSIM requirements.

MA8-8 had no alarm points during scan surveys of 100% of the surface. Scan MDCs were adequate. Eleven fixed point measurements were all less than the DCGLw. Scan fraction and number of fixed point measurements meets LTP and MARSSIM requirements.

MA8-9 had no alarm points during scan surveys of 100% of the surface. Scan MDCs were adequate. Eleven fixed point measurements were all less than the DCGLw. Scan fraction and number of fixed point measurements meets LTP and MARSSIM requirements.

MA8-10 had no alarm points during scan surveys of 100% of the surface. Scan MDCs were adequate. Eleven fixed point measurements were all less than the DCGLw. Scan fraction and number of fixed point measurements meets LTP and MARSSIM requirements.

MA8-11 had no alarm points during scan surveys of 100% of the surface. Scan MDCs were adequate. Twelve fixed point measurements were all less than the DCGLw. Scan fraction and number of fixed point measurements meets LTP and MARSSIM requirements.

MA8-12 had no alarm points during scan surveys of 100% of the surface. Scan MDCs were adequate. Eleven fixed point measurements were all less than the DCGLw. Scan fraction and number of fixed point measurements meets LTP and MARSSIM requirements.

MA8-13 had no alarm points during scan surveys of 100% of the surface. Scan MDCs were adequate. Eleven fixed point measurements were all less than the DCGLw. Scan fraction and number of fixed point measurements meets LTP and MARSSIM requirements.

MA8-16 had no alarm points during scan surveys of 100% of the surface. Scan MDCs were adequate. Eleven fixed point measurements were all less than the DCGLw. Scan fraction and number of fixed point measurements meets LTP and MARSSIM requirements.

MA8-17 had no alarm points during scan surveys of 100% of the surface. Scan MDCs were adequate. Eleven fixed point measurements were all less than the DCGLw. Scan fraction and number of fixed point measurements meets LTP and MARSSIM requirements.

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

7.3.1 Several survey units had small adjacent macadam surfaces added during the survey to ensure completeness of coverage of the macadam, specifics discussed throughout the report above.

7.3.2 Several survey units had small areas within the macadam areas that did not have any macadam surface but were exposed soil, specifics discussed throughout the report above.

7.3.3 Twenty nine fixed point locations were relocated up to six feet (typically about 3 feet) to place the points on macadam when the design location of the point fell on a soil hole or at soil along and uneven edges in the pavement which could not be completely accounted for in the initial design layout. These relocations were made in accordance with flexibility intended in the survey design and do not significantly affect the randomness and quality of the design. Points relocated are: five in MA8-6, four in MA8-8, two in MA8-9, six in MA8-10, three in MA8-11, two in MA8-12, four in MA8-13, and three in MA8-16.

### **7.4 QC comparisons**

#### **7.4.1 Scan surveys**

Multiple locations throughout the several survey units were partially rescanned as QC duplicates. The QC rescans did not identify any activity above alarm points and so are in agreement with the primary scans. QC scans were conducted on 92m<sup>2</sup> of the survey unit using the 43-37 GFPC, which represents about 12 percent of the 760 m<sup>2</sup> area scanned with the 43-37. This exceeds the minimum 5% required.

#### **7.4.2 Fixed Point measurements**

One fixed point measurement from each of the ten survey units received QC duplicate GFPC measurements. These duplicates had good agreement as shown in the table below (Table 12) because they support the same conclusion, that the survey units pass. Ten QC splits out of 111 measurements represents about 9.0% and exceeds the 5% minimum criterion.

**Table 12 – QC Fixed point duplicate comparison**

Fixed Point	Result (cpm)	QC Result (cpm)
MA8-6 3	375	428
MA8-7 1	304	283
MA8-8 2	276	394
MA8-9 1	293	401
MA8-10 6	321	322
MA8-11 7	296	343
MA8-12 5	300	376
MA8-13 2	280	349
MA8-16 1	263	381
MA8-17 1	301	428

## **8.0 Final Survey Conclusions**

The macadam pavement surfaces in OL1 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 all of the survey unit areas.

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 Surface Area consisting of nine survey units of surface exposed macadam pavement in the OL1 area and designated MA8-6, MA8-7, MA8-8, MA8-9, MA8-10, MA8-11, MA8-12, MA8-13, MA8-16, and MA8-17 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
- 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) # SR234
- 9.10 SNEC Survey Request (SR) # SR235
- 9.11 SNEC Survey Request (SR) # SR236

## **10.0 Appendices**

- Appendix A - SNEC Calculation E900-05-015 "OL1 Paved and Miscellaneous concrete surfaces MA8, PF1, DB5, DB1 – Survey Design" (11 pages plus numerous attachments)
- Appendix B - SNEC Calculation E900-05-015 Rev 1 "OL1 Paved and Miscellaneous concrete surfaces MA8, PF1, DB5, DB1, SS12, SS24 – Survey Design" (13 pages plus numerous attachments)