ORISE
OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION

September 29, 2004

Mr. Thomas Dragoun
NRR/DRIP
U.S. Nuclear Regulatory Commission
475 Allendale Road
King of Prussia, PA 19406

SUBJECT: FINAL SITE-SPECIFIC DECOMMISSIONING INSPECTION REPORT NO. 3 FOR THE SAXTON NUCLEAR EXPERIMENTAL CORPORATION, SAXTON, PENNSYLVANIA (DOCKET NO. 50-146; TASK 1)

Dear Mr. Dragoun:

Enclosed is the final Site-Specific Decommissioning Inspection Report for the Saxton Nuclear Experimental Corporation (SNEC), Saxton, Pennsylvania, for the document review of the SNEC on-site laboratory procedures and inspection activities performed on-site on July 8, 2004.

Please contact me at (865) 576-3356 or Timothy J. Vitkus at (865) 576-5073 should you require any additional information.

Sincerely,

Timothy J. Bauer
Health Physicist
Environmental Survey and
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Enclosure

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FINAL
SITE-SPECIFIC DECOMMISSIONING INSPECTION REPORT NO. 3 FOR THE SAXTON NUCLEAR EXPERIMENTAL CORPORATION SAXTON, PENNSYLVANIA

At the request of the Nuclear Regulatory Commission's (NRC) Office of Nuclear Reactor Regulation, the Environmental Survey and Site Assessment Program (ESSAP) of the Oak Ridge Institute for Science and Education (ORISE) performed site-specific decommissioning inspection activities at the Saxton Nuclear Experimental Corporation (SNEC) in Saxton, Pennsylvania. This report describes the in-process inspection activities for the SNEC on-site laboratory which included a review of laboratory procedures, viewing of SNEC staff preparing soil samples on July 8, 2004, and an interlaboratory comparison of five SNEC soil samples.

The following applicable checklist items were taken from Section 5.0 of the Site-Specific Decommissioning Inspection Plan (ORISE 2003). In addition, ORISE reviewed the SNEC quality control program to determine if the program met the intent of NRC Regulatory Guide 4.15 as specified in the SNEC License Termination Plan (LTP) Section 5.2.7 (NRC 1979 and GPU 2004). Bulleted observations and recommendations are noted under each checklist item.

5.0 ANALYTICAL PROCEDURES

ESSAP performed an inspection of the SNEC analytical procedures during the period March 27 through 29, 2001 (ORISE 2001). The following items will be reviewed for additions and/or modifications that have been incorporated since the 2001 inspection.

5.1 Review the laboratory instrumentation that will be used for sample analysis. Determine appropriateness and sensitivity of the selected equipment for the radionuclides of concern.

Observations: SNEC procedures E-900-OPS-4524.33, Operation of the SNEC Gamma Spectroscopy System, and E900-OPS-4524.46, Operation of the Packard Tri-Carb 2550 TR/AB Liquid Scintillation Analyzer, were reviewed (SNEC 2004 and 2002a). The procedures generally followed typical industry practices and instrumentation used was capable of detecting the radionuclides of concern. While the procedures themselves do not provide specific sensitivity requirements, there are provisions that sample analyses meet targeted minimum detectable activities (MDAs)—for example, refer to Section 4.3.12 of procedure E-900-OPS-4524.33. Two recommendations are included as a result of the review and are discussed below.

Recommendations: The following recommendations are provided for consideration:

1. Move Section 4.2.6 of procedure E-900-OPS-4524.33 to Section 4.2.2, as training must be completed before starting work.

2. Section 4.2 of procedure E900-OPS-4524.46 should include training requirements, such as Section 4.2.6 of procedure E-900-OPS-4524.33.

5.2 Review the licensee's laboratory analytical procedures for radiological analyses. Specifically:

5.2.1 Evaluate the laboratory's sample preparation techniques—geometries used for gamma spectrometry on soil samples, etc.

Observations: SNEC procedure E900-IMP-4520.02, Preparation of Sample Materials for Analysis (SNEC 2003a), was reviewed. The procedure generally followed typical industry practices. Two recommendations are included as a result of the review and are discussed below.

ESSAP staff also observed SNEC staff preparing collected soil samples. One concern raised during the observation regarded the lack of decontamination of the sieves and mallets used during the sample reduction process to minimize the potential to cross contaminate other samples. SNEC staff indicated that the tools were only used for samples screened and determined to be at environmental levels and that high activity samples (>20 pCi/g) are processed in a different area, reducing the risk of cross contamination. This process was not specifically stated in procedure E900-IMP-4520.02; however Section 4.1.3 generally discusses taking precautions to prevent sample cross contamination.

Recommendations: The following recommendations apply to procedure E900-IMP-4520.02:

1. Consider moving Section 4.1.4 to 4.1.1, as training must be completed before starting work.

2. Delete the word "adequate" from Section 4.1.6, because chain-of-custody must be maintained per SNEC procedure E900-ADM-4500.39, Chain of Custody for Samples (SNEC 2003b).

5.2.2 Review the protocol the laboratory uses to interpret the gamma spectrometry results, particularly the radionuclide total absorption peaks used to identify various contaminants.

Observations: SNEC procedure E900-OPS-4524.33, Operation of the SNEC Gamma Spectroscopy System, was reviewed (SNEC 2004). Specifically, Section 4.3 addresses sample analysis. The procedure generally followed typical industry practices. Of note was that the procedure required personnel evaluating the results review each peak identified in the analysis report, rather than relying on the radionuclide identification algorithms of the software.

Recommendations: While not specifically stated in a reviewed procedure, SNEC laboratory practice is to report "<MDA" values for analytical results. The reporting of MDA values is no longer an accepted

practice in radioanalytical laboratories. This is the recommendation provided in Section 2.3.5 of the MARSSIM (NRC 2000). Also refer to the Department of Energy (DOE) Quality Systems Manual for Analytical Services for general information (DOE 2004).

For a specific example, refer to Section D-4.6 of the Data Reduction and Quality Assurance Manual for NRC Office of Nuclear Material Safety and Safeguards (NRC 1998). Page 8.2 states "The information reported to the inspector or project manager regarding the analytical results shall include as a minimum:

- Identification of the laboratory;
- Identification of the inspector requesting analysis;
- The sample results with error limits assigned; and
- Signature of person responsible for verification of data quality."

5.2.3 Review the laboratory QA/QC procedures, including duplicates, blanks, and matrix spikes. Determine the frequency of analysis for each of the QC checks. Determine whether the laboratory participates in an adequate cross-check or performance evaluation program, such as that offered by EML [Environmental Measurements Laboratory] and EPA [Environmental Protection Agency].

Observations: SNEC procedure E900-QAP-4220.02, SNEC Count Room Quality Assurance Program, was reviewed (SNEC 2002b). The various QA/QC procedures are discussed in the following paragraphs.

Section 4.2 described the procedure for replicate (duplicate) samples. Monthly, approximately 5% of samples counted on the SNEC Gamma Spectroscopy System and Tri-Carb Liquid Scintillation Analyzer are selected for replicate analysis. The frequency and quantity of replicate samples were adequate; however, the evaluation of the results using the resolution and ratio quantities based on NRC Inspection Procedure 84750 (NRC 1994) does not appear to have sufficient rigor. See the recommendations below for additional discussion.

Section 4.3 discusses SNEC's participation in interlaboratory comparison programs. Interlaboratory comparison results for the period July 1, 2003 through December 31, 2003 are provided in the Count Room Quality Assurance Report (SNEC Undated). SNEC participated in both the EML and Mixed Analyte Performance Evaluation Program (MAPEP) cross-check programs. As of July 2004, EML no longer maintains the cross-check program as a result of integration into the Department of Homeland Security. No recommendations are noted.

Section 4.4 discusses blank samples. Blank sample analysis is not specified in this procedure and is left to the Quality Assurance Officer

(QAO) to establish. Blank sample results for the period July 1, 2003 through December 31, 2003 are provided in the Count Room Quality Assurance Report (SNEC Undated). See the recommendations below for additional discussion.

Section 4.5 discusses spike samples. Spike sample analysis is based on the interlaboratory comparison programs, with other spike samples prepared and analyzed as established by the QAO. Spike sample results for the period July 1, 2003 through December 31, 2003 are provided in the Count Room Quality Assurance Report (SNEC Undated). See the recommendations below for additional discussion.

Recommendations: Three recommendations were identified during the review of procedure E900-QAP-4220.02 for consideration:

1. The use of a resolution factor, as discussed in Section 4.2.2, for comparing duplicate results does not appear to have sufficient rigor. The acceptance criteria are too broad and failure of the criteria is almost impossible. Most of the acceptance criteria that are commonly in use by commercial and government laboratories include the uncertainty from each measurement. The following acceptance criteria can be found in the DOE Quality Systems Manual for Analytical Services, Section D-4.2 Analytical Variability/Reproducibility (DOE 2004).

$$\text{Replicate} = \frac{|S - D|}{\sqrt{(CSU_S)^2 + (CSU_D)^2}} =< 3$$

   Where: S = Sample Result
   D = Duplicate Result
   CSU_S = Combined Standard Uncertainty of the sample
   CSU_D = Combined Standard Uncertainty of the duplicate

2. For blank samples, the procedure is ambiguous as to the frequency for performing these QC checks, leaving it to the discretion of the QAO. The Count Room Quality Assurance Report (SNEC Undated) provided results of these QC checks. For the period July 1, 2003 through December 31, 2003, 43 gamma spectroscopy analyses were performed on 42 blank samples; however, this frequency was ambiguous because no technical basis for this frequency was provided in the report and the procedure does not provide a procedural requirement. ESSAP recommends providing specific guidance in the procedure for collection of these QC checks. For general discussion of laboratory data quality indicators, refer to the MARSSIM Section 7.2.2.2 (NRC 2000).

3. For spike samples, the procedure is ambiguous as to the frequency for performing these QC checks, as noted with the blank samples above. The Count Room Quality Assurance Report (SNEC Undated) provided

results of these QC checks and noted that "Count Room Technicians prepare tritium check standards (non-blind spike samples) that are analyzed with each batch of regular samples." The acceptance criterion is also noted as "within ±2 sigma of the calculated check standard activity." ESSAP recommends this process be specifically incorporated into the procedure. For general discussion of laboratory data quality indicators, refer to the MARSSIM Section 7.2.2.2 (NRC 2000).

5.3 Analyze split-samples of media such as soil, building debris, and water for comparison with SNEC's on-site laboratory results.

Observations: Five SNEC 1-liter soil samples ranging in Cs-137 activity from 5 to 20 pCi/g were returned to ESSAP's laboratory in Oak Ridge, TN. Samples were analyzed in accordance with the ESSAP Laboratory Procedures and the Quality Assurance Manuals (ORISE 2004). The ESSAP and SNEC results are provided in Table 1. The data shows general agreement between the two data analyses. It should be noted that ESSAP is no longer calibrated to the 1-liter Marinelli geometry. ESSAP uses a 0.5-liter geometry instead. Therefore, the SNEC samples were split into two aliquots, each aliquot was analyzed individually, and the subsequent results averaged and compared to the licensee's data.

Recommendations: None.

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Saxton Nuclear Experimental Corporation. Facility Policy and Procedure Manual: SNEC Count Room Quality Assurance Program, E900-QAP-4220.02, Revision 3. Saxton, PA; February 6, 2002b.

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Saxton Nuclear Experimental Corporation. Facility Policy and Procedure Manual: Chain of Custody for Samples, E900-ADM-4500.39, Revision 6. Saxton, PA; October 1, 2003b.

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U.S. Nuclear Regulatory Commission (NRC). Quality Assurance for Radiological Monitoring Programs (Normal Operations) – Effluent Streams and the Environment. Washington, DC; NUREG-4.15; Revision 1, February 1979.

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U.S. Nuclear Regulatory Commission. NRC Inspection Manual, Inspection Procedure 84750, Radioactive Waste Treatment, and Effluent and Environmental Monitoring. Washington, DC; March 15, 1994.

U.S. Nuclear Regulatory Commission. Data Reduction and Quality Assurance Manual for Office of Nuclear Material Safety and Safeguards, Revision 1.0. Washington, DC; May 12, 1998.

U.S. Nuclear Regulatory Commission. Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM). Washington, DC; NUREG-1575; Revision 1, August 2000.

ORISE TABLE 1

COMPARISON OF GAMMA SPECTROSCOPY RESULTS OF RADIONUCLIDE CONCENTRATIONS IN SOIL SAMPLES CP1, REVISION 13 SAXTON NUCLEAR EXPERIMENTAL CORPORATION SAXTON, PENNSYLVANIA

ORISE Sample ID[a]	SNEC Sample ID	Radionuclide Concentrations (pCi/g dry weight)				Cs-137 Comparison Ratio[c]
		ORISE Values[b]			SNEC Value for Cs-137	
		Co-60	Cs-137	Cs-137 Average		
968S001A	SX-SL-4657	0.06 ± 0.05[d]	15.70 ± 0.80	15.46 ± 0.55	15.0 ± 1.1[e]	1.03[f]
968S001B		0.02 ± 0.04	15.21 ± 0.76			
968S002A	SX-SL-4661	0.10 ± 0.05	11.21 ± 0.59	11.62 ± 0.42	10.0 ± 0.7	1.16
968S002B		0.04 ± 0.06	12.02 ± 0.61			
968S003A	SX-SL-4754	0.05 ± 0.04	14.95 ± 0.71	16.41 ± 0.55	15.7 ± 1.8	1.05
968S003B		0.12 ± 0.05	17.87 ± 0.84			
968S004A	SX-SL-4767	0.36 ± 0.07	20.40 ± 0.99	21.3 ± 0.7	21.8 ± 1.9	0.98
968S004B		0.45 ± 0.09	22.2 ± 1.1			
968S005A	SX-SL-4984	0.02 ± 0.04	5.50 ± 0.31	5.14 ± 0.22	4.7 ± 0.4	1.09
968S005B		0.05 ± 0.05	4.78 ± 0.30			

[a]SNEC provided 1-Liter soil samples. ORISE split the samples into two 0.5-Liter samples for measurement. The last letter of the ORISE sample ID indicates the measured portion of the SNEC 1-Liter sample: An "A" represents the top portion and a "B" represents the bottom portion.
[b]The average MDC for a 1-hour count of soil in a 0.5-Liter Marinelli for Co-60 is 0.06 pCi/g and for Cs-137 is 0.04 pCi/g.
[c]Calculated by dividing the average ORISE result by the SNEC result.
[d]ORISE uncertainties represent the 95% confidence level, based on total propagated uncertainties.
[e]SNEC uncertainties represent the 95% confidence level, based on counting statistics.
[f]Uncertainties were not propagated for the Comparison Ratio calculation because ORISE and SNEC errors were not determined in the same manner.