Environmental Restoration Program

VERIFICATION SAMPLING AND ANALYSIS PLAN

POTENTIAL RELEASE SITE 86
RELEASE BLOCK F
Aciumium Septic Tank Removal (Area 7)

MOUND PLANT
MIAMISBURG, OHIO

May 1997

Final

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SAMPLING AND ANALYSES PLAN

PRS No. 86

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ACRONYMS

ARARs	Applicable or Relevant and Appropriate Requirements
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	Chain of Custody
DOT	Department of Transportation
DQO	Data Quality Objective
HASP	Health and Safety Plan
IATA	International Air Transportation Association
IDM	Investigative Derived Material
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NCR	Nonconformance Report
OVA	Organic Vapor Analyzer
PPB	Parts Per Billion
PRG	Preliminary Remediation Goal
RSE	Removal Site Evaluation
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
SOP	Standard Operating Procedure
SVOC	Semi-volatile Organic Compound
VOC	Volatile Organic Compound
VSAP	Verification Sampling and Analysis Plan

1.0 INTRODUCTION

The Verification Sampling and Analysis Plan (VSAP) has been prepared as part of the Environmental Restoration (ER) Program for Potential Release Site (PRS) 86 at the U.S. Department of Energy (DOE) Mound Plant, Miamisburg, Ohio. The VSAP is intended to summarize specific methods and procedures used for fulfilling the Data Quality Objectives (DQO) for PRS 86 verification. The primary objective of this plan is to verify that the actinium removal action has been successfully completed. To determine this, soil samples will be collected at specific locations and depths and analyzed for radionuclides. The following section presents a summary of historical information and previous investigations.

1.1 HISTORICAL INFORMATION

Potential Release Site (PRS) 86 (a.k.a. Area 7A) is a former disposal site located south of Building 29. Due to elevated levels of actinium^{227} contamination in the soil, a decision was made in 1995 to conduct a Removal Site Evaluation (RSE) and as a result implementation of a Removal Action began in August of 1995.[1]

The PRS 86 area was identified as a suspected burial location for radioactive contaminated soils from SW Building. In 1959/60, approximately three truckloads of soil and gravel containing radium^{226}, actinium^{227}, and thorium^{228} were disposed of near an inactive septic tank. The septic tank, estimated to be a 1,500 to 3,000 gallon poured concrete tank, was used during the original Mound Plant construction activities and was abandoned in the 1950's.[2]

1.2 PREVIOUS INVESTIGATIONS

The Radiological Site Survey in 1983[3] PRS 86 soils from four sample locations (S0274, S0276, C0008, and C0009) were analyzed for radioactivity:

Contaminant	Maximum Concentration Detected	Guideline Criteria
Actinium^{227}	1400 pCi/g	1 pCi/g
Cesium^{137}	1.2 pCi/g	0.46 pCi/g

The soil concentrations of Plutonium-238, Thorium, Cobalt-60, Radium-226, and Americium-241 were below guideline criteria.

The Operable Unit 5 Area 7 Investigation[4] In 1995, PRS 86 soil from one sample location, B16, was analyzed for radioactivity:

Contaminant	Maximum Concentration Detected	Guideline Criteria
Actinium^{227}	44.68 pCi/g	1 pCi/g

The soil concentrations of Plutonium, Thorium, Uranium, Tritium, Cesium^{137}, Radium^{226}, and Americium^{241} were below guideline criteria.

Volatile Organic Compound (VOC) Investigations:
During the Soil Gas Reconnaissance Sampling[5] in 1992/93, Freon 11 was detected at a concentration of 33 ppb and Tetrachloroethene (PCE) was detected at a concentration of 6 ppb. Both of these concentrations are below guideline criteria. No other compounds were detected within PRS 86.

During the Operable Unit 5 Area 7 Investigation[4], the only VOC detected was 2-Butanone at a concentration of 110 ppb or 0.110 mg/kg which is below guideline criteria.

2.0 SAMPLING OBJECTIVES AND RATIONALE

2.1 INTRODUCTION

This Verification Sampling and Analysis Plan (VSAP) is designed to provide guidance to field personnel in implementing the proposed verification sampling activities associated with PRS 86 (Area 7A). The main objective of this VSAP is to ensure that the field activities, sampling techniques, and sample handling procedures meet the data quality objectives stated in the OU9 QAPP[6]. Specific objectives of the verification sampling program are as follows:

- Provide environmental data obtained through sampling and analysis that is comparable in quality to Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Remedial Investigations using regulatory agency approved procedures.

- Verify that the removal action has met the established cleanup goals of:

  5 pCi/g for actinium^{227} established in the Action Memorandum for PRS 86

  15 pCi/g for radium^{226} per CFR 192.12 and

  .42 pCi/g for cesium^{137} which is Mound background.

The scope of this study is designed to provide closure on PRS 86 by verifying the attainment of the above cleanup goals. Thorium contamination will not be included in this verification because any thorium in the remaining portion of Area 7 will be addressed by PRS 66.[7]

The sampling and analysis guidelines set forth in this document are consistent with those specified in the OU9 QAPP. Guidance for the selection and definition of field methods, sampling procedures and sample custody was obtained from Mound Plant ER Program Standard Operating Procedures (SOPs), which have been approved by appropriate regulatory agencies and used successfully during other Mound environmental investigations. These SOPs will be used and incorporated into the SAP by reference, to the extent possible.

2.2 SITE DESCRIPTION

The PRS 86 Actinium Removal Action area, consists of a small portion of PRS 66, near Building 29, as shown in Figure 2.2. The area is bounded by Building 29 to the northwest, the plant entrance road to the north, the asphalt-lined pond to the east and the Area 7 parking lot to the south. The removal reached a final depth of approximately 25 feet. After the excavation was complete, the area was partially back filled with clean material.

2.3 SAMPLE SIZE CONSIDERATIONS

The objective of the verification sampling is to provide high-quality data that confirms the removal action was successful. This section describes the area to be sampled, the number and location of samples to be collected, and the analyses to be performed.

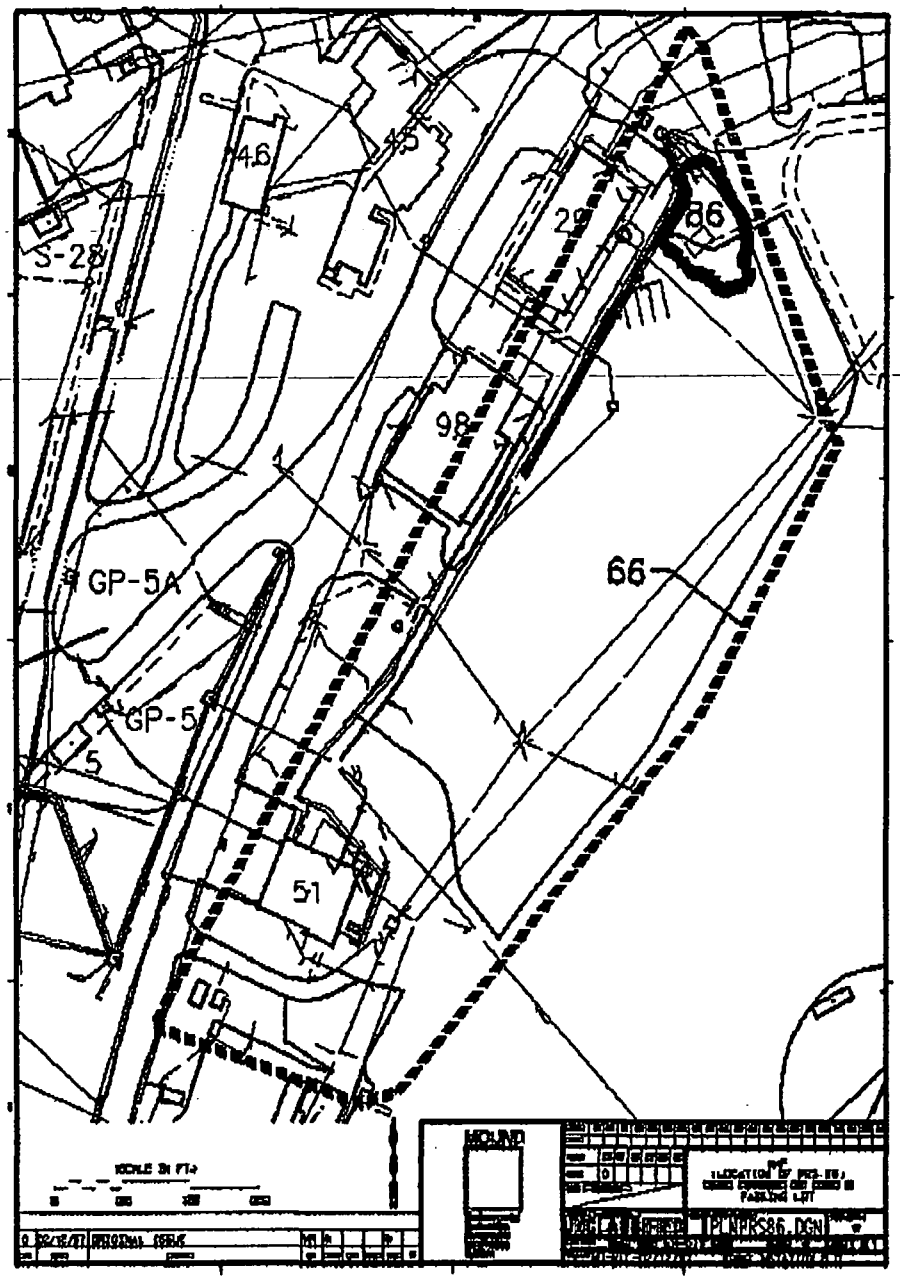

Figure 2.2. PRS 86 Location within PRS 66

The validity of the decision that a site meets the cleanup standard depends on how well the soil samples represent the site, how accurately the soil samples are analyzed, and in the inherent differences in soil samples, all of which are subject to variation. This variation introduces uncertainty into the decision concerning the attainment of the cleanup standard. Given the uncertainty associated with the decision process, procedures that err in favor of the environment or human health will be used. That is, if an incorrect decision is made, it is better environmentally to decide that PRS 86 is dirty when it is not (Type II error, or beta) rather than decide that PRS 86 is clean when in fact it is dirty (Type I error, or alpha). For the purpose of this VSAP, an alpha = 0.05 and beta = 0.20 were selected. These values reflect acceptance of errors that could adversely impact human health and the environment five percent of the time, and that could involve cleaning up a "non-problem" 20 percent of the time.

With these alpha and beta values and estimated values of mean, standard deviation, and variance obtained from the field screening data, EPA guidance[8] was used to determine the number of samples required to verify that the cleanup standards have been met.

2.4 SAMPLE TYPES

All samples obtained during the post-removal action, or verification, sampling program will be subsurface soils taken from beneath the fill. It is not anticipated that groundwater, or surface water will be sampled for verification purposes. Soil sampling procedures to be followed are presented in the Mound Plant ER Program Methods Compendium.[9]

2.5 SAMPLE LOCATIONS AND FREQUENCY

The sample area for verification sampling is the geographic area defined by a modified systematic random sampling strategy. Any point within the boundary of the removal area is a possible bore location, and samples will be collected from material beneath the fill but within two feet of the excavation / fill interface. In addition, points within two feet of the outside of the excavation area will be included in the sample area to determine that the lateral extent of contamination has been removed. The number of verification samples and the procedure for locating the sample points are discussed below.

Verification sampling and analysis will be carried out to decide whether concentrations in the residual area meet the cleanup standards. Verification of cleanup, based on the mean concentration, is appropriate if the true mean concentration is of primary concern with respect to human health risks associated with the contaminants, and extreme concentrations are anticipated to be unlikely as a result of removal action design.[8] Field screening results were used to guide the removal where on-going field measurements were employed to determine if additional removal was required in "real time". This procedure should ensure the removal of any extreme concentrations. In the unlikely event that the mean concentration is not found suitable, alternative methods are available (e.g., using the median or upper 95 percentile of the data).

Determination of the sample size required for verification is based on the following hypothesis testing structure. The null hypothesis (H_0) is that the site is contaminated at levels exceeding the cleanup standard; that is, the mean concentration (μ) is greater than the cleanup standard (C_s). The null hypothesis is assumed true unless sufficient evidence exists to show that it is false. The alternative hypothesis (H_1) is typically formulated as that which is intended to be proven. In this case, the goal is to prove that the remaining contamination is below the cleanup standard; that is, the mean concentration (μ) is equal to some value (μ_1) less than C_s.

Given the above hypothesis structure for the actinium verification, consider the two possible types of error. First, the site could be declared below the cleanup guidelines, when if fact it is contaminated at levels above the cleanup standard. This is considered a false positive result, or in statistical terms, a Type I error. Conversely, the site could be declared in exceedance of cleanup guidelines, when in fact it is below the cleanup guidelines. This is referred to as a false negative result, or a Type II error. Alpha (α) is used to represent the probability of a Type I error and beta (β) is used to represent the probability of a Type II error. Typically, α is specified as 0.05 and β is specified as 0.20. These values reflect that we accept an error that could adversely impact human health and the environment five percent of the time, and that could involve cleaning up a "non-problem" 20 percent of the time.

The following is an example of the calculations used to determine the verification sample size at PRS 86. The example presented is for actinium, the primary contaminant. The sample size (η) required for the statistical test described above is determined by the following formula:

$$\eta = \sigma^2(z_{1-\beta} + z_{1-\alpha})^2/(C_s - \mu_1)^2$$

where:

η = sample size
α = false positive error rate
β = false negative error rate
$z_{1-\alpha}$ = critical value for a normal distribution with probability $1-\alpha$
$z_{1-\beta}$ = critical value for a normal distribution with probability $1-\beta$
σ = standard deviation of the distribution of radionuclide concentration
C_s = cleanup standard
μ_1 = mean concentration controlling for the false negative error rate (μ_1 is a specific value of mean concentration, less than C_s, such that there is an 80% chance of declaring the site below the cleanup standard when the true mean is μ_1).

To calculate η, the following quantities were used:

$\alpha = 0.05$; $\beta = 0.20$; $\sigma = 5.0$ pCi/g; $C_s = 5$ pCi/g; and $\mu_1 = 3$ pCi/g.

Referring to a table for the standard normal distribution yields

$z_{1-0.05} = 1.645$; and $z_{1-0.20} = 0.842$.

The standard deviation (σ) is, of course, unknown. To calculate η requires that an estimate of σ be used. Standard procedures for this include using previous sampling results, other related data (if available), special preliminary sampling, worst case guessing, most likely case guessing, or a combination of these to come up with a reasonable value to use for σ. Previous sampling (in-process analyses during excavation) results exist, but they are not likely to be representative of the standard deviation that will be observed following cleanup. A conservative estimate of 5 pCi/g for σ was chosen after a review of the Mound screening results for samples taken during the final stages of excavation.

An alpha of 0.05 implies that there is no more than a 5% chance of declaring the site below the cleanup standards when the true mean concentration of actinium is greater than 5 pCi/g. Beta equal to 0.20 and μ_1 equal to 3 pCi/g implies an 80% confidence that the site will be declared below the cleanup standards when the true mean concentration is no more than 3 pCi/g.

With the above definitions and constraints, the sample size for verification is calculated:

$$\eta = 5.0^2(0.842 + 1.645)^2/(5.0 - 3.0)^2$$

$$\eta = 38.66 = 39 \text{ samples}$$

Accordingly, at least 39 points within the sample area will be selected to locate the verification sample points.

The following procedure can be used to select the sample locations according to a systematic random sampling strategy. A 12-ft. by 12-ft. rectangular grid will be superimposed over the sample area as follows:

1. Select two random numbers*, x and y, between 0 and 10.

2. Measure x feet due north from the centroid of the sample area and then y feet due west to locate the random origin of the sampling grid.

* e.g., standard uniform random number generator computer programs.

3. Locate the remaining nodes by proceeding in 12-foot increments in the x and y directions until the entire sample area is covered. Each of the nodes that is located within sample area boundary can be used for verification sampling.

An example realization is illustrated in Figure 2.5. In this example, 41 locations result. It should be noted that this number can vary slightly based on the actual random origin realization and if less than 39 locations result, the grid spacing can be adjusted to increase the number of locations.

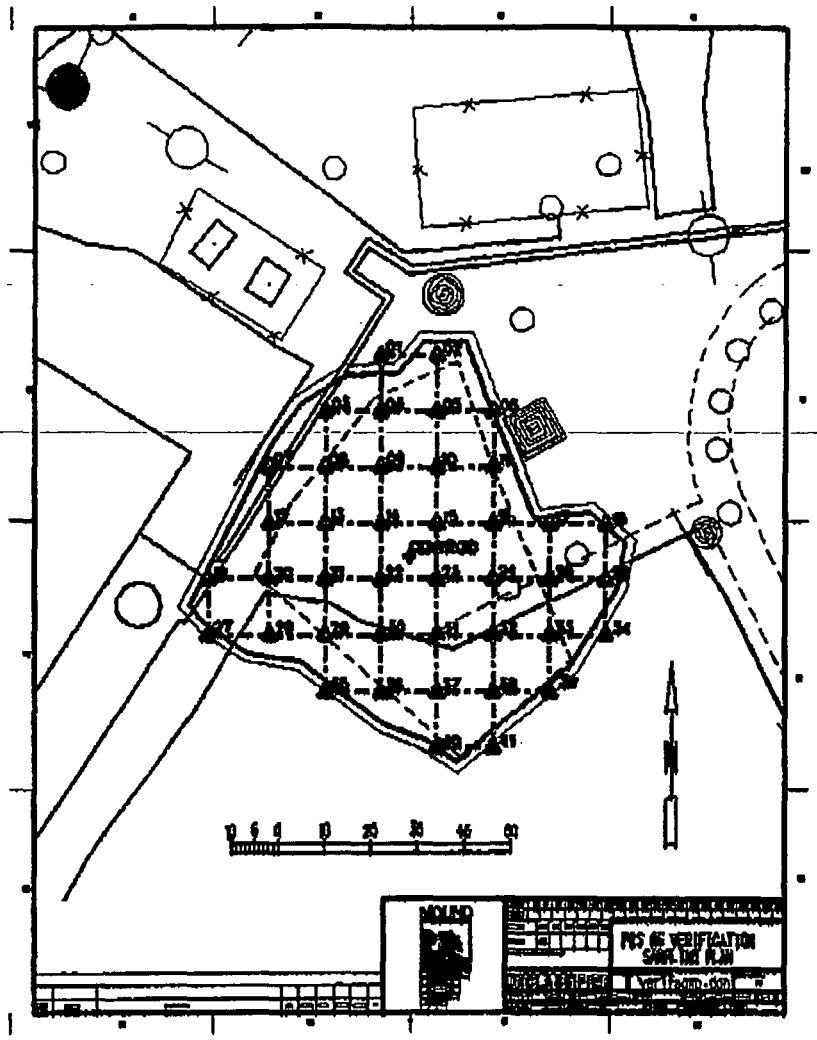

Figure 2.5. PRS 86 Sample Locations

3.0 SAMPLE DESIGNATION

Soil and quality control (QC) samples will be identified and labeled according to procedures in ER Program SOP 3.1, Sample Control and Documentation located in Appendix A of the Remedial Investigation/Feasibility Study, Operable Unit 9, Site-Wide, Quality Assurance Project Plan, Final 1995 (QAPP).[6] Sample identification labels will be used for each sample container. Samples will be sealed in containers immediately after collection. Labels will be completed prior to collection to minimize the handling of the sample containers. Each label will include the following information:

- Sample identification
- Time and date of collection
- Parameters to be analyzed
- Sampler's initials

Collected samples will be uniquely identified according to the system PRS86-W-XX-YY-ZZZZZZ, where:

W = QC sample
0 = no QC sample
1 = field duplicate
2 = equipment rinsate
3 = matrix spike
4 = matrix spike/laboratory duplicate

XX = the horizontal grid locator (i.e., A1)
YY = depth in feet (i.e., 00, 04, 08, etc.)
ZZZZZZ = a unique, sequential six digit sampler identifier (i.e., 000001, 000002, etc.) to be used on the laboratory chain of custody

Appendix A presents Table A.1 which shows the field entry form. This form will be used during the investigation to track field information required for the DQO.

4.0 SAMPLING EQUIPMENT AND PROCEDURES

The investigation SOPs will follow those presented in the QAPP. The following subsections describe the procedures for field sampling, field measurement, and field screening.

4.1 FIELD SAMPLING PROCEDURES

Field sampling procedures will be in accordance with ER Program SOPs found in Appendix A of the QAPP as well as the Mound Methods Compendium. Table 4.1 presents the SOPs, a summary description, and applicable deviations to the SOPs.

Table 4.1. Summary of Applicable Field ER Program SOPs

SOP No. and Title	Procedure Description	Deviations
1.3 Sample Control and Documentation	• Follow procedures outlined in the SOP.	None.
1.4 Sample Containers and Preservation	• Follow procedures outlined in the SOP.	None.

1.5 Guide to Handling, Packaging, and Shipping of Samples	• Follow procedures outlined in the SOP.	None.
1.6 General Equipment Decontamination	• All downhole equipment will be decontaminated. • All sampling equipment will be decontaminated between sampling intervals and locations.	Methanol and hexane rinses for the decontamination of sampling equipment will not be required because the target compounds do not contain organic contaminants.
1.15 Guide to Management of Collected IDM	• Follow procedures outlined in the SOP.	None.
1.15 a, Guide to Collection of IDM Soils	• Follow procedures outlined in the SOP.	None.
4.1 Soil Boring	• Use hollow stem auger or comparable drilling techniques.	• Abandonment will consist of using a bentonite sealer (i.e., hole plug) for borings less than 15-feet deep • For borings greater than 15-feet deep, the procedures in the SOP will be followed. • After a period of 24 hours, the borings will be checked for settling and the remaining depression will be filled with asphalt patch.
5.2 Sampling with a Spade and Scoop	• Follow procedures outlined in the SOP.	None
6.4 Total Alpha Surface Contamination Measurements	• Follow procedures outlined in the SOP.	Record only the detections on the check form. The instrument will be used and calibrated by Mound Health Physicists.

6.7 Near Surface and Soil Sample Screening for Low-Energy Gamma Radiation Using the FIDLER	• Follow procedures outlined in the SOP.	Record only the detections on the check form. The instrument will be used and calibrated by Mound Health Physicists.
6.15 Measurements of Gamma-Ray Fields Using a Sodium Iodide (NaI) Detector	• Follow procedures outlined in the SOP.	Record only the detections on the check form. The instrument will be used and calibrated by Mound Health Physicists.

4.2 FIELD MEASUREMENTS

A health physicist will screen each soil sample in the field using a FIDLER, alpha scintillometer and Geiger-Müller pancake probe (or equivalents) for radioactivity. These will be appropriately documented in accordance with SOPs 6.4, 6.7, and 6.15 presented in Table 4.1.

5.0 ANALYSES

Upon completion of soil sampling, all soil samples (100%) will be submitted to an offsite laboratory for analysis. The soil samples will be analyzed for actinium^{227}, cesium^{137} and radium^{226} by gamma spectrometry method (A-15). This method is included in the Mound Methods Compendium[9] and has reporting limits of 1 pCi/g for actinium^{227}, 0.1 pCi/g for cesium^{137} and 0.3 pCi/g for radium^{226}. In addition, each sample will be analyzed for isotopic Thorium by alpha spectrometry method (A-12). Thorium results will not be used for verification, but are being obtained as a matter of convenience to support PRS 66 characterization, which is going on in parallel.

6.0 SAMPLE DATA EVALUATION – determining whether the mean concentrations of the site are less than the cleanup standards

The upper one-sided 95% confidence interval will be used to test whether the site meets cleanup standards. The upper one-sided 100(1-α) percent confidence limit is given by:

$$\mu U_\alpha = \bar{x} + t_{1-\alpha,df}\, s/n^{1/2}$$

Where $\bar{x}$ is the computed mean level of contamination, and s is the corresponding standard deviation. The appropriate value of $t_{1-\alpha,df}$ is obtained from Table A.1. of the USEPA Guidance[8].

Using the above equation to determine whether or not the site attains the cleanup standards (Cs), the following decision rules apply:

If $\mu U_\alpha \geq$ Cs, conclude that the area is contaminated at levels exceeding the cleanup standard

If $\mu U_\alpha <$ Cs, conclude that the site is below the cleanup standard

If the 95% upper confidence limit for the area exceeds the action level, further remediation may be necessary. If the confidence interval limit is below the cleanup standard, assume that the objective has been met and that to the 95% confidence level the mean concentrations are less than the cleanup standards.

7. REFERENCES

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2) Mound Plant Underground Storage Tank Program Plan and Regulatory Status Review, Final, November 1992.

3) Operable Unit 9, Site Scoping Report: Volume 3-Radiological Site Survey, Final, June 1993.

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5) Reconnaissance Sampling Report, Soil Gas Survey and Geophysical Investigations, Mound Plant Main Hill and SM/PP Hill, February 1993.

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8) EPA 1989. Methods for Evaluating the Attainment of Cleanup Standards. Volume 1: Soils and Soil Media. U.S Environmental Protection Agency Statistical Policy Branch.

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