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CP2-WM-0307/FR1A

Paducah Waste Characterization Sampling and Analysis Plan

FOUR RIVERS NUCLEAR PARTNERSHIP, LLC

This document is approved for public release per review by:

David Hayden 5-1-19

FRNP Classification Support Date

Paducah Waste Characterization Sampling and Analysis Plan

Issued—May 2019

Prepared for the
U.S. DEPARTMENT OF ENERGY
Office of Environmental Management

Prepared by
FOUR RIVERS NUCLEAR PARTNERSHIP, LLC,
managing the
Deactivation and Remeditaion Project at the
Paducah Gaseous Diffusion Plant
under Contract No. DE-EM0004895

APPROVALS

Paducah Waste Characterization Sampling and Analysis Plan

CP2-WM-0307/FR1A

May 2019

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ACRONYMS

COC	chain of custody
DOE	U.S. Department of Energy
DOT	U.S Department of Transportation
DQO	data quality objectives
FRNPFRNP	Four Rivers Nuclear Partnership, LLC
NDA	non-destructive assay
OREIS	Oak Ridge Environmental Information System
PCB	polychlorinated biphenyl
PEMS	Project Environmental Measurements System
PGDP	Paducah Gaseous Diffusion Plant
QC	quality control
RAD	radiological or radiochemical
RCRA	Resource Conservation and Recovery Act
S&DM	Sample and Data Management organization
SAP	sample analysis plan
SVOA	semi-volatile organic analytes
TID	tamper-indicator device
TSCA	Toxic Substances Control Act
TSDF	treatment, storage, and disposal facility
VOA	volatile organic analytes
WAC	waste acceptance criteria
W&M	Waste and Materials

1. INTRODUCTION AND PURPOSE

The Waste and Materials (W&M) organization of Four Rivers Nuclear Partnership, LLC (FRNP) Paducah Deactivation and Remediation Project is responsible for managing legacy, newly generated, deactivation, and remediation waste stored in permitted and approved waste storage facilities at the Paducah Gaseous Diffusion Plant (PGDP). It also is responsible for managing the on-site contained landfill.

FRNPFRNP and, therefore, the Waste and Materials organization, have committed to characterize waste in accordance with applicable regulations, U.S. Department of Energy (DOE) orders, profile and procedure requirements; and the applicable treatment, storage, and disposal facility (TSDF) waste acceptance criteria (WAC). The W&M organization includes characterization personnel who direct sampling and analyses activities to characterize waste. The W&M organization is also committed to planning and executing sampling in accordance with the DOE data quality objectives (DQOs) process in order to minimize cost while not sacrificing effectiveness.

The purpose of this sampling and analysis plan is to provide and document the systematic approach used by the W&M organization to conduct sample planning and collection.

2. DATA QUALITY OBJECTIVES

The DQO process is a strategic planning approach based on the scientific method to prepare for a data collection activity. It provides a systematic procedure for defining the criteria that a data collection design should satisfy. Results from implementing the DQO process for waste characterization activities include information such as when and where to collect samples, how many samples to collect, and the tolerable level of decision error for the study. Its goal is to balance risk and cost in an acceptable manner.

Using the DQO process will assure that the type, quantity, and quality of data used in decision making will be appropriate for the intended application, resulting in decisions that are technically and scientifically sound and legally defensible. In addition, the DQO process will guard against committing resources to data collection efforts that do not support a defensible decision.

The formal DQO process is specified in the procedure CP3-ES-5003, *Quality Assured Data*.

3. ROLES AND RESPONSIBILITIES

The organizational roles and responsibilities pertaining to sampling are as follows:

Procurement: Establish purchase orders or contracts with analytical laboratories.

Records Management: Manage records generated from sampling activities.

Environmental Monitoring: Provide sampling support, develop analytical Statements of Work, coordinate delivery of samples to analytical laboratories, coordinate data validation services, maintain, input, create reports, and carry out all other activities necessary to manage sample analytical data provided by the projects. This includes management of the Paducah Oak Ridge Environmental

Information System (OREIS) and Paducah Project Environmental Measurements System (PEMS) databases.

Project Characterization Personnel: Identify waste/materials that require sampling and determine the applicable Data Quality Objectives (DQOs). Develop specific Sampling and Analysis Plans (SAPs) and/or Sampling and Analysis Event Plans (CP2-WM-0307-F01) as identified in this generic SAP. Characterize the waste/material based on the analytical data obtained and the applicable process knowledge.

Project Field Engineer: Ensure approved work control is in place that references the applicable sampling procedure(s).

Project Waste Sampler: Ensure the waste/material is sampled in accordance with the applicable sampling procedure and an approved *Sampling and Analysis Event Plan* (CP2-WM-0307-F01).

Quality Assurance: Maintain oversight of the *Quality Assurance Program Description for the Paducah Gaseous Diffusion Plant* (CP2-QA-1000) and ensure that the requirements are implemented within the project.

Radiation Protection: Develop radiological (RAD) work permits prior to beginning work and provide job coverage of waste sampling activities as needed.

Regulatory Compliance and Policy: Ensure that appropriate regulations pertaining to waste determinations are followed.

Industrial Hygiene: Provide guidance on personal protective equipment and provide support monitoring for contaminants.

4. SAMPLE PLANNING

The seven steps of the DQO process are shown below and are utilized as the basis of sample planning. For waste characterization purposes, the DQO process will be applied informally for each sampling event. In some cases, the reader is referred to CP2-WM-0307-F01, (see Appendix A) where project-specific information may be found for each sampling event. When completed, CP2-WM-0307-F01and any associated attachments will become part of the project data assessment package. Specific elements of the sampling event will be reviewed and approved through the work controls system.

IF, form CP2-WM-0307-F01is composed of multiple and sequential sampling events also known as a blanket sampling event, THEN form CP2-WM-0307-F02 (see Appendix B) may be completed as an addendum to CP2-WM-0307-F01 in order to note any differences associated with each sequential sampling event. Addendum information may include, but is not limited to sequential event identification, event location, event timeframe, or event parameter variances. When completed, both forms will become part of the project data assessment package.

Sampling of waste may take place in any of the following facilities: C-331, C-335, C-333, C-337, C-746-B1, C-759, C-760, C-761, C-752-C, C-746-U, C-746-H3, C-746-Q, C-747, C-612, C-752-A, C-753-A, C-755, C-757, C-754 , C-746-Q1 or C-733. In support of project work, sampling events may also take place throughout the PGDP footprint in accordance with the applicable safety basis documents.

4.1 STATE THE PROBLEM

Concisely describe the problem to be studied. Review prior and existing information to gain a sufficient understanding to define the problem.

4.1.1 Background Information

Background information related to the waste stream serves as input to the problem. Process knowledge of the waste stream and/or generating process is considered.

Based on process knowledge and historical sampling and analysis of recycled uranium at the PGDP, the following radionuclides are believed to be present at detectable levels: ^{241}Am, ^{137}Cs, ^{237}Np, ^{238}Pu, $^{239/240}$Pu, ^{99}Tc, ^{228}Th, ^{230}Th, ^{232}Th, ^{234}U, ^{235}U, and ^{238}U. Material is expected to be volumetrically contaminated and/or surface area contaminated. Other potential contaminants of concern include ignitability, corrosivity, reactivity, heavy metals, pesticides & herbicides, volatile organic analytes (VOA) and/or semi-volatile organic analytes (SVOA). Contaminants regulated under the Resource Conservation and Recovery Act (RCRA) may be characteristic or listed. Polychlorinated biphenyls (PCBs) and asbestos may also be encountered and are regulated under the Toxic Substances Control Act (TSCA).

Details of the waste description, media, and matrix for each sampling event will be described in CP2-WM-0307-F01 (see Appendix A).

4.2 IDENTIFY THE GOALS OF THE STUDY

Identify the questions that need to be answered and what actions may result, in order to resolve the problem.

4.2.1 Decision Statement

The decision statement for all waste characterization activities is to determine whether or not the contaminants of concern are at or below allowable levels for storage, treatment and/or disposal. For wastes that do not meet levels for disposal or require further treatment, additional decision statements will need to address waste classification and alternatives for treatment and/or disposal. Additional sampling of the wastes and containers may be required to address these decisions.

4.3 IDENTIFY INFORMATION INPUTS

Identify the information and measurements that are needed to resolve the problem.

4.3.1 Contaminants of Concern

The appropriate contaminants of concern for each sampling event will initially be established using process knowledge, but may require additional sampling to fully characterize individual wastes or container contents. Wastes may be categorized as one or a combination of the following: RCRA waste, TSCA waste, low-level radioactive waste (LLW), low level mixed (hazardous or TSCA) waste, PCB bulk product, PCB Remediation waste, asbestos waste, free released waste, no longer contains waste, and/or waste that meets Authorized Limits for the C-746-U landfill.

Contaminants of concern for RCRA waste material may consist of heavy metals, pesticides & herbicides, volatile organics and/or semi-volatile organics. In addition, waste may exhibit characteristics of ignitability, corrosivity, or reactivity. RCRA contaminates may be characteristic or listed.

Potential contaminants of concern for TSCA waste materials consist of PCBs and asbestos.

Based on process knowledge and historical sampling and analysis of recycled uranium at the PGDP, the following radionuclides may be present at detectable levels: ^{241}Am, ^{137}Cs, ^{237}Np, ^{238}Pu, $^{239/240}$Pu, ^{99}Tc, ^{228}Th, ^{230}Th, ^{232}Th, ^{234}U, ^{235}U, and ^{238}U. Material sampled under this plan may be volumetrically contaminated and/or surface area contaminated.

Any known contaminants for each sampling event are documented in CP2-WM-0307-F01 (see Appendix A).

4.3.2 Characterization Strategy

The characterization strategy will be established using a variety of input criteria such as population size, homogeneity of the waste population, requirements of the treatment and disposal facility, on-site management requirements such as Nuclear Criticality Safety controls, etc. The characterization strategy may range from direct sampling of each container, using a variety of sample methodologies, to sampling of a statistical subset of the population.

In most cases, the sample methodology will be based on the approach that gives the most representative sample of the waste material; however, on some occasions, the sampling may be biased in order to obtain a worse case scenario. The types of sample methods that may be employed include grab, core, composite, survey, and wipe. If the samples are to be for NCS purposes, there are specific controls for ensuring analytical results are truly independent and have no common-mode failures for characterization of independent samples. NCS must be contacted for guidance regarding implementation of these controls by off-site laboratories.

Inputs to the characterization strategy and the resulting characterization strategies will be documented in CP2-WM-0307-F01 (see Appendix A).

4.3.3 Action Level

The action levels are dependent on regulatory thresholds for contaminants and/or the WAC and applicable profile(s) for the disposal facility chosen for each waste stream. The applicable disposal facility for the waste is documented in CP2-WM-0307-F01 (see Appendix A) for each sampling event.

4.4 DEFINE THE BOUNDARIES OF THE STUDY

Specify the time periods and spatial area to which decisions will apply.

4.4.1 Temporal

Generally containerized waste does not have temporal boundaries for sampling.

4.4.2 Spatial

The spatial boundaries will be determined for each sampling event and, if applicable, will be documented

in CP2-WM-0307-F01 (see Appendix A).

4.5 DEVELOP THE ANALYTIC APPROACH

Define the parameters of interest, specify action levels, and integrate the previous DQO outputs into "if...then" statements that describes the logical basis for choosing among alternative actions.

4.5.1 Data Use and Statistical Evaluation

The data use and statistical evaluation will be determined on a "per sampling event" basis and will be documented in CP2-WM-0307-F01 (See Appendix A). If statistical evaluation is used, actions will follow, at a minimum, the guidance in U.S. Environmental Protection Agency (EPA) *Publication Test Methods for Evaluating Solid Waste Physical Chemical Methods*, SW-846, third edition.

4.5.2 Decision Statement

The decision statement for all waste characterization activities is: If the results exceed the allowable limits, alternate options for storage, treatment and/or disposal will be evaluated.

4.6 SPECIFY PERFORMANCE OR ACCEPTANCE CRITERIA

General guidelines for statistical error criteria in SW-846 or the TSDF WAC will be applied.

4.7 DEVELOP THE PLAN FOR OBTAINING DATA

Information from the previous DQO steps will be evaluated and alternative data collection designs will be generated. The most resource-effective design that meets all DQOs will be selected.

4.7.1 .Type of Data to Be Obtained

Data may include screening and definitive data. Screening data typically include field analyses to determine underlying waste characteristics, (e.g. pH, ignitability) to identify potential waste types such as volatile organic compounds (VOCs), PCBs or asbestos, or to assess levels of radioactivity that may be present. In addition, definitive characterization data may be needed to support waste disposition to an appropriate TSDF. To ensure that data are of sufficient quality to meet the WAC of the TSDF, these data will be obtained from a fixed-base Sample and Data Management organization (S&DM)-approved laboratory. However, field data may be used in conjunction with process knowledge and/or analytical data for waste decision making (e.g. test kits). All field data and samples for fixed-base analyses through the S&DM will be obtained in a manner consistent with CP3-ES-5003, *Quality Assured Data*.

4.7.2 Approach to Sample Selection

The sampling approach will be determined based on the waste stream and/or containers, and any background information that is available, and field information that is obtained from observation or screening. The specific approach for sampling and characterization will be documented in CP2-WM-0307-F01 (see Appendix A).

5. SAMPLE MANAGEMENT

5.1 ANALYTICAL LABORATORY CONTRACTING

Analytical laboratory contracting is the responsibility of the FRNP S&DM for all sampling.

5.2 SAMPLE SHIPMENT

FRNP ships samples (when appropriate) to off-site laboratories that are contracted and accepted by the FRNP S&DM.

Prior to any samples being shipped to an off-site laboratory for analysis a review must be conducted by the FRNP transportation department. The review performed will determine whether the sample shipment will be regulated or non-regulated. The review and approval is documented utilizing the bottom of form CP2-WM-0307-F01 (see Appendix A).

Samples to be analyzed at off-site laboratories require RAD, physical, and chemical characteristics gathered from process knowledge, historical data, or RAD screening data from an on-site laboratory and/or RADCON surveys. Waste engineers must provide adequate information and data for laboratory notification and U.S. Department of Transportation (DOT) decisions. In accordance with DOE requirements, external RAD release surveys are collected as applicable from the shipping containers.

The off-site laboratory accepting samples for analysis is notified of pertinent RAD, physical, and chemical characteristics including any asbestos-containing samples. Either written or verbal acceptance to allow the shipment of the samples to the accepting laboratory facility is required and can be documented on the signed Statement of Work and/or acceptance form CP3-WM-9503-F01/WD-F-0059 from CP3-WM-9503 or equivalent information.

Samples are held under chain of custody (COC) until shipment is made. Samples if not shipped the same day are kept at a temperature of 4 degrees Celsius when applicable until shipment is made. All sample shipments are made by FRNP in accordance with DOT hazardous materials regulations and according to FRNP procedures.

5.3 CHAINS OF CUSTODY

From the time of sampling through receipt at the laboratory, the integrity of the samples is ensured by documenting the COC through strict adherence to COC procedures. The COCs are prepared using the PEMS database. Copies of the completed COCs are submitted to the FRNP S&DM upon delivery to the analytical laboratory. A copy is maintained with the project files.

5.4 TAMPER INDICATOR DEVICES

A tamper indicator device (TID) is used to ensure that unauthorized additions to a container's contents can be detected visually. The TID is placed in a manner such that opening the container breaks the seal. A TID is placed on the following containers, if applicable:

- All points of entry on the sampled containers, if possible;

- Analytical samples not delivered to the laboratory within 24 hours of sampling or not stored in a secure storage facility; and

- Containers holding composited or consolidated material to be sampled.

5.5 PRESERVATION AND BOTTLE REQUIREMENTS

Waste samples are preserved by maintaining the samples at 4 ˚C $\pm$ 2 ˚C or as specified by the method. Quality Control (QC) samples are preserved as described in SW-846. All preservation and bottle requirements will be provided on the COCs.

6. QUALITY ASSURANCE AND QUALITY CONTROL

All sampling and characterization activities will be performed in accordance with CP3-QA-1000, *Quality Assurance Program Description for the Fluor Federal Services, Inc. Paducah Deactivation Project Paducah, Kentucky*. Following data assessment, valid data produced as a result of the sampling event are considered data of known quality in accordance with CP3-ES-5003, *Quality Assured Data.*

6.1 QUALITY GOALS

The following are applicable for WM waste characterization activities:

- *Precision* will be evaluated by review of field and laboratory duplicates.

- *Accuracy* will be evaluated by review of the laboratory comments concerning matrix spike and matrix spike duplicate recoveries when applicable.

- *Representativeness* will not be measured directly, but will be inferred by submission of properly preserved samples that have a continuous COC and are analyzed by the lab in a timely manner. In addition, field duplicates will evaluate the representativeness of the samples.

- *Completeness* goals for sampling and analyses are 100 percent.

- *Comparability* is reviewed when characterization data is compared to background or historical data, when applicable. If unexpected results are obtained (i.e., significantly different from historical data), then the usability of the data is evaluated during data assessment.

6.2 DOCUMENTATION

Fieldwork is documented by sampling personnel as described by organizational procedures. All records generated by the performance of this procedure will be maintained in accordance with CP3-RD-0010, *Records Management Process*.

6.3 QUALITY CONTROL SAMPLES

The need for quality control (QC) samples will be determined on a per sampling event basis by characterization personnel. QC samples may include equipment rinseate blanks, PCB equipment rinseate blanks, field blanks, trip blanks and/or field duplicate samples per guidance in FRNP procedure CP3-ES-5003, *Quality Assured Data*, and are prepared as outlined in CP4-ES-2704, *Trip, Equipment and Field Blank Preparation*.

7. ANALYSES AND DATA REPORTING SCHEDULE

Analyses to be performed and turn-around times for data reporting are specific to each sampling event. Methods will be determined by the characterization personnel and S&DM. Methods will meet the requirements of the disposal facility WAC and will follow established standards such as SW-846 or American Society for Testing Materials.

Sample parameters, methods and turnaround times will be listed in an attachment to CP2-WM-0307-F01 (see Appendix A).

8. DATA REVIEW AND USE

8.1 DATA REVIEW

Following receipt, the analytical data is reviewed as described in procedure CP3-ES-5003, *Quality Assured Data*. That review includes verification and assessment. Data review goals are:

- All data receives 100 percent verification (electronic and document reviews of specified data quality checks) following the guidance in FRNP procedure CP3-ES-5003, *Quality Assured Data*.

- All data receives 100 percent assessment (qualitative and quantitative evaluation for usability) following the guidance in FRNP procedure CP3-ES-5003, *Quality Assured Data*.

- Formal data validation requirements will be determined per sampling event. Data validation will be performed according to FRNP validation procedures.

8.2 DATA USE

Unless specifically exempted, data assessment must be completed and documented before data can be used for decision making. All data is loaded into the Paducah OREIS database prior to release to external agencies or companies. Final reports incorporate only data that resides in Paducah OREIS.

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APPENDIX A
CP2-WM-0307-F01 SAMPLING AND ANALYSIS EVENT PLAN

Chg
A

Sampling Project ID: _____

CP2-WM-0307-F01 - Sampling and Analysis Event Plan

Section 1- Population(s)

Number of populations within this SAEP: _____
(Note: Complete sections 2, 3 and 4 for each population (i.e., 2a, 2b, etc.)

Section 2- Waste Description

Waste Stream General Description:

Waste to be **characterized** is ☐ Containerized ☐ Not containerized
(Instruction: Attach list of containers or describe surface area, volume and location)

Process Knowledge/Historical Information (Instruction: List PK data **sources**, historical data **sources**, plant documents, SME (Name, expertise), etc.):

Media:
☐ Gas ☐ Solids ☐ Particulate solids ☐ Sludge ☐ Liquid ☐ Multiple phases ☐ Other: _____
Matrix Type: ☐ Homogeneous ☐ Heterogeneous
Contamination:
☐ Volumetric ☐ Surface ☐ Contamination varies randomly ☐ Potential "hot spots" ☐ Other: _____
Contaminant(s) of concern:
☐ RAD ☐ Metals ☐ VOAs ☐ SVOAs ☐ PCBs ☐ Asbestos ☐ Other: _____

Section 3- Purpose of Sampling / Characterization Strategy

Purpose of Sampling (check all that apply):
☐ Preliminary information gathering (scaling factors, site media PK, etc.):
☐ IH/HP Information Collection
☐ Other: _____
Disposal Options: ☐ Waste water discharge ☐ Onsite disposal ☐ Offsite disposal ☐ Other: _____
Characterization Strategy: ☐ Direct characterization ☐ Statistical characterization ☐ Other (Explain below):

Characterization Strategy Description:

EXAMPLE

Sampling Project ID: _____

CP2-WM-0307-F01 - Sampling and Analysis Event Plan

Section 4- Sampling Strategy

Requested Observations (check all that apply):
☐ N/A ☐ Number of phases ☐ Relative ratio of phases ☐ Media description ☐ Other: _____

Sample Collection Method (check all that apply):
☐ Representative Full Core ☐ Representative by Media: ☐ Judgemental grab / ☐ Composite (representative grab
☐ Sample location selection by grid (describe or attach sketch)
☐ Alternate containers / Location identified (attach list or sketch)
☐ Order of sample preference identified (if inadequate material for all, list preference order):

Sampling Description:

Planned number of characterization samples (Not including QC): _____
(See CP3-WM-0437 and/or attached sample size selection chart for reference, if needed)
Results needed on a Dry Weight basis? ☐ **Yes** ☐ **No**
Utah-certified or NELAC-certified lab required? ☐ **Yes** ☐ **No**
Sampling will occur in accordance with onsite sampling and DQO procedures? ☐ **Yes** ☐ **No**

EXAMPLE

Sampling Project ID: _____

CP2-WM-0307-F01 - Sampling and Analysis Event Plan

This SAEP and supporting documentation contains the elements of the DQO Process (EPA QA/G-4) as shown below:

Element		Output Location
Step 1:State the Problem	Description	SAEP Section 2, Waste Description
	Planning Team	• SME - SAEP Section 2, Waste Description • Waste Engineer and Peer Reviewer (signatories) - SAEP End • DOT Representative signatory (if applicable) – SAEP End • Project Manager signatory - Identified on sample summary attachment and signature on SOW • SMO – Throughout writing and contracting phases
	Conceptual Model	NA for waste sampling
Step 2: Goal	Purpose of Project	SAEP Section 3, Purpose of Sampling / Characterization Strategy
Step 3: Input Information	Types and Sources of Information	SAEP Section 2, Waste Description
Step 4: Boundaries	Target Population	SAEP Section 2, Waste Description
	Sampling Unit	SAEP Section 2, Waste Description and SAEP Section 4, Sampling Strategy
Step 5: Analytical Approach	Sampling Goals	SAEP Section 4, Sampling Strategy
Step 6: Performance or Acceptance Criteria		SAEP Section 4, Sampling Strategy and Statement of Work (Methods and Detection Limits)
Step 7: Detailed Plan		SAEP Section 4, Sampling Strategy and sample summary attachment

_____ _____

Preparer: (Print/Signature) Date

_____ _____

Waste Engineer Review and Approval: (Print/Signature) Date

IF samples are going to an off-site laboratory for analysis THEN complete the following:

_____ _____

Transportation Specialist Review and Approval: (Print/Signature) Date

Sample Shipment: ☐ Regulated ☐ Non-Regulated

EXAMPLE

APPENDIX B
CP2-WM-0307-F02 BLANKET SAMPLE REQUEST FORM

CP2-WM-0307-F02 - BLANKET SAMPLE REQUEST FORM

Base Sample Project ID:_____ Blanket Sequential ID: _____

REQUESTER

Requester:_____ Charge Code: _____
(Print Name)

Request Date _____ __Date Required_____Priority __ low __medium __high
(MM/DD/YY) (MM/DD/YY) (Mark ONLY one)

Project Name: _____

Project Location: _____

List any known outliers or deviations from the blanket SOW (i.e., TAT, parameters,

etc.)?:_____

Task Purpose (i.e., PCB Spill Sampling, Waste Sampling, Water Sampling, etc.):

_____

Attachments to this Request
(Mark all applicable)

_____ SAP
_____ Form Attached
_____ PCB Event Forms
_____ Document Number _____
_____ Other _____

Comments _____

_____

_____

_____

_____

_____

_____

Requester Signature: | Date:

CP2-WM-0307-F02 Rev. FR1

EXAMPLE