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OPERABLE UNIT 3 WORK PLAN ADDENDUM VOLUME 3 OF 4 SAMPLING AND ANALYSIS PLAN JUNE 1992

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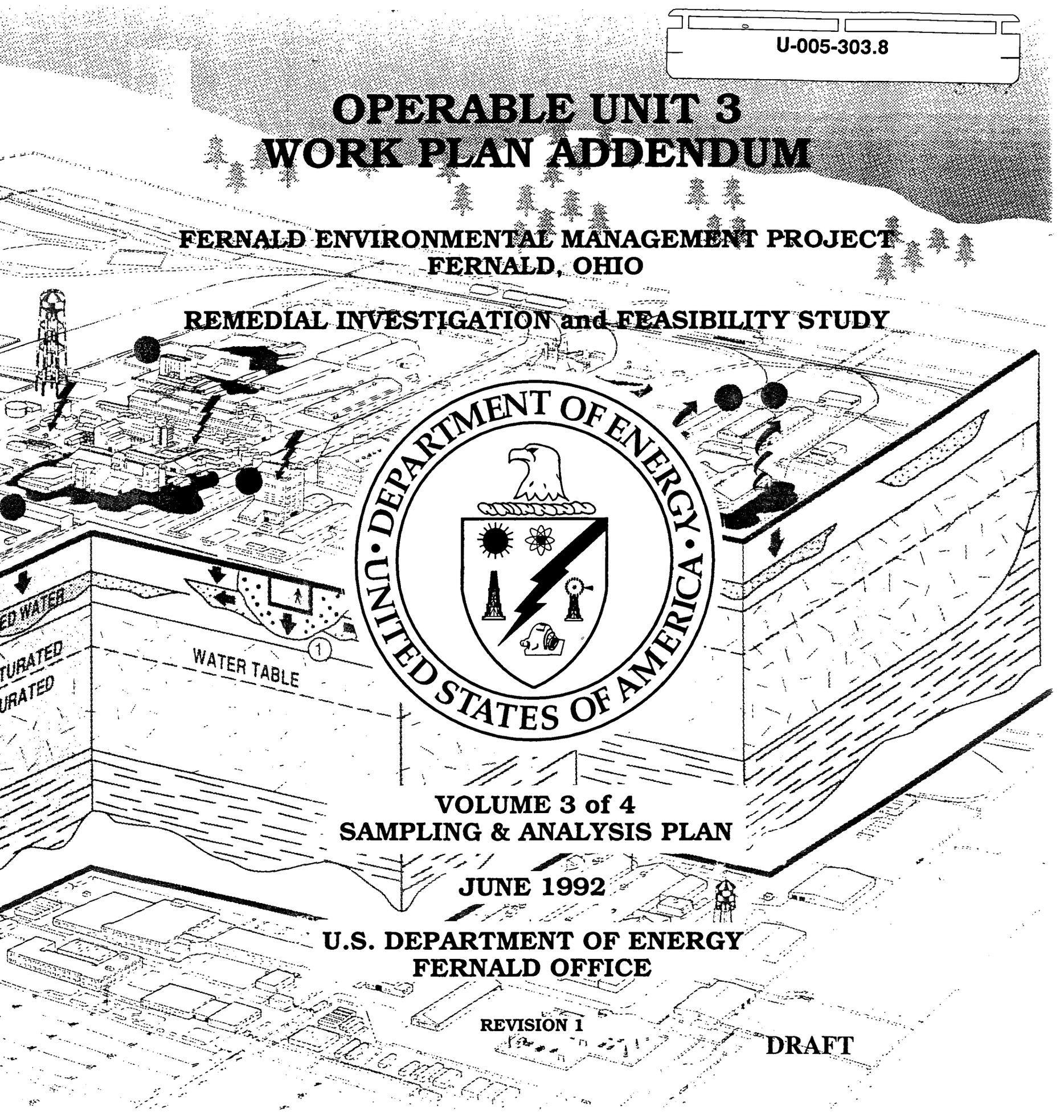
OPERABLE UNIT 3
WORK PLAN ADDENDUM

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
FERNALD, OHIO

REMEDIAL INVESTIGATION and FEASIBILITY STUDY



VOLUME 3 of 4
SAMPLING & ANALYSIS PLAN

JUNE 1992

U.S. DEPARTMENT OF ENERGY
FERNALD OFFICE

REVISION 1

DRAFT

3297

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WORK PLAN ADDENDUM

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
FERNALD, OHIO

REMEDIAL INVESTIGATION AND FEASIBILITY STUDY

VOLUME 3 OF 4
SAMPLING AND ANALYSIS PLAN

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U.S DEPARTMENT OF ENERGY
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Revision 1

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APPENDIX D

SAMPLING AND ANALYSIS PLAN

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D.1

APPENDIX D

SAMPLING AND ANALYSIS PLAN

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D.1 INTRODUCTION

D.1.1 Purpose and Scope

This Sampling and Analysis Plan (SAP) contains the guidance and requirements for the remedial investigation (RI) characterization of the facilities and components within Operable Unit 3 (OU3) of the Fernald Environmental Management Project (FEMP). This SAP defines the organization and responsibilities necessary to complete the characterization task. Objectives are related to information needs and to the means to obtain that information. Specific protocols are established to define the nature and extent of observations, including instrument measurements, sampling, and analysis. Specific procedures also are identified for making these measurements, for collecting the samples, and for meeting the analytical requirements for those samples. The means for data management and assessment with quality assurance measures are included. Finally, the operational plans and schedules are provided, and the personnel resources that are required are defined.

The SAP differs somewhat in organization from that suggested in guidance, wherein a SAP comprises two main parts: (1) a Quality Assurance Project Plan (QAPjP), and (2) a Field Sampling Plan (FSP). At the FEMP, all quality assurance related elements have been compiled in a single document, the Site-Wide CERCLA QAPjP (SCQ). The SCQ addresses all sampling activities at the FEMP (which includes OU3). All required sampling and analysis procedures are, or will be, incorporated into, and approved through, that document. The relevant sections of the SCQ are included in the SAP by reference to fulfill the requirements of a QAPjP. Applicable SCQ sampling and analysis procedures are identified in Section D.6, while abstracts of the procedures are provided in Attachment D.I for informational purposes.

Before RI characterization activities are initiated for a specific component, a field implementation procedure (FIP) will be prepared for that component. The protocols and procedures specified in this SAP, when carefully followed, provide for the development and

implementation of the specific sampling activities related to each component. These specific details are documented in the form of a FIP.

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D.1.2 Description of Operable Unit 3

OU3, as defined in the Amended Consent Agreement of 1991, consists of the Production Area and all production-associated facilities and equipment (including all above- and belowgrade improvements). Components within OU3 include all structures, equipment, utilities, drums, tanks, solid waste, waste product, thorium, effluent lines, K-65 transfer line, wastewater treatment facilities, fire training facilities, scrap metal piles, feedstocks, and coal piles. The Production Area covers approximately 136 acres and operated essentially as a uranium refinery and foundry with an extensive array of support and related facilities. The soil and water under OU3 are a part of OU5, Environmental Media. Under the terms of the Amended Consent Agreement, soil and debris waste piles around the site that resulted from previous waste management practices are also included in OU3. However, any soils beneath these waste piles are considered within OU5.

Detailed descriptions of all components within OU3 are provided in the components of the OU3 work plan addendum noted below:

Section 1 Description of the FEMP and Operable Unit 3

Section 2 Site Background and Environmental Setting

Appendix A Summary Tables

Table A.1.0 Operable Unit 3 Component Identification List

Table A.2.1 Description of Structures and Processes

Table A.3.2 Component-Specific Contaminants of Interest

D.1.3 Changing Conditions

The characteristics of some components within OU3 will change during the RI because of planned and ongoing interim actions that include removal from the site or treatment and/or translocation of major quantities of product, feed inventory, contaminants, and wastes. Section 2.5 of the work plan addendum summarizes those actions. To minimize premature field data collection, characterization of those components will be scheduled

following completion of the interim actions, if possible, or toward the end of the characterization period when the duration of interim actions is uncertain. Some affected components will be characterized before completion of interim actions in order to meet the Consent Agreement schedule for the OU3 RI report.

D.1.4 Field Sampling Program Approach

The integration of the work plan rationale, the SAP, and the component-specific FIPs define the complete OU3 field program. Section 4 of the work plan addendum provides the rationale for addressing OU3 components in a timely manner. The SAP provides the details on number and types of samples required to meet the data quality objectives (DQOs). The FIPs describe the component-specific details of contaminants targeted by the sampling, sample locations, total number of samples, and the media being sampled. This integration includes consideration of ongoing site activities and interim actions which are discussed in Section 4 of the work plan. Timing factors associated with the development of all the FIPs are discussed in Section D.8.

The SAP provides the basic framework and guidance for developing the FIPs, and includes:

- Both comprehensive and component-specific lists of radiological and chemical contaminants and physical/chemical parameters of interest are provided as a part of this work plan (Section D.4 and Appendix A).
- Media- and material-specific sampling and measurement protocols (linked to the 11 OU3 component categories) that define situational measurement and sampling quantities and spatial distributions (Section D.5)
- Identification of appropriate field instrument measurement procedures, of expected sample media and media-specific sampling procedures, and of analytical methods and procedures for each contaminant/media (Section D.6)

D.2

The FIPs will be developed (as described in Section D.4.11) on the basis of the protocol and procedure guidelines in this SAP to define the component-specific measurement/sampling locations.

In addition, health and safety screening for worker protection will be required for all components. For those components for which there is little or no specific knowledge on contaminants of concern, the health and safety screening results will assist in the FIP development.

D.2 ORGANIZATION AND RESPONSIBILITIES

D.2.1 Organization

This section describes the organization structure to be used in managing the implementation of the approved OU3 RI/FS work plan addendum in the field at the FEMP. Figure D.1 illustrates the relationships between the various organizations involved. An environmental restoration management contractor (ERMC) approach is being implemented to manage the restoration activities at the FEMP. The ERMC, which will report directly to the Department of Energy Fernald Field Office (DOE-FN), will act as the main contractor for FEMP activities and coordinator of technical support and remediation subcontracts. An RI/FS Group has been established within the current contractor organization to implement the OU3 work plan addendum. At this time, Westinghouse Environmental Management Company of Ohio (WEMCO) is the prime contractor at the site and is functioning to the extent practical in the role of an ERMC. A decision on whether to retain the current organizational structure will be made after the ERMC is selected and begins operating.

D.2.2 Responsibilities

The major tasks that constitute the OU3 RI/FS field program implementation and the organizational responsibilities to carry out those tasks are identified here. Implementation of the field program will be the primary responsibility of the OU3 RI/FS

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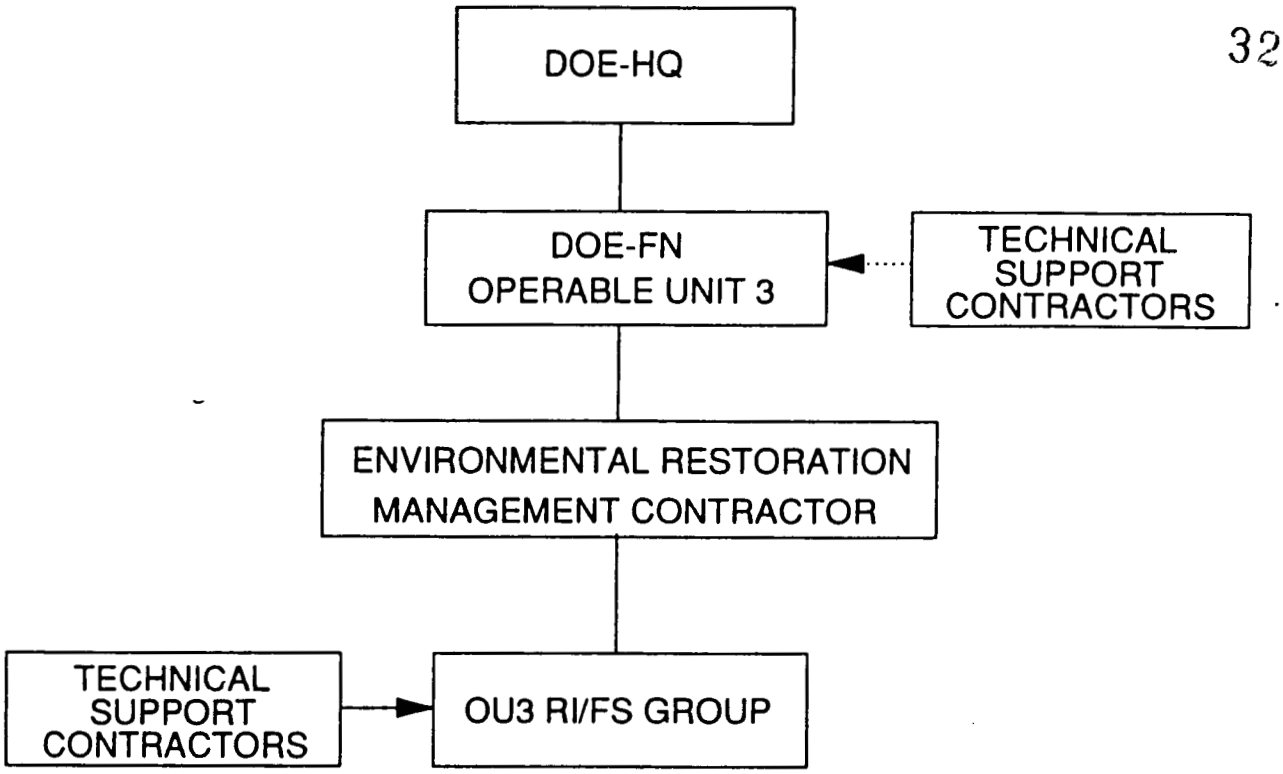

FIGURE D.1 RI/FS Organization for OU3

Group within the WEMCO organization, with support from internal organizations and subcontracts. The implementation of the field program consists of eight specific task areas:

1. Preparation and approval of OU3 sampling and analytical procedures will be completed under the direction of the WEMCO OU3 RI/FS Group Manager. New procedures will be submitted to the U.S. Environmental Protection Agency (EPA) as addenda to the site-wide CERCLA Quality Assurance Project Plan (SCQ).

2. Design and procurement of a field analytical facility to support field measurement activities and sample preparation will be a responsibility of the OU3 RI/FS Group.

3. Preparation of component-specific field implementation procedures (FIPs) in accordance with the approach outlined in Section D.4.11 will be accomplished by the OU3 RI/FS Group before each component is sampled. Review and approval of each FIP will be the responsibility of the WEMCO and DOE-FN respective OU3 managers. Each FIP will be provided to the EPA and the Ohio Environmental Protection Agency (Ohio EPA) before sampling activities are initiated.

4. Conduct of the field program in accordance with the FIPs, including all aspects of monitoring, sampling, and shipment of samples, will be accomplished by the RI/FS field teams reporting to the OU3 RI/FS Group Manager.

5. Review and validation of data collected during the field sampling/field characterization program will be conducted by an OU3 RI/FS data validation team on an ongoing basis throughout the data collection and reporting processes. The data validation team will function in accordance with the SCQ data-validation procedures approved at the time of the validation. Validated data will be entered into the FEMP RI/FS database.

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6. Assessment and evaluation of the field characterization data to verify attainment of data quality objectives of the work plan addendum will be performed by the OU3 RI/FS Group.

7. Identification of any supplemental data needs that were not fulfilled by data collected in the field program will be conducted so that any necessary additional information collection and/or sampling efforts can be identified and a supplemental FIP prepared.

8. Overall planning, integration, execution, and support of the OU3 RI/FS field implementation is a responsibility of the WEMCO OU3 RI/FS Group and other WEMCO departments matrixed to the OU3 RI/FS Group.

D.3 OBJECTIVES AND APPROACH

D.3.1 RI/FS Objectives and Approach

Information must be collected from individual components in order to meet the unfulfilled RI/FS data needs for OU3. However, the complexity of the components, the heterogeneity of OU3, and the difficulties associated with interim actions and other ongoing site activities can affect the degree and type of sampling that will be required in the future. Therefore, preparation, at this time, of a comprehensive SAP that defined every sample point, method, and procedure would be impractical and inefficient and would lead to duplication of effort.

A method to develop and implement a field program that allows total management of all OU3 components is presented in Section 4.1 of the work plan. The methodology requires the creation of a library of general protocols and procedures. The protocols are presented in Section D.5, and a complete list of procedures and corresponding abstracts (stating scope and objective) are provided in Section D.6 and Attachment D.I., respectively. Use of this library of protocols and procedures to develop component-specific FIPs is discussed in Section D.4.11. All procedures needed to support the OU3 field characterization program

will be included in the SCQ. The major steps in the process to obtain the necessary data according to this methodology are as follows:

1. Evaluate existing information,
2. Identify needed information,
3. Develop the DQOs,
4. Select the approaches and methods required to obtain the information,
5. Choose the appropriate protocols and procedures,
6. Develop the component-specific FIP,
7. Ensure DQOs are met, and
8. Implement the FIP.

This process will ensure that the data gathered is adequate to meet the RI/FS objectives of evaluating risk and developing remedial action alternatives. Steps 1 and 2 are discussed in detail in Sections 2 and 3 of the OU3 RI/FS work plan addendum. Steps 3 through 5 are defined and discussed as part of this SAP. Steps 6, 7, and 8 are component-specific requirements and will be incorporated into the FIP for each component within OU3. The FIP for each component will include such parameters as the number of samples required, specific locations for sampling, and specific sample analytes. The FIP will also reference the SAP for the required approaches, protocols, and procedures to be used for sampling each OU3 component.

D.3.2 Field Program Objectives

The primary objective of the field sampling program is to collect information regarding the nature and extent of contamination within OU3. This objective is met only if the data obtained will support the following activities of an RI/FS:

1. Perform risk assessments (baseline and FS);
2. Develop general response actions (GRAs), remedial action objectives (RAOs), and preliminary remediation goals (PRGs);

3. Develop and evaluate remedial action alternatives (RAAs) including waste characterization;
4. Assure compliance with applicable or relevant and appropriate requirements (ARARs); and
5. Satisfy worker protection requirements.

Data needs for these activities are presented in detail in the appropriate sub-sections of Section 3 of the OU3 work plan addendum.

For risk assessment, sufficient data are needed to accomplish the following tasks: (1) defining the source term, (2) evaluating release and transport mechanisms, and (3) developing and evaluating exposure scenarios. The sample results necessary to support these needs are as follows: specific contaminants detected, relative magnitude of the contaminants (total concentration and total quantity), and a relative estimate of the migration potential (diffusion rates, resuspension characteristics, general physical and chemical forms).

Data needs for RAAs, GRAs, RAOs, and PRGs can be summarized as follows: (1) where the contaminants are and how readily they can be removed, fixed, or treated; (2) penetration depth of contaminants into specific media and whether the contaminated media has future value or use potential; (3) relative volumes of contaminated material; and (4) waste disposal criteria. Once the data needs for risk assessment and development/evaluation of RAAs have been satisfied (which also requires satisfaction of the data needs for GRAs, RAOs, and PRGs), the remaining concerns associated with ARARs and worker protection generally will have also been satisfied.

D.3.3 Sampling Approaches

When the field sampling program for OU3 is being developed to fill these data needs, sampling strategies (or approaches) must be developed to characterize contamination nonuniformly distributed over a very large and complex site. The developed approaches can then be assigned to the various OU3 component groupings. Section 4 of the work plan addendum discusses in detail the grouping methodology used for the OU3 components and the data needs associated with the various component groups.

This section focuses on the basic sampling approaches used to characterize the nature and extent of contamination and address the major data needs identified above. The approaches employ judgmental and/or statistical methods (systematic and random) for selecting sampling locations. The strengths and weaknesses of each approach are discussed. Section 4 of the work plan presents the rationale and the effects of practical constraints on the various sampling approaches. The principal constraint is considered to be the suitability of the collected data to meet the end use. In the same discussion, the variable designations U, F, and S represent a means of control on the assignment of a sampling approach at the component level. With these concepts and tools, an initial sampling approach can be assigned to each component of OU3. This initial approach is subject to change if the status of the component changes before sampling.

The various approaches used are incorporated into the 12 sampling protocols presented in Section D.5, and are implemented when the protocols are invoked. Approaches were assigned to each sampling protocol on the basis of their applicability to historical contamination patterns and the physical constraints specific to each sampling region defined by the protocol. Key elements that were considered in the development of the approach for each sampling or measurement protocol included the following: (1) physical specification of the items to be sampled or sampling region (e.g., walls, drums, HVAC system, drains); (2) specification of sample accuracy requirements; (3) specification of the number of samples that must be collected to meet the accuracy requirements with the sampling strategy selected (meeting the DQOs); (4) selection of sample locations within the defined region; (5) identification of potential sources of sample bias, including judgment biases; and (6) establishment of required sensitivity of measurements in light of the detection limits of available instruments and analytical methods.

The applicable sampling region for each sampling protocol is defined in Section D.5. Sampling accuracy requirements will be expressed in terms of confidence intervals based on the needs of the risk assessment and remedial action design tasks. The DQOs (presented in Section 4.2.2 of the work plan) present the uncertainty and confidence requirements associated with the radiological and chemical sampling for OU3.

Three commonly used approaches to sampling are employed: (1) *judgmental* sampling, (2) *systematic* sampling, and (3) *random* sampling. In Table D.1, one or more of these approaches is assigned to each OU3 component. The following subsections discuss the strengths and weaknesses of each approach for selecting sample locations within OU3 components.

D.3.3.1 Judgmental Sampling and Measurement

Judgmental sampling and measurement is the subjective selection of sampling or measurement locations on the basis of site knowledge, exposure modeling, or both. Its greatest value lies in the use of prior knowledge to focus sampling efforts on locations of particular concern, such as the boundaries between regions that are known historically to be contaminated and those that are believed to be free of contamination. Judgmental sampling is more efficient and precise in defining such contamination regions, or populations, than either random or systematic sampling.

Because judgment-based selection of sampling locations focuses on suspected regions of concern, the samples provide a potentially biased basis for estimating the contamination distribution parameters. Judgmental selection of representative sample locations within an identified region may also introduce bias. Sample data acquired from judgmental sampling, therefore, will be labeled as biased in both the field sampling records and the database. For example, sample schemes focusing on areas with the highest probability of contamination will tend to produce overestimates of contamination in the general area. Judgmental sampling is influenced by such factors as the accessibility of the media to be sampled, the precision and accuracy required of the results, and the intended use of the information obtained. The impact from the use of potentially biased data on the risk assessment and the development and evaluation of remedial action alternatives has been considered in the initial evaluation of the data needs and was appropriately considered in the development of DQOs.

D.3.3.2 Systematic Sampling or Measurement

Systematic sampling or measurement consists of taking samples or measurements at locations selected according to a uniform pattern. For example, samples may be taken at

TABLE D.1 Operable Unit 3 Component Designation and Sampling Approach

Component	Component Designation		Grid	Category: Level I	Category: Level II	Category: Level III U	Category: Level III F	Category: Level III S	Potential Dispostion	Sampling Approach
Storage Shed (West)	56	B	17	1	A	1	1	1	Interim/Remedial Action	Sys
Storage Shed (East)	56	C	17	1	A	1	1	1	Interim/Remedial Action	Sys
Pilot Plant Shelter	54	B	26	1	A	1	1	2	Removal Action	J-Sys
Plant 1 Storage Shelter	1	B	27	1	A	1	2	1	Interim/Remedial Action	Sys
Plant 4 Warehouse	4	B	13	1	A	1	2	1	Interim/Remedial Action	Sys
Plant 5 Filter Building	5	E	12	1	A	1	2	1	Interim/Remedial Action	Sys
Plant 5 Covered Storage Pad	5	F	12	1	A	1	2	1	Interim/Remedial Action	Sys
Chemical Warehouse	30	A	18	1	A	1	2	1	Interim/Remedial Action	Sys
Drum Storage Warehouse	30	B	27	1	A	1	2	1	Interim/Remedial Action	Sys
Magnesium Storage Building	32	A	2	1	A	1	2	1	Interim/Remedial Action	Sys
Building 32 Covered Loading Dock	32	B	2	1	A	1	2	1	Interim/Remedial Action	Sys
Plant 6 Covered Storage Area	6	B	6	1	A	1	2	2	Interim/Remedial Action	J-Sys
CP Storage Warehouse	56	A	17	1	A	1	2	2	Interim/Remedial Action	J-Sys
Quonset Hut #1	60		16	1	A	1	2	2	Interim/Remedial Action	J-Sys
Quonset Hut #2	61		16	1	A	1	2	2	Interim/Remedial Action	J-Sys
Quonset Hut #3	62		16	1	A	1	2	2	Interim/Remedial Action	J-Sys
KC-2 Warehouse	63		9	1	A	1	2	2	Interim/Remedial Action	J-Sys
General In-Process Warehouse	71		27	1	A	1	2	2	Interim/Remedial Action	J-Sys
Drum Storage Building	72		27	1	A	1	2	2	Interim/Remedial Action	J-Sys
Finished Products Warehouse (4A)	77		3	1	A	1	2	2	Interim/Remedial Action	Sys
Tension Support Structure #1	TS-001		17	1	A	2	2	1	Interim/Remedial Action	J-Sys
Tension Support Structure #2	TS-002		17	1	A	2	2	1	Interim/Remedial Action	J-Sys
Tension Support Structure #3	TS-003		17	1	A	2	2	1	Interim/Remedial Action	J-Sys
Cylinder Storage Building	12	B	11	1	A	2	2	1	Interim/Remedial Action	J-Sys
Lumber Storage Building	12	C	11	1	A	2	2	1	Interim/Remedial Action	J-Sys
Plant 5 Ingot Storage Shelter	5	G	12	1	A	2	2	2	Interim/Remedial Action	J-Sys
Plant 8 Warehouse	80		20	1	A	2	2	2	Interim/Remedial Action	J-Sys
Plant 9 Warehouse	81		3	1	A	2	2	2	Interim/Remedial Action	J-Sys
Plant 6 Warehouse	79		4	1	A	2	2	3	Interim/Remedial Action	J-Sys

TABLE D.1 (Cont'd)

Component	Component Designation		Grid	Category: Level I	Category: Level II	Category: Level III U	Category: Level III F	Category: Level III S	Potential Dispostion	Sampling Approach
Plant 7	7	A	13	1	A	3	1	3	Removal Action	J-R
Thorium Warehouse	64		2	1	A	3	1	3	Removal Action	J-R
(Old) Plant 5 Warehouse	65		2	1	A	3	1	3	Removal Action	J-R
Plant 1 Thorium Warehouse	67		24	1	A	3	1	3	Removal Action	J-R
Pilot Plant Warehouse	68		26	1	A	3	1	3	Removal Action	J-R
Guard Post on South End of 'D' St.	28	C	7	1	B	1	1	1	Remedial Action	Sys
Fire Brigade Training Center Bldg.	73	A	FT	1	B	1	1	1	Remedial Action	Sys
Skeet Range Building	90		8	1	B	1	1	1	Remedial Action	Sys
Process Trailers	G-009			1	B	1	2	1	Interim/Remedial Action	Sys
Non-process Trailers	G-010			1	B	1	2	1	Interim/Remedial Action	Sys
Human Resources Building	28	B	14	1	B	1	2	1	Remedial Action	Sys
In-Vivo Building	53	B	14	1	B	1	2	1	Remedial Action	Sys
Administration Building	14	A	14	1	B	1	2	2	Remedial Action	Sys
Security Building	28	A	14	1	B	1	2	2	Remedial Action	Sys
Health & Safety Building	53	A	14	1	B	2	2	2	Remedial Action	J-Sys
Service Building	11		14	1	B	2	2	3	Remedial Action	J-Sys
NAR Control House	3	C	19	1	B	3	1	2	Remedial Action	J
Rust Engineering Building	45	A	25	1	B	3	2	3	Interim/Remedial Action	J-Sys
Plant 6 Salt Oil Heat Treat Building	6	F	6	1	C	1	1	1	Remedial Action	Sys
Plant 9 Sump Treatment Facility	9	B	3	1	C	1	1	1	Remedial Action	Sys
Waste Oil Decant Shelter	39	B	19	1	C	1	1	2	Removal Action	J-Sys
Metal Dissolver Building	2	D	19	1	C	1	1	3	Removal Action	J-Sys-R
Green Salt Plant	4	A	13	1	C	1	1	3	Remedial Action	J-Sys-R
Special Products Plant	9	A	3	1	C	1	1	3	Remedial Action	J-Sys-R
Sump Pump House	13	C	26	1	C	1	1	3	Removal Action	J-Sys-R
Six to Four Reduction Facility #1	54	A	26	1	C	1	1	3	Removal Action	J-Sys-R
Drum Reconditioning Building	66		27	1	C	1	1	3	Remedial Action	J-Sys-R
Plant 6 Sump Building	6	G	6	1	C	1	2	1	Interim/Remedial Action	Sys
Rotary Kiln/Drum Reconditioning	8	C	20	1	C	1	2	1	Interim/Remedial Action	Sys
Biodenitrification Towers	18	D	19	1	C	1	2	1	Interim/Remedial Action	Sys
Clearwell Pump House	18	G	31	1	C	1	2	1.	Interim/Remedial Action	Sys
BDN Effluent Treatment Facility	18	H	20	1	C	1	2	1	Interim/Remedial Action	Sys
Preparation Plant	1	A	27	1	C	1	2	2	Interim/Remedial Action	J-Sys

TABLE D.1 (Cont'd)

Component	Component Designation		Grid	Category: Level I	Category: Level II	Category: Level III U	Category: Level III F	Category: Level III S	Potential Dispostion	Sampling Approach
Metals Production Plant	5	A	12	1	C	1	2	3	Interim/Remedial Action	J-Sys-R
Metals Fabrication Plant	6	A	6	1	C	1	2	3	Interim/Remedial Action	J-Sys-R
Engine House/Garage	31	A	7	1	C	1	2	3	Interim/Remedial Action	J-Sys-R
Plant 6 Electrostatic Precipitator (South)	6	C	6	1	C	2	1	2	Remedial Action	J-Sys
Plant 6 Electrostatic Precipitator (North)	6	E	6	1	C	2	1	2	Remedial Action	J-Sys
Electrostatic Precipitator	9	F	3	1	C	2	1	2	Remedial Action	J-Sys
Decontamination Building	69		1	1	C	2	1	2	Remedial Action	J-Sys
Ore Refinery Plant	2	A	19	1	C	2	1	3	Removal Action	J-Sys-R
Hot Raffinate Building	3	E	19	1	C	2	1	3	Removal Action	J-Sys-R
Pilot Plant Annex	37		26	1	C	2	1	3	Removal Action	J-Sys-R
Incinerator Building	39	A	19	1	C	2	1	3	Removal Action	J-Sys
Slag Recycling Building	55	A	12	1	C	2	1	3	Remedial Action	J-Sys
Slag Recycling Pit/Elevator	55	B	12	1	C	2	1	3	Remedial Action	J-Sys
Pilot Plant Wet Side	13	A	26	1	C	3	1	3	Removal Action	J-R
Recovery Plant	8	A	20	1	C	3	2	3	Interim/Remedial Action	J-R
Laboratory	15		21	1	C	3	2	3	Remedial Action	J-R
Plant 5 Ingot Pickling	5	B	12	1	D	1	1	1	Interim/Remedial Action	Sys
West Derby Breakout/ Slag Milling	5	D	12	1	D	1	1	1	Remedial Action	Sys
Tank Farm Control House	19	C	11	1	D	1	1	1	Remedial Action	Sys
Incinerator Sprinkler Riser House	39	C	19	1	D	1	1	1	Remedial Action	Sys
Refrigeration Building	3	G	19	1	D	1	1	2	Remedial Action	J-Sys
Pilot Plant Maintenance Bldg.	13	B	26	1	D	1	1	2	Removal Action	J-Sys
Pilot Plant Dissociator Shelter	54	C	26	1	D	1	1	2	Removal Action	J-Sys
Boiler Plant	10	A	10	1	D	1	2	1	Remedial Action	Sys
Pump Station & Power Center	20	A	11	1	D	1	2	1	Interim/Remedial Action	Sys
Water Plant	20	B	10	1	D	1	2	1	Interim/Remedial Action	Sys
Well House #1	20	E	25	1	D	1	2	1	Interim/Remedial Action	Sys
Well House #2	20	F	25	1	D	1	2	1	Interim/Remedial Action	Sys
Well House #3	20	G	26	1	D	1	2	1	Interim/Remedial Action	Sys
Gas Meter Building	22	A	6	1	D	1	2	1	Interim/Remedial Action	Sys
Pump House-HP Fire Protection	26	A	25	1	D	1	2	1	Interim/Remedial Action	Sys
Propane Storage	38	A	10	1	D	1	2	1	Interim/Remedial Action	Sys
Six to Four Reduction Facility #2	51		26	1	D	1	2	1	Interim/Remedial Action	Sys

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TABLE D.1 (Cont'd)

Component	Component Designation		Grid	Category: Level I	Category: Level II	Category: Level III U	Category: Level III F	Category: Level III S	Potential Dispostion	Sampling Approach
Receiving/Incoming Mat'ls. Insp.	82		4	1	D	1	2	1	Interim/Remedial Action	Sys
Electrical Power Center Building	3	L	19	1	D	1	2	2	Interim/Remedial Action	J-Sys
Plant 4 Maintenance Building	4	C	13	1	D	1	2	2	Interim/Remedial Action	J-Sys
Plant 5 Electrical Substation	5	C	12	1	D	1	2	2	Interim/Remedial Action	J-Sys
Plant 8 Maintenance Building	8	B	20	1	D	1	2	2	Interim/Remedial Action	J-Sys
Plant 9 Substation	9	D	3	1	D	1	2	2	Interim/Remedial Action	J-Sys
Boiler Plant Maintenance Bldg.	10	B	10	1	D	1	2	2	Interim/Remedial Action	J-Sys
Main Electrical Station	16	A	7	1	D	1	2	2	Interim/Remedial Action	J-Sys
Electrical Substation	16	B	14	1	D	1	2	2	Interim/Remedial Action	J-Sys
Main Electrical Switch House	16	D	7	1	D	1	2	2	Interim/Remedial Action	J-Sys
Railroad Engine House	24	B	11	1	D	1	2	2	Interim/Remedial Action	J-Sys
Main Electrical Strainer House	26	C	7	1	D	1	2	2	Interim/Remedial Action	J-Sys
General/Refinery Sump Control Building	2	B	19	1	D	1	2	3	Interim/Remedial Action	J-Sys
Maintenance Building	3	A	19	1	D	1	2	3	Interim/Remedial Action	J-Sys
Main Maintenance Building	12	A	11	1	D	1	2	3	Interim/Remedial Action	J-Sys
Heavy Equipment Building	46		7	1	D	1	2	3	Interim/Remedial Action	J-Sys
Plant 8 Railroad Filter Building	8	D	20	1	D	2	1	1	Remedial Action	J-Sys
Plant 9 Cylinder Shed	9	E	3	1	D	2	1	1	Remedial Action	J-Sys
Guard Post on West End of 2nd St.	28	D	24	1	D	2	1	1	Remedial Action	J-Sys
Utility Shed East of Rust Trailers	45	B	25	1	D	2	1	1	Remedial Action	J-Sys
Bulk Lime Handling Building	2	C	19	1	D	2	1	3	Remedial Action	J-Sys
Ozone Building	3	B	19	1	D	2	1	3	Remedial Action	J-Sys
Wet Salt Storage Bin	10	C	10	1	D	2	2	1	Interim/Remedial Action	J-Sys
Storm Sewer Lift Station	22	B	14	1	D	2	2	1	Interim/Remedial Action	J-Sys
Truck Scale	22	C	4	1	D	2	2	1	Interim/Remedial Action	J-Sys
Scale House & Weigh Scale	22	D	25	1	D	2	2	1	Interim/Remedial Action	J-Sys
Railroad Scale House	24	A	16	1	D	2	2	1	Interim/Remedial Action	J-Sys
Chlorination Building	25	A	32	1	D	2	2	1	Interim/Remedial Action	J-Sys
M.H.#175/Eff. Line/Sampling Bldg.	25	B	32	1	D	2	2	1	Interim/Remedial Action	J-Sys
Sewage Lift Station Building	25	C	7	1	D	2	2	1	Interim/Remedial Action	J-Sys
U.V. Disinfection Building	25	D	32	1	D	2	2	1	Interim/Remedial Action	J-Sys
Digester & Control Building	25	E	32	1	D	2	2	2	Interim/Remedial Action	J-Sys

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TABLE D.1 (Cont'd)

Component		Component Designation		Grid	Category: Level I	Category: Level II	Category: Level III U	Category: Level III F	Category: Level III S	Potential Dispostion	Sampling Approach
D & D Building(Under Constr.)		78		2	1	D	3	2	1	Interim/Remedial Action	J
Mobile Containers (Sea-Land)		G-015			2	A	1	1	1	Interim/Remedial Action	Sys
Pilot Plant Ammonia Tank Farm		19	B	26	2	A	1	1	1	Remedial Action	Sys
Fire Training Tank		73	C	FT	2	A	1	1	1	Remedial Action	Sys
Confined Space Burn Tank		73	E	FT	2	A	1	1	1	Remedial Action	Sys
Dikes		G-005			2	A	1	1	2	Remedial Action	J-Sys
Aboveground Storage Tanks		G-008			2	A	1	1	2	Remedial Action	J-Sys
Drums (Non-RCRA)		G-012			2	A	1	1	2	Remedial Action	J-Sys
RCRA Drums		G-013			2	A	1	1	2	Remedial Action	J-Sys
Inventory		G-014			2	A	1	1	2	Removal Action	J-Sys
Combined Raffinate Tanks		3	J	19	2	A	1	1	2	Remedial Action	J-Sys
Old North Tank Farm		19	D	11	2	A	1	1	2	Remedial Action	J-Sys
Refinery Sump		3	H	19	2	A	1	2	1	Interim/Remedial Action	Sys
High Nitrate Storage Tank		18	M	31	2	A	1	2	1	Interim/Remedial Action	Sys
Main Tank Farm		19	A	11	2	A	1	2	1	Interim/Remedial Action	Sys
Process Water Storage Tank		20	H	10	2	A	1	2	1	Interim/Remedial Action	Sys
General Sump		18	B	19	2	A	1	2	2	Interim/Remedial Action	J-Sys
Methanol Tank		18	J	31	2	A	1	2	2	Interim/Remedial Action	J-Sys
NFS Storage & Pump House		2	E	27	2	A	2	1	2	Removal Action	J-Sys
NAR Towers		3	D	19	2	A	2	1	2	Remedial Action	J-Sys
Harshaw System		3	F	19	2	A	2	1	3	Remedial Action	J-Sys
Elevated Potable Storage Tank		20	D	4	2	A	2	2	1	Interim/Remedial Action	J-Sys
Elevated Water Storage Tank		26	B	25	2	A	2	2	1	Interim/Remedial Action	J-Sys
Plant 1 Ore Silos		1	C	27	2	A	3	1	3	Removal Action	J-R
Pilot Plant Thorium Tank Farm		13	D	26	2	A	3	1	3	Removal Action	J-R
Trickling Filters		25	H	32	2	A	3	2	3	Interim/Remedial Action	J-R
Underground Storage Tanks		G-007			2	B	1	1	2	Remedial Action	J-Sys
Sumps		G-004			2	B	2	2	2	Interim/Remedial Action	J-Sys
Fire Training Burn Trough		73	D	FT	2	B	3	1	2	Remedial Action	J-Sys
East of Plant 2	Dirt	P-001		19	3		1	1	1	Removal Action	Sys
South of Plant 8 (West)	Dirt	P-002		20	3		1	1	1	Removal Action	Sys
South of Plant 8 (Mid)	Dirt	P-003		20	3		1	1	1	Removal Action	Sys
South of Plant 8 (East)	Dirt	P-004		20	3		1	1	1	Removal Action	Sys

TABLE D.1 (Cont'd)

Component		Component Designation	Grid	Category: Level I	Category: Level II	Category: Level III U	Category: Level III F	Category: Level III S	Potential Dispostion	Sampling Approach
South of Bldg. 80	Dirt	P-005	20	3		1	1	1	Removal Action	Sys
West of Plant 5	Dirt	P-006	12	3		1	1	1	Removal Action	Sys
West of 7 Plex (North)	Dirt	P-007	14	3		1	1	1	Removal Action	Sys
Covered West of 7 Plex (South)	Dirt	P-008	14	3		1	1	1	Removal Action	Sys
North of Plant 9 (Near Basin)	Dirt	P-009	3	3		1	1	1	Removal Action	Sys
Covered Dirt Pile between R.R. track #6 and #9	Dirt	P-010	9	3		1	1	1	Removal Action	Sys
Construction rubble pile East of coal pile run off basin	Dirt	P-011	11	3		1	1	1	Removal Action	Sys
East of coal pile run off basin	Dirt	P-012	11	3		1	1	1	Removal Action	Sys
Covered East of Bldg. 56	Dirt	P-015	17	3		1	1	1	Removal Action	Sys
Partially covered along Track #11	Dirt	P-020	18	3		1	1	1	Removal Action	Sys
Southwest corner of lab	Dirt	P-021	21	3		1	1	1	Removal Action	Sys
North of Bldg. 67	Dirt	P-022	24	3		1	1	1	Removal Action	Sys
NW rubble piles	Dirt	P-024	31	3		1	1	1	Removal Action	Sys
Sand piles South of Bldg. 61	Sand	P-014	16	3		1	2	1	Interim/Remedial Action	Sys
Outside Equipment Storage Area	Metal	P-025	9	3		2	1	1	Remedial Action	J-Sys
Third Street dirt pile	Dirt	P-019	17	3		2	1	3	Removal Action	J-Sys-R
Rock salt pile South of Bldg. 61	Rock Salt	P-013	16	3		2	2	1	Interim/Remedial Action	J-Sys
Gravel North of Bldg. 56	Gravel	P-016	17	3		2	2	1	Interim/Remedial Action	J-Sys
Copper metal scrap pile	Copper	P-017	17	3		3	1	3	Remedial Action	J-R
Scrap metal pile	Metal	P-023	1	3		3	1	3	Remedial Action	J-R
Coal pile	Coal	P-018	10	3		3	2	2	Interim/Remedial Action	J-Sys
Old Ten Ton Scale		30 C	18	4		1	1	1	Remedial Action	Sys
Old Truck Scale		31 B	7	4		1	1	1	Remedial Action	Sys

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TABLE D.1 (Cont'd)

Component	Component Designation		Grid	Category: Level I	Category: Level II	Category: Level III U	Category: Level III F	Category: Level III S	Potential Dispostion	Sampling Approach
Plant 2 West Pad	74	B	19	4		1	1	2	Removal Action	J-Sys
Cont. Oil/Graphite Burn Pad	10	D	10	4		1	1	3	Remedial Action	J-Sys-R
Plant 2 East Pad	74	A	19	4		1	1	3	Removal Action	J-Sys-R
Plant 8 Old Metal Dissolver Pad	74	Q	20	4		1	1	3	Remedial Action	J-Sys-R
Roads	G-002			4		1	2	1	Interim/Remedial Action	Sys
Parking Lot	89		15,8	4		1	2	1	Interim/Remedial Action	Sys
Plant 8 East Pad	74	C	20	4		1	2	2	Interim/Remedial Action	J-Sys
Plant 8 West Pad	74	D	20	4		1	2	2	Interim/Remedial Action	J-Sys
Plant 7 Pad	74	F	13	4		1	2	2	Interim/Remedial Action	J-Sys
Plant 5 South Pad	74	H	12	4		1	2	2	Interim/Remedial Action	J-Sys
Building 12 North Pad	74	N	11	4		1	2	2	Interim/Remedial Action	J-Sys
Plant 4 Pad	74	E	13	4		1	2	3	Interim/Remedial Action	J-Sys-R
Plant 5 East Pad	74	G	12	4		1	2	3	Interim/Remedial Action	J-Sys-R
Plant 6 Pads	74	J	6	4		1	2	3	Interim/Remedial Action	J-Sys-R
Plant 9 Pad	74	K	3	4		1	2	3	Interim/Remedial Action	J-Sys-R
Plant 8 North Pad	74	R	20	4		1	2	3	Interim/Remedial Action	J-Sys-R
Building 63 West Pad	74	S	9	4		1	2	3	Interim/Remedial Action	J-Sys-R
Laboratory Pad	74	V	21	4		1	2	3	Interim/Remedial Action	J-Sys-R
Building 65 West Pad	74	L	2	4		2	1	2	Removal Action	J-Sys
Building 64 East Pad & R.R. Dock	74	M	2	4		2	1	2	Removal Action	J-Sys
Pilot Plant Pad	74	U	26	4		2	1	2	Removal Action	J-Sys
Railroad Tracks	G-001			4		2	2	1	Interim/Remedial Action	J-Sys
Plant 1 Storage Pad	74	T	27	4		2	2	2	Interim/Remedial Action	J-Sys
Decontamination Pad	74	P	1	4		2	2	3	Interim/Remedial Action	J-Sys
Plant 7 Overhead Crane	7	B	13	5	A	3	1	1	Removal Action	J
Cold Side Ore Conveyor	2	F	19	5	A	3	1	2	Removal Action	J-Sys
Plant 6 Electrostatic Precipitator (Central)	6	D	6	5	A	3	1	2	Remedial Action	J-Sys
Plant 8 Old Drum Washer	8	F	20	5	A	3	1	2	Remedial Action	J-Sys
Plant 9 Dust Collector	9	C	3	5	A	3	1	2	Remedial Action	J-Sys
Hot Side Ore Conveyor	2	G	19	5	A	3	1	3	Removal Action	J-R
Sewage Treatment Plant Incinerator	39	D	32	5	A	3	1	3	STP Removal Action	J-R
Pipe Bridges	G-011			5	A	3	2	1	Interim/Remedial Action	J
Drum Conveyor Shelter	8	E	20	5	A	3	2	1	Interim/Remedial Action	J

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TABLE D.1 (Cont'd)

Component	Component Designation		Grid	Category: Level I	Category: Level II	Category: Level III U	Category: Level III F	Category: Level III S	Potential Dispostion	Sampling Approach
Building 14 EOC Generator Set	14	B	14	5	A	3	2	1	Interim/Remedial Action	J
Meteorological Tower	23		30	5	A	3	2	1	Interim/Remedial Action	J
Cylinder Filling Station	38	B	10	5	A	3	2	1	Interim/Remedial Action	J
Cooling Towers	20	C	11	5	A	3	2	2	Interim/Remedial Action	J-Sys
Electrical Panels & Transformer	16	C	7	5	A	3	2	3	Interim/Remedial Action	J-R
Main Electrical Transformers	16	E	7	5	A	3	2	3	Interim/Remedial Action	J-R
Trailer Substation #1	16	F	7	5	A	3	2	3	Interim/Remedial Action	J-R
Trailer Substation #2	16	G	7	5	A	3	2	3	Interim/Remedial Action	J-R
Old Cooling Water Tower	3	K	19	5	B	1	1	2	Remedial Action	J-Sys
Storm Sewer System	G-003			5	B	2	2	3	Interim/Remedial Action	J-Sys-R
Utility Trench to Pit Area	22	E	25	5	B	2	2	3	Interim/Remedial Action	J-Sys-R
Clearwell Line	88		31	5	B	2	2	3	Interim/Remedial Action	J-Sys-R
Conveyor Tunnel (From Plant 1)	2	H	19	5	B	3	1	3	Removal Action	J-R
Utility Lines	G-006			5	B	3	2	1	Interim/Remedial Action	J
Storm Water Retention Basin	18	E	30	6		1	2	1	Interim/Remedial Action	Sys
Low Nitrate Tank	18	K	31	6		1	2	2	Interim/Remedial Action	J-Sys
High Nitrate Tank	18	L	31	6		1	2	2	Interim/Remedial Action	J-Sys
BDN Surge Lagoon	18	A	31	6		1	2	3	Interim/Remedial Action	J-Sys-R
Coal Pile Runoff Basin	18	C	11	6		2	2	2	Interim/Remedial Action	J-Sys
Fire Training Pond	73	B	FT	6		3	1	3	Remedial Action	J-R
Sludge Drying Beds	25	F	32	6		3	2	3	Interim/Remedial Action	J-R
Primary Settling Basins	25	G	32	6		3	2	3	Interim/Remedial Action	J-R

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TABLE D.1 (Cont'd)

LEGEND:

LEVEL I	LEVEL II		LEVEL III		Sampling Approach
1. Buildings	A. Warehouse/Storage B. Administration C. Process D. Process Support	Similar No Future Use Insignificant	U-1 U-2 U-3 F-1 F-2 S-1 S-2 S-3	Unique Interim Use Significance	J - Judgmental Sys - Systematic R - Random
2. Containers/Containerized Material	A. Aboveground B . Belowground				
3. Bulk Material		U - Uniqueness	F - Facility Dispostion		S - Significance
4. Parking Lots/Railroad/Roads/Pads					
5. Piping/Utilities/Equipment (RPIE)	A. Aboveground B. Belowground	Physical Similarity Ease of Clean Up	Degree of Containment Structural Integrity		Degree of Containment Level of Contamination
6. Ponds and Basins		Ease of Assessment	Predisposition		Type of Contaminant
		Types of Materials Types of Processes Special Protocols	Salvage Potential Interim Use Spatial/Temporal Issues Ongoing Site Activities		Structural Integrity Inventory/Source Term Accident/Release Potential Depth of Contamination Fixed/Loose Contamination

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equidistant intervals along a linear component of the plant, or on a grid pattern defined on a wall, ceiling, or floor surface. Systematic sampling is a statistically based strategy for estimating means, totals, and patterns of contamination. Difficulties arise when selected sample sites fall on locations where retrieval of information is impractical. In these instances, the grid has to be reevaluated to determine the next best location, and the impact on precision and accuracy must be examined. The re-evaluation process actually becomes a form of judgmental sampling.

Random sampling within blocks defined by a systematic grid is a useful combination of the random and systematic approaches to sampling. In this approach, the sample space is divided into blocks or segments of equal size, and one or more samples are taken at random locations within each block or segment. This procedure allows for a more uniform coverage of the sample region than does simple random sampling. The procedure also is less vulnerable than systematic sampling to the introduction of bias in sampling a space with cyclical variation patterns.

In this SAP, use of the systematic sampling approach is usually combined with the random approach. The systematic grid is merely a means of establishing the measurement and sample space.

D.3.3.3 Random Sampling and Measurement

Random sampling is also a statistical method of sample selection. Random sampling is not equivalent to picking sample locations haphazardly. The number of samples required within the sample space is dictated entirely by the confidence levels, precision, and accuracy needed. These factors also control the total number of samples required. The most basic type, called simple random sampling, employs a formal procedure and a list of random numbers to make precise selection of locations to be sampled. This formal procedure provides every part of the entire sample region an equal chance of being selected for measurement and keeps the selection of one sample location from influencing the selection of other locations. Simple random sampling is most appropriate for estimating means and totals if the population does not contain major trends, cycles, or patterns of contamination.

The random sampling approach is used in cases where the bias must be kept to a minimum and the precision and accuracy needs are strict. The random approach will be

applied to those OU3 components that have greater data accuracy and precision requirements (e.g., components with a high significance [S] ranking).

D.3.4 Analytical Support Levels (ASLs)

Analytical support levels (ASLs) refer to the type of information needed, as provided by various analytical options, and the amount of supporting documentation required to meet the data needs of the RI. ASLs follow directly from the data needs and intended data uses and are specified in the DQOs. A detailed discussion of ASLs is included in the FEMP SCQ. ASLs range from A to E, generally in ascending order of information content. In general, ASLs A and B represent field instrument measurements; ASLs C, D, and E represent samples that undergo laboratory analysis of increasing specificity.

ASL A represents field survey or screening methods for general levels of contamination with portable instrumentation. Field screenings of gross alpha, beta, and gamma radiation are examples of ASL A, as is screening for organic vapors with a photoionization detector. ASL B represents a broad range of analytical options that yield results ranging from qualitative to semiquantitative to quantitative. ASL C represents quantitative methods with a high level of information content and a commensurate level of QA/QC. ASL D represents the same types of methods as ASL C, but differs in that it requires the reporting of raw instrument output. ASL E represents nonstandard methods.

Applicable ASLs are specified in each of the protocols in D.5. In the protocols, an ASL B/C is frequently specified. This designation is intended to provide some discretion in selection of the number of high-level samples required for a given sampling context, and thereby control analysis costs. Level B methods can be used when the obtained data meets the data quality objectives for the subject sampling area. Frequently, a smaller number of ASL C samples will be taken in combination with ASL B samples from a given sampling area to meet overall QA objectives at reasonable costs. Generally, a small number of ASL D samples will be collected, as specified in the protocols, for each component or component group as a QA check on the analytical laboratory and to support data validation.

D.4 INFORMATION NEEDS AND MEASUREMENT PROGRAM 3297

D.4.1 Introduction

Section D.3 outlined the RI objectives to be met and introduced the approaches for achieving those objectives. In addition, references were provided to sections of the OU3 RI/FS work plan addendum that analyze the overall information requirements for the RI. This section discusses specific observations, measurements, sampling, and analyses in the field and laboratory that will provide the data needed to meet the objectives.

During the conduct of an RI, a need for supplemental information is frequently discovered. The sampling team must remain alert to this possibility and coordinate their activities with the assessors and users of the RI information.

A set of general information needs and measurement parameters is defined and described throughout this section. Process knowledge and other current data may modify the scope of measurements and sampling for a specific component of OU3. Component history and knowledge may be comprehensive, and the scope of required measurements and sampling may be low. However, a limited number of samples will be taken to assess the conclusions from historical information. The sampling approaches, methods, protocols, and procedures presented in this document may be modified on the basis of existing data and the specific data needs for a particular component to meet the objectives of the RI.

Action levels (ALs) and decision levels (DLs), discussed in Section D.4.7, guide decision making during the RI. The protocols discussed in Section D.5 define measurement and sampling quantities and locations. When ALs or DLs are exceeded, additional measurements and sampling may be required. Modifications of the protocols may be required that involve changes in the grid sizes for selecting sample sites and in the total quantity of samples needed for a particular area. These modifications are based on component-specific evaluation of existing data, physical features of the particular component, and process knowledge related to expected contaminants and concentrations.

D.4.2 Radiological Contaminants

A list of radionuclides of interest for OU3 has been drawn from a number of references that are summarized in the OU3 RI/FS work plan addendum, including

Section 2.4.2 and Table A.3.0. The following radionuclides have been identified through analyses of samples from surface and subsurface soils adjacent to OU3 components and from other sampling activities related to interim actions:

Cesium (Cs)-137	Strontium (Sr)-90	Thorium (Th)-232
Radium (Ra)-228	Thorium (Th)-230	Uranium (U)-238
Thorium (Th)-228	Uranium (U)-235, 236	Lead (Pb)-210
Uranium (U)-234	Radium (Ra)-226	Polonium (Po)-210
Plutonium (Pu)-238	Technetium (Tc)-99	

Other radionuclides known to be (or to have been) present in OU3 components include:

Plutonium (Pu)-239, 40	Plutonium (Pu)-241	Plutonium (Pu)-242
Neptunium (Np)-237	Uranium (U)-233	Ruthenium (Ru)-106

In addition, any other radionuclides in the uranium-238, thorium-232, or uranium-235 decay series (Figures D.2, D.3, and D.4) are of potential interest in OU3.

The radiological characteristics of the isotopes present in OU3 will determine the instruments that can be used and the analytical procedures needed for identification. Table D.2 summarizes those characteristics. Information presented includes the isotopes, their half-lives, the type (alpha, beta, or gamma) of radiation emitted, and the energies and abundances of those emissions. In addition, those same characteristics are provided for decay products (daughters) of the parent isotopes. The table shows only those emissions that have an abundance of at least 10%.

Significant daughters are selected on the basis of a half-life of 24 days or less. Any contaminant that has existed for six months or longer since any physical or chemical separation will have those daughters present in equal activity concentrations relative to the parent isotope.

Younger half-lived daughters, with a half-life of 138 days or more, are listed as a primary isotope. Physical and/or chemical separations can cause movement away from the parent isotope because of properties that are different from those of the parent. For example, it is possible for the lead-210 daughter of radium-226 to be present in reduced or increased activity concentrations relative to the parent. These kinds of disequilibrium are known to exist within OU3.

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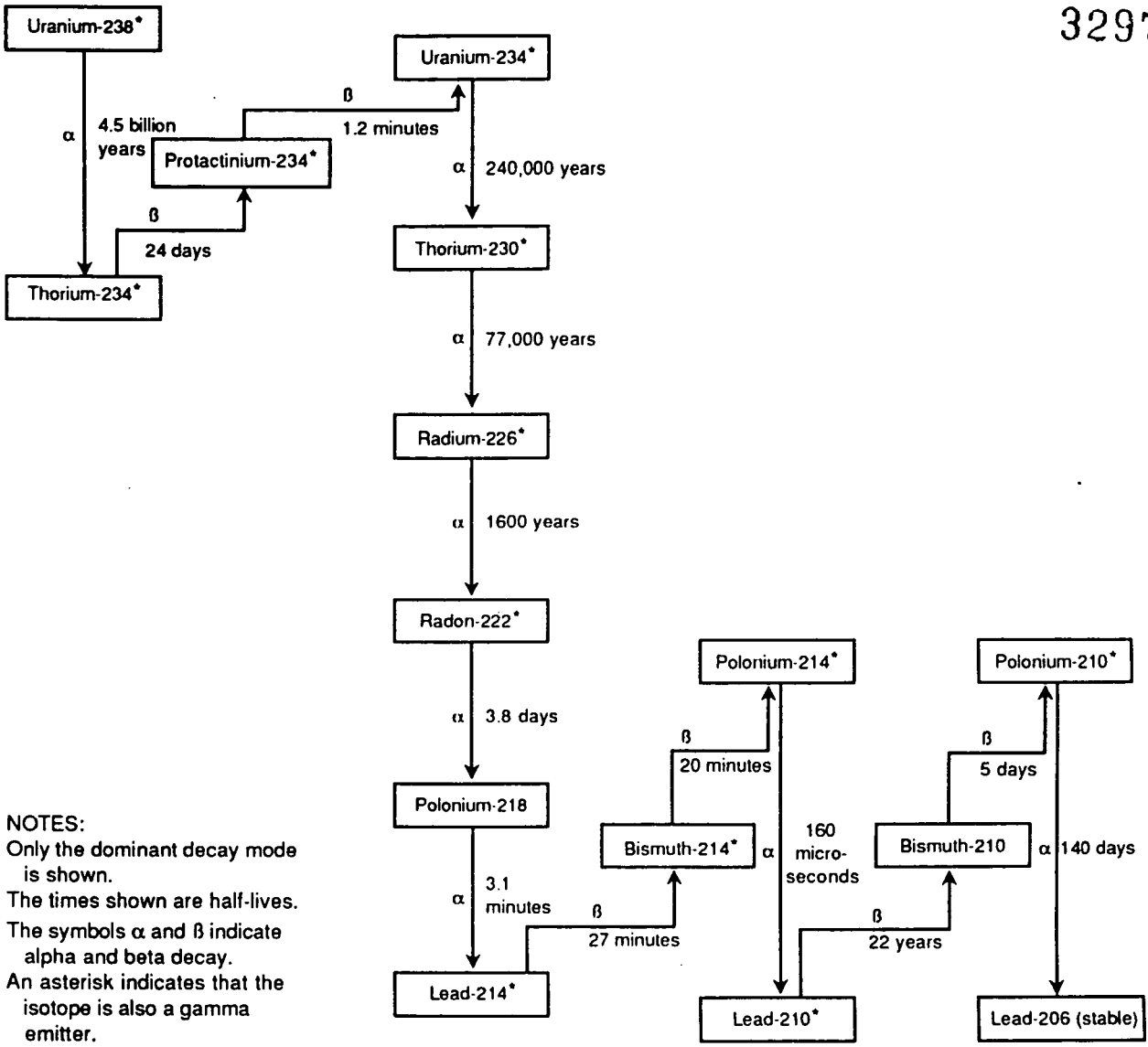

NOTES:
Only the dominant decay mode is shown.
The times shown are half-lives.
The symbols α and ß indicate alpha and beta decay.
An asterisk indicates that the isotope is also a gamma emitter.

FIGURE D.2 Uranium-238 Radioactive Decay Series

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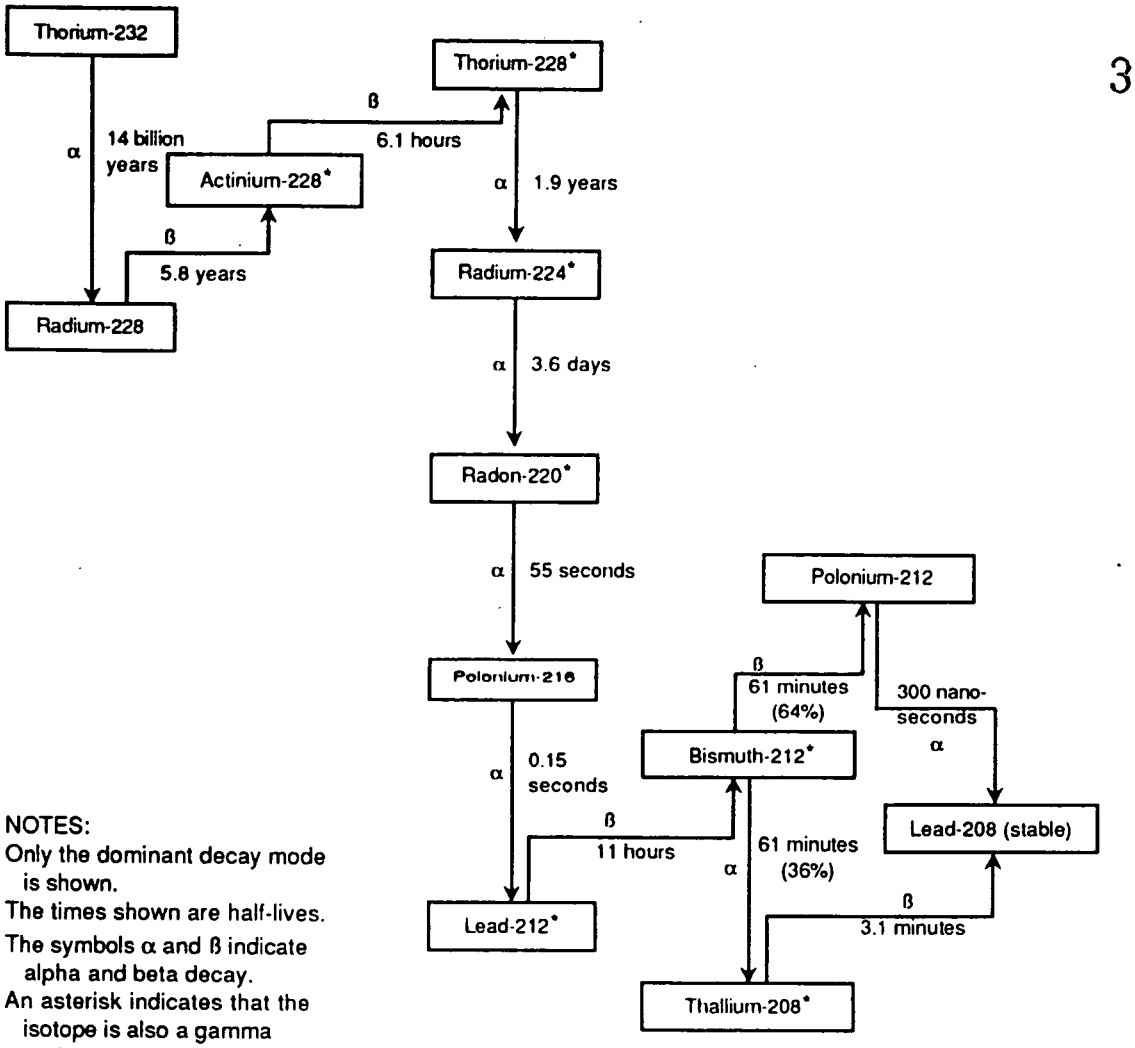

NOTES:
Only the dominant decay mode is shown.
The times shown are half-lives.
The symbols α and ß indicate alpha and beta decay.
An asterisk indicates that the isotope is also a gamma emitter.

FIGURE D.3 Thorium-232 Radioactive Decay Series

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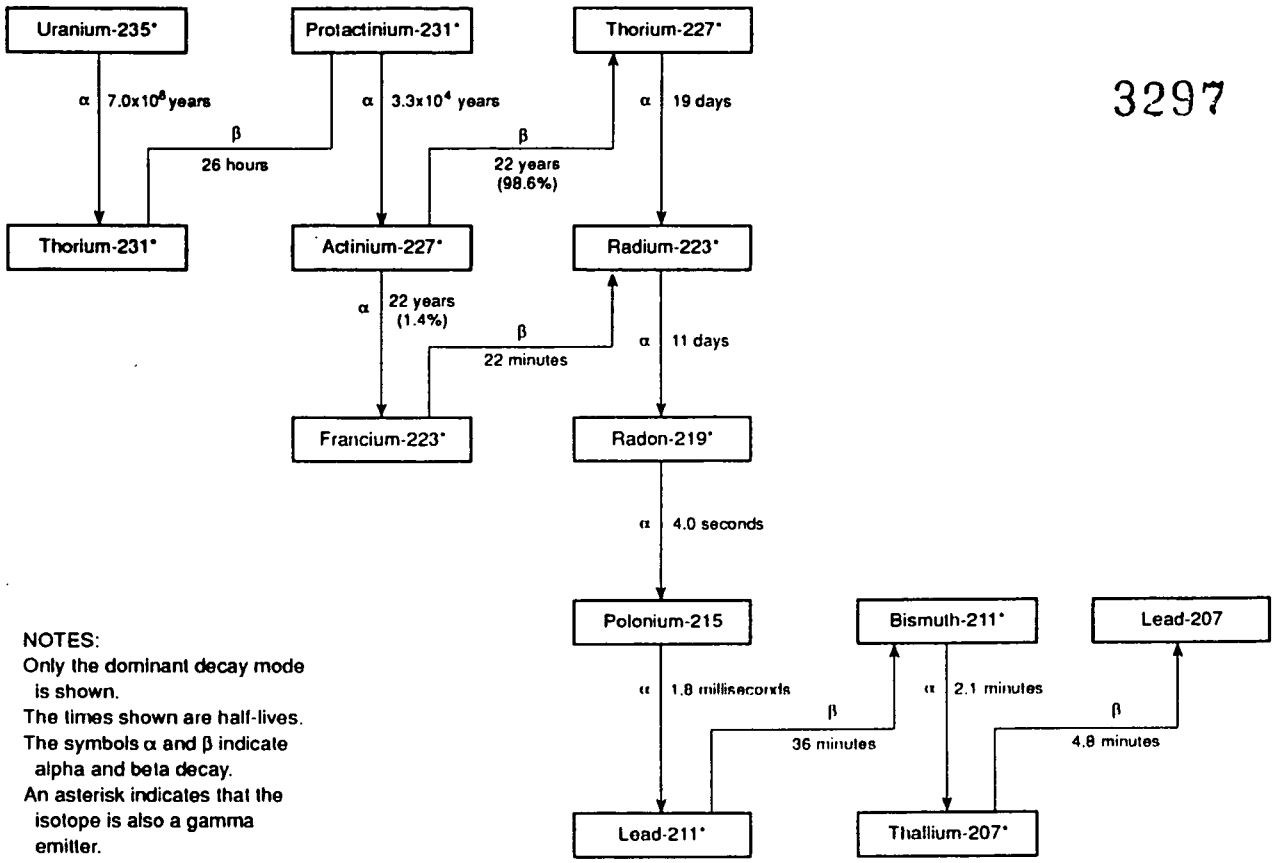

NOTES:
Only the dominant decay mode is shown.
The times shown are half-lives.
The symbols α and β indicate alpha and beta decay.
An asterisk indicates that the isotope is also a gamma emitter.

FIGURE D.4 Actinium (Uranium-235) Radioactive Decay Series

TABLE D.2 Significant Radioactive Emissions and Abundances for Radioactive Contaminants of Interest

Primary Isotope (half-life)[a]	Alpha Particles[b] (keV[%])	Beta Particles[c] (keV)	Gamma Rays[b] (keV[%])	Significant Daughters[d] (half-life)[a]	Alpha Particles[b] (keV[%])	Beta Particles[c] (keV)	Gamma Rays[b] (keV[%])
Transuranic Isotopes							
Pu-241 (14.4 y)		5.23		Am-241			
Am-241 (232 y)	5,443 [12.8]		59.5 [35.9]	Np-237			
Pu-239 (2.4 E+04 y)	5,155 [73.3] 5,143 [15.1] 5,105 [11.5]			U-235			
Np-237 (2.1 E+06 y)	4,788 [47.0] 4,771 [25.0]		29.4 [14.0] 86.5 [12.6]	Pa-233 (27.4 d)		58	312 [38.6] 98.4 [17.6] 94.7 [10.8]
				U-233[e]			
U-233 (1.6 E+05 y)	4,824 [84.4] 4,784 [13.2]						
Uranium-238 Series							
U-238 (4.5 E+09 y)	4,196 [77.0] 4,147 [23.0]			Th-234 (24.1 d)		43.5	
				Pa-234 m (1.17 m)		819	
				U-234			

TABLE D.2 (Cont'd)

Primary Isotope (half-life)[a]	Alpha Particles[b] (keV[%])	Beta Particles[c] (keV)	Gamma Rays[b] (keV[%])	Significant Daughters[d] (half-life)[a]	Alpha Particles[b] (keV[%])	Beta Particles[c] (keV)	Gamma Rays[b] (keV[%])
U-234 (2.5 E+05 y)	4,776 [72.4] 4,724 [27.4]			Th-230			
Th-230 (7.7 E+04 y)	4,688 [76.3] 4,621 [28.4]			Ra-226			
Ra-226 (1,600 y)	4,785 [94.5]			Rn-222 (3.82 d)	5,490 [100]		
				Po-218 (3.05 m)	6,003 [100]		
				Pb-214 (26.8 m)		219	352 [37.2] 295 [19.2]
				Bi-214 (19.9 m)		632	609 [46.3] 1,764 [15.8] 1,120 [15.1]
				Po-214 (1.6 E-04s)	7,687 [100]		
				Pb-210			
Pb-210 (22.3 y)		6.5		Bi-210 (5.01 d)		389	
				Po-210			
Po-210 (138 d)	5,305 [100]						

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TABLE D.2 (Cont'd)

Primary Isotope (half-life)[a]	Alpha Particles[b] (keV[%])	Beta Particles[c] (keV)	Gamma Rays[b] (keV[%])	Significant Daughters[d] (half-life)[a]	Alpha Particles[b] (keV[%])	Beta Particles[c] (keV)	Gamma Rays[b] (keV[%])
Thorium-232 Series							
Th-232 (1.4 E+10 y)	4,010 [77.0] 3,953 [23.0]			Ra-228			
Ra-228 (5.75 y)		9.9		Ac-228 (6.13 h)		375	911 [27.7] 969 [16.6] 338 [11.4]
				Th-228			
Th-228 (1.91 y)	5,423 [72.7] 5,341 [26.7]			Ra-224 (3.62 d)	5,686 [95.1]		
				Rn-220 (55.6 s)	6,288 [100]		
				Po-216 (0.15 s)	6,779 [100]		
				Pb-212 (10.6 h)		99.4	239 [44.6]
				Bi-212 (60.6 m)	64% Branch 6,051 [25.2] 6,090 [10.0]	36% Branch 717	727 [11.8]

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TABLE D.2 (Cont'd)

Primary Isotope (half-life)[a]	Alpha Particles[b] (keV[%])	Beta Particles[c] (keV)	Gamma Rays[b] (keV[%])	Significant Daughters[d] (half-life)[a]	Alpha Particles[b] (keV[%])	Beta Particles[c] (keV)	Gamma Rays[b] (keV[%])
				Po-212 (3.0 E-07 s)	64% Branch 8785 [100]		
				Tl-208	36% Branch -----	559	2,615 [100] 583 [84.2] 511 [21.6] 860 [12.5]
Uranium-235 Series							
U-235 (7.0 E+08 y)	4,396 [55.0] 4,364 [11.0]		184 [54.0] 144 [10.5]	Th-231 (25.5 h)		76.4	25.6 [14.7]
				Pa-231			
Pa-231 (3.3 E+04 y)	5,011 [25.4] 4,950 [22.8] 5,028 [20.0]			Ac-227			
Ac-227 (21.8 y)		9.6		Th-227 (18.7 d)	6,038 [24.5] 5,978 [23.4] 5,757 [20.3]		236 [11.5]
				Ra-223 (11.4 d)	5,715 [52.5] 5,606 [24.2]		269 [13.6]
				Rn-219 (3.96 s)	6,819 [79.6] 6,553 [12.9]		271 [10.6]

TABLE D.2 (Cont'd)

Primary Isotope (half-life)[a]	Alpha Particles[b] (keV[%])	Beta Particles[c] (keV)	Gamma Rays[b] (keV[%])	Significant Daughters[d] (half-life)[a]	Alpha Particles[b] (keV[%])	Beta Particles[c] (keV)	Gamma Rays[b] (keV[%])
				Po-215 (1.8 ms)	7,386 [100]		
				Pb-211 (36.1 m)		453	
				Bi-211 (2.15 m)	6,623 [83.5] 6,279 [16.2]		351 [12.9]
				Ti-207 (4.77 m)		493	
Fission Products							
Cs-137 (30.2 y)		171		Ba-137 m (2.55 m)			662 [90.0]
Ru-106 (368 d)		10		Rh-106 (29.9 s)	-	1411	512 [20.6]
Tc-99 (2.1 E+05 y)		85					
Sr-90 (28.6 y)		196		Y-90 (64.1 h)		935	

TABLE D.2 (Cont'd)

[a] Half-lives are given in years (y), days (d), hours (h), minutes (m), or seconds (s).

[b] Information provided for alpha particles and gamma rays is energy (keV) (outside of brackets) and percent abundance (inside brackets).

[c] Information for beta particles is average energy (keV) for the beta particle spectrum.

[d] Half-lives listed for daughters are for less than 24 days. Longer half-lived daughters are listed under the "Primary Isotope" column.

[e] Underlined daughters are those with longer half-lives and are presented in the table as primary isotopes because processes may cause them to exist independent of parent radionuclides.

Through knowledge of process operations at the FEMP, the nature of contaminants can be related to the isotope mixtures that can be expected for the various facilities. The types of materials related to the expected isotopic mixtures are listed in Table D.3.

Table D.2 presents radiological properties for each of the isotopes listed in Table D.3. Wherever possible, process and operations knowledge, along with existing data, will be used to focus analytical requirements to specific components. A limited number of samples will be analyzed for all potential FEMP radionuclides to assure completeness.

Three radionuclides of potential significance have not been included specifically in RI/FS analyses thus far — uranium-233, protactinium-231, and actinium-227. These may require consideration for the situations described below. Uranium-233 is present in a thorium-232 matrix in Building 68, with a minor amount in Building 67. Analysis by alpha spectrometry does not permit resolution of uranium-233 and uranium-234 because the alpha particle energies are nearly equivalent. Analytical distinction is not critical because the committed effective dose equivalent through inhalation and ingestion is only slightly higher with uranium-233 (approximately 2%).

Where uranium-235 concentrations are significant, concentrations of the daughters protactinium-231 and actinium-227 should be known because of their contribution to the committed effective dose equivalent; this can be important for risk assessment. Protactinium-231 is present in natural uranium. Following chemical separation to produce normal, depleted, or enriched uranium, protactinium-231 and actinium-227 go to the waste stream. Subsequent in-growth of the two uranium-235 daughters is insignificant because of the 33,000-year half-life of protactinium-231. There is no routine analytical procedure specific for either of the daughters. Instead, isotopic thorium alpha spectrometry provides results using the 6.04 MeV alpha particle energy from thorium-227. Protactinium-231 and actinium-227 are conservatively assumed to be in secular equilibrium.

D.4.3 Chemical Contaminants

Table D.4 lists chemical contaminants of potential interest that have been identified through the RI/FS sampling and analyses of environmental media near OU3 components or identified by process knowledge (Tables A.3-1 and A.3.0 in Appendix A).

TABLE D.3 Isotopes Expected to be Associated with Selected Material at OU3 3297

Material	Expected Isotopes
Natural uranium (Ores)	U-238 series (U-238 through Po-210) U-235 series (U-235 through Tl-207) [0.7 % weight] May contain significant Th-232 series (Th-232 through Tl-208)
Normal uranium	U-238+Th-234+Pa-234m U-235+Th-231 U-234
Depleted uranium	U-238+Th-234+Pa-234m
Enriched uranium	U-238+Th-234+Pa-234m U-235+Th-231 (higher than normal) U-234 (higher than normal) Tc-99
Uranium tailings (unprocessed)	Th-230+Ra-226+daughters
K-65 residues (Silos 1&2)	Th-230/Ra-226/Pb-210 = 0.25/1.00/1.10
Metal oxides (Silo 3)	Th-230/Ra-226/Pb-210 = 1.00/0.05/0.05
Natural thorium (ores)	Th-232 series (Th-232 through Tl-208)
Normal thorium	Th-232 (Slow in-growth of Ra-228+Ac-228; equilibrium in about 40 years)
Breeder thorium	U-233+Th-232 (Building 67 & 68 only)
Fission products	Cs-137, Ru-106, Sr-90
Transuranics	Pu-242, Pu-241, Am-241, Pu-239, Pu-238, Np-237

TABLE D.4 Identified Chemical Contaminants of Concern 3297

Volatile Organic Compounds (VOCs)		
Acetone	1,1-Dichloroethane	Methylene chloride
Benzene	1,1-Dichloroethene	Tetrachloroethene
2-Butanone	1,2-Dichloroethene	Toluene
Carbon disulfide	Chloroform	1,1,1-Trichloroethane
Chlorobenzene	Ethylbenzene	Trichloroethene
Chloroform	4-methyl-2-pentanone	Xylenes
Semivolatile Organic Compounds (SVOCs)		
Acenapthene	Bis(2-ethylhexyl)-phthalate	N-nitrosodi-phenylamine
Anthracene	Chrysene	Naphthalene
Benzo (a) anthracene	Di-n-butylphthalate	PCB-1248
Benzo (a) pyrene	Dibenzo(a,h)-anthracene	PCB-1254
Benzo (b) fluoranthene	Dibenzofuran	PCB-1260
Benzo (k) fluoranthene	Fluoranthene	Pentachlorophenol
Benzoic acid	Fluorine	Phenanthrene
Benzo(g,h,i)-perylene	Indeno(1,2,3-cd)-pyrene	Phenol
Beta-BHC	2-Methylnapthalene	Pyrene
Metals		
Aluminum	Copper	Selenium
Antimony	Iron	Silver
Arsenic	Lead	Sodium
Barium	Magnesium	Thallium
Beryllium	Manganese	Vanadium
Cadmium	Mercury	Zinc
Calcium	Molybdenum	Zirconium
Chromium	Nickel	
Cobalt	Potassium	
Nonmetals		
Ammonia	Magnesium	Thorium hydroxide
Ammonium	Zirconate	Thorium nitrate
hydroxide	Nitrate	Thorium oxalate
Barium chloride	Nitric acid	Uranium hexafluoride
Calcium carbonate	Nitrogen compounds	Uranium tetrafluoride
Fluorides	Potassium chloride	Uranium oxides
Hydrofluoric acid	Phosphates	Uranyl nitrate
Magnesium fluoride	Sodium chloride	Zirconium oxide
Magnesium oxide	Sodium hydroxide	Zirconium silicate
Other Materials		
Kerosene	Paints	Ash residues
Asbestos	Raffinates	Solvents
Oils		

Grouping of the chemical contaminants of interest by analysis class aids in identifying appropriate analytical methods and in discussing the general sources, concerns, and rationale for selection of chemical contaminants (Table D.5).

D.4.3.1 Selecting Component-Specific Contaminants of Interest

The list of chemical contaminants of interest presented in Table D.4 is comprehensive for all of OU3 and likely will be reduced for most individual components. A component-specific list of contaminants of interest will be created during preparation of component-specific FIPs. These specific lists will start with the preliminary list given in Section D.4.10. Determining chemical contaminants of interest is not as straightforward as determining radiological contaminants of concern, which can be related to processes. Chemicals were generally used as reagents or in a fashion ancillary to the main plant processes and therefore are not readily related to the process materials themselves. This section is intended to provide some general guidance for determining chemical contaminants of interest on an individual component basis.

Three types of information about the component should be considered in determining contaminants of interest for individual components: (1) process considerations, (2) media considerations, and (3) general considerations. The list presented in Table D.6 illustrates the types of chemical contaminants of potential interest by analysis group under each of these types of considerations.

D.4.3.2 Sample Locations for Chemical Contaminants

Selection of locations for collecting samples for chemical analysis will rely heavily on existing plant knowledge, as well as on visual observations and on collection of samples from natural collection points, such as in sumps and drains, ditches, and lagoon sediments. Field survey instruments will be used where there is evidence or suspicion of contamination of a type to which those instruments respond, but such instruments will not be used for general surveying of large surface areas.

Widespread chemical contamination over large surfaces at levels of concern is not expected in most OU3 components. Hazardous chemicals were used in relatively small

TABLE D.5 Chemical Contaminants of Interest by Analysis Class 3297

Analysis Class[a]	Likely Sources	Concerns/Rationale
VOCs (34)	Solvents, fuels	Toxicity, volume, mobility
SVOCs (65)	General industrial	Toxicity
PCBs (7)	Transformers High temperature uses	Toxicity, persistence
Metals (23)	Ores, waste streams	Toxicity, volume
Anions	Acids, salts (nitrate, sulfate, phosphate, fluoride, chloride)	Water quality (runoff)
Asbestos	Insulation, transite	Toxicity, mobility
Total petroleum hydrocarbons	Petroleum, oils, and lubricants	Waste disposal, water quality
Wet methods	General industrial (inorganic nitrogen, cyanide, sulfide, phenols)	Toxicity, safety, water quality

[a] Number in parentheses are the approximate number of analytes determined in the corresponding group by EPA methods.

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TABLE D.6 Illustration of Chemical Contaminants of Potential Interest by Analysis Group

Analysis Group	Contaminants of Interest[a]
Process Type	
Ore storage	Metals
Ore crushing	Metals
Digestion	Metals, anions
Extraction	Metals, anions, TBP, kerosene
NAR	Nitrate, metals
Raffinate	Metals, anions, VOCs
Cooling Water	Metals, anions
Electrical Supply	PCBs
Maintenance	VOCs, SVOCs, POL, metals
Hydrofluorination	Anions, inorganics, nitrogen
Metals production	Metals, anions, VOCs, POL
Metals fabrication	Metals, anions, VOCs, POL
Scrap recovery	Metals, anions, VOCs, POL
Media/Material Type	
Sump sediments/sludges	Metals, VOCs, SVOCs, PCBs, POL, wet methods
Sump and surface waters	Metals, VOCs, SVOCs, PCBs, POL, anions
Concrete floors	Metals, PCBs, POL
Steel and transite surfaces	Metals, POL
Bulk organic liquids	Metals, PCBs, POL
General Considerations	
Buildings	Asbestos, PCBs
Surfaces	Metals
Waters, liquids	VOCs, metals, anions
Sediments	VOCs, SVOCs, PCBs, metals, wet methods

[a] Acronyms: TBP = tributylphosphate; VOCs = volatile organic compounds; PCBs = polychlorinated biphenyls; SVOCs = semivolatile organic compounds; POL = petroleum, oils, and lubricants.

amounts compared with process materials, or were trace constituents of process materials, such as nonradioactive metals. Chemicals used in bulk were generally nonhazardous (such as lime), highly mobile (such as anions from mineral acids), or volatile (such as solvents). Mobile or volatile contaminants are not likely to adhere to or remain on surfaces.

Therefore, it will not be an objective of this plan to conduct surveys for chemical contaminants over large surface areas, as is being done for radiological contamination. Moreover, such surveys would be very cost inefficient. Rapid, sensitive, and inexpensive field survey techniques, such as those that exist for radioactivity, are not available for many chemical contaminants of potential interest, thus requiring that expensive laboratory analysis be conducted of any such survey samples. Instead, samples for chemical contaminants will be selected from the following sampling contexts: (1) areas that are collection points for runoff, or that would otherwise integrate contaminants that are diffusely dispersed at low concentrations over large areas, such as sumps or other runoff collection points; (2) areas that are pathways to environmental or human receptors outside the component, such as unlined sumps, ditches, or lagoons; or (3) areas suspected from process knowledge of being contaminated, such as ore storage pads, or other materials handling areas. Bulk liquids and solids of uncertain identity will be sampled as needed.

Field survey instruments or field test kits for chemical contaminants will be used to their best advantage in areas of suspected contamination. Photoionization detectors will be used to identify areas contaminated with volatile hydrocarbons, such as fuels and solvents, and therefore will help guide sample collection for VOCs. Field test kits for PCBs may be used in areas around electrical transformers or equipment to help guide collection of laboratory samples. A portable X-ray fluorescence analyzer may be used in the field or in a field laboratory to locate areas with trace metals contamination. Because new technology in field instrumentation is rapidly developing, emerging technologies, as well as existing technologies not mentioned, can and should be used when they meet field investigation needs.

D.4.4 Field Survey Instrument Measurements

This section discusses the various methods used for field screening and surveys. The screening and survey instruments allow for rapid determination of the extent and relative

magnitude of radiological and/or chemical contamination. The applicable radiological and chemical instruments are discussed in separate subsections.

The primary difference between radiological and chemical contaminant detection is that radioactivity can be measured without direct contact with the contaminant. This condition is made possible by the radioactive disintegrations in the form of alpha, beta, and gamma rays. These particles may travel in air from several millimeters to as far as several meters, depending on the energy of the particles. Radiological instrumentation is discussed in Section D.4.4.1 and is divided into three basic groups: (1) surface contamination measurements, (2) low-level gamma radiation detectors, and (3) measurements of gamma ray exposure rates.

Instruments available to measure nonradiological (chemical) contaminants are discussed in Section D.4.4.2. Chemical survey instruments are limited in the types of contaminants that can be detected. Chemical contaminants are not universally detectable in the field, as are most radioactive contaminants. Chemical survey instruments will be used where applicable, but locating chemical contamination will also rely heavily on site knowledge and on the expected behavior of chemical contaminants.

D.4.4.1 Radiological Monitoring

Surface Contamination Measurements

Surface contamination measurements will be taken with ZnS(Ag) alpha scintillation detectors and "pancake" thin-window (2 mg/cm^2) Geiger-Müller (G-M) beta-gamma detectors. The alpha scintillation detectors respond very selectively to alpha-emitting contaminants. Beta-gamma levels expected at the FEMP will not interfere with these measurements. Instrument response to a given alpha particle energy is relatively constant, while response to different alpha emitters is comparable. Instrument backgrounds are typically low, and sensitivity, in the scaler mode, is adequate to meet the most restrictive ALs. However, there is a variation in radiotoxicity among various alpha emitters, and the constituent isotopes in the contaminants must be known for comparison to proper ALs.

The thin-window G-M beta-gamma detector response to beta particles is energy dependent. Potential contaminants represent a range of average beta particle energies (e.g.,

85 keV from Tc-99 and 935 keV from the Y-90 daughter of Sr-90). The constituent isotopes in the contaminants must be known to interpret instrument response. This response may be indeterminate with a variable mix of beta-emitting contaminants. Response to gamma rays is also a function of energy, and similarly it may be impossible to interpret response with a mix of gamma emitters. A mix of beta emitters further complicates interpretation. In addition, the thin window allows some limited response to alpha emitters that may be present. One approach for qualifying G-M measurements would be calibration to a single contaminant species that may be present. For example, calibration to a depleted uranium standard would be useful where that is the only contaminant present. Even though response may be nonspecific, the G-M detector is the most reasonably sensitive tool for beta-emitter monitoring. Further details on surface contamination monitoring are provided in Section D.4.9.1.

Low-Level Gamma Radiation

Two types of NaI (Tl) gamma scintillation detectors are used to measure gamma ray fields at low levels (on the order of ambient background). Where higher energy gamma-emitting contaminants (>100 keV) are to be measured, a cylindrical 2- × 2-in. detector is used. Effective monitoring of low-energy gamma-emitting contaminants, through reduced response to higher energies, is afforded by use of the thin FIDLER detectors. With both detectors, response depends on the energy of the gamma rays present and therefore knowledge of the identity of gamma emitters is needed for interpretation of measurements. Low-level gamma ray measurements can be used three ways.

1. As relative levels to guide sampling (generating isopleths may be possible);
2. Through statistical comparison of measured levels to background or ambient levels, to determine if measurements exceed ambient levels; or
3. Through comparison of measured levels to those expected from the radioactive constituents identified in the soil, or other substrate, beneath the detector measurement location.

For item 2, elevated ambient levels may require more accurate measurement of gamma ray exposure rates with instruments described below. Further details related to gamma ray measurements are provided in Section D.4.9.1.

Gamma Ray Exposure Rate

Gamma ray exposure rates will be measured at locations known, or suspected to have levels in excess of background. The AL is 20 µrem/h above background. Exposure rates will be measured with a pressurized ion chamber (PIC). The PIC responds uniformly to a broad range of gamma ray energies; therefore, the gamma-emitting isotopes need not be completely identified.

The PIC response is less accurate with gamma ray energies below 40 keV. Where higher ambient gamma exposure rates are encountered, in excess of the range of the PIC, alternative instruments will be used. An energy-compensated (external plastic probe sheath) G-M detector is effective within the range of 0.1 to 100 mR/h. An ion chamber survey instrument (e.g., Cutie Pie) is effective for exposure rates in excess of 10 mR/h.

D.4.4.2 Nonradiological Monitoring

The following instruments may be used for organic vapor and physical property measurements:

- Combustible gas indicators,
- Photoionization Detectors (PID),
- Organic Vapor Analyzers (OVA),
- Indicator tubes (e.g., Draegaes--NH_3 vapors),
- pH meters,
- Screening kits (e.g., Dexsil),
- Hygrometers/temperature measurement devices,
- Noise monitors,
- Conductivity meters, and
- Oxygen percent meters.

Organic Vapor Detection

A variety of organic vapors can be detected with a hand-held photoionization detector (PID) at levels as low as 0.1 ppm by volume (ppmv). The PID uses an ultraviolet (UV) light source of either 10.2 eV or 11.7 eV energy to ionize and thereby detect organic vapors. The PID is not a universal detector, because only substances that can be ionized at the energy of the light source can be detected. It does respond to a wide variety of chemical classes, however, particularly to aromatics, including benzene, toluene and xylene, and olefins, such as chlorinated ethenes (e.g., TCE, PCE). Fuels can be detected primarily because of their

aromatic content (aliphatic hydrocarbons give poor response). The PIDs are nonselective; therefore, the identity of the suspected volatile organic substance must be determined by a selective method, usually gas chromatography/mass spectrometry (GC/MS). PIDs are very useful for determining the areal extent of contamination and for locating hot spots. Usually, only a few confirmatory samples are needed to establish the identity of the contamination from a given location.

PCB Field Test Kits:

Field test kits are available for detecting PCB contamination in the field. PCBs can be detected at low concentrations in a variety of media, including oils, waters, and surface swipes. The test kits use a chemical reagent to strip chlorine atoms from PCB molecules. The chlorine atoms are displaced as chloride ions, which are then detected potentiometrically with a chloride-specific electrode. The concentration of chloride measured is proportional to the concentration of PCB in the original sample. The test, which requires a fair amount of skill to be conducted reliably, should be performed only by a trained field technician. The test is nonspecific for a particular PCB mixture (Aroclor) and is subject to interference by other chlorinated organic compounds. Its speed and low cost, however, make it a useful screening tool for selecting laboratory samples.

Portable X-Ray Fluorescence Instrument

Many trace metal contaminants of interest can be detected in a variety of media with a portable X-ray fluorescence (XRF) spectrometer. Metal atoms are detected directly in their host media, eliminating the need for digesting samples, or otherwise isolating the atoms prior to measurement, as is required in laboratory methods. Most instruments use a detection cell that holds the sample, requiring some sample preparation for determining metals in bulk media. Some instruments also use a probe for directly detecting trace metal contamination on surfaces. In either case, various metals are detected with varying sensitivities, corresponding to their ability to fluoresce under the influence of the X-ray source. Therefore, the response characteristics of the instrumentation must be considered in light of the sensitivity requirements of the investigation to establish the usability of this technique. This emerging technology may prove to be a very useful tool for guiding field sampling for trace metal contamination.

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D.4.5 Sampling and Analysis

This section discusses that portion of the characterization process involving discrete sampling and the associated analyses. Section D.4.5.1 discusses the sampling media and the related liquid and solid samples that will be required. Available media-specific sampling and analyses procedures are listed in Section D.6. Abstracts of the procedures are given in Attachment D.I (Volume IV), while the actual procedures are listed in the SCQ. Some procedures currently being developed will be included in the SCQ by the time sampling starts. The relationships among the sample, the sample media, and the required data are identified in the DQO summary forms that will be maintained in the project planning office on the site.

Section D.4.5.2 discusses the various analyses required for both radiological and chemical contaminants. The analytical methods are directly related to the procedures identified in Section D.6. In addition, the characterization of physical and chemical waste properties of the potential contaminants is discussed.

D.4.5.1 Sampling

Table D.7 summarizes the sample media to be collected for analysis and the procedures that will be used to collect those samples.

D.4.5.2 Analyses

This section discusses in separate sections (1) radiological and (2) chemical analytical techniques (and the associated constituents) and (3) the physical/chemical waste property considerations.

Radionuclide Analysis

Radioanalytical procedures frequently yield results for more than one radionuclide. Some procedures are element specific and can provide results for more than one isotope of that element. Analyses for OU3 may include the following:

- Isotopic uranium — U-233 (as U-234), U-234, U-235, U-236, and U-238;

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TABLE D.7 Potential Sample Media and Required Sampling Procedures for OU3 Component Groups

Component Category	Sample Procedure	Potential Media
Buildings	Samples from surface water	Water, aqueous liquid, organic liquid
	Cores from slabs	Concrete, wood, asphalt, transite, drywall, structural steel, masonry
	Air samples-particulate	Filter media
	Air samples-gases	Adsorbents, air
Containerized materials	Liquid samples from tanks	Water, aqueous liquid, organic liquid, inorganic liquid
	Liquid samples from drums	Water, aqueous liquid, organic liquid, inorganic liquid
	Solid samples from tanks	Salts/powders, sludge, organic residues, inorganic residues
	Solid samples from drums	Salts/powders, sludge, organic residues, soils/sand/gravel, sediments, heterogeneous waste
Bulk materials	Surface samples	Soil/sand/gravel
	Samples at depth	Soil/sand/gravel
	Samples from waste piles	Concrete, wood, asphalt, transite, drywall, structural steel, other metals, glass, masonry, soil/sand/gravel, paint
Parking lots, storage pads, roads, railroads	Core samples from pads	Concrete, wood, asphalt, structural steel, soil/sand/gravel
	Samples from surface water	Water, aqueous liquids, organic liquids

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TABLE D.7 (Cont'd)

Component Category	Sample Procedure	Potential Media
Piping, utilities, equipment	Liquid samples from process equipment	Water, aqueous liquids, organic liquids
	Liquid samples from pipes-pressurized	Water, aqueous liquids, organic liquids
	Liquid samples from pipes-unpressurized	Water, aqueous liquids, organic liquids
	Liquid samples from ducts	Water, aqueous liquids, organic liquids
	Effluent samples-grab	Water, aqueous liquids, organic liquids
	Effluent samples-timed	Water, aqueous liquids, organic liquids
	Effluent samples-proportional	Water, aqueous liquids, organic liquids
	Solid samples from pipes-unpressurized	Salts/powders, sludge, dust, organic residues, inorganic residues
	Solid samples from ducts	Salts/powders, sludge, dust, organic residues, inorganic residues
	Solid samples from process equipment	Salts/powders, sludge, dust, organic residues, inorganic residues
Basins and ponds	Samples from surface liquids	Water, aqueous liquid, organic liquid
	Solid samples underlying surface liquids	Sludge, sediment, salts/powders, soil/sand

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- Isotopic thorium Th-227, Th-228, Th-230, and Th-232; and
- Isotopic plutonium Pu-238, Pu-239, Pu-240, and Pu-242.

In addition to the three isotopic analyses above, a fourth analytical procedure will be gamma spectrometry for Ru-106, Cs-137, Pb-214, Bi-214, Ac-228, Pb-212, Tl-208, Th-227, Ra-223, Bi-211, Th-231, and Am-241.

Gamma ray spectrometry does not normally require chemical separation before analysis. Many gamma-emitting radionuclides can be quantified; the scope and sensitivity depends on the configuration of the analytical system and the energy and abundance of gamma rays from specific isotopes.

Because of chemical and radiological properties, certain radionuclides are usually analyzed through specific radiochemical procedures. The following require such analytical procedures: Pu-241, Np-237, Ra-226, Ra-228, Tc-99, Sr-90, Pb-210, and Po-210.

Chemical Analysis

The extensive list of potential chemical contaminants are analyzed through a relatively short list of analytical methods. Table D.8 summarizes the class of chemical contaminants and the analytical method.

Gas chromatography/mass spectrometry (GC/MS) will be used to analyze volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs). GC/MS is a reliable technique to analyze specific organic contaminants in environmental matrices. GC/MS is generally regarded as the most authoritative analysis available for identifying organic contaminants. It is also capable of reliable quantitative analysis when appropriate protocols are followed. The technique uses a gas chromatograph to separate contaminants in a mixture, the condition in which organics are typically present in environmental samples. Individual contaminants are then analyzed in the mass spectrometer portion of the instrument through the generation of their mass spectra.

Gas chromatography with conventional detectors will be used to analyze polychlorinated biphenyls (PCBs), and possibly to analyze for hydrocarbons. PCBs and hydrocarbons are identified by their characteristic chromatographic patterns and retention

TABLE D.8 Summary of Chemical Contaminant Classes and Corresponding Analytical Method

Contaminant	Analytical Method
VOC	Gas chromatography/mass spectrometry
SVOC	Gas chromatography/mass spectrometry
PCBs	Gas chromatography
TPH	Gas chromatography, infrared spectroscopy
Metals	Atomic absorption spectroscopy, inductively coupled plasma-atomic emission spectroscopy
Anions	Ion chromatography
Asbestos	Light microscopy
Phenols	Wet Methods
Sulfides	Wet Methods
Cyanides	Wet Methods
Inorganic N	Wet Methods
Oil and Grease	Gravimetry

times by comparison with those of authenticated standards. Total petroleum hydrocarbons (TPH) can be determined by analysis in an infrared analyzer at lower cost than GC when characterization of the hydrocarbon mixture is not of interest.

Trace metals will be analyzed by one of two instrumental techniques — atomic absorption spectroscopy (AAS), or inductively coupled plasma-atomic emission spectroscopy (ICP-AES). AAS is more sensitive than ICP-AES for certain metals, such as lead, mercury, thallium, arsenic, and selenium. ICP-AES is generally cheaper and faster for analysis of many metals in individual samples. The sensitivity requirements determined by the DQOs of the investigation will dictate which technique will be used for particular trace metals. Typically, both techniques are employed in investigations of this type. The techniques rely on the absorption (AAS) or emission (ICP-AES) of light of characteristic wavelengths for the identification and quantification of metals.

Anions, such as sulfate, nitrate, phosphate, chloride and fluoride, usually originating from mineral acids used in uranium processing will be analyzed by ion chromatography (IC). This process has the ability to separate and analyze multiple anions in a single analysis. It usually employs an anion exchange column to separate anions and a conductivity cell to detect them. Specific anions are identified by their characteristic retention times.

So-called "wet" methods, generally those that involve characteristic chemical reactions, as opposed to instrumental methods, will be used as needed for a variety of analytes, including total phenols, sulfides, cyanides, and inorganic (ammonia) nitrogen. For some analytes, field analysis of air samples can be performed with Draeger tubes that involve similar chemistries. Total oil and grease will be determined by gravimetry (weighing) after a simple extraction and drying process.

Physical and Chemical Waste Properties

Characterization of the physical properties of the contaminants, or contaminated matrices, is needed to supplement the risk assessments and is particularly important to establish and assess potential remedial actions. Such physical properties include particle-size distributions, porosity and void fractions, viscosity, and density.

Chemical properties of the contaminant and/or contaminated matrix are important for both risk assessment and potential remedial action alternatives. Much information will

become available through analysis for chemicals and hazardous materials; however, limited additional analyses can be expected. For example, the chemical form of the contaminated matrix will bear upon decontamination and other treatment for waste minimization. For stabilization, storage, and disposal options, the solubility and potential for migration are also important properties.

Most of the information necessary to adequately characterize wastes is already available through analysis for contaminants of concern and through the determination of physical and chemical properties. Known existing wastes and waste forms are sanitary waste, low-level radioactive waste, RCRA hazardous waste, mixed wastes, and other forms of waste that may require controls and proper disposition. The ultimate disposition of wastes presumes the existence of waste acceptance criteria that may require additional characterization and documentation.

D.4.6 Assessment of Existing Information

The RI objectives guide the assessment of existing knowledge of radiological contaminants, chemical contaminants, other potentially hazardous materials, and the physical and chemical characteristics of the contaminants or contaminant matrices. Currently available information is reviewed and assessed to see if the RI objectives can be met. Possible conclusions are:

1. Sufficient data exist to conclude that the facility or component is clean or contaminated. All information necessary to achieve objectives, such as the risk assessment and development/evaluation of remedial action alternatives, is complete. A modest amount of measurement and sampling will be performed to ensure current information is valid and complete.

2. Current data may indicate an uncertain status. The uncertainty may pertain to an entire component or to blocks of information relative to the objectives.

A further analysis of components with an uncertain status clarifies needs for further data collection. Possibilities include:

1. Some portions of a component may be well characterized while some features may lack any characterization. This missing information could be for a physically distinct portion of the facility or it could relate to a discrete but very important factor, such as the depth of contaminants in concrete. The field sampling program will be principally directed to obtain the missing information. Only necessary work will be performed.

2. Within a component, the characterization of radiological and chemical contaminants may be incomplete. The field sampling will be directed to complete the information.

3. A component may be well characterized for the quantity and extent of contamination, but the physical and chemical properties important for waste characterization may not be known. Field sampling will be directed to obtain that information.

The nature and extent of information required will depend upon the expected disposition of the component and the numerous subcomponents. Waste characterization is needed to estimate the concentrations and quantities of contaminants present and the volumes of contaminated materials. Additional information is also required to assess waste minimization through decontamination and waste treatment. Decontamination of concrete surfaces could dramatically reduce the amount of concrete requiring controlled disposal. The same is true for soil that can have contaminants washed or separated.

A different level of investigation is proposed comparable to the level and extent of current knowledge. If a component or subcomponent has been sufficiently characterized to meet the objectives with certainty, no further work is required. This certainty can apply to a clean or to a contaminated item and could significantly reduce the field data collection effort. A component need not be characterized for contaminants if that information is known. However, important waste minimization information, such as contaminant depth and other information to support possible decontamination processes, may be lacking and may become the major thrust of the field sampling program.

D.4.7 Action and Decision Levels

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This section discusses both action levels (ALs) and decision levels (DLs). ALs determine specific controls that must be implemented when the specified level is exceeded; DLs provide supporting information for making decisions related to the sampling or measurement program. When ALs are exceeded, regulations require specified actions; however, when DLs are exceeded, a judgment is required to ascertain whether additional measurements or samples are needed.

Both ALs and DLs identify minimum or maximum contamination levels and contaminant concentrations in air, solids, and liquids for purposes of management. The ALs are ARARs driven, including acceptable risk ranges, while the DLs are driven by the objectives of the sampling and measurement program (supporting risk assessment and RAA development and evaluation).

D.4.7.1 Interpretation of Data for Comparison to Action and Decision Levels

ALs and DLs are identified through reference to ARARs and sampling objectives, respectively. ALs are based upon values that identify specific and appropriate control actions. DLs, as used here, establish the degree to which information can be used to meet the RI objectives. Where information is complete, the RI evaluation can proceed. Where information is incomplete, additional measurements, sampling, and analysis will be undertaken to meet the RI objectives and information needs. However, discovery of unexpected contamination and in-depth assessment of information obtained may lead to the conclusion that additional measurements and sampling are needed.

Some ALs are clearly defined. For example, surface contamination limits for specific radionuclides are provided in units of disintegrations per minute per 100 square centimeters (dpm/100 cm^2). Other concentration limits for contaminants in solids, liquids, and air are also provided. These limits, in themselves, may require some additional evaluation. For example, surface contamination limits are not to be used for bulk contaminants (those that exist throughout a given medium). The models used to extrapolate to potential inhalation or ingestion from surface contamination levels assume that a thin layer of contaminant is available. Where multiple contaminants exist, a fractional weighing of each may be required

for comparison with the AL limit. For example, if two radionuclides are present at the surface contamination limit for each, the limit is exceeded by a factor of two.

Direct numerical ALs are not available for all potential contaminants and for all conditions that may be encountered. Applicable ARARs also include indirect control limits. Some are based upon the expected committed effective dose equivalent to a receptor (e.g., 10 mrem/yr due to inhalation and 4 mrem/yr through ingestion of drinking water). Another requirement is for risk to be limited to 10^{-4} to 10^{-6} for the environmental receptor. These are specific; however, they do not allow direct comparison to measurement and analytical data. When the field sampling program is being implemented, data may require interpretation for comparison to the indirect regulatory requirements.

One additional dimension required for implementing ALs is knowing the quantity and availability of the contaminant for transport. A significant difference exists in the appropriate response between smaller contaminant quantities (pounds) and larger quantities (tons). If contaminants are completely fixed, they are of lesser concern than contaminants that can be readily entrained to air and water.

DLs are developed on a component-specific basis as needed and appropriate. Statistical analysis of the radiological survey and swipe measurement data will establish the variability in the data. The DLs will be specified after the initial radiological survey measurements have been taken and statistically evaluated. The mean and standard deviation (variability) of the measurement data will be compared with the DLs.

D.4.7.2 Action Levels

This section discusses the use and character of ALs associated with radiological and chemical contaminants. Subsections discuss radioactive surface contamination, external gamma exposure rates, waterborne and airborne radionuclides, and chemical contaminants within the materials. Many of the ALs are derived from existing regulations and require specific actions to be taken.

Surface Contamination

Surface contamination control limits are provided for radioactive contaminants in Table D.9. This information is obtained through the use of portable radioactive detection instruments and by counting of swipes to show any removable contamination. Because these measurements are not radionuclide specific, assessment requires laboratory analyses of surface samples. Portable instrument response can be properly interpreted when the radionuclide mix is known. Current information of potential contaminants associated with a specific surface or item will also be used for interpretation.

External Gamma Exposure Rates

The external gamma ray exposure rate ALs (from DOE Order 5400.5) is 20 µrem/h above ambient background.

Generic Guidelines. The generic guidelines for residual concentrations of Ra-226, Ra-228, Th-230, and Th-232 are (1) 5 pCi/g averaged over the first 15 cm of soil below the surface, or 15 pCi/g averaged over 15-cm-thick layers of soil more than 15 cm below the surface.

Ingrowth and Mixtures — These guidelines take into account ingrowth of Ra-226 from Th-230 and of Ra-228 from Th-232, and assume secular equilibrium. If both Th-230 and Ra-226 or both Th-232 and Ra-228 are present and not in secular equilibrium, the appropriate guideline is applied as a limit for the radionuclide with the higher concentration. If other mixtures of radionuclides occur, the concentrations of individual radionuclides shall be reduced so that either the dose for the mixtures will not exceed the basic dose limit, or the sum of the ratios of the soil concentration of each radionuclide to the allowable limit for that radionuclide will not exceed 1. Explicit formulas for calculating residual concentration guidelines for mixtures are given in DOE/CH-8901 (*A Manual for Implementing Residual Radioactive Guideline* [ANL 1989 with 1991 revision]).

Guidelines for residual concentrations of other radionuclides shall be derived from the basic dose limits by means of an environmental pathway analysis using specific property

TABLE D.9 Surface Contamination Action Levels 3297

Radionuclides[a]	Action Level (dpm/100 cm^2)[b] Average[c,d]	Maximum[d,e]	Removable[d,f]
Transuranics, Ra-226, Ac-227, Ra-228, Th-228, Th-230, Pa-231	300	900	20
Th-Natural, Sr-90, Ra-223, Ra-224, U-232, Th-232	1,000	15,000	200
U-Natural, U-235, U-238, and associated decay product, alpha emitters	5,000	15,000	1,000
Beta-gamma emitters (radionuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above [g]	5,000	15,000	1,000

[a] Where surface contamination by both alpha- and beta-gamma-emitting radionuclides exists, the limits established for alpha- and beta-gamma-emitting radionuclides should apply independently.

[b] As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute measured by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

[c] Measurements of average contamination should not be averaged over an area of more than 1 m^2. For objects of less surface area, the average should be derived for each such object.

[d] The average and maximum dose rates associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 mrad/h and 1.0 mrad/h, respectively, at 1 cm.

[e] The maximum contamination level applies to an area of not more than 100 cm^2.

[f] The amount of removable material per 100 cm^2 of surface area should be determined by wiping an area of that size with dry filter or soft absorbent paper, applying moderate pressure, and measuring the amount of radioactive material on the wiping with an appropriate instrument of known efficiency. When removable contamination on objects of surface area less than 100 cm^2 is determined, the activity per unit area should be based on the actual area and the entire surface should be wiped. It is not necessary to use wiping techniques to measure removable contamination levels if direct scan surveys indicate that the total residual surface contamination levels are within the limits for removable contamination.

[g] This category of radionuclides includes mixed fission products, including the Sr-90 which is present in them. It does not apply to Sr-90 which has been separated from the other fission products or mixtures where the Sr-90 has been enriched.

Source: DOE Order 5400.5

data where available. Procedures for these derivations also are given in DOE/CH-8901. Residual concentrations of radioactive material in soil are defined as those in excess of background concentrations averaged over an area of 100 m^2.

Hot Spots — If the average concentration in any surface or below-surface area less than or equal to 25 m^2 exceeds the limit or guideline by a factor of $(100/A)^{0.5}$ (where A is the area [in square meters] of the region in which concentrations are elevated), limits for "hot-spots" shall also be developed and applied. Procedures for calculating these hot-spot limits, which depend on the extent of the elevated local concentrations, are given in DOE/CH-8901. In addition, reasonable efforts shall be made to remove any source of radionuclide that exceeds 30 times the appropriate limit for soil, irrespective of the average concentration in the soil.

ALs for Waterborne and Airborne Radionuclides

ALs for waterborne and airborne radionuclides, which are derived from tables in DOE Order 5400.5, correspond to a committed effective dose equivalent of 100 mrem/yr. Table D.10 presents these ALs, adjusted as follows:

1. Ingested water derived concentration guides are those in DOE Order 5400.5 divided by 25 to approximate the EPA Drinking Water Limit corresponding to 4 mrem/yr.

2. Inhaled air derived concentration guides are those in DOE Order 5400.5 divided by 10 to meet the NESHAPS limit of 10 mrem/yr.

In many cases, these adjustments may represent an oversimplified approach; however, a basis is provided. Comparisons can demonstrate the need for better interpretation of site-specific conditions and potential pathways. Airborne source terms can be assessed through the EPA code AIRDOS/Radrisk and AIRDOS-PC, as required under the Clean Air Act Standards and DOE Order 5400.5.

The only expected significant concentrations of radium-226, and therefore potentially significant airborne radon and radon daughter concentrations, are associated with the K-65 transfer line and Building 65 thorium storage warehouse. The thorium quantities in the

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TABLE D.10 Action Levels for Waterborne and Airborne Radionuclides

Radionuclide	Ingested Water DCG[a] (µCi/mL)	Inhaled Air DCG (µCi/mL)[b] Solubility - Clearance Class		
		Day	Week	Year
Sr-90				
Soluble	4.E-08	5.E-12	-	-
Insoluble	4.E-07			9.E-13
Tc-99	4.E-06	1.E-09	2.E-10	-
Ru-106	2.4E-07	2.E-11	1.E-11	3.E-12
Cs-137	1.2E-07	4.E-11	-	-
Pb-210	1.2E-09	9.E-14	-	-
Po-210	3.2E-09	1.E-13	1.E-13	-
Ra-226	4.E-09	-	1.E-13	-
Ra-228	4.E-09	-	3.E-13	-
Ac-227	4.E-10	2.E-16	7.E-16	1.E-15
Th-228	1.6E-08	-	5.E-15	4.E-15
Th-230	1.2E-08	-	4.E-15	5.E-15
Th-232	2.E-09	-	7.E-16	1.E-15
Pa-231	4.E-10	-	9.E-16	1.E-15
U-233				
Soluble	2.E-08	4.E-13	2.E-13	-
Insoluble	2.E-07	-	-	9.E-15
U-234				
Soluble	2.E-08	4.E-13	2.E-13	-
Insoluble	2.E-07	-	-	9.E-15
U-235				
Soluble	2.4E-08	5.E-13	2.E-13	-
Insoluble	2.E-07	-	-	1.E-14
U-238				
Soluble	2.4E-08	5.E-13	2.E-13	-
Insoluble	2.4E-07	-	-	1.E-14
Np-237	1.2E-09	-	2.E-15	-
Pu-238				
Soluble	1.6E-09	-	3.E-15	-
Insoluble	1.2E-07	-	-	4.E-15
Pu-239				
Soluble	1.2E-09	-	2.E-15	-
Insoluble	8.E-08	-	-	4.E-15
Pu-241				
Soluble	8.E-08	-	1.E-13	-
Insoluble	4.E-06	-	-	2.E-13
Am-241	1.2E-09	-	2.E-15	-

[a] Ingested water derived concentration guides are those in DOE Order 5400.5 divided by 25 to approximate the EPA Drinking Water Limit corresponding to 4 mrem/yr.

[b] Inhaled air derived concentration guides are those in DOE Order 5400.5 divided by 10 to meet the NESHAPS limit of 10 mrem/yr.

thorium warehouses (Buildings 64, 65, 67, and 68) warrant consideration of airborne concentrations of thoron (radon-220) and daughters. ALs for radon, thoron, and daughters are as follows:

	Gas	Daughters
Radon-220	3.E-10 µCi/mL	0.02 WL
Radon-222	3.E-10 µCi/mL	0.02 WL

Chemical Contaminants in OU3 Materials and Media

ALs for chemical contaminants currently do not exist for the wide variety of materials and media that make up OU3, as they are atypical of environmental media. Therefore, PRGs for soils and waters proposed for OU5 (Environmental Media) will be used as guidance, to the extent applicable, for OU3 materials and media, including building and construction materials, other solids, sediments, and surface runoff. The applicability of the soil and water guidelines will be decided in the field on a case-by-case basis.

Care must be taken in interpreting the guidelines (which apply to bulk media) to surface contamination. Generally, higher surface concentrations can be tolerated than bulk concentrations, as the former represents a smaller source term. Surface contamination, however, may pose greater potential releasability; therefore both factors, amount and releasability, should be considered when guidelines for environmental media are being interpreted.

A further consideration is the total volume of the material or medium under consideration. For OU3 components, innumerable distinct materials or media of very small size, relative to typical environmental media, will be encountered. Relatively high contaminant concentrations in small volume media should be evaluated more leniently than high levels in large volume media.

D.4.8 Sample Numbering System

An established sample numbering system shall be used for identifying samples according to project, component, location, and type. General label marking for identification of samples is described in the SCQ. Sample labels shall include all necessary cross references to completely relate them to the Daily Logs, Requests for Analysis, and Chain-of-Custody

records described in the SCQ. Additional requirements dealing with various media and specific types of samples that may affect the information included on the sample labels are also contained in the SCQ. The sample numbering system shall be consistent with the RI/FS Sampling Plan, Volume 1 (DOE 1988) or as specified in project-specific work plans or established routine sampling program procedures.

The plan location of each environmental media sample point shall be identified with the state planar coordinate system. Plan location of sample points shall be established by survey to within +/- 0.3 ft relative to state planar coordinates. Elevation of sample points shall be defined as needed within +/- 0.3 ft relative to mean sea level.

During the sampling process, any samples obtained with unavoidable displacements from the surveyed sample points shall be documented in the Daily Log and Chain-of-Custody forms. Sample points shall be identified in such a manner that the sample will not be contaminated by paint, chalk, or other materials or procedures used to mark the points.

D.4.9 Representativeness and Sensitivity

The importance of choosing the appropriate sample locations, media, measurements, and analyses to achieve a specific measurement objective depends on the sensitivity of the instruments used and the representativeness of the results to the media being investigated. This section discusses the factors of representativeness and sensitivity so that the appropriate choices are made. This section is divided into two primary areas: (1) instrument measurements and (2) samples.

D.4.9.1 Field Survey Instrument Measurements

This section discusses the general applicability (related to sensitivity and representativeness) of instruments used for field screening and surveys. The three subsections present details on the range of applicable particle energies and the related sensitive areas. Various radiation detection instruments are discussed and compared for applicability to the radioisotopes of concern in OU3.

Surface Contamination Measurements

Alpha scintillation detectors (~60 cm^2 sensitive area) are relatively uniform in response to the limited range of alpha particle energies from expected contaminants (4-6 meV). Measurements (counts per minute [cpm]) can be reasonably converted to disintegrations per minute (dpm) for AL comparisons. Where the alpha radionuclide mix is well characterized, the specific detector efficiency may be adjusted and refined for more accurate conversion to dpm. The range of an alpha particle in a solid matrix is on the order of 15 µm. Deeper alpha emissions will not be detected.

Thin-window pancake G-M detectors (~30-cm^2 sensitive area) are sensitive to alpha particles (with limited efficiency), beta particles, and gamma rays. Unless there is specific knowledge of the radionuclides being monitored, the count rate cannot be converted to dpm because of the range of potential radioactive energies and the resultant detector efficiency. Where contaminants are well characterized, known detector efficiencies can be applied. Detection response is determined by interpretation from calibration data. When there is a complex and/or variable mixture of several radionuclides, it may not be possible to accurately convert from observed cpm to radionuclide dpm.

Technetium-99 represents a relatively small committed effective dose rate equivalent per unit of activity. Monitoring effectively for technetium-99 is a particular challenge because of the low beta energy and attendant low detector efficiency. It may be impossible to monitor for technetium-99 contaminants in the presence of other higher-energy beta particle emitters and/or with significant levels of gamma radiation.

Because of the sensitivity required for the ALs, monitoring instruments will be used in the scaler (not ratemeter) mode. For areas where the most restrictive alpha emitters may be present (300 dpm/100 cm^2), a minimum count time of one minute duration will be used. For other areas, both alpha and beta-gamma monitors will utilize 30-second count times. In addition to providing improved sensitivity, this time provides a better set of data for statistical interpretation.

It is essential to know the radionuclide mix being monitored to interpret contamination measurements. Some retrospective analysis of survey data can be expected following radionuclide-specific analyses of the surveyed contamination.

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Exposure Rate Measurements

Gamma ray exposure rate measurements are made with gamma-energy-compensated G-M detectors and ionization chambers. Because of these instruments' relatively uniform response to a broad range of gamma ray energies, concern exists only with lower energy gamma ray emitters (<60 keV), the measurement of which may require extrapolation from calibration data for the specific detector.

It is essential to know the radionuclide mix to interpret exposure rate measurements, and retrospective interpretation of measurements may be required following radionuclide-specific analyses of contamination.

Low-Level Gamma Ray Measurements

Low-level gamma ray measurements are performed with 2- x 2-in. NaI (Tl) scintillation detectors for higher energy gamma ray emitters (>100 keV) and with the FIDLER thin-crystal scintillation detector for lower energies. The objective of these measurements is to determine bulk concentrations of contaminants in media such as soil or concrete. These measurements are sensitive, but sensitivity varies with the gamma energies of the source contaminants. Isopleths showing the area distribution of gamma emitters will be useful in guiding discrete sampling.

Gamma ray measurements may be limited to qualitative assessment. A comparison of measurements can be made using the following process:

1. Determine the mean and standard deviation of ambient gamma ray count rates for the area being monitored.
2. If the mean, minus three standard deviations, is negative (less than zero), inspect the data for better representation as a log normal distribution. If so, establish the mean and geometric standard deviation.
3. Select gamma measurements that exceed the mean, plus three standard deviations, or the mean plus three geometric standard deviations.
4. Review the distribution of measurements and isopleths of the gamma levels to determine possible extent and dimensions of the contaminated zone or object.

Sensitivity will be impaired for areas where the ambient gamma level is greater than the natural radiation background.

Correlation of gamma measurements to bulk concentrations of radionuclides is possible by collecting a number of samples (e.g., 12) from below the detector measurement locations. Analyze these samples as a single composite, and plot correlations relating gamma measurements to radionuclide concentrations. A reasonable correlation may not be achievable, however, where there is a complex and/or variable mix of gamma emitters.

Depending upon the gamma ray energies and concentrations of the contaminants, low-level gamma measurements reveal contaminants at a relatively limited depth from the surface. For a practical estimate, FIDLER measurements are representative for depths up to 1 in., and 2 x 2 measurements are representative for depths up to 6 in. Low-level gamma ray measurements will have reasonable sensitivity and statistics with the instruments in the scaler mode and with count times of at least 30 seconds.

D.4.9.2 Samples

Limitations and considerations associated with swipes and liquid/solid sampling are discussed in this section. Information on the limits on the minimum amount of material required for analysis in both the liquid and solid media is presented. The information presented provides a general guideline for the sample extraction effort. Specific details associated with the error and uncertainty will be presented in the specific analytical procedures.

Swipe Samples

Removable surface contamination is determined by swiping potentially contaminated surfaces. All swipes are assessed with low-background alpha-beta counting instruments. The efficiency of the counter for alpha and beta particles depends upon the energy of the radiation. Alpha particle counting efficiency varies less with energy compared with the beta particle energies that might be present in contaminants. The counting data are interpreted in relation to the isotopic mix expected or known. Where significant area contamination is detected in excess of ALs, the swipes will be composited from similar locations for analysis to identify the radionuclide mix that is present.

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Liquid Samples

Analytical results for liquid samples require that reasonably large samples be collected compared with availability. For a complete array of radiochemical and chemical analyses, a 6-L sample is required. Where less than 1 L of liquid is present, composites of the similar liquids should be made to achieve the desired sample volume. It is not desirable to analyze samples of less than 100 mL per analyte. Small samples are only permissible when relatively high concentrations are expected and when no other sample is available. Certain organic constituents have specific sampling procedures that require sample volumes that vary from the general guidance. An example is the procedure for VOC sampling, which requires a specific type of sample bottle (40 mL) and cap (teflon lined). Contaminant-specific procedures are listed in Section D.6 and are available in the SCQ.

Solid Samples

A very broad range of solid sample types will be collected. The desired sample size is 1 kg. It is not desirable to analyze samples of less than 10 g per analyte. Where only limited quantities of the solids are present, composites of like solids will allow for more reasonable sample sizes. Very small quantities of solids may not yield useful contaminant detectability. Again, specific sampling procedures for specific analytes are listed in Section D.6 and are available in the SCQ.

D.4.10 Component-Specific Contaminants of Interest

This section provides a preliminary list of contaminants of interest for each component in OU3 to provide initial input to the component-specific FIPs. Table D.11 provides this list in terms of analysis groups. Contaminants are given by the group in which they are analyzed for convenience in setting up the analytical program and for estimating numbers of samples and associated costs. For example, if one or more isotopes of uranium is of interest, an X is placed in the box for uranium by alpha spectrometry.

Table D.11 was developed by comparing lists of radiological and chemical contaminant analysis groups given in Section D.4.5.2 with Table A.3.2 in Appendix A, which lists contaminants of interest for each component. Table A.3.2, was produced from

TABLE D.11 Component-Specific Analyses[a]

Component/Designation	Radiological Contaminants					Chemical Contaminants						
	Alpha Spectrometry			Gamma Spec	Radio-chem[b]							
	U	Th	Pu			VOCs	SVOCs	PCBs	TPH	Metals	Pb/Hg	Anions
Preparation Plant (1A)	X	X	X	X	A, B, C, D, E, F, H, J, K	X				X		
Plant 1 Storage Shelter (1B)	X	X		X	C, D, F	X				X		
Plant 1 Ore Silos (1C)	X	X		X	C, D, F, E					X		
Ore Refinery Plant (2A)	X	X	X	X	B, C, D, F, H, J, K	X	X	X		X		X
General/Refinery Sump Control Building (2B)	X				C, D, E							
Bulk Lime Handling Building (2C)	X	X			B, C, D, E, F					X		
Metal Dissolver Building (2D)	X	X	X		B, C, D, E, F, H, J, K							
NFS Storage & Pump House (2E)	X	X	X		B, C, D, E, F, H, J, K							X
Cold Side Ore Conveyor (2F)	X	X		X	C, D, E, F					X		
Hot Side Ore Conveyor (2G)	X	X		X	B, C, D, E, F					X		
Conveyor Tunnel (From Plant 1) (2H)	X	X		X	C, D, E, F					X		
Maintenance Building (3A)	X	X			B, C, D, E, F	X	X	X	X	X		X
Ozone Building (3B)	X				C, D, E			X				
NAR Control House (3C)	X				C, D, E							
NAR Towers (3D)	X				C, D, E							X
Hot Raffinate Building (3E)	X	X		X	C, D, E, F	X				X		X
Harshaw System (3F)	X				C, D, E							X
Refrigeration Building (3G)	X			X								
Refinery Sump (3H)	X	X	X	X	C, D, E, F, H, J, K					X		X
Combined Raffinate Tanks (3J)	X	X		X	C, D, E, F	X			X	X		X
Old Cooling Water Tower (3K)	X	X		X						X		
Electrical Power Center Building (3L)	X							X				
Green Salt Plant (4A)	X	X		X	B, F					X		X
Plant 4 Warehouse (4B)	X				B							
Plant 4 Maintenance Building (4C)	X					X	X	X	X	X		X
Metals Production Plant (5A)	X	X		X	B	X			X	X		X
Plant 5 Ingot Pickling (5B)	X	X		X	F							X
Plant 5 Electrical Substation (5C)	X							X				
West Derby Breakout/ Slag Milling (5D)	X											
Plant 5 Filter Building (5E)	X											
Plant 5 Covered Storage Pad (5F)	X	X			F							
Plant 5 Ingot Storage Shelter (5G)	X	X			B, F							
Metals Fabrication Plant (6A)	X	X			F	X		X	X	X		X
Plant 6 Covered Storage Area (6B)	X	X			C, D, F							
Plant 6 Electrostatic Precipitator (South) (6C)	X	X			F				X		X	
Plant 6 Electrostatic Precipitator (Central) (6D)	X	X			F				X		X	
Plant 6 Electrostatic Precipitator (North) (6E)	X	X			F				X		X	
Plant 6 Salt Oil Heat Treat Building (6F)	X								X	X		
Plant 6 Sump Building (6G)	X											
Plant 7 (7A)	X	X			F					X		
Plant 7 Overhead Crane (7B)	X	X			F							

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TABLE D.11 (Cont'd)

Component/Designation	Radiological Contaminants					Chemical Contaminants						
	Alpha Spectrometry			Gamma Spec	Radio-chem[b]							
	U	Th	Pu			VOCs	SVOCs	PCBs	TPH	Metals	Pb/Hg	Anions
Recovery Plant (8A)	X	X	X	X	B, C, D, E, F, H, J, K	X	X	X	X	X		X
Plant 8 Maintenance Building (8B)	X	X			C, D, E, F	X	X	X	X	X		
Rotary Kiln/Drum Reconditioning (8C)	X	X		X	C, D, E, F							
Plant 8 Railroad Filter Building (8D)	X				C, D, E					X		
Drum Conveyor Shelter (8E)	X				C, D, E							
Plant 8 Old Drum Washer (8F)	X	X			C, D, E, F					X		
Special Products Plant (9A)	X	X		X	B, C, D, E, F	X			X	X		X
Plant 9 Sump Treatment Facility (9B)	X				B	X			X	X		X
Plant 9 Dust Collector (9C)	X	X			F					X		
Plant 9 Substation (9D)	X							X				
Plant 9 Cylinder Shed (9E)	X											
Electrostatic Precipitator (9F)	X	X			B, F				X		X	
Boiler Plant (10A)	X	X		X	B, C, D, E, F	X			X		X	
Boiler Plant Maintenance Bldg. (10B)	X				C, D, E	X			X		X	
Wet Salt Storage Bin (10C)	X				C, D, E				X			
Cont. Oil/Graphite Burn Pad (10D)	X				B, C, D, E	X	X	X	X	X		
Service Building (11)	X	X			C, D, E	X	X		X	X		
Main Maintenance Building (12A)	X	X			C, D, E, F	X	X	X	X	X		
Cylinder Storage Building (12B)	X				C, D, E							
Lumber Storage Building (12C)	X				C, D, E					X		
Pilot Plant Wet Side (13A)	X	X		X	B, C, D, E, F	X	X	X		X		X
Pilot Plant Maintenance Bldg. (13B)	X	X			C, D, E	X	X	X	X	X	X	
Sump Pump House (13C)	X	X		X	C, D, E, F					X		
Pilot Plant Thorium Tank Farm (13D)	X	X		X	C, D, E, F	X				X		X
Administration Building (14A)	X				C, D, E							
Building 14 EOC Generator Set (14B)	X				C, D, E				X			
Laboratory (15)	X	X	X	X	B, C, D, E, F, H, J, K	X	X	X	X	X		
Main Electrical Station (16A)	X				C, D, E			X				
Electrical Substation (16B)	X				C, D, E			X				
Electrical Panels & Transformer (16C)	X				C, D, E			X				
Main Electrical Switch House (16D)	X				C, D, E			X				
Main Electrical Transformers (16E)	X				C, D, E			X				
Trailer Substation #1 (16F)	X				C, D, E			X				
Trailer Substation #2 (16G)	X				C, D, E			X				
BDN Surge Lagoon (18A)	X				C, D, E	X						X
General Sump (18B)	X	X		X	C, D, E, F	X						X
Coal Pile Runoff Basin (18C)	X	X		X	C, D, E, F	X						X
Biodenitrification Towers (18D)	X	X			C, D, E, F							
Storm Water Retention Basin (18E)	X	X		X	C, D, E, F							X
Clearwell Pump House (18G)	X				C, D, E	X						
BDN Effluent Treatment Facility (18H)	X	X			C, D, E, F				X			
Methanol Tank (18J)	X				C, D, E							
Low Nitrate Tank (18K)	X				C, D, E	X						

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TABLE D.11 (Cont'd)

Component/Designation	Radiological Contaminants: Alpha Spectrometry: U	Th	Pu	Gamma Spec	Radio-chem[b]	Chemical Contaminants: VOCs	SVOCs	PCBs	TPH	Metals	Pb/Hg	Anions
High Nitrate Tank (18L)	X				C, D, E	X						X
High Nitrate Storage Tank (18M)	X				C, D, E							
Main Tank Farm (19A)	X								X	X		X
Pilot Plant Ammonia Tank Farm (19B)	X											
Tank Farm Control House (19C)	X											
Old North Tank Farm (19D)	X									X		X
Pump Station & Power Center (20A)	X	X										
Water Plant (20B)	X	X								X		
Cooling Towers (20C)	X	X			C, D, E, F					X		
Elevated Potable Storage Tank (20D)	X											
Well House #1 (20E)	X											
Well House #2 (20F)	X											
Well House #3 (20G)	X											
Process Water Storage Tank (20H)	X											
Gas Meter Building (22A)	X				C, D, E							
Storm Sewer Lift Station (22B)	X				C, D, E							
Truck Scale (22C)	X				C, D, E							
Scale House & Weigh Scale (22D)	X				C, D, E							
Utility Trench to Pit Area (22E)	X	X			C, D, E, F	X				X		
Meteorological Tower (23)	X											
Railroad Scale House (24A)	X											
Railroad Engine House (24B)	X								X			
Chlorination Building (25A)	X	X	X	X	A, B, C, D, E, F, H, J, K							
M.H.#175/Eff. Line/Sampling Bldg. (25B)	X	X	X	X	A, B, C, D, E, F, H, J, K	X	X	X	X	X		X
Sewage Lift Station Building (25C)	X	X	X	X	A, B, C, D, E, F, H, J, K							
U.V. Disinfection Building (25D)	X	X	X	X	A, B, C, D, E, F, H, J, K							
Digester & Control Building (25E)	X	X	X	X	A, B, C, D, E, F, H, J, K	X	X			X		
Sludge Drying Beds (25F)	X	X	X	X	A, B, C, D, E, F, H, J, K	X	X			X		
Primary Settling Basins (25G)	X	X	X	X	A, B, C, D, E, F, H, J, K	X	X			X		
Trickling Filters (25H)	X	X	X	X	A, B, C, D, E, F, H, J, K	X	X			X		
Pump House-HP Fire Protection (26A)	X								X			
Elevated Water Storage Tank (26B)	X											
Main Electrical Strainer House (26C)	X											
Security Building (28A)	X											
Human Resources Building (28B)	X											
Guard Post on South End of 'D' St. (28C)	X											
Guard Post on West End of 2nd St. (28D)	X											
Chemical Warehouse (30A)	X	X			E, F					X		
Drum Storage Warehouse (30B)	X				C, D, E							
Old Ten Ton Scale (30C)	X				C, D, E							

TABLE D.11 (Cont'd)

Component/Designation	Radiological Contaminants					Chemical Contaminants						
	Alpha Spectrometry			Gamma Spec	Radio-chem[b]							
	U	Th	Pu			VOCs	SVOCs	PCBs	TPH	Metals	Pb/Hg	Anions
Engine House/Garage (31A)	X				C, D, E	X			X	X		
Old Truck Scale (31B)	X				C, D, E							
Magnesium Storage Building (32A)	X	X		X	A, B, C, D, F	X				X		
Building 32 Covered Loading Dock (32B)	X	X		X	A, B, C, D, F					X		
Pilot Plant Annex (37)	X	X		X	B, F	X	X		X	X		X
Propane Storage (38A)	X											
Cylinder Filling Station (38B)	X											
Incinerator Building (39A)	X	X	X	X	A, B, C, D, E, F, H, J, K	X	X		X		X	
Waste Oil Decant Shelter (39B)	X				C, D, E	X	X		X			
Incinerator Sprinkler Riser House (39C)	X				C, D, E							
Sewage Treatment Plant Incinerator (39D)	X	X	X	X	A, B, C, D, E, F, H, J, K				X		X	
Rust Engineering Building (45A)	X					X			X			X
Utility Shed East of Rust Trailers (45B)	X											
Heavy Equipment Building (46)	X	X		X	A, C, D, E, F	X			X			
Six to Four Reduction Facility #2 (51)	)X											
Health & Safety Building (53A)	X				E						X	
In-Vivo Building (53B)	X				E							
Six to Four Reduction Facility #1 (54A)	X	X		X	B, F	X		X	X	X		X
Pilot Plant Shelter (54B)	X	X			F							
Pilot Plant Dissociator Shelter (54C)	X	X		X	F					X		
Slag Recycling Building (55A)	X				B					X		X
Slag Recycling Pit/Elevator (55B)	X				B					X		
CP Storage Warehouse (56A)	X							X	X	X		
Storage Shed (West) (56B)	X											
Storage Shed (East) (56C)	X											
Quonset Hut #1 (60)	X	X		X	F							
Quonset Hut #2 (61)	X	X		X	F							
Quonset Hut #3 (62)	X	X		X	B, C, D, E, F							
KC-2 Warehouse (63)	X					X		X	X			
Thorium Warehouse (64)	X	X		X	A, B, C, D, E, F				X			
(Old) Plant 5 Warehouse (65)	X	X		X	A, B, C, D, E, F							
Drum Reconditioning Building (66)	X	X		X	A, B, C, D, E, F	X				X		
Plant 1 Thorium Warehouse (67)	X	X		X	F							
Pilot Plant Warehouse (68)	X	X		X	F					X		
Decontamination Building (69)	X	X			A, B, C, D, F, H, J, K	X		X	X	X		
General In-Process Warehouse (71)	X	X		X	B, F				X			
Drum Storage Building (72)	X	X			B, F							
Fire Brigade Training Center Bldg. (73A)	X											
Fire Training Pond (73B)	X					X		X	X			
Fire Training Tank (73C)	X											

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TABLE D.11 (Cont'd)

Component/Designation	Radiological Contaminants					Chemical Contaminants						
	Alpha Spectrometry			Gamma Spec	Radio-chem[b]							
	U	Th	Pu			VOCs	SVOCs	PCBs	TPH	Metals	Pb/Hg	Anions
Fire Training Burn Trough (73D)	X					X	X	X	X	X		
Confined Space Burn Tank (73E)	X											
Plant 2 East Pad (74A)	X	X			B, F							X
Plant 2 West Pad (74B)	X	X	X	X	A, B, C, D, E, F, H, J, K				X	X		X
Plant 8 East Pad (74C)	X	X	X	X	A, B, C, D, E, F, H, J, K				X	X		X
Plant 8 West Pad (74D)	X	X			F	X			X	X		X
Plant 4 Pad (74E)	X	X			B, F							
Plant 7 Pad (74F)	X	X			B, ,F							
Plant 5 East Pad (74G)	X	X			B, F					X		
Plant 5 South Pad (74H)	X	X			F					X		
Plant 6 Pads (74J)	X	X			B, F							
Plant 9 Pad (74K)	X	X		X	A, B, C, D, E, F							
Building 65 West Pad (74L)	X	X		X	B, F							
Building 64 East Pad & R.R. Dock (74M)	X	X		X	B, F	X				X		
Building 12 North Pad (74N)	X					X	X	X	X	X		
Decontamination Pad (74P)	X	X		X	B, C, D, E, F			X	X	X		
Plant 8 Old Metal Dissolver Pad (74Q)	X									X		
Plant 8 North Pad (74R)	X	X			B, F					X		
Building 63 West Pad (74S)	X											
Plant 1 Storage Pad (74T)	X	X	X	X	A, B, C, D, E, F, H, J, K	X				X		X
Pilot Plant Pad (74U)	X	X		X	F				X			X
Laboratory Pad (74V)	X	X	X	X	A, B, C, D, E, F, H, J, K					X		X
Finished Products Warehouse(4A) (77)	X				B							
D & D Building (Under Constr.) (78)	X											
Plant 6 Warehouse (79)	X											
Plant 8 Warehouse (80)	X											
Plant 9 Warehouse (81)	X											
Receiving/Incoming Mat'ls. Insp. (82)	X											
Clearwell Line (88)	X	X			B, C, D, E, F							X
Parking Lot (89)	X								X			
Skeet Range Building (90)	X										X	
Railroad Tracks (G-001)	X	X			C, D, E, F					X		
Roads (G-002)	X	X			A, B, C, D, E, F				X			
Storm Sewer System (G-003)	X	X		X	A, B, C, D, E, F							
Sumps (G-004)	X	X		X	A, B, C, D, E, F							
Dikes (G-005)	X	X			A, B, C, D, E, F							
Utility Lines (G-006)	X											
Underground Storage Tanks (G-007)	X	X		X	A, B, E, F							X

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TABLE D.11 (Cont'd)

Component/Designation	Radiological Contaminants					Chemical Contaminants						
	Alpha Spectrometry			Gamma Spec	Radio-chem[b]							
	U	Th	Pu			VOCs	SVOCs	PCBs	TPH	Metals	Pb/Hg	Anions
Aboveground Storage Tanks (G-008)	X											X
Process Trailers (G-009)	X											
Non-process Trailers (G-010)	X											
Pipe Bridges (G-011)	X										X	
Drums (Non-RCRA) (G-012)	X	X			B, E, F							
RCRA Drums (G-013)	X	X			B, E, F							
Inventory (G-014)	X	X			B, F							
Mobile Containers (Sea-Land) (G-015)	X	X		X	B, C, D, E, F							
East of Plant 2 (P-001)	X	X	X	X	B, C, D, E, F, H, J, K	X	X					
South of Plant 8 (West) (P-002)	X	X	X	X	B, C, D, E, F, H, J, K	X	X					
South of Plant 8 (Mid) (P-003)	X	X	X	X	C, D, E, F, H, J, K	X	X					
South of Plant 8 (East) (P-004)	X	X	X	X	C, D, E, F, H, J, K	X	X					
South of Bldg. 80 (P-005)	X	X		X		X	X					
West of Plant 5 (P-006)	X	X		X		X	X					
West of 7 Plex (North) (P-007)	X	X		X		X	X					
Covered West of 7 Plex (South) (P-008)	X					X	X					
North of Plant 9 (Near Basin) (P-009)	X	X		X	B, C, D, E, F	X	X					
Covered Dirt Pile between R.R. track #6 and #9 (P-010)	X	X		X	A, B, C, D, E, F	X	X					
Construction rubble pile east of coal pile runoff basin (P-011)	X	X		X	A, B, C, D, E, F	X	X					
East of coal pile runoff basin (P-012)	X	X		X	A, B, C, D, E, F	X	X					
Rock salt pile South of Bldg. 61 (P-013)	X											
Sand piles South of Bldg. 61 (P-014)	X											
Covered East of Bldg. 56 (P-015)	X					X	X					
Gravel North of Bldg. 56 (P-016)	X											
Copper metal scrap pile (P-017)	X	X		X	B, C, D, E, F					X		
Coal pile (P-018)	X	X		X	B, C, D, E, F							
Third Street dirt pile (P-019)	X	X		X	B, E, F	X	X					
Partially covered along Track #11 (P-020)	X					X	X					
Southwest corner of lab (P-021)	X					X	X					
North of Bldg. 67 (P-022)	X					X	X					
Scrap metal pile (P-023)	X	X		X	A, F					X		
NW rubble piles (P-024)	X					X	X					
Outside Equipment Storage Area (P-025)	X	X		X	A, C, D, E, F				X		X	
Tension Support Structure #1 (TS-001)	X	X										
Tension Support Structure #2 (TS-002)	X	X										
Tension Support Structure #3 (TS-003)	X	X										

See footnotes on next page.

TABLE D.11 (Cont'd)

[a] If a component designated as an S1 exceeds action or decision levels, the component will be sampled according to the component-specific analyses listed above.

[b] LEGEND

A = Strontium-90
B = Technetium-99 (enriched uranium)
C = Polonium-210
D = Lead-210
E = Radium-226
F = Radium-228 with thorium-232
H = Neptunium-237 (whenever plutonium-239 & americium-241)
J = Plutonium-241
K = Americium-241

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Tables A3.0 and A3.1 by applying the discussion of radiological contaminants in Section D.4.2 and chemical contaminants in Section D.4.3. Table A.3.0 includes all substances, hazardous or nonhazardous, known to have been used in significant quantities in each component. Table A.3.1 summarizes EPA-listed contaminants detected in environmental media (soil or water) in samples taken in the vicinity of specific OU3 components. Table A.3.2, therefore, includes contaminants that are both suspected of being present in OU3 components and are of interest from a health and environmental standpoint.

The contaminants listed in Table A.3.1 (environmental media) may or may not have originated in the associated OU3 components. Moreover, because of their high mobility, some classes of contaminants that may have originated in OU3 components may no longer be present there at levels of concern. This possibility applies particularly to VOCs and anions, which migrate readily in surface runoff. VOCs (and SVOCs) and anions, therefore, will be sampled mainly at the interfaces between OU3 and environmental media, particularly in sumps and drains, to account for their presence in environmental media. Such locations are also of interest in that they represent collection points for runoff from floors and other large surfaces of OU3 components. Therefore such locations can be considered integrated source terms.

Table D.11 is divided into radiological and chemical contaminant sections. Under each, contaminants of interest are given by their associated analysis group. For instance, all of the specific uranium isotopes determined by alpha spectrometry for uranium given in Section D.4.5.2 will be analyzed. Similarly for gamma spectrometry, the entire suite of radioactive contaminants listed in Section D.4.5.2 will typically be analyzed when this analysis is called for. Radiochemistry, on the other hand, will be performed on specific radionuclides of interest from the list in Section D.4.5.2. The selected analytes will vary from component to component, depending on process knowledge.

For organic chemical contaminants, the group names refer to standard EPA lists of contaminants that are analyzed for in their entirety for a given sample. For instance, approximately 34 VOCs or 65 SVOCs are analyzed in a single run of each analysis. Unlike the lists of radiological contaminants, not all of the substances on a given analysis list may be suspected in a particular sample, but are analyzed efficiently at minimum additional cost. Because these analysis groups embrace a comprehensive list of industrial chemical

contaminants, analysis of the entire group will ensure that all plausible chemical contaminants of concern are analyzed, even though many of them are not suspected of being present at levels of concern in OU3.

The analysis of trace metals has been broken down into two groups given as "metals" and "Pb/Hg." The former refers to the 23 metals on the EPA's target analyte list (TAL), while the latter refers only to lead and mercury. Analysis of TAL metals is appropriate when all or some (usually several) of the metals on the list, which includes lead and mercury, are of interest. Lead and mercury analysis, on the other hand, is appropriate when only these elements are of interest because of general concerns in OU3 components. (Lead is of concern because of its use in construction materials, and mercury is of concern because of its mobility and high toxicity.) To save the expense of analyzing the entire TAL when only lead and mercury are of interest, a separate grouping is given. Further partitioning of the TAL is not considered necessary or cost effective.

D.4.11 Development of Field Implementation Procedures

This section outlines the general procedure to be followed when component-specific field implementation procedures (FIPs) are compiled. The "libraries" of actual protocols and procedures to be used in the FIPs are presented in Sections D.5 and D.6, respectively. Component-specific FIPs will be compiled for each component before sampling. However, to ensure that the prevailing condition of the component is accommodated, final revisions are possible up until the actual time of sampling. This approach provides considerable flexibility and specificity for sampling individual components, while retaining provisions for overall quality assurance and standardized protocols and procedures in the SAP itself.

The sampling approach and methods found in individual FIPs will initially be dictated by the significance (S) designation of individual components in conjunction with any specific data needs identified for a component to support specific RI/FS objectives. Protocols and procedures will be modified to meet any component-specific RI/FS data needs. This initial configuration should be considered a default condition for sampling a component. The configuration can and should be modified in the various FIPs if the status of the component with respect to the RI/FS data needs changes prior to sampling, or if additional information emerges regarding contamination levels in the component.

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D.4.11.1 Content of the FIPs

The primary function of the component-specific FIPs is to identify actual sampling locations and analytes of interest in individual OU3 components. Therefore, FIPs will make extensive use of maps and drawings. These maps and drawings will be used with the standardized sampling protocols given in Section D.5. Sampling locations will be determined on the basis of the sampling approaches and protocols and will be indicated on the associated maps or drawings when the FIP is compiled.

The second major component of the FIPs will be a listing and description of all elements and of all media to be sampled. This information will be recorded on a standard "element and media inventory" (EMI) form that will be developed. Media sampling locations will also be indicated on a map or drawing.

The third major component of the FIPs will be an inventory of all items and features within a given OU3 component that need to be addressed in the sampling program. Each item or feature in the inventory will be categorized into one of the 12 "elements" for which sampling protocols are available in Section D.5 and recorded on the EMI form. The objective of this process is to ensure complete characterization of OU3 components by accounting for and categorizing every item and feature within a given component.

The last major component of the FIP will be a compilation of all sampling and analysis protocols and procedures required for the various categories of sampling elements present in a given component, and found in the SAP libraries of protocols (Section D.5) and procedures (Section D.6). These "default" sampling protocols will be modified as necessary to account for the prevailing condition of the component and thus produce the set of "final" sampling protocols and sampling and analysis procedures required.

D.4.11.2 Procedure for Preparing Component-Specific FIPs

The following is a detailed procedure for compiling FIPs for individual OU3 components, once the decision has been made to proceed with sampling a given component. The protocol is presented in a step-by-step fashion.

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1. Review the U, F, and S ranking for the component.
   (a) Review the reasons codes applied to the component for the U, F, and S rankings.
   (b) Tour the facility to perform a visual inspection of the component features.
2. Review the component-specific RI/FS data needs.
   (a) Review work plan Section 3.1 to determine data needs related to risk assessment.
   (b) Review work plan Section 3.4 to determine data needs related to remedial action alternatives evaluation process.
   (c) Evaluate 2a and 2b with respect to step 1 above.
   (d) Summarize information from steps 1 and 2.
3. Obtain all current maps and/or drawings for the component of sufficient detail and accuracy to show all significant component features and sampling locations.
   (a) Generate a comprehensive set of drawing files for each component.
   (b) Use photographic and videographic techniques to supplement any missing drawings, or to add additional detail for U3 components or unique component features (e.g., equipment), and/or to support training.
4. Review relevant existing information on the component. Compare to the data needs collected in steps 1 and 2 and determine data gaps for the component. If data gaps exist, continue.
   (a) Review existing summary level data in work plan Appendix A.
   (b) Obtain most current radiological survey data from site sources.
   (c) Obtain relevant data generated by removal actions and ongoing activities.
   (d) Review data from past OU3 and current OU5 RI/FS sampling.

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(e) Review current RCRA program assessments related to the component.

(f) Review other relevant sources of information as needed (Spill Prevention Control and Countermeasures Plan, Asbestos Site Survey, Air Emissions Permits, Historical Emissions Data, etc.).

(g) Validate the data to the levels necessary to support data quality objectives. Nonvalidated data can be used as indicative, but not definite.

(h) Summarize 4a through 4g.

(i) Finalize the component-specific list of analyses from Table D.11.

5. Inventory all significant surfaces, features, equipment, and other items to be sampled within the component. Compare the inventory with existing lists. Account for missing items and document. Note the presence of previously unidentified items and document.

(a) Review listings of installed equipment and features for the component (capital equipment lists, safe shutdown program equipment inventories, abandoned-in-place (AIP) equipment lists, etc.).

(b) Perform component inspection to validate listings and/or augment/correct.

6. Assign each significant surface, item, or feature within the component to one of the 12 sampling protocols of the OU3 SAP. Complete one FIP element and media inventory (EMI) form per component or component group.

7. Write a sampling strategy statement for the component. State briefly how each major objective of the RI/FS will be met, including risk assessment, ARARs, and remedial alternatives development/evaluation.

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8. Identify all relevant protocols, procedures, etc., to be utilized for component evaluation.

   (a) Select and identify all require element-specific sampling protocols from the SAP, Section D.5.

   (b) Compile all required parameter and media-specific sampling and analysis procedures from the SAP, Section D.6.

   (c) Modify, if necessary, the standard approaches, methods, protocols, and procedures to meet component-specific conditions if different from standard conditions/assumptions.

9. Modifications must be reviewed and concurred with by the quality assurance manager and the statistical team manager to provide an equivalent level of data quality to that of the standard approach, method, protocol, or procedure. Need for modifications will be based on evaluation of existing data or unique features.

10. Lay out measurement and sampling grids on maps and/or drawings, indicating locations for media-specific sampling and the locations for specific analytes.

    (a) Identify locations for analytical support levels (ASLs) A & B measurements.

    (b) Identify locations for ASLs C & D sampling (preliminary, then final following evaluation of ASL A/B measurements).

11. Describe a sample designation and documentation scheme for all survey and discrete sampling locations and samples (database management).

    (a) Operate in accordance with procedures for database management.

12. Indicate the locations, parameters, and frequency of quality assurance samples to be collected, consistent with relevant analytical support levels as described in SAP Section D.3.

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D.5 PROTOCOLS FOR MEASUREMENTS AND SAMPLING

The measurement and sampling protocols presented in this section provide the basis for characterizing the nature and extent of contamination in OU3. The protocols employ the sampling approaches and ASLs described in Section D.3. When implemented, protocols are set up specifically for each OU3 component by describing the expected media encountered and defining the nature, quantity, and spatial distribution of measurements and sampling.

The protocols have been developed for groups of related sampling situations and subjects that are similar with regard to measurement and sampling requirements. All major types of sampling situations in OU3 are represented within the following list of 12 protocols as illustrated in Table D.12. These protocols, when applied to each component, establish the total number of samples to be taken and the level and type of analysis to be performed for both radioactive and chemical contaminants:

1. *Buildings* — This protocol provides characterization guidelines and criteria for all buildings, warehouses, trailers, tension-support structures, and quonset huts. Elements of this protocol provide for characterization of common aspects such as floors, interior and exterior walls, ceilings, roofs, girders and beams, hoods and booths, stairs and stairwells, elevators, and other fixed features (such as light fixtures). Building materials are also examined for any bulk contaminant concentrations that are the result of penetration and/or absorption.

2. *Machinery* — This protocol provides characterization criteria to investigate larger fixed and semifixed machines, such as mills, lathes, balers, briquetters, shredders, jaw crushers, saws, presses, shears, grinders, turbines, and associated motors and transmissions.

3. *Vessels and Associated Support Structures* — This is a collective protocol and provides characterization criteria for a broad variety of tanks, vats, furnaces, baths, basins, pits, and similar vessels within production facilities and production support functions. This protocol also includes condensers, digestors, reactors, extraction columns, scrubbers, process sumps, and other containers that have similar features. Surfaces, and liquid and solid contents are characterized for potential contaminants.

TABLE D.12 Protocols Related to Component Categories I/II 3297

Level I/II Component Grouping	Typically Applicable Protocols[a]
1A — Warehouse and storage buildings[b]	1 — Buildings 2 — Pipes, lines, pumps, and valves 5 — Vessels 6 — Air filtration and paths 9 — Containerized materials and wastes
1B — Administrative buildings[b]	1 — Buildings 4 — Pipes, lines, pumps, and valves 6 — Air filtration and paths
1C — Process buildings[b]	1 — Buildings 4 — Pipe, lines, pumps, and valves 5 — Vessels 6 — Air filtration and paths 7 — Liquid filtration and paths 9 — Containerized materials and wastes 11 — Transferring, handling, and sampling equipment 13 — Machinery
1D — Process support buildings[b]	1 — Buildings 4 — Pipes, lines, pumps, and valves 5 — Vessels 6 — Air filtration and paths 7 — Liquid filtration and paths 9 — Containerized materials and wastes 11 — Transferring, handling, and sampling equipment 13 — Machinery
2A — Aboveground containers and containerized materials	5 — Vessels 9 — Containerized materials and wastes
2B — Belowground containers and containerized materials	2 — Surface impoundments and runoff systems 5 — Vessels 9 — Containerized materials and wastes
3 — Bulk material	3 — Waste piles 5 — Vessels 13 — Machinery

TABLE D.12 (Cont'd) 3297

Level I/II Component Grouping	Typically Applicable Protocols[a]
4 — Parking lots, railroads, roads, and pads	11 — Transferring, handling, and sampling equipment 12 — Pads and pavement
5A — Aboveground piping, utilities, and equipment	4 — Pipes, lines, pumps, and valves 5 — Vessels 6 — Air filtration and paths 11 — Transferring, handling, and sampling equipment 13 — Machinery
5B — Belowground piping, utilities, and equipment	4 — Pipes, lines, pumps, and valves 5 — Vessels 11 — Transferring, handling, and sampling equipment
6 — Ponds and basins	2 — Surface impoundments and runoff systems 4 — Pipes, lines, pumps, and valves 7 — Liquid filtration and paths

[a] Protocol 14, Other Items, may be applicable to most or all of the level I/II component groupings.

[b] Protocol 12, Pads and Pavement, may be applicable to most of the level I/II component groupings 1 (buildings).

4. Pipes, Lines, Pumps and Valves — This protocol provides for the characterization of all piping, lines, pumps, traps and valves associated with process lines, sanitary sewer lines, and similar conduits. External and internal surfaces are characterized, along with any expected contaminants in liquid and solid form.

5. Heating, Ventilating and Air Conditioning (HVAC) Equipment and Air Pathways — This protocol provides characterization criteria for HVAC ducts and filters, dust collectors and ductwork, cyclone separators, precipitators, stacks, and similar items potential surface and bulk solid contaminants.

6. Liquid Pathways and Filtration — This protocol provides characterization criteria for solids, liquids, and surface for sand filters, bed filters, separators, centrifuges, and similar features.

7. Containerized Materials and Wastes — This protocol provides characterization guidelines and criteria for any surface contaminants, plus the internal contents of drummed and containerized material. These are containers of products, process and maintenance materials, and wastes. These items are considered sufficiently distinct from others that a specific protocol was developed. The materials and the containers holding the material have had a single purpose for use, storage, and disposition, thereby necessitating a distinct protocol.

8. Transferring, Handling, and Sampling Equipment — This protocol provides characterization criteria for conveyors, bucket elevators, drum sampling equipment, loading/unloading stations, scales, drum dumpers, cranes, and related items.

9. Surface Impoundments and Pathways — This protocol provides characterization criteria for the broad scope of impoundments, ranging from larger units (such as the storm water retention basin) to small dikes, dams, and sumps in the surface runoff pathways. These items are associated with man-made facilities within OU3 and do not include similar features that are a part of OU5 (Environmental Media). Water and liquids are characterized along with sediments and freeboard perimeters.

10. Waste Piles — This protocol provides characterization criteria for waste soil and construction rubble piles for the nature and extent of contaminants in soil, concrete, asphalt, and related materials. Scrap metal piles are also provided for within this protocol.

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11. Pads and Pavement — This protocol provides characterization criteria for exterior concrete pads, sidewalks, roadways, parking lots, and similar surfaces for potential surface contaminants and bulk concentrations through any penetration or absorption.

12. Other Items — This protocol provides characterization criteria for generic measurement and sampling of items that are not otherwise provided for in one of the above protocols. This protocol also discusses the ongoing programs involving drummed material.

Each of the above 12 protocols is described in detail in Sections D.5.1 through D.5.12. As discussed in Section 4.1 of this work plan addendum, there are distinct levels of investigation related to the U, F, S designations for OU3 components. The variable with the strongest relationship to the development of the protocols is the significance (S) rankings for each component, since this variable is based on the type, extent, and level of contamination. Protocols will identify the nature of measurements related to the component-specific contaminants present. The types of samples to be collected are identified, and analyses are related to the component-specific analyte list discussed in Section D.4.10. Allowance is made for alteration of the protocols to exclude investigation of known contamination or characteristics and to further investigate areas of concern. These adjustments will occur in preparation of the component-specific field implementation procedures (FIPs).

The protocols are complete in that they address the data needs and decision requirements as presented in the work plan. The base condition or assumption for applying these protocols is that all components are expected to have some contamination. (S1 indicates little or none, but assumes the component is not ready for free release.) Additional assumptions include recognition that existing information will be used to the fullest extent practical. To ensure efficient sampling, the judgmental approach will be used to select the regions of a component that are to be measured or sampled. Process knowledge in connection with the component specific analyte list is used to direct the sampling effort. The following protocols, therefore, take into account that samples and measurements are taken in areas where similar activities have taken place. This assumption provides a means of comparing all sample results taken from similar areas. Information collected in this manner supports both qualitative and quantitative uncertainty analysis, as well as specified confidence limits.

The lineal and areal extent of surveys and sampling are provided. Many of the survey and sampling locations are fixed (e.g., a matrix, a grid over an area, or some minimum

number of locations for a given areal extent), while some are more loosely identified (e.g., one sample per larger specified areas and one per HVAC unit within a building). Most of the sample and measurement areas or regions are selected in a judgmental fashion as discussed in Section D.3.3.1, thereby specifying suspected contaminated sampling areas (e.g., exit/entries to controlled areas, vacuum cleaner dirt, HVAC filter aliquots). The selection of specific sampling locations within a region is randomized (see Sections D.3.3.2 and D.3.3.3). A fraction of the selected sample locations provide material suitable for detailed analysis of the component-specific contaminants at high ASLs. This procedure ensures a complete investigation, taking into account process and operations knowledge and/or recent data from other programs (e.g., removal actions and routine health physics and industrial hygiene monitoring).

It is not likely that a specific component within OU3 is presently characterized to the degree that no additional measurements, sampling, or analyses are required to meet the objectives of the RI. However, that possibility does exist and may be applied with justification. It is the likely case that some knowledge of specific characteristics may be known, but that certain additional information is necessary to provide satisfactory characterization. It is intended that all existing data (summarized in Appendix A, Volume 2) will be used to the maximum extent practical. The number and location of additional contaminant surveys are based on the use of the existing data.

As shown in Appendix A, there are essentially no significant components within OU3 whose status or characteristics are completely unknown. Each component has its own challenges and features that require judgments that may result in limited departure from the standard protocols at the time field procedures are implemented. The potential need for additional measurements and sampling following access to more complete information has been built into each protocol.

D.5.1 Buildings

Hazardous locations without secure access, such as high-pitched roofs and high elevations, will be avoided. The nearest access or downgradient path will be characterized. Examples of the latter locations include nearest flooring, stairs, landings, walkways, gutters,

and runoff paths. If significant contamination is expected on an inaccessible area, special safe services will be established to permit characterization through appropriate protocols.

For the purposes of developing the buildings protocol two distinct types of surfaces are assumed: (1) vertical and inaccessible and (2) horizontal and accessible. These types of surfaces are described in the buildings protocol as class A surfaces and class B surfaces, respectively. The segregation on this basis stems from process knowledge and the recognition that the potential for spreading of contaminants, as well as the deposition processes, are significantly affected by the geometric orientation of the surface.

D.5.1.1 Class A Surfaces

Class A surfaces are identified as walls, ceilings, roofs, and similar surfaces. This class also includes doors, windows, curtains, exterior canopies and covers, drapes, hoods, booths, interior subwalls and panels, closets, stalls, cabinets, other interior room-like enclosures.

Radiological Surveys and Sampling

Surveys (direct surveys and swipes) at the ASLs A and B are required for those components without existing data. Surveys may also be required to ensure a complete data set for those components with existing data. The determination of which components with existing data need additional measurements is based on the number of measurements required by these protocols compared with the number of existing measurements. Included in this evaluation is the representativeness of the existing sample and survey distribution within areas with similar activities and uses.

Instrument Surveys and Removable Contamination Swipes. Alpha and/or beta-gamma contamination measurements, as appropriate for known and/or suspect contaminants, will be made at random locations over the appropriate feature area. The specific features to be measured within a component are selected by a judgmental approach so as to afford the greatest precision with respect to addressing the problem areas. Existing data and process knowledge will be used to select the features to be surveyed.

The number of measurement locations for a particular feature (e.g., a wall, a floor, etc.) within a component depends on the significance level initially assigned to the component and on the particular feature being characterized. Components designated S1 will require measurements on class A surfaces corresponding to one measurement location (survey and swipe) for every 1,000-ft^2 area. Components designated S2 will require two measurement locations for each 1,000-ft^2 area, and components designated S3 will require three measurement locations for each 1,000-ft^2 area. The precise determination of measurement locations is based on the use of a grid divided into cells as appropriate. A random number generator will be used to determine the appropriate location within the cell to measure, thus ensuring that the entire area has an equal probability of being characterized.

Swipes of removable surface contamination are to be taken near the same location as the instrument surveys. After gross alpha and beta counting, swipes in excess of the removable AL will be retained for compositing for analysis at ASLs C and D for known and/or suspected contaminants. Those locations with radiological results (surveys and swipes) in excess of ALs or DLs will be used to direct the selection of locations to obtain solid and liquid samples for analysis at ASLs B, C, or D.

Liquid Samples. ASLs B/C and D are required for components initially designated as and S2 or S3. Most liquids that are associated with buildings are covered by other protocols. It is possible that standing liquids may be present on these surfaces, particularly on flat roofs. One composite sample will be collected per component, as available, and analyzed for the component-specific contaminants of interest at ASL B/C.

Solid Samples. ASLs B/C and D are required for components initially designated as and S2 or S3. Contamination survey results, including instrument measurements and swipe samples at ASLs A and B, will be inspected. If no ALs have been exceeded, no solid samples of these surfaces are necessary. S2 and S3 components where ALs have been exceeded require ASL B/C sampling of one location with high ASL A or B results per distinct process area within the component. A minimum of one ASL B/C sample per component is required. Additionally, S3 components require sampling of 10 locations per process area (representing an average contamination level for that process area) composited for one ASL B/C analysis per process area. For S3 components, one ASL D sample will be submitted

for analysis for every 10 ASL B/C samples submitted. A minimum of one ASL D sample per S3 component is required.

Examples of potential solid samples include surfaces or cores of concrete, surfaces or cores of wood, surfaces and pieces of metal, drywall pieces, surfaces or sections of transite and similar construction materials, and surface residues from various media. In the majority of cases the solid samples will be restricted to porous material and will be obtained with standard scraping tools. For class A surfaces where the contamination appears to have penetrated into the media, a core sample will be obtained and analyzed to determine the depth of contamination. Core samples will be taken at the frequency specified above for ASL B/C and D samples. Scrapings and cores must be obtained such that there is a minimum of 100 g of solid for each analysis.

Chemical Surveys and Sampling

ASL A and B samples or measurements will be taken only in those components that have suspected chemical contaminants. The procedures and equipment used will include X-ray fluorescence (XRF) for trace metal surface contamination and PID measurements of non-specific organic vapors. PCB field test kits may be used in areas around electrical equipment. Section D.4.3 provides guidance in collecting ASL B/C and D samples for chemical contaminants.

Instrument Surveys and Removable Contamination Swipes. XRF measurements for trace metals may be made on class A surfaces in S2 or S3 components. When ALs are exceeded, the specific locations in the immediate vicinity are evaluated to determine the appropriate location for the level B/C and D samples. PID monitoring for organic vapors can also be used if necessary. The same sample site selection criteria (random selection based on S1, S2 and S3) as used for radiological measurements is to be used. When the dimension of a feature is less than the minimum dimension specified a single measurement will be taken in that area or region.

Liquid Samples. Refer to the corresponding radiological sampling section for class A surfaces.

Solid Samples. If specific chemical-directed sampling efforts are warranted to supplement sampling performed for the radiological protocol above, it will be directed at suspect areas. At a minimum, S2 and S3 components will require ASL B/C sampling of one suspect area, as available. If ASL A and B surveys indicate contamination levels in excess of DLs, then at least one ASL B/C sample will be required in each suspect area, as available. A minimum of one sample per component is required. Additionally, S3 components will require sampling of 10 locations per process area where chemical contaminants are suspected (representing an average contamination level for that process area), composited for one ASL B/C analysis per process area. A minimum of one ASL B/C sample will be generated per S3 component. Additionally, one ASL D sample will be submitted for analysis for every 10 ASL B/C samples submitted. A minimum of one ASL D sample per S3 component is required. Potential solids for sampling are the same as identified for radiological samples above.

D.5.1.2 Class B Surfaces

Class B surfaces are floors and horizontal surfaces with potential for accumulated contamination. This class includes horizontal surfaces within buildings that are associated with items listed for class A. Included are such items as counter tops, shelves, and the bases of hoods, booths, and cabinets. Sampling and measurements locations are increased (higher ratio of samples to sample area) because of the increased possibility for accumulation of contaminants relative to vertical surfaces.

Radiological Surveys and Sampling

ASL A and B measurements and swipes are required as appropriate. The guidelines for determining the appropriateness of sampling is in general similar to that for class A surfaces. The relationship between the number of measurements and the sample area is also similar to that for class A surfaces.

Instrument Surveys and Removable Contamination Swipes. Alpha and/or beta-gamma contamination measurements, as appropriate for known and/or component-specific contaminants, will be made at random locations within cells. The number of cells, and hence the measurements, is the same as that used for the surveys.

Supplemental gamma ray measurements can be made in areas where the contamination levels are high with a 2- x 2-in. NaI (Tl) detector on the same matrices as those established for contamination measurements. These additional measurements are used to determine the specific isotopes contributing to the measured activity. Section D.4.7 describes suggested usage.

Components designated S1 will require measurements on class B surfaces corresponding to one measurement location (for both the survey and the swipe) for every 360-ft^2 area. Components designated S2 will require two measurement locations for each 360-ft^2 area. Components designated S3 will require three measurement locations for each 360-ft^2 area. The precise determination of the measurement locations is based on the use of a grid divided into cells as appropriate. A random number generator will be used to determine the appropriate location within the cell to measure, thus ensuring that the entire area has an equal probability of being characterized (see Section D.3.3).

Swipes of removable surface contamination are to be taken near the same location as the instrument surveys. After gross alpha and beta counting, swipes in excess of the removable AL will be retained for compositing for analysis at ASLs B/C and D for known and/or suspected contaminants. Those locations with radiological results (surveys and swipes) in excess of ALs or DLs will be used to direct the selection of locations to obtain solid and liquid samples for analysis at ASLs B/C, or D.

Liquid Samples. ASLs B/C and D are obtained as appropriate on the basis of the process areas encountered and the availability of sufficient liquid material for analysis. Most liquids are associated with units covered under other protocols. Standing liquids on roofs have been described in the first part of this protocol. It is possible that standing liquids may be present on floor surfaces. One composite sample will be collected per component, as available, and analyzed for all potential contaminants at ASL B/C.

Solid Samples. ASLs B/C and D are obtained as appropriate on the basis of the process areas encountered and the availability of sufficient solid material for analysis. Contamination survey results, including instrument measurements and swipe samples at ASLs A and B, will be inspected. If no ALs have been exceeded, no solid samples of these surfaces are necessary. S2 and S3 components where ALs have been exceeded require

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ASL B/C sampling of one area with high ASL A or B results per distinct process area within the component. A minimum of one ASL B/C sample per component is required. Additionally, S3 components require sampling of 10 locations per process area (representing an average contamination level for that process area) composited for one ASL B/C analysis per process area. For S3 components, one ASL D sample will be analyzed for every 10 ASL B/C samples submitted. A minimum of one ASL D sample per S3 component is required.

Chemical Measurements and Sampling

ASL A and B samples or measurements will be taken only in those components suspected to have chemical contaminants. X-ray fluorescence (XRF) will be used for trace metal surface contamination, and PID measurements will be taken of nonspecific organic vapors. PCB field test kits may be used in areas around electrical equipment. Section D.4.3 provides guidance in collecting ASL B/C and D samples for chemical contaminants.

Instrument Surveys and Removable Contamination Swipes. XRF measurements for trace metals may be made on class B surfaces and are used where warranted on the basis of the surface contamination. When ALs are exceeded, additional locations in the immediate vicinity will be selected to determine areal extent. As necessary, PID monitoring for organic vapors can also be used. The grid specified for radiological measurements can be employed. Where the dimension of a feature is less than the specified dimension to be applied, a single measurement will be taken in that region. Swipe samples for removable chemical contamination may be taken when appropriate.

Liquid Samples. Refer to the radiological sampling section for class B surfaces.

Solid Samples. ASLs B/C and D are required. If specific chemical-directed sampling efforts are warranted to supplement sampling performed as described in the radiological section above, it will be directed to suspect areas. Components with S2 and S3 ratings will require, as a minimum, ASL B/C sampling of one suspect area as available. If ASL A and B surveys indicate contamination levels in excess of DLs, at least one ASL B/C sample will be required in each suspect area as available. A minimum of one ASL B/C sample per component is required. Additionally, S3 components will require sampling of

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10 locations per process area composited for one ASL B/C analysis per process area. For S3 components, one ASL D sample will be taken for every 10 ASL B/C samples taken. A minimum of one ASL D sample per S3 component is required.

D.5.1.3 Air Samples

Air samples are collected to determine the airborne concentration of air particulate radionuclides with long half-lives. Additional sampling will be conducted for thoron (radon-222) and/or radon-222 daughters in buildings where significant radium-226 is present. In buildings where significant thorium-232 is present, additional sampling will be conducted for thoron (radon-220) daughters.

Airborne concentrations are primarily of significance for occupational exposure. These concentrations also serve for input to risk assessment, and they can demonstrate the degree of entrainment and resuspension that occurs from contaminant sources. Air sampling locations are selected to be most representative of worker breathing zones within the facilities. High-volume air samples (tens of cubic feet per minute) should be used where sampling periods may be limited (noncontinuous). Where possible, continuous air sampling will be used for representativeness.

At least one air sampler will be in operation per building undergoing investigation. This sampler will be started one week before data collection to establish ambient conditions and to indicate any potential need for respiratory protection. IRS&T health physics air sample data will be assessed when appropriate.

The number of air sampling locations, beyond one per building, will depend on the ongoing work, the number of personnel, and the number and size of the rooms. At a minimum, an air sampler will be in operation in each room that is occupied for 40 hours per week and where it is possible that contaminants could lead to airborne concentrations in excess of health and safety ALs.

In buildings where radium-226 could lead to airborne radon-222 and/or where thorium-232 could lead to airborne radon-220, grab samples will be collected daily for one week (five work days) before RI work begins. If the grab samples show concentrations in excess of 0.02 working level (WL) then a continuous sampling program will be initiated. Radon and/or thorium daughters will be monitored by a continuous air monitor. If the chosen

unit does not have real-time readout, the stored data within the instrument will be read out every 24 hours for comparison with ALs.

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D.5.1.4 Other Measurements and Sampling

The buildings within OU3 encompass a broad range of potential sources of contamination. The sample collection team will be alert to conditions that indicate the need for supplemental measurements and sampling. Some examples of areas with high potential for contamination include entry/exit points and frequently handled items, such as light switches and control handles. Some items represent additional sensitivity and may deserve sampling. Examples include cleaning equipment, such as mop heads and vacuum cleaner contents, which may be retained and composited for ASL B/C and D analysis.

D.5.2 Machinery

The machinery protocol provides for investigation of larger fixed and semifixed machines, such as mills, lathes, bailers, briquetters, shredders, jaw crushers, saws, presses, shears, grinders, turbines, and associated motors and transmissions. An initial inspection will be performed and notice will be taken of the presence of grindings, shavings, and similar materials that have been created through use of the machinery. In addition, notice will be taken of any accumulated fluids, such as lubricants, cutting oils, or other liquids.

Review of existing information will suggest the nature of materials associated with the machinery and the potential presence of contaminants of concern. Particular attention will be paid to lubricants, solvents, and similar materials that may contain RCRA-regulated constituents.

D.5.2.1 Radiological and Chemical Surveys and Sampling

ASLs A and B are required, as appropriate, for components designated as S2 and S3. Machinery in components designated as S1 will only be surveyed if a problem is known, otherwise no ASL A or B measurements will be taken.

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Unless it is being monitored through another protocol, any distinct base or subsurface associated with the machinery will be monitored for alpha and/or beta-gamma emitting contaminants as appropriate for the component-specific radionuclides of interest. Large surfaces, on the order of 300 ft^2 or more, will be monitored at random locations with the same approach as that for class B surfaces under the buildings protocol. Areas smaller than 300 ft^2 will require two measurements for components designated as S2 and three measurements for components designated as S3. Additionally, any residues associated with the machine, such as grindings, shavings, or metal scraps, will be monitored to determine the presence of potential contaminants. One measurement will be made of each material of a visibly different type.

The functional areas of each machine will be monitored for potential contamination. Examples include cutting tools, saw blades, grinding wheels, cutting blades, pressing and crushing surfaces, and objects of a similar nature. For larger implements, at least one measurement will be made per 4 ft^2 of surface area. At least one measurement will be made of each smaller item. Small areas that cannot be effectively monitored by radiation detection probes will be swiped with at least one swipe per item.

Motors, transmissions, and similar linkages will be monitored for potential surface contamination on external and accessible internal surfaces. Dimensions that are primarily lineal will be monitored along 6-ft intervals with at least one measurement per length. Where dimensions and surfaces deny effective instrument monitoring, swipe samples will be collected (at least one swipe per characteristic surface). Any air or liquid effluent paths associated with the machine will be monitored in accordance with appropriate protocols.

Swipe samples for removable surface contamination will also be taken at measured surface locations. As indicated above, at least one swipe will be taken to characterize a surface where effective instrument monitoring is not possible. Swipe samples exceeding removable contamination ALs will be retained to form composite samples from identical or similar surfaces (one composite for each surface type) for ASL B/C analysis.

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Gamma Ray Measurements

Qualitative gamma ray measurements will be taken at the initial approach to each machine system. Appropriate controls will follow any measurements definitely in excess of the ambient gamma ray levels. If extended areas (more than 25 ft^2) of surface contamination are encountered, gamma surveys may proceed on an approximately 2- × 3-ft grid to characterize the extent of the contaminated zone.

Liquid Samples

ASL B/C and D samples, as discussed previously, will be collected where appropriate on machinery. Any significant accumulated liquids (more than 6 L) associated with a machine will be sampled with at least one sample per liquid type. Composite samples may be appropriate, for liquid accumulations of similar qualities, when sufficient liquid quantities are unavailable.

Solid Samples

ASL B/C and D samples will be collected where appropriate on machinery. Any residues associated with a machine, including grindings, shavings, metal scraps, and similar items that have revealed the presence of contaminants through instrument measurements will be collected for analysis. For components designated as S2 and S3, at least one ASL B/C sample will be collected per machine for each different material present. Additionally, one ASL D sample will be collected per component to represent machines within the component.

D.5.2.2 Other Measurements and Sampling

Machines with low levels of fixed contaminants may have a potential for future reuse in similar operations elsewhere. They also may be useful in remedial action activities for such functions as decontamination and waste minimization. The sampling team will be alert for any other measurements and sampling that will improve the characterization process, given these considerations.

D.5.3 Vessels and Associated Support Structures

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This protocol is intended for a variety of tanks, vats, furnaces, ovens, baths, basins, and pits that are present in OU3. Any associated external structures used for support are also included. A large percentage of these vessels have contained nonhazardous materials (e.g., water storage tanks) and may not need to be characterized. Other vessels have held hazardous and/or radioactive materials, but the characteristics may be adequately known to accomplish most objectives of the RI. Assessment of known or potential hazards is essential before entry or access to any vessels is attempted. No entries will be made without thorough health and safety assessments. Samples from vessels containing hazardous substances will be limited to those sufficient for confirmation, for better estimates of the inventory and source terms of contaminants, and for waste characterization and minimization studies. Related features such as lines, pumps, and valves are covered under Protocol D.5.4 and containerized materials are covered under Protocol D.5.7.

D.5.3.1 Radiological and Chemical Measurements and Sampling

ASLs A and B are required, as appropriate, for components that fit within this protocol. In general, measurements and samples at all ASLs will be required and will be based on the component-specific analyses list (see Table D.11).

Instrument Surveys

Exposed internal and external surfaces will be monitored for alpha and/or beta-gamma emitting contaminants, as appropriate, for known and suspected contaminants. For open vessels with a perimeter surface (e.g., curbing, concrete pit, or sump) contamination surveys will be made 6-ft intervals along the perimeter. With smaller perimeters, at least two representative measurements will be made. Exposed external and internal surfaces will be monitored on a 6- × 6-ft grid. For smaller surfaces, about one measurement will be collected per 9 ft^2 of exposed area, with no less than two measurements per surface (internal and external). Process sumps will require one measurement. Where leakage from vessels to adjacent surfaces or media is evident or likely, those surfaces will be monitored to a reasonable extent.

Where internal contents are known to contain high levels or large quantities of hazardous or radioactive materials, no internal surface contamination measurements will be made. Characterization will be limited to collection of material from the contents for analysis at ASLs B/C and/or D.

Where vessel configuration does not permit internal access by radiation detection probes, contamination surveys will be limited to external surfaces. Where vessels are buried or otherwise inaccessible, no external surface contamination surveys will be made. There is provision for additional characterization through conditional statements later in this protocol. XRF or PID field measurements for chemicals are to be taken in situations where useful.

Removable Contamination Swipes

Swipe samples also will be collected on surfaces in or near the same location as the surveys. In addition, swipe samples will be collected from any vessel opening that is too small to permit access of radiation detection probes. Swipe samples showing greater than removable contamination ALs or DLs will be retained for analysis. The analysis will be made by compositing the swipes from identical or similar items.

Gamma Ray Measurements

Limited qualitative measurements may be made with a 2- × 2-in. NaI (Tl) gamma scintillation detector. Where access to sealed vessels is not possible, external contact gamma ray measurements will be made. When possible, surfaces indicative of potentially higher quantities of contaminants, such as the bottom of a tank where sediments may be present, will be monitored. These measurements will be compared with ambient gamma ray intensity in that area. Contents may be known from process knowledge and similar information. If the contents are unknown, then liquid and solid samples, as appropriate, will be collected to characterize the contents.

Where appropriate, gamma measurements can be used to determine the extent of a contaminated area adjacent to a vessel that has been, or may have been, exposed to contaminants from a leaking or breached vessel. Supplemental surface sampling will also be required.

Liquid Samples

ASLs B/C and D are to be collected, as appropriate, when sufficient material is available or where the rinsate procedure is used. For vessels with sufficient material available and whose contents are unknown, liquid samples will be collected either through immersion of the sampler or release of liquid contents through a valve. At least one ASL B/C composite sample will be taken from each vessel containing an unknown liquid. If less than 6 L is available, then either no sample will be collected, a limited and focused analytical set will be indicated to achieve appropriate sensitivity, or a rinsate procedure will be used. Composite samples from reasonably similar vessels are acceptable. Process sumps will be sampled as needed for evaluation.

Solid Samples

ASLs B/C and D are required for solid samples. Solid samples, if available, will be collected from each vessel of unknown contents. Solid samples may include ashes, sediments, sludges, and other solids that may be present in the vessels. When available, one sample will be collected of relatively loose or available solids per vessel. Solids may also include other media within the vessels, such as ion exchange resins, catalysts, and similar materials related to the process or use of the vessels. When the solid matrix is known, that information will be recorded. As appropriate and available, solid samples will be collected from the interior surface of each vessel requiring characterization where contamination ALs or DLs are exceeded, from internal surfaces that are too small to admit radiation detectors, and from vessels that show definite elevated gamma ray intensities.

At a minimum, vessels within S2 or S3 components will require one composite sample at ASL B/C. S3 components also require one composite sample at ASL D. Samples will be submitted for radiological and chemical analyses. Where vessels are constructed of bulk materials (e.g., concrete) and where contaminated surfaces are identified through surveys, solid samples will be collected from areas where contaminant levels exceeded ALs. The methods described for contaminated floors in the buildings protocol will be followed.

D.5.3.2 Other Measurements and Samples

The sample collection team will remain alert to conditions that indicate the need for supplemental measurements and sampling. The Health and Safety Plan defines procedures regarding entry to confined spaces. For special situations, it may be appropriate to obtain a grab sample of gas-phase contents with a portable pulse pump into a nonreactive (e.g., tedlar) sampling bag. Contents can be analyzed to determine potentially hazardous constituents in the gas phase.

High concentrations of alpha-emitting radionuclides are only known to exist in silos 1 and 2 at the FEMP. In the unlikely event that high alpha-emitter concentrations are encountered elsewhere, the consequences of oxygen and fluoride compound matrices with high alpha particle fluxes should be considered. Nuclear reactions might create neutron fields, which warrant monitoring by neutron detection instruments. As always, liquid and solid samples will be collected for waste characterization or for waste treatability studies when extensive volumes of contaminated materials are identified.

D.5.4 Pipes, Lines, Pumps, and Valves

This protocol provides for pipes, lines, pumps, valves, and related trains within OU3. A large percentage of these features have been used to convey nonhazardous materials and need not be characterized. Such features include services for drinking water, steam, and other nonhazardous process and support materials. Other cases require only limited confirmation sampling, including lines known to carry hazardous or radioactive materials. Samples of the latter will be limited to those sufficient for confirmation, for better estimates of the internal inventory and source term, or for waste treatability and minimization studies (vessels, filters, separators, and similar systems are part of Protocols D.5.3 and D.5.7).

D.5.4.1 Radiological and Chemical Surveys and Sampling

ASLs A and B are required, as appropriate, for components that fit within this protocol. In general, measurements and samples at all ASLs will be required and will be based on the component-specific analyses list (see Table D.11).

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Instrument Surveys and Removable Contamination Swipes

Exposed external surfaces will be monitored for alpha and beta-gamma emitting contaminants, as appropriate, for known or suspect contaminants at 100-ft intervals for aboveground lines outside containment areas (buildings, pads, etc.). Belowground piping will be monitored at accessible locations as practical. Piping and lines within buildings will be assumed to be adequately addressed by inclusion in assessments of leaked materials and vessel contents, thereby reducing the total number of piping systems characterized.

Exposed surfaces of pumps, valves, valve boxes, drain traps, and similar features associated with the line components will be monitored for surface contamination. One measurement will be made per square foot of surface area, with no less than two measurements per item. Those items with openings adequate to admit detector probes will be monitored at influent and effluent surfaces.

Swipe samples will be taken at or near locations where surface contamination measurements are taken. In addition, swipes will be taken from internal surfaces with dimensions too small to permit entry of instrument detectors. Swipes with results in excess of removable contamination ALs will be retained for potential ASL C analysis. The compositing of swipe material or filters must be from similar items.

Gamma Ray Measurements

Limited qualitative gamma ray measurements can be made with a 2- × 2-in. NaI (Tl) gamma scintillation detector. For some features, such as pumps, valves, and traps, access to internal components will be difficult or impossible. External contact gamma ray measurements will be taken on each such component. The measurement will be compared with ambient gamma ray intensity in that area. Contaminants are to be characterized at the nearest influent/effluent paths and will be assumed to be present within the closest valve, pump, or fitting. Such measurements may not be effective for items containing contaminants with minimal levels of gamma-emitting radionuclides.

Liquid Samples

Liquid samples will be collected only for those components initially designated as S2 or S3. When cracking lines in preparation for internal access to lines, valves, pumps, and

similar features, the sampler will place a container below the joint to catch any liquids that may be released. In addition to the liquids intentionally conveyed along these paths, condensate or other unexpected liquids may be present. For appropriate analysis, a total of 6 L per sample is the needed. Composites of like liquids may be made to achieve this volume. With lesser sample volumes, analyses will be limited to the principal known or suspected contaminants to permit adequate sensitivity. A minimum of one sample per S2 and S3 component at ASL B/C is required. One ASL D sample is required for S3 components. Standing liquids will be collected from each trap. The same sample size goals described above apply.

Solid Samples

Solid samples will be collected from the interior of these items and, conditionally, from contaminated media (such as soils) in the vicinity of these items. Solid samples will be collected from the following:

1. Internal surfaces and materials where contamination ALs or DLs are exceeded,
2. Internal surfaces and materials that cannot be accessed for contamination surveys and warrant detailed inspection, and
3. Items that exhibit elevated gamma ray fields (where possible).

For buried lines longer than 25 ft that are known to contain hazardous materials, borings will be made to points below the surface to check for possible leakage to soil. Where possible, as-built drawings will be used to locate joints where leakage may be more probable. Soil samples will be collected through borings beneath those joint locations. Otherwise, borings will be made at 100-ft intervals along the line. Samples will be collected to 1 ft below the base elevation of the line. Any liquid encountered during boring will be sampled. If contamination in excess of ALs is found, borings will be made to deeper locations, in 1-ft intervals, until the extent of contamination is determined. Samples collected in this manner will be submitted for ASL B/C analysis for S2 components and for ASL D analysis for S3 components.

When leakage has occurred, it is common that the runoff path is downgradient of that point, with transport along the soil-pipe interface. If a low point occurs downgradient of a significant leak, that location should also be bored and soil (and any liquid) samples collected for analysis. Flow and capillary action can also result in an upwelling of contaminated fluids within the soil column above a buried line. The sampling team should be alert to that possibility.

D.5.4.2 Other Measurements and Samples

The sampling team will be alert for conditions that indicate a need for further measurements and sampling. When the K-65 slurry line is accessed, a grab radon air sample will be collected, because elevated radon concentrations may be expected. Respiratory protection may be required while this line is being sampled.

Geophysical measurements (e.g., ground-penetrating radar) may be required to locate buried lines if drawings are not adequate. Success with this technique at the FEMP has been limited in the past. Gamma measurements with a 2- × 2-in. NaI (Tl) detector may be useful where lines have leaked gamma-emitting contaminants and where contaminants may be at or near the surface of the adjacent media. Additional liquid and solid samples will be collected where contaminant quantities show the need for characterization of wastes and for waste minimization studies.

D.5.5 HVAC Equipment and Air Pathways

This protocol provides for the characterization of air particulate filtering or collecting systems and conduits, including HVAC ducts and filters, dust collectors, cyclone separators, and precipitators. Characteristically, large volumes of air have passed through these items, with particulates removed or deposited. Relatively significant concentrations of radon-222 daughters, lead-210, and polonium-210 can be expected because of natural ambient airborne radon-222. Other operational sources of lead-210 and polonium-210 may also be present. At least initially, no attempt will be made to distinguish enhanced natural activity from operationally produced activity. The ALs tabulated in Section D.4.7 will be directly applied to contaminant levels encountered.

Of note is the fact that the process of filtration and collection can result in the concentration of contaminants. In a sense, HVAC air filters correspond to very high-volume air samples and can be a sensitive indicator of airborne particulate contaminants.

D.5.5.1 Radiological and Chemical Surveys and Sampling

ASLs A and B are required, as appropriate, for components in this protocol. In general, measurements and samples at all ASLs will be required and will be based on the component-specific analyses list (see Table D.11).

Instrument Surveys and Removable Contamination Swipes

External and internal accessible surfaces of ducts, conduits, and containers will be monitored for alpha and beta-gamma contaminants, as appropriate, for known and suspected materials. Measurements will be taken at 30-ft intervals in major ductwork systems. Internal measurements and swipes will be limited to accessible locations.

Access will be made to permit monitoring of internal surfaces (top, bottom, and sides) at the extreme influent and effluent ends, for a total of four measurements at each end. Also, four measurements (top, bottom and sides) will be made just upgradient and just downgradient of each filtration, collection, or other separating unit. Entire filters will be exchanged during sampling. Each filter removed will be immediately monitored to note the degree of safety and contamination control measures required. Filters with an effective collection area of 3 ft^2 or less will be bagged and will constitute one sample. For filters with a larger effective collecting area, a segment of approximately 3 ft^2 will be cut from the overall filter. The remainder of the filter will be bagged and controlled as potentially contaminated waste. If possible, the flow rate (cubic feet per minute), and the duration of filter service will be recorded to estimate the total air volume filtered. Filter segment areas will be compared to the total effective area of that filter for similar information.

Exposed surfaces of HVAC components such as filter systems, dust collectors, cyclone separators, scrubbers, and precipitators will be monitored for potential contaminants; one measurement will be collected per square foot of exposed area and no less than four measurements per unit. Internal surfaces that can be readily exposed will be monitored in an identical fashion. If the internal contents include hazardous materials, the item will

remain closed, and no internal contamination measurement will be taken. If the interior contains solids, liquids, or sludges, only the available exposed surfaces will be monitored. Contents will be sampled as described below.

When ductwork and similar conduits have been determined to contain contaminants in excess of ALs, it will be necessary to determine the lineal extent of contaminants in runs longer than 40 ft. Penetrations will be made into ducts or conduits that are large enough to accommodate radiation detection probes. Internal surface measurements (top, bottom, and sides) will be made at 40-ft intervals, and swipes will be taken similarly.

Air-moving equipment, including housings, fans, and blowers, are assumed to be contaminated if upgradient items are contaminated. It is not unusual to measure relatively high levels (several thousand counts per minute) of polonium-210 on these surfaces because of the passage and deposition of ambient background radon-222 daughters.

Swipe samples will be taken at locations where survey measurements are made. Swipes also will be taken from interior surfaces too small to permit access of radiation detection probes. These locations are primarily the distal ends of conduits. Swipes showing contamination levels in excess of the removable contamination ALs or DLs will be composited by like or contiguous surfaces and submitted for analysis.

Gamma Ray Measurements

Limited, or qualitative, gamma measurements can be taken using a 2- × 2-in. NaI (Tl) gamma scintillation detector. External contact measurements will be made at collecting/concentration locations to show any potential for substantial quantities of gamma-emitting contaminants. Access to internal components will be appropriately controlled if elevated gamma intensities are indicated. Some features may not permit reasonable access. Gamma measurements will be made for possible substantial quantities of contaminants. Where reasonable access is not possible, the contained contaminants will be assumed to have the characteristics of the nearest contiguous influent and effluent locations.

Liquid Samples

Liquid samples will only be collected from suspect containers. Each collecting/concentrating unit containing liquids will be sampled. Accompanying suspended sediments

will be filtered out either before shipment or upon receipt at the analytical laboratory (solid samples of sludge contents will be collected). Suspected locations for condensate accumulation will be checked for liquids, and samples will be collected if liquids are present. For S2 and S3 components, ASL B/C analyses will be performed on a minimum of one composite sample. For S3 components, a minimum of one composite sample will be submitted for ASL D analysis.

Solid Samples

In addition to samples of filters (described above), solids will be collected from within collecting/concentrating locations if the nature of hazardous contents are not already known. One sample will be collected from each collecting/concentrating location. Contaminated duct runs and conduits showing appreciable accumulation of residues will also be sampled. A minimum of 10 g should be collected for each analyte. Composites may be made, or analyses limited to the main contaminants of interest. For S2 and S3 components, ASL B/C analyses will be performed on a minimum of one composite sample. For S3 components, a minimum of one composite sample will be submitted for ASL D analysis.

D.5.5.2 Other Measurements and Samples

Sample collectors must remain alert to other measurements and samples of possible value. Most HVAC facilities are located within buildings where air sampling is also considered in the buildings protocol, D.5.1. Focused air sampling, including personal breathing zone samples, may be appropriate when the interior of the items discussed in this protocol are accessed.

D.5.6 Liquid Pathways and Filtration

This protocol provides for liquid-borne particulate and solutes filtration/collection units, including sand filters, bed filters, separators, centrifuges, and similar features. Protocols D.5.3 and D.5.4 are used in conjunction with this protocol for field data collection activities associated with pipes, lines, pumps, valves, and vessels. As in other protocols, liquid filtering units associated with innocuous paths such as water supply treatment resins,

need not be characterized. Containments of removed particulates and solutes whose hazardous contents are well known will not require further characterization.

D.5.6.1 Radiological and Chemical Measurements and Sampling

ASLs A and B are required, as appropriate, for components that fit within this protocol. In general, measurements and samples at all ASLs will be required and will be based on the component-specific analyses list (see Table D.11).

Instrument Measurements and Removable Contamination Surveys

External exposed surfaces of these components will be monitored for alpha and beta-gamma-emitting contaminants, as appropriate, for known and suspected materials. One measurement per 4 ft^2 will be made for surfaces, with no fewer than two measurements per feature.

Containers will be disconnected from up- and down-flow conduits. Water-catching containers will be placed to collect potential spills and to provide liquid samples. Newly exposed dry surfaces will be monitored. Wet surfaces may be allowed to dry before monitoring is begun, and hair dryers can be used to speed drying so long as the potential to create airborne contaminants or other safety related problems is limited. At least one measurement will be taken per opening, and for large exposed areas, one measurement will be taken per 4 ft^2 of surface area. Smaller openings that cannot accommodate detector probes will not be monitored in this fashion.

Swipe samples will be taken at as many locations as practical where surface contamination measurements have been made. Swipes also will be taken from internal surfaces too small to accommodate radioactive detection probes. Swipes with results in excess of removable contamination ALs or DLs will be retained and composited from similar items to be analyzed at ASL B/C for known and expected contaminants.

Gamma Ray Measurements

Qualitative gamma ray measurements can be taken with 2- × 2-in. NaI (Tl) gamma scintillator detectors. Contact measurements will be made before a containing component is opened. When the measured level exceeds the mean plus three standard deviations of the

ambient gamma environment, the presence of significant contaminant levels is indicated. This method also will be used for items that are sealed and have no reasonable access. When gamma ray fields are definitely in excess of ambient levels, contents will be assumed to have the characteristics of adjacent, or similar, contaminated items.

Liquid Sampling

Where liquids remain within the concentration or collecting vessel, a sample will be collected from each item. As noted earlier, before these containers are accessed, catching containers will be in place to catch any liquids that may drain upon opening. For some items, the entire volume may contain liquid, and a sufficiently large receiving container must be in place. Liquids beyond those required for sampling will be drummed or similarly containerized until analytical results are received. Proper disposition will be based upon those analytical results.

Solid Samples

Solid samples will be obtained of media within each containment. These may be damp solids, such as ion exchange resin, in which case only the solid component will be collected. Where contents are a solid/liquid mixture, in the vicinity of a 50-50 mixture, both solids and liquids will be collected and separated into the two distinct phases through filtration in the field or at the receiving analytical laboratory. Two distinct samples, solid and liquid, will be analyzed separately. A minimum of one ASL B/C sample is required for each S2 and S3 component feature. Additionally, S3 component features require one ASL D sample.

D.5.6.2 Other Measurements and Sampling

As always, the sampling team must identify supplemental measurements and samplings on the basis of conditions encountered. Extensive volumes of contaminants are not expected; however, if significant quantities are discovered, samples will be collected for waste minimization studies.

D.5.7 Containerized Materials and Wastes

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Drums and other storage containers within OU3 will contain a variety of materials, including products, process and maintenance materials, and wastes. Tables A.5.0 and A.5.1 in Appendix A of the work plan addendum summarize the containerized waste inventories. Most containers at the FEMP are to be characterized as part of ongoing activities. Only containers not addressed through current programs will be characterized by this protocol. While there is no need for further characterization of the contents, an important part of the RI is to confirm the identity and contents of each container. Therefore, a complete inventory will be taken to ensure that the nature, location, and quantity of contained materials is well known. This task will be accomplished in the RI by compiling data resulting from current programs.

When containers exist in a hazardous or highly contaminated environment, only a best estimate of contents will be made by comparing containers with inventories or process knowledge. This procedure is done both for safety and as low as reasonably achievable (ALARA) considerations. For example, the thorium storage building (Building 65) has ambient exposure rates exceeding 100 mrem/h, and radioactive airborne concentrations exceed occupational exposure limits to the extent that respiratory protection is required. As part of ongoing interim actions, Building 65 (and other thorium storage buildings) is expected to have been substantially remediated before RI measurements and sampling occurs.

The RI sampling and measurements program will not duplicate or replace the existing process of waste characterization. It is the goal of the RI to affirm that all containers are present and accounted for and to identify and characterize unknown or questionable containerized materials. In some cases, the sampling and analysis team may recommend that certain containers undergo additional characterization (e.g., for the presence of RCRA hazardous materials). In the RI process, the investigation of unknown materials may provide waste characterization information, including wastes that will be generated and containerized during the RI. Additional characterization will be performed in accordance with existing procedures and waste acceptance criteria.

D.5.7.1 Radiological and Chemical Surveys and Sampling

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ASLs A and B are required, as appropriate, for components that fit within this protocol. In general, measurements and samples at all ASLs will be required and will be based on the component-specific analyses list (see Table D.11).

Instrument Surveys and Removable Contamination Surveys

Exposed external surfaces will be monitored for alpha and/or beta-gamma-emitting contaminants as appropriate for known and/or suspect contaminants. In general, the containerized materials at the FEMP are well characterized because of ongoing programs. Measurements and sampling will be performed on an as-needed basis. For conditions where more information is necessary, each container will be monitored with one measurement for each 2 ft^2 of surface area. For large groups of containers whose condition is known, 1 in 10 will be monitored as above. Swipes will be collected only at locations where measurements exceed surface contamination ALs. Swipe samples showing greater than removable contamination ALs will be retained for analysis of composited swipes from identical or similar surfaces.

Gamma Ray Measurements

Qualitative gamma ray measurements may be made at contact for each container with unknown contents. The 2- × 2-in. NaI (Tl) detector will be used. Results will be compared with the mean gamma ray level plus three standard deviations for the surrounding environment. Gamma levels in excess of background will be cause for subsequent sampling of contents. Gamma levels at or less than background do not preclude significant presence of other contaminants.

Liquid Samples

As indicated above, containerized materials at the site are typically well characterized. In cases where sampling is needed, one liquid sample will be collected from each container of unknown liquids. Any notable characteristic of that liquid will be recorded (e.g., organic solvent, aqueous solution, or other apparent feature). Care will be exercised during handling in recognition of potentially hazardous contents. Where concentrations are

in excess of ALs, additional sampling may be required to determine additional physical and chemical characteristics to meet risk assessment objectives and for remedial alternative evaluations, including waste minimization.

Solid Samples

For containers to be characterized, one composited solid sample will be collected from each container of unknown solids. Any notable characteristics of that solid will be recorded (e.g., color, gross nature of particulate, and similar apparent features). Care will be exercised during handling in recognition of the potential for hazardous contents. Where concentrations exceed ALs, additional samples may be collected to determine additional physical and chemical characteristics to meet risk assessment objectives and for remedial action alternative evaluations, including waste minimization.

D.5.7.2 Other Measurements and Sampling

Other measurements and sampling opportunities may be presented. Where container contents may have leaked or spilled on adjacent surfaces, radiation detection instruments will be used to determine the presence and extent of contamination. In addition, it may be apparent that nonradioactive contaminants have leaked from the containers. A sample should be collected for appropriate analysis. Further characterization of contaminated waste in undocumented containers will be conducted to complete requirements.

D.5.8 Transferring, Handling, and Sampling Equipment

This protocol is to be used for the broad variety of materials handling and transfer equipment present in OU3, such as conveyors, bucket elevators, drum sampling equipment, loading and unloading stations, scales, drum dumpers, and similar equipment.

Hoppers, storage silos, and similar reservoirs or receivers used to supply and receive the materials are covered in other protocols. Before characterization of material handling and transfer facilities begin, it should be assured that supply and receiving locations have been sufficiently secured to not cause subsequent transfer of materials back onto the conveyances characterized in this protocol. All equipment will be deactivated and no conveyances will be operated during the investigation.

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D.5.8.1 Radiological and Chemical Surveys and Sampling

ASLs A and B are required, as appropriate, for components that fit within this protocol. In general, measurements and samples at all ASLs will be required and will be based on the component-specific analyses list (see Table D.11).

Instrument Surveys and Removable Contamination Swipes

Floors, pads, and similar surfaces below material handling equipment will be inspected for evidence of spilled materials. Where such surfaces exist, they will be monitored for alpha and/or beta-emitting contaminants, as appropriate for known and/or suspected materials.

Every surface of the conveyances with appropriate features to allow access of detectors will be monitored with at least one measurement for every three lineal feet. This measurement will be performed on all surfaces. For example, the top, bottom, and internal surfaces of conveyors will be monitored. Where surfaces are irregular or have dimensions too small to admit the detector probe for proper monitoring, swipe samples will be collected. The same distribution will be utilized for swipe samples. Measurements will include, or be supplemented to include, surface areas that show evidence of spilled materials. Swipe samples will be collected from as many locations where surface measurements were made as is practical. Swipe samples will also be collected from surfaces that are not accessible for direct surface contamination measurements — one for every 4 ft^2 of surface area. Composites of swipes from like surfaces and similar items will be made where removable contaminants exceed ALs. Composite samples will be analyzed for known and suspect contaminants at ASL B/C.

Gamma Ray Measurements

Qualitative measurements can be made with the 2- × 2-in. NaI (Tl) scintillation detector at any locations indicating accumulations of potentially contaminated materials. Levels definitely in excess of the gamma environment for that area (mean plus three standard deviations) will be investigated. Solid residues or other suspect material will be surveyed.

Liquid Samples

Liquids are not expected to be associated with conveyances. If liquids are encountered during the survey, one sample will be collected from each accumulation. A sample of 6 L is required for aqueous samples, if available. No less than 100 mL will be collected per analyte; however, composites may be possible. Where samples are limited in size, analyses will be restricted to the main contaminants of interest. One composite per component will be submitted for ASL B/C analysis in S2 and S3 components.

Solid Samples

Accumulated residues on the order of 1 kg or more that are encountered during the survey will be collected. One sample per equipment item is sufficient, unless the appearance of residues suggests that more than one potentially contaminated matrix type is present. Then, one sample of each type will be collected.

Residues of lesser quantity will be sampled at locations exceeding ALs for surface contamination or for removable surface contamination or where gamma ray levels are expected to be in excess of ambient levels. At least one sample will be collected from each contaminated area indicated by the instrument and swipe measurements. Composite samples will be submitted for ASL B/C analysis for S2 and S3 components.

D.5.8.2 Other Measurements and Sampling

Additional samples will be collected of liquids and solids that are of sufficient quantity to warrant waste minimization consideration.

D.5.9 Surface Impoundments and Pathways

The purpose of this protocol is to characterize contaminant concentrations in water, sediments, beaches, freeboard areas, and associated runoff pathways. Gamma ray exposure rates are also determined.

D.5.9.1 Radiological and Chemical Surveys and Sampling

ASLs A and B are required, as appropriate, for components that fit within this protocol. In general, measurements and samples at all ASL levels will be required and will be based on the component-specific analyses list (see Table D.11).

Instrument Surveys and Removable Contamination Swipes

Alpha and/or beta-gamma contamination measurements, as appropriate for known and/or suspected contaminants, are performed in a limited fashion in this protocol. These measurements are limited to the following:

Item	Frequency
1. Collected solid samples	each sample
2. Exposed impoundment liners	50-ft intervals
3. Exposed concrete base, curb or dam	50-ft intervals

For small impoundments (less than 25,000 ft^2 surface area) that have exposed liners or concrete surfaces, contamination survey intervals will be less than 50 ft, with no less than four measurements per surface. For very small impoundments, a minimum of two measurements will be required. Swipe samples will be taken at the same locations where instrument measurement are taken. Swipes showing greater than removable ALs will be composited for laboratory analysis at ASL B/C.

Gamma Ray Measurements

If there are exposed dry freeboard or beach areas peripheral to the impoundment, 2- × 2-in. NaI (Tl) scintillation detectors can be used to take measurements at 50-ft intervals. If the area is extensive, or if the impoundment surface is dry, the gamma measurements will be at random locations within the cells formed by a 50-ft grid. Associated runoff (and runon) pathways will also be monitored at 50-ft intervals along the pathway. If the freeboard area is small, measurements will be evenly spaced at less than 50-ft intervals with no less than four measurements for the smallest areas. If the dry impoundment or runoff pathway represents a small area, the grid will be reduced in size, with no less than four measurements for the smallest potentially contaminated area.

Liquid Samples

Water in impoundments will be sampled by collection of six separate 1-L samples at locations uniformly distributed over the surface area. The six samples will be composited to form a single 6-L sample. Sediments and suspended solids will be filtered out of the liquid phase either in the field or at the laboratory. The 6-L sample will be analyzed for all known and suspected contaminants. A minimum of one composite sample will be submitted for ASL B/C analysis for S2 components. A minimum of one ASL D composite sample will be submitted for S3 components. No liquid samples will be collected if less than 6 L is available. Water pumped up from drainage collection systems beneath impoundments will be sampled if available.

Solid Samples

Samples taken of solids will be composited at a 6 to 1 ratio for ASL B/C analysis (S2 and S3 components) and for ASL D analysis (S3 components).

Sediments

Six distinct sediment samples will be collected from beneath the water within each impoundment. The sampling locations will be uniformly distributed over the impoundment area, with one sample downgradient of any significant influent path. Contaminants are frequently associated with organic matter and fine particulates. Care will be taken to ensure that those constituents are not washed away during sample collection. For small pools and puddles, one sediment sample will be collected.

Freeboards, Beaches, and Dry Impoundments

Surface soil samples will be collected from these areas at locations indicated by elevated gamma ray survey measurements. If gamma ray measurements do not indicate a requirement for specified sampling locations, then six uniformly distributed locations will be sampled.

If surface samples have concentrations in excess of the ALs, borings will be made to collect samples at 1-ft increments until the depth of contamination is identified. Care will be taken to avoid penetration of any liner or base containment material. In addition, an

additional six surface soil samples will be collected to identify the areal extent of the contaminated freeboard. With strong gamma-emitting contaminants, it is likely that gamma ray measurements will indicate the extent of contamination and provide focus for the six supplemental surface soil samples.

D.5.9.2 Other Sampling

The sampling team will remain alert to other samples of potential value. A scum, foam, or organic layer on the surface of the water may be collected for potential contaminants. If contaminants are substantial, aquatic vegetation and burrowing rodent dens may be sampled for contaminants.

D.5.10 Waste Piles

Temporary waste piles consisting of soil, construction rubble, and scrap metal are considered under this protocol.

D.5.10.1 Radiological and Chemical Surveys and Samplings

ASLs A and B are required, as appropriate, for components in this protocol. In general, measurements and samples at all ASLs will be required and will be based on the component-specific analyses list (see Table D.11).

Instrument Surveys and Removable Contamination Swipes

Alpha and beta-gamma contamination measurements, as appropriate for known and/or suspect contaminants, will be performed in a limited fashion in this protocol. These measurements will be limited to:

	Item	Frequency
1.	Collected solid samples	Each sample
2.	Peripheral accessible solids grid	3- × 3-ft
3.	Along the lineal extent of pipe and objects that are primarily linear in dimension	At 3-ft intervals

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Item	Frequency
4. Over the area of nonlineal objects that are segregated and available and that will be separately disposed of due to their size and/or distinctive characteristics	3- × 3-ft grid with no less than four measurements per object

Each pipe or open-ended conduit present with a sufficiently large diameter to accommodate the detector probe will be monitored at each end. If no contamination is noted on the outside or on the ends, it will be assumed that the balance of the interior has no contamination. If evidence exists of contamination in excess of ALs, and if the diameter is too small to admit the detector probe, swipe and solid samples will be collected for analysis.

Large nonlineal objects will be monitored for contamination over the exterior and accessible interior on a 6- × 6-ft grid. Section D.5.1.2, Class B Surfaces, provides directions for handling grid site determination for S1, S2, and S3 designations and for subsampling of the materials where contaminant concentrations exceed ALs. For smaller objects, at least four exterior and four interior measurements will be made.

Surfaces of soil and rubble piles will not be monitored in this fashion. Gamma surveys (below) and solids sampling will be used for characterization.

If surfaces and objects show contaminant levels in excess of ALs, swipe samples will be taken at points that exceed ALs. Swipe samples will be taken from the interior of pipes and similar conduits with dimensions that prevent insertion of contamination monitoring probes. Composites of swipes from like surfaces that show removable contaminants in excess of ALs will be analyzed for known and/or potential contaminants.

Gamma Ray Measurements

Gamma ray measurements may be made with the 2- × 2-in. NaI (Tl) scintillation detectors over the surface of soil and rubble piles, with extension to potentially affected areas surrounding the piles. Measurements will be made at random locations within the cells formed by a 9- × 9-ft grid. These surface dimensions allow for the convex shape of a pile. Inspection of the data, including possible use of isopleths, will be the basis for directing soil sampling described below.

Liquid Samples

Liquids are not expected to be associated with waste and scrap piles. However, standing water may be present from precipitation. Given that opportunity, a sample may be collected and analyzed for known and/or potential contaminants. For liquids encountered, two composite samples per pile for S2 components, and three composite samples for S3 components are required at ASL B/C. S3 components require one sample at ASL D.

Solid Samples

For solid sampling, two composite samples per pile for S2 components, and three composite samples for S3 components are required at ASL B/C. In addition, S3 components require one sample at ASL D.

Sampling Waste Piles

Gamma measurements are expected to show locations for discrete sampling. Surface soil samples will be collected from biased and randomly distributed locations. A total of at least 30 surface soil samples will be collected, and, to the extent practical, the locations will be dictated by the gamma ray measurements. Several biased samples will be collected at higher gamma ray areas. The balance will be uniformly distributed over the gamma measurement grid.

No less than six locations per pile will be sampled to establish the depth profile of contaminants. Borings will sunk to gather subsurface samples at 1-ft intervals down to the base of the pile. Care will be taken to avoid breaching any containing layer beneath the pile.

Solid samples of concrete and other rubble and construction materials within a dirt pile will also be collected. Depending upon the availability of those items, the goal is to collect 30 samples per pile.

Pipe, conduit, and other objects in scrap piles will be surveyed for surface contamination to the extent possible, as described above. When access to inner surfaces is not possible to permit instrument monitoring, inner surfaces may be swiped for removable contamination. Such pipes, conduits, and similar objects may be reamed or ground at each end. The sample will consist of any scale or other residue within the conduit, plus metal and corroded metal from the surface of the object. These samples are generally too small for

desired analytical sensitivity; therefore, pipe, conduit and similar objects will be grouped in identified batches of 10. The reamings from each end (a total of 20 samples) will be composited and analyzed for known and/or suspect contaminants. A possible alternative, to accommodate the field situation, will be to saw or cut off 1-ft sections of each end to allow collection of internal residues at a more convenient location.

D.5.10.2 Other Measurements and Sampling

The sampling team must remain alert for conditions that indicate opportunities for supplemental measurements and sampling. There is no assurance that scrap materials will be contaminated by gamma-emitting materials. However, random inspection of scrap materials, with the 2- × 2-in. NaI (Tl) gamma scintillation detector, would reveal objects that are so contaminated. These measurements are only qualitative and are not conclusive, but they are useful to focus sampling on obviously contaminated items.

Where waste minimization may be possible, samples of the contaminated media will be collected for testing of decontamination/cleaning methods. Similarly, samples can be collected to determine physical and chemical properties which will affect disposition options.

D.5.11 Pads and Pavement

This protocol provides the methods for surveying and sampling exterior concrete pads, sidewalks, roadways, parking lots, railroad lines, and similar exterior surfaces. Because of the action of weathering and precipitation, it is likely that surface contaminants will be found downgradient of these surfaces, with off-surface accumulations. Similarly, there will be a focus on grates, drains, and associated sumps that are runoff paths for these surfaces. Contaminants may gather in cracks, crevices, and seams (such as expansion joints) across these surfaces.

Ample evidence exists that pavements have been laid down over contaminated surfaces in OU3. Contaminants may be expected in soil below the pavement, at interfaces above old pavement and beneath the current surface, and along cracks and seams in all surfaces.

Old asphaltic materials and patching compounds may require sampling and analysis for RCRA hazardous constituents, in addition to radiological contaminants.

D.5.11.1 Radiological and Chemical Surveys and Sampling

ASLs A and B are required, as appropriate, for components that fit within this protocol. In general, measurements and samples at all ASLs will be required and will be based on the component-specific analyses list (see Table D.11).

Instrument Surveys and Removable Contamination Swipes

Alpha and beta-gamma contamination measurements, as appropriate for known or suspected contaminants, will be taken along the extent of every expansion joint associated with that surface at 9-ft linear intervals. Major cracks that are at least 9 ft long and 0.5 in. or more wide will be similarly monitored. Surfaces will be surveyed on a 100- × 100-ft grid at random locations within the cells for S1 components. S2 and S3 components will be measured on a 10- × 10-ft grid at random locations within the cells.

Where measurements from expansion joints and cracks exceed ALs, the area will be inspected for the presence of associated residues. These areas will be monitored at random locations within the cells formed by a 3- × 3-ft grid.

Any surface runoff areas from surfaces being monitored will also be surveyed at the area immediately contiguous to the pavement. Nine measurements will be taken — three at 1-ft intervals along the obvious or expected channels observed and additional measurements 1 ft to the left and right of each of these channels.

Railroad ties may require surface contamination measurements at the center of each and at both ends outboard of the rails, depending on gamma ray measurements described below.

No swipe samples will be routinely taken as part of this protocol. Surfaces are washed by precipitation and loose contamination is highly unlikely. Solid samples will be collected for characterizing contaminants.

Gamma Ray Measurements

Pavements and similar surfaces that are expected to be free of contaminants will be monitored for gamma activity at contact with the surface at random locations within the cells

formed by a 50- × 50-ft grid. Such surfaces that have high potential for contamination will be similarly monitored on a 3- × 3-ft grid.

All sidewalks will be monitored at 3-ft intervals along the centerline and at points just off the sidewalk pavement to the left and right of the 3-ft intervals. Sidewalks greater than 3 ft wide will be monitored at random locations within the cells formed by a 3- × 2-ft grid extended to cover surfaces just beyond the pavement.

Gamma ray surveys will be conducted along railroad tracks in the downgradient runoff channel to either one or both sides of the track run (depending on gradients) at 9-ft intervals. Definite excess gamma levels will be cause for surface contamination measurements to be taken on associated railroad ties.

All runoff paths will be monitored at 3-ft intervals along the obvious or apparent runoff channel. These will be followed to a low point, where possible, for a distance of at least 30 ft.

Basins, sumps, and other runoff accumulation points will be monitored at contact with the contained sediments. Gratings or similar covers will be removed to permit access. The high gamma level locations and areas will be further sampled as indicated below.

Liquid Samples

Liquid samples may not be available for these areas. If available, possibly after a rain, one liquid sample collected downgradient from each surface monitored will be sampled. Where possible, one sample per 20,000 ft^2 is to be submitted for ASL B/C analysis for S2 and S3 components. S3 components require one composite sample at ASL D.

If survey measurements indicate the presence of contaminants, every downgradient path will be sampled for any available liquids.

Solid Samples

Where surface contamination measurements exceed ALs, a sample will be collected of joint expansion material or of the associated surface soil as appropriate. There will be at least one sample per contaminated zone indicated by survey measurements, including the point of highest measurement. One composite sample per 20,000 ft^2 is to be submitted for

ASL B/C analysis for S2 and S3 components. The S3 components require one composite sample at ASL D.

Conditionally, wood samples will be collected from railroad ties where surface contamination measurements exceed ALs. As appropriate, soil, concrete, asphalt, and similar construction materials will be sampled as indicated by instrument measurements. Soil samples include accumulated sediments in catchments.

Concrete, asphalt, and similar paving materials will be core sampled at locations indicated by high instrument measurements. If, in retrieval of the cores, an obvious construction interface surface is presented, that surface will be monitored for alpha and/or beta surface contamination levels. The upper and lower fractions will be segregated to preserve distinct characteristics. Cores will be sliced into 1-in.-long segments to define the profile of contaminants. If cores do not remain intact, the best possible depth segregation will be sought. At least one sample will be collected per contaminated zone from the location of the highest instrument measurement.

D.5.11.2 Other Measurements and Samples

Where contamination may be present at or near the surface, and especially where low-energy gamma-emitting contaminants are expected, it may be useful to duplicate the gamma ray measurement locations with use of a FIDLER thin scintillation crystal detector. The sampling team will remain alert to other measurement and sampling opportunities.

D.5.12 Other Items — General Approach

Because of the diversity of components, areas, and the myriad items within OU3, it is possible that some situations may be encountered that are not clearly within the scope of one of the above protocols. This final protocol contains generic guidance that can be applied to items and conditions that are not otherwise associated with specific protocols.

This protocol also covers the investigation and characterization associated with RCRA and non-RCRA drums and containers. The RI/FS program objectives are implicitly addressed within the wide scope of the ongoing programs related to waste characterization at the FEMP. Integration of the information obtained from these programs will be managed

and used in the development of the RI and FS reports. A general overview of the various drum characterization programs is provided below.

D.5.12.1 Generic Guidance

Identification of the characteristics of components and items must be related to the two basic RI objectives: conducting risk assessments and evaluating potential remedial actions.

Items that are sufficiently characterized through existing information to meet the RI/FS objectives need not be further investigated. This consideration is particularly important where sampling situations are known to constitute safety hazards, and could result in unnecessary radiation exposure. It is important to research current information before accessing confined areas where substantial risk may exist. Among other documents, the most recent IRS&T data related to health physics and industrial hygiene will be reviewed and evaluated. Where industrial safety hazards exist, such as the risk of falling from high elevations, the value of characterization will be compared with the extent of risk. Where characterization must proceed, special safety services, such as scaffolding, safety harnesses, and similar measures, will be provided before the task begins.

Initial approaches to suspect items should involve a qualitative check with a low-level gamma ray detector.

Any instrument measurements must be assessed in relation to the potential contaminants present. Principal radiations from radioactive contaminants are provided in Table D.2. Section D.4.2 also lists the characteristic radionuclides associated with the radiological contaminants that are present in OU3. Serious errors may attend measurements that are believed to be from one set of contaminants but that are, in fact, different from those actually present. Analytical sample results must be consulted for appropriate interpretation of potential contaminants present and applicable ALs.

For proper assessment, it is also important to be aware of the difference between a thin veneer of surface contamination and bulk contaminated materials. Surface contamination ALs are inadequate to provide for the potential problems associated with bulk contamination. Alpha surface monitoring can be assumed to be effective for a 15-μm depth. Beta particles will travel further, but still only a fraction of an inch, depending upon the beta

particle energy and the containing matrix. The FIDLER gamma detector is sensitive to gamma-emitter contaminants on the surface. Depending upon the gamma ray energy, the quantity of contaminant, and the gamma-absorbing matrix, 2- × 2-in. NaI (Tl) detectors can be expected to be effective to a contaminant depth of several inches. It is important to know the volumes of contaminated liquids and solids present for conducting risk assessments and evaluating remedial action alternatives.

A general approach to pipes, ducts, conduits, containers, and similar objects is that influent and effluent ends will be characterized. Where necessary, further characterization can proceed.

When faced with large quantities of potentially contaminated items, such as scrap metal piles, like components can be grouped for characterization by instrument measurements and sampling. Any need for further detailed characterization of items will be assessed from these initial results.

Long runs of large ducts, pipes, and vessels may require further inspection after initial characterization. These inspections may be pursued with the use of remote TV scanners (e.g., sewer line inspection camera) or other special devices that allow instrument monitoring and sampling. For example, a small trolley can be rigged to move a radiation detector linked to a remote readout up to 200 ft from the detector.

The sampling crew should record situations where current conditions have potential for change. These include deteriorating conditions that may lead to spillage of contaminated materials, allowing subsequent precipitation or wind action to spread contaminants. In conducting this investigation, care will be taken to avoid actions that can create new problems through spillage of liquids and solids.

It is useful to note the degree of fixation of contaminants. Swipe samples are expected to demonstrate the extent of removable contamination. It can also be useful to compare airborne concentrations, through air sampling, to the associated surface levels to help establish the degree of containment migration from surfaces to air.

Liquid and air pathways for known contaminants will be investigated downgradient, downwind, and for depth of penetration in materials to establish boundaries of an affected area.

The sampling team will remain aware of potential sampling of items that may be a particularly sensitive indicator of the presence of contaminants. Such items are diverse and can range from cleaning equipment and vacuum cleaner contents to aquatic vegetation in contaminated impoundments.

Large quantities of contaminated liquids and solids will be assessed for processes to minimize wastes. Quantification of the physical and chemical properties of the waste matrix may be required to evaluate disposition options.

D.5.12.2 Instrument Measurements

Surface Contamination Surveys

Vertical surfaces are less likely to accumulate contaminants than are horizontal surfaces. Measurement grids can therefore be larger for vertical surfaces. The following general guidance for instrument measurement location distributions should be followed:

Surface Size	Measurement Frequency
1. Large surface areas (>1,000 ft^2)	9- × 9-ft grid
2. Moderate surface areas (20-1,000 ft^2)	Four measurements per 20 ft^2, up to 12 measurements per 1,000 ft^2. Also, a 3- × 3-ft grid may be used
3. Small surfaces (<20 ft^2)	At least one measurement per square foot of surface area
4. Linear objects	One measurement per 3 ft of length, with one measurement for each shorter length

Removable Surface Contamination

For large areas (covering more than 1,000 ft^2) where instrument surface measurements are elevated, swipes will be taken of surfaces between instrument measurement locations. The swipe samples will be taken at the center of each grid (instrument measurements are taken at random locations within the cells) and between surface measurements along a linear object.

Swipes will be taken at instrument locations showing contamination in excess of ALs. Swipes also will be taken within inaccessible areas that prevent effective placement of the instrument detector. When removable contamination ALs are exceeded, swipes of similar surfaces will be composited into a single sample. Samples will be analyzed at ASL B/C or D to reveal the identity of the contaminants.

Gamma Ray Measurements

Gamma ray measurements may be limited to a qualitative assessment. A comparison of measurements can be made using the following process:

1. Determine the mean and standard deviation of ambient gamma ray count rates for the area being monitored.
2. If the mean minus three standard deviations is negative (less than 0), inspect the data for better representation as a log normal distribution. If so, establish the mean and geometric standard deviation.
3. Select locations where gamma measurements exceed the mean plus three standard deviations or the mean plus three geometric standard deviations.
4. Review the distribution of gamma measurements and isopleths of gamma levels to evaluate the extent of the contaminated zone or object.

Sensitivity will be impaired in areas where the ambient gamma level is greater than natural radiation background.

For monitoring large areas (in excess of 1,000 ft^2), gamma ray surveys will be taken at random locations within the cells formed by a 9- × 9-ft grid. Moderate areas will be monitored at random locations within the cells formed by a 3- × 3-ft grid.

In areas that are identified as having gamma radiation levels equal to or greater than two times the ambient background, exposure rate will be measured. A pressurized ion chamber will be used for such measurements at locations that include the highest indicated gamma ray field. If the exposure rate exceeds the range of the pressurized ion chamber, the following instruments will be used:

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Instrument	Range
Energy compensated G-M detector	0.1-100 mrem/h
Ion chamber survey instrument	10 mrem/h and higher

D.5.12.3 Air Sampling

The air sampling protocol, D.5.1.3, provides details for routine air sampling requirements. Special provisions for air sampling are contained in other protocols where the presence of airborne contaminants is possible. Where large volumes of air pass through filters or contact air movers, elevated lead and polonium-210 concentrations may be encountered, due simply to naturally occurring ambient levels of radon-222.

D.5.12.4 Liquid Samples

Liquid samples will be collected from each volume of liquid present as part of a process and from incidental liquids in significant quantities. Six liters (aqueous samples) is required for a complete set of analyses. Where smaller quantities are available, composites of like liquids can be made to increase sample size. There will be no less than 100 mL of sample per analysis. Analytical procedures may be limited to the main contaminants of interest.

The identity of known liquids will be recorded. For unknown liquids, other notable characteristics will be recorded, such as appearance, color, and other apparent features.

Where damp solids are encountered, and the liquid portion is relatively small, the solids will be collected. If samples are primarily liquid, solids will be filtered out and the liquid phase analyzed. Where contents approach half liquid and half solid, the phases will be separated into two distinct samples.

D.5.12.5 Solid Samples

Solid samples are collected from each volume of contaminated bulk material. Solid samples will be collected from incidentally encountered suspect materials present in significant quantities.

D.8

A solid sample requires 1 kg (2.2 lb) for a complete set of analyses to be performed. Composites of like materials can be made to meet this requirement. A minimum of 10 g of solid material will be required per analyte. Analytical procedures may be limited to the main contaminants of interest.

Surface samples from relatively intact surfaces greater than 1,000 ft^2 will consist of a composite of 15 subsamples of 100-cm^2 area collected to a depth of 3-4 mm. Results may be correlated to gamma ray measurements for the same area. Surface soil samples will be taken to a depth of 5 cm.

Corings, borings, and drillings will be used to define the extent of contamination and the vertical profile of contaminants. Core samples of materials such as concrete and asphalt will be sliced in one-inch increments for profile definition.

The identify of known solid materials will be recorded. For unknown solids, characteristics will be recorded such as color, shape, texture, apparent constituents, possible organic matter content and other notable features.

D.6 PROCEDURES

This section identifies the procedures that support the OU3 field characterization program. These procedures address health and safety, instrument measurement, field sampling, and laboratory analysis. Attachment D.I includes abstracts of these supporting procedures. The associated requirement is to have all the identified procedures in the SCQ before actual measurements, sampling, and analyses begin.

Currently, the following source documents have been identified and are being examined for information on sources of procedures:

1. FEMP SCQ (current version was submitted to EPA for review on March 4, 1992)
2. DOE *Analytical Methods Compendium* (through Los Alamos National Laboratory)
3. EPA (Region IV) *Standard Operating Procedures and Quality Assurance Manual*, February 1, 1991

4. Installation Restoration Program (IRP), Volume 2, *Quality Assurance Project Plan, Field Standard Operating Procedures*, February 22, 1991
5. Westinghouse Hanford Company, *Environmental Investigations and Site Characterization Manual*, July 24, 1989
6. *Environmental Restoration Program, Standard Operating Procedures*, DOE, Albuquerque Operations Office, December 1988
7. Remedial Action Program Information Center (RAPIC)

D.6.1 Health and Safety Procedures

The following procedures have been identified as applicable to OU3 field activities and will be included in the RI/FS Health and Safety Plan and/or the SCQ, as necessary:

1. Evaluation of work areas;
2. Health and safety planning;
3. Access control;
4. Confined space entry;
5. Heat stress;
6. Cold stress;
7. Equipment decontamination;
8. Sampling media, chemicals storage; and
9. Personnel monitoring.

D.6.2 Field Instrument Measurement Procedures

The following field instrument procedures have been identified as applicable for OU3 activities:

- Radiological
  - Use of a NaI detector (cylindrical and FIDLER),
  - Use of a MicroR meter,

- Use of a pressurized ion chamber (PIC),
- Use of an alpha scintillation detector,
- Use of a pancake GM detector,
- Use of a gas flow proportional detector, and
- Use of a radon monitor;

• Chemical

- Use of a combustible gas indicator,
- Use of a HNu (PID) monitor,
- Use of an OVA monitor,
- Use of indicator tubes (e.g., Draegars — NH_3 vapors),
- Use of a pH meter, and
- Use of screening kits (e.g., Dexsil — PCBs);

• Physical

- Use of hygrometers/temperature measurements,
- Use of noise monitors,
- Use of an electromagnetic radiation monitor, and
- Use of conductivity meter.

D.6.3 Field Sampling Procedures

The required sampling procedures are identified in Table D.13 and are organized by the six OU3 level I component groups. Potential media in each of the six groups are identified and the status of existing procedures is given.

D.6.4 Analytical Procedures

This section identifies the required analytical procedures for the expected sample matrices and analytes. Table D.14 shows the potential sample matrices grouped by sample

TABLE D.13 Potential Sample Media and Required Sampling Procedures for Level I Component Groups

Level I Component Group/Sampling Procedure	Potential Media	Procedure Identification[a]
Buildings		
Samples from surface water	Water	NA
	Aqueous liquid	N
	Organic liquid	N
Cores from slabs	Concrete	K.8.3
	Wood	K.8.3
	Asphalt	N
	Transite	N
	Drywall	N
	Structural steel	N
	Masonry	N
Air samples-particulate	Filter media	K.6.3, K.6.4.1, K.6.4.5
Air samples-gases	Adsorbents	K.6.3, K.6.4.1, K.6.4.5
	Air	K.6.2, K.6.6, RE-S-01-0002(M)
Containerized Materials		
Liquid samples from tanks	Water	K.5.5(M)
	Aqueous liquid	K.5.5(M)
	Organic liquid	K.5.5(M)
	Inorganic liquid	N
Liquid samples from drums	Water	K.5.5.6, FMPC-2185(M)
	Aqueous liquid	K.5.5.6, FMPC-2185(M)
	Organic liquid	N, FMPC-2185(M), 2-C-921(M)
	Inorganic liquid	N, FMPC-2185(M)
Solid samples from tanks	Salts/powders	K.5.5(M)
	Sludge	K.5.5(M)
	Organic residues	N
	Inorganic residues	K.5.5(M)
Solid samples from drums	Salts/powders	K.5.5, K.5.5(M), FMPC-2185(M)
	Sludge	K.5.5, K.5.5(M), FMPC-2185(M)
	Organic residues	N, FMPC-2185(M)
	Inorganic residues	K.5.5, K.5.5(M), FMPC-2185(M), 1-C-604(M)
		K.5.5, K.5.5(M), FMPC-2185(M)
	Soils/sand/gravel	K.5.5, K.5.5(M), FMPC-2185(M)
	Sediments	N, FMPC-2185(M),1-C-604(M)
	Heterogeneous waste	
Bulk Materials		
Surface samples	Soil/sand/gravel	K.5.1, 5.5.2, K.5.4

TABLE D.13 (Cont'd)

Level I Component Group/Sampling Procedure	Potential Media	Procedure Identification[a]
Bulk Materials (Cont'd)		
Sample at depth	Soil/sand/gravel	K.5.3, K.5.3.1, K.5.4
Samples from waste piles	Concrete	K.8.3
	Wood	K.8.2
	Asphalt	N
	Transite	N
	Drywall	N
	Structural steel	N
	Other metals	N
	Glass	N
	Masonry	N
	Soil/sand/gravel	K.5.1(M),K.5.2
	Paint	K.8.1
Parking Lots, Storage Pads, Roads, Railroads		
Core samples from pads	Concrete	K.8.3
	Wood	K.8.2
	Asphalt	N
	Structural steel	N
Samples from surface water	Water	K.4.3,K.4.4,43-C-06(M),43-C-314(M)
	Aqueous liquid	K.4.3, K.4.4
	Organic liquid	N
Piping, Utilities, Equipment		
Liquid samples from process equipment	Water	N, 43-C-324(M)
	Aqueous liquids	N
	Organic liquids	N
Liquid samples from pipes-pressurized	Water	N, 43-C-324(M)
	Aqueous liquids	N
	Organic liquids	N
Liquid samples from pipes-unpressurized	Water	N, 43-C-324(M)
	Aqueous liquids	N
	Organic liquids	N
Liquid samples from ducts	Water	N, 43-C-324(M)
	Aqueous liquids	N
	Organic liquids	N
Effluent samples-grab	Water	N, 43-C-324(M)
	Aqueous liquids	N
	Organic liquids	N

TABLE D.13 (Cont'd)

Level I Component Group/Sampling Procedure	Potential Media	Procedure Identification[a]
Piping, Utilities, Equipment (Cont'd)		
Effluent samples-timed	Water	N, 43-C-324(M)
	Aqueous liquids	N
	Organic liquids	N
Effluent samples-proportional	Water	N, 43-C-324(M)
	Aqueous liquids	N
	Organic liquids	N
Solid samples from pipes-unpressurized	Salts/powders	N
	Sludge	N
	Dust	N
	Organic residues	N
	Inorganic residues	N
Solid samples from ducts	Salts/powders	N
	Sludge	N
	Dust	K.8.4
	Organic residues	N
	Inorganic residues	N
Solid samples from process equipment	Salts/powders	N
	Sludge	N
	Dust	K.8.4
	Organic residues	N
	Inorganic residues	N
Basins		
Samples from surface liquids	Water	K.4.3 &
	Aqueous liquids	K.4.4
	Organic liquids	N
Solid samples underlying surface liquids	Sludge	K.5.1, K.5.2, K.5.4
	Sediment	K.5.1, K.5.2, K.5.4
	Salts/powders	N
	Soil/sand	K.5.1, K.5.2, K.5.4
Sample collection forms	All	K.9
Field storage and shipment of samples	All	K.10
Decontamination of sampling equipment	All	K.11

[a] NA = not applicable; N = new procedure required; M = existing procedure modification; K = procedures contained in SCQ; FMPC procedures contained in the RI/FS procedures manual; all others are existing WEMCO procedures.

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TABLE D.14 Sample Matrices

Sample Type	Sample Matrix
Aqueous samples	Water
	Aqueous liquids
Organic samples	Organic liquids
	Asphalt
	Organic residues
Solids	Concrete
	Transite
	Wood
	Drywall
	Soil/sediment/sand
	Gravel
	Sludge
	Salts/powders
	Masonry
	Steel/metals
	Glass
	Inorganic residues
	Dust
Heterogeneous waste	Miscellaneous substances, trash, etc.
Air samples	Filter media
	Air

type. Table D.15 shows the status of required radiochemical analytical procedures (e.g., either currently in the SCQ; or requires modification of an existing SCQ procedure, etc.). Table D.16 summarizes the status of required organic/inorganic and physical characteristic analytical procedures. All of the procedures identified in this section will be included in the SCQ. Table D.17 is a summary of all necessary analytical procedures that do not currently exist in the SCQ.

D.7 QUALITY ASSURANCE AND QUALITY CONTROL

A draft final five-volume SCQ has been recently printed. The following is a summary of sections of the SCQ applicable to the OU3 SAP. Much is included by reference. Section 4.2 of the OU3 work plan addendum discusses the strategy for developing the DQOs. The results of the strategy and any additional details associated with that logic process are discussed here.

D.7.1 General Quality Assurance/Quality Control (QA/QC) Requirements

A successful QA/QC program must establish positive controls over planning, implementation, and assessment of all sampling and analysis activities. Because of the breadth and complexity of the facilities and components found in OU3, it is essential that all these controls be applied in RI/FS activities from their initiation.

A key objective of the SAP QA/QC effort is to provide sampling and analysis results that comply with the administrative and regulatory requirements applicable to the FEMP. These requirements are documented in Section 1 of the SCQ. The details necessary for attaining these QA objectives are discussed in Section 4 of the SCQ and should be thoroughly reviewed before implementing this SAP. Below is a brief outline of these key requirements:

- Data must be legally traceable and defensible.
- Appropriate field quality assurance samples must be taken (including, as required, trip blanks, field blanks, equipment rinsate samples, preservative blanks, container blanks, duplicate samples, split samples, spiked samples and materials blanks).
- Analytical accuracy, precision, and sensitivity must be determined, and they must meet the specified acceptance values in the SCQ.

TABLE D.15 Radiochemical Analytical Procedures[a]

Sample Matrix	U Isot(1)	Pu Isot(2)	Th Isot(3)	Gamma Spect.(4)	PU-241	AM-241	NP-237	RA-226
Aqueous Samples								
Water	RAD0100	RAD0010	RAD0080M	RAD0140	EM	EM	EM	RAD0050
Aqueous liquids	RAD0100	RAD0010	RAD0080M	RAD0140	EM	EM	EM	RAD0050
Organic Samples								
Organic liquid	RAD0100M	RAD0010M	RAD0080M	RAD0140M	EM	EM	EM	RAD0050M
Asphalt	RAD0110M	RAD0010M	RAD0080M	RAD0140M	EM	EM	EM	RAD0060M
Org. residues	RAD0110M	RAD0010M	RAD0080M	RAD0140M	EM	EM	EM	RAD0060M
Solid Samples								
Concrete	RAD0110M	EM	RAD0080M	RAD0140M	EM	EM	EM	RAD0060M
Transite	RAD0110M	EM	RAD0080M	RAD0140M	EM	EM	EM	RAD0060M
Wood	RAD0110M	EM	RAD0080M	RAD0140M	EM	EM	EM	RAD0060M
Drywall	RAD0110M	EM	RAD0080M	RAD0140M	EM	EM	EM	RAD0060M
Soil/sediment/sand	RAD0110	EM	RAD0080M	RAD0140	EM	EM	EM	RAD0060
Gravel	RAD0110M	EM	RAD0080M	RAD0140M	EM	EM	EM	RAD0060M
Sludge	RAD0110M	EM	RAD0080M	RAD0140M	EM	EM	EM	RAD0060M
Salts/powders	RAD0110M	EM	RAD0080M	RAD0140M	EM	EM	EM	RAD0060M
Masonry	RAD0110M	EM	RAD0080M	RAD0140M	EM	EM	EM	RAD0060M
Steel/metals	RAD0110M	EM	RAD0080M	RAD0140M	EM	EM	EM	RAD0060M
Glass	RAD0110M	EM	RAD0080M	RAD0140M	EM	EM	EM	RAD0060M
Inorg. residues	RAD0110M	EM	RAD0080M	RAD0140M	EM	EM	EM	RAD0060M
Dust	RAD0110M	EM	RAD0080M	RAD0140M	EM	EM	EM	RAD0060M
Hetero. waste	RAD0110M	EM	RAD0080M	RAD0140M	EM	EM	EM	RAD0060M
Part. air samples	RAD0100	EM	RAD0080M	RAD0140	EM	EM	EM	RAD0060
Gas Samples								
Adsorbents	NA	NA	NA	NA	NA	NA	NA	NA
Air	NA	NA	NA	NA	NA	NA	NA	NA

TABLE D.15 (Cont'd)

Sample Matrix	RA-228	TC-99	SR-90	RN-222/ PROGENY	PB-210	PO-210	Gross Alpha	Gross Beta
Aqueous Samples								
Water	RAD0040	D	D	EM	RAD0070	EM	RAD130	RAD130
Aqueous liquids	RAD0040	D	D	EM	RAD0070	EM	RAD130	RAD130
Organic Samples								
Organic liquid	RAD0040M	EM	EM	NA	EM	EM	NA	NA
Asphalt	RAD0040M	EM	EM	NA	EM	EM	NA	NA
Org. residues	RAD0040M	EM	EM	NA	EM	EM	NA	NA
Solid Samples								
Concrete	RAD0040M	EM	EM	NA	EM	EM	NA	NA
Transite	RAD0040M	EM	EM	NA	EM	EM	NA	NA
Wood	RAD0040M	EM	EM	NA	EM	EM	NA	NA
Drywall	RAD0040M	EM	EM	NA	EM	EM	NA	NA
Soil/sediment/sand	RAD0040M	EM	EM	NA	EM	EM	NA	NA
Gravel	RAD0040M	EM	EM	NA	EM	EM	NA	NA
Sludge	RAD0040M	EM	EM	NA	EM	EM	NA	NA
Salts/powders	RAD0040M	EM	EM	NA	EM	EM	NA	NA
Masonry	RAD0040M	EM	EM	NA	EM	EM	NA	NA
Steel/metals	RAD0040M	EM	EM	NA	EM	EM	NA	NA
Glass	RAD0040M	EM	EM	NA	EM	EM	NA	NA
Inorg. residues	RAD0040M	EM	EM	NA	EM	EM	NA	NA
Dust	RAD0040M	EM	EM	NA	EM	EM	NA	NA
Hetero. waste	RAD0040M	EM	EM	NA	EM	EM	EM	EM
Part. air samples	RAD0040	D	D	EM	RAD0070	EM	RAD130M	RAD130
Gas Samples								
Adsorbents	NA	NA	NA	NA	NA	NA	NA	NA
Air	NA	NA	NA	N	NA	NA	NA	NA

[a] Abbreviations: M = modification of existing SCQ procedure; N = requires new procedure; NA = analysis not determined in the matrix indicated; EM = modification of existing procedure; D = procedure in draft; (1) = 233/234U, 235U, and 238U; (2) = 238Pu, 239/240Pu, and 242Pu; (3) = 227Th, 228Th, 230Th, 232Th; (4) = 60Co, 106Ru, 137Cs, Pb-214, 214Bi, 228Ac, 212Pb, 208Tl, 227Th, 223Ra, 211Bi, 231Th.

TABLE D.16 Organic/Inorganic Chemical and Physical Property Analytical Procedures[a]

Sample Matrix	VOC GC/MS	VOC GC(P&T)	Di, Tri, Tetra-Chloroethylene	SVOC GC/MS	TBP	PCB/PEST	TPH	GFAA Metals	Flame AA Metals
Aqueous Samples									
Water	ORG0010	ORG0050	ORG0050M	ORG0060	ORG0060M	ORG0030	CON0200	INO0010	INO0020
Aqueous liquids	ORG0010	ORG0050	ORG0050M	ORG0060	ORG0060M	ORG0030	CON0200	INO0010	INO0020
Organic Samples									
Organic liquid	ORG0010M	ORG0050M	ORG0050M	ORG0060M	ORG0060M	ORG0030M	EM	INO0010M	INO0020M
Asphalt	ORG0010M	ORG0050M	ORG0050M	ORG0060M	ORG0060M	ORG0030M	EM	INO0010M	INO0020M
Org. residues	ORG0010M	ORG0050M	ORG0050M	ORG0060M	ORG0060M	ORG0030M	EM	INO0010M	INO0020M
Solid Samples									
Concrete	NA	NA	NA	NA	NA	ORG0030M	NA	INO0010M	INO0020M
Transite	NA	NA	NA	NA	NA	ORG0030M	NA	INO0010M	INO0020M
Wood	NA	NA	NA	NA	NA	ORG0030M	NA	INO0010M	INO0020M
Drywall	NA	NA	NA	NA	NA	NA	NA	INO0010M	INO0020M
Soil/sediment/sand	ORG0010	ORG0050	ORG0050M	ORG0060	ORG0060M	ORG0030	CON0200M	INO0010	INO0020
Gravel	NA	NA	NA	NA	NA	NA	NA	INO0010M	INO0020M
Sludge	ORG0010M	NA	NA	ORG0060M	ORG0060M	ORG0030M	CON0200M	INO0010M	INO0020M
Salts/powders	NA	NA	NA	NA	NA	NA	NA	INO0010M	INO0020M
Masonry	NA	NA	NA	NA	NA	NA	NA	INO0010M	INO0020M
Steel/metals	NA	NA	NA	NA	NA	NA	NA	INO0010M	INO0020M
Glass	NA	NA	NA	NA	NA	NA	NA	INO0010M	INO0020M
Inorg. residues	NA	NA	NA	NA	NA	NA	NA	INO0010M	INO0020M
Dust	NA	NA	NA	NA	NA	NA	NA	INO0010M	INO0020M
Hetero. waste	NA	NA	NA	NA	NA	NA	NA	INO0010M	INO0020M
Part. air samples	NA	NA	NA	NA	NA	NA	NA	INO0010M	INO0020M

TABLE D.16 (Cont'd)

Sample Matrix	ICP Metals	Mercury	Zirconium	Nitrogen Nitrates Nitrites	Fluoride	Chloride	Sulfate	Sulfide	Cyanide
Aqueous Samples									
Water	INO0030	INO0040	INO0030M	CON0040	CON0300	CON0120	CON0280	CON0130	CON0010
Aqueous liquids	INO0030	INO0040	INO0030M	CON0040	CON0300	CON0120	CON0280	CON0130	CON0010
Organic Samples									
Organic liquid	INO0030M	INO0040M	INO0030M	NA	NA	NA	NA	NA	NA
Asphalt	INO0030M	INO0040M	INO0030M	NA	NA	NA	NA	NA	NA
Org. residues	INO0030M	INO0040M	INO0030M	NA	NA	NA	NA	NA	NA
Solid Samples									
Concrete	INO0030M	INO0040M	INO0030M	NA	NA	NA	NA	NA	NA
Transite	INO0030M	INO0040M	INO0030M	NA	NA	NA	NA	NA	NA
Wood	INO0030M	INO0040M	INO0030M	NA	NA	NA	NA	NA	NA
Drywall	INO0030M	INO0040M	INO0030M	NA	NA	NA	NA	NA	NA
Soil/sediment/sand	INO0030	INO0040	INO0030M	NA	NA	NA	NA	EM	CON0010M
Gravel	INO0030M	INO0040M	INO0030M	NA	NA	NA	NA	NA	NA
Sludge	INO0030M	INO0040M	INO0030M	N	NA	NA	NA	N	CON0010M
Salts/powders	INO0030M	INO0040M	INO0030M	NA	NA	NA	NA	NA	NA
Masonry	INO0030M	INO0040M	INO0030M	NA	NA	NA	NA	NA	NA
Steel/metals	INO0030M	NA	INO0030M	NA	NA	NA	NA	NA	NA
Glass	INO0030M	NA	INO0030M	NA	NA	NA	NA	NA	NA
Inorg. residues	INO0030M	INO0040M	INO0030M	NA	NA	NA	NA	NA	NA
Dust	INO0030M	INO0040M	INO0030M	NA	NA	NA	NA	NA	NA
Hetero. waste	INO0030M	INO0040M	INO0030M	NA	EM	EM	EM	EM	EM
Part. air samples	INO0030M	NA	NA	NA	NA	NA	NA	NA	NA

TABLE D.16 (Cont'd)

Sample Matrix	Oil/ Grease	TOC	TC	Asbestos	TCLP	Corrosivity	Ignitability	Reactivity	Physical Characteristics
Aqueous Samples									
Water	CON0180	CON0080	EM	NA	MISC0010	MISC0020	NA	NA	N
Aqueous liquids	CON0180	CON0080	EM	NA	MISC0010	MISC0020	MISC0030	MISC0040	N
Organic Samples									
Organic liquid	CON0180M	NA	NA	NA	MISC0010	MISC0020	MISC0030	MISC0040M	N
Asphalt	CON0180M	NA	NA	NA	MISC0010	NA	MISC0030	MISC0040M	N
Org. residues	CON0180M	NA	NA	NA	MISC0010	NA	MISC0030	MISC0040M	N
Solid Samples									
Concrete	NA	NA	NA	NA	MISC0010	NA	NA	NA	N
Transite	NA	NA	NA		MISC0010	NA	NA	NA	N
Wood	NA	NA	NA		MISC0010	NA	NA	NA	N
Drywall	NA	NA	NA		MISC0010	NA	NA	NA	N
Soil/sediment/sand	NA	EM	EM	NA	MISC0010	NA	NA	NA	GTT11,12,14, 21-25,31-33, 41-44, 51, 61-63, 72
Gravel	NA	NA	NA	NA	MISC0010	NA	NA	NA	Same as above
Sludge	CON0180M	EM	EM	NA	MISC0010	NA	MISC0030M	MISC0040	N
Salts/powders	NA	NA	NA	NA	MISC0010	NA	NA	MISC0040	N
Masonry	NA	NA	NA		MISC0010	NA	NA	NA	N
Steel/metals	NA	NA	NA	NA	MISC0010	NA	NA	N	N
Glass	NA	NA	NA	NA	MISC0010	NA	NA	NA	N
Inorg. residues	NA	NA	NA	NA	MISC0010	NA	MISC0030M	NA	N
Dust	NA	NA	NA	NA	MISC0010	NA	NA	NA	N
Hetero. waste	EM	NA	NA	EM	MISC0010	MISC0020	MISC0030M	MISC0040	N
Part. air samples	NA	NA	NA	EM	NA	NA	NA	NA	N

[a] Abbreviations: M = modification of existing SCQ procedures; N = requires new procedure; NA = analyte not determined in the matrix indicated; EM = modification of existing procedures.

TABLE D.17 Summary of Required Analytical Procedures[a] 3297 1

Parameter	SCQ Proc. No.	Aqueous			Organic			Solid			
		M	EM	N	M	EM	N	M	EM	N	2
Isotopic uranium	RAD0100				X						3
Isotopic uranium	RAD0110				X			X			4
Isotopic plutonium	RAD0010				X				X		5
Isotopic thorium	RAD0080	X			X			X			6
Gamma spectroscopy	RAD0140				X			X			7
Plutonium 241			X			X			X		8
Americium 241			X			X			X		9
Neptunium 237			X								10
Radium 226	RAD0050				X						11
Radium 226	RAD0060				X			X			12
Radium 228	RAD0040				X			X			13
Technetium 99			X			X			X		14
Strontium 90			X			X			X		15
Radon 222/progeny			X								16
Lead 210	RAD0070					X			X		17
Polonium 210			X			X			X		18
Gross alpha	RAD0130										19
Gross beta	RAD0130										20
VOC(GC/MS)	ORG0010				X			X			21
VOC(P&T)	ORG0050	X			X			X			22
SVOC(GC/MS)	ORG0060	X			X			X			23
PCB/PEST	ORG0030				X			X			24
TPH	CON0200					X		X			25
GFAA metals	INO0010				X			X			26
FLAME AA metals	INO0020				X			X			27
ICP metals	INO0030	X			X			X			28
Mercury(CVAA)	INO0040				X			X			29
NO_3, NO_2, tot. nitrate	CON0040							X			30
Fluoride	CON0300										31
Chloride	CON0120										32
Sulfate	CON0280										33
Sulfide	CON0130								X		34
Cyanide	CON0010							X			35
Oil/grease	CON0180				X			X			36
TOC	CON0080								X		37
TC			X						X		38
Asbestos											39
TCLP	MISC0010										40
Corrosivity	MISC0020										41
Ignitability	MISC0030							X			42
Reactivity	MISC0040				X				X		43
Physical characteristics	GTT'S		X			X			X		44
Totals		4	9	0	18	8	0	18	12	0	45

TABLE D.17 (Cont'd)

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Parameter	SCQ Proc. No.	Hetero. Waste M	Hetero. Waste EM	Hetero. Waste N	Air Part. M	Air Part. EM	Air Part. N
Isotopic uranium	RAD0100						
Isotopic uranium	RAD0110	X					
Isotopic plutonium	RAD0010		X			X	
Isotopic thorium	RAD0080	X			X		
Gamma spectroscopy	RAD0140	X					
Plutonium 241			X			X	
Americium 241			X			X	
Neptunium 237							
Radium 226	RAD0050						
Radium 226	RAD0060	X					
Radium 228	RAD0040	X					
Technetium 99			X			X	
Strontium 90			X			X	
Radon 222/progeny						X	
Lead 210	RAD0070		X			X	
Polonium 210			X			X	
Gross alpha	RAD0130		X		X		
Gross beta	RAD0130		X				
VOC(GC/MS)	ORG0010						
VOC(P&T)	ORG0050						
SVOC(GC/MS)	ORG0060						
PCB/PEST	ORG0030						
TPH	CON0200						
GFAA metals	INO0010	X			X		
FLAME AA metals	INO0020	X			X		
ICP metals	INO0030	X			X		
Mercury(CVAA)	INO0040	X			X		
NO_3, NO_2, tot. nitrate	CON0040						
Fluoride	CON0300		X				
Chloride	CON0120		X				
Sulfate	CON0280		X				
Sulfide	CON0130		X				
Cyanide	CON0010		X				
Oil/grease	CON0180		X				
TOC	CON0080						
TC							
Asbestos			X			X	
TCLP	MISC0010						
Corrosivity	MISC0020						
Ignitability	MISC0030	X					
Reactivity	MISC0040						
Physical characteristics	GTT'S		X				
Totals		10	17	0	6	9	0

TABLE D.17 (Cont'd)

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Parameter	SCQ Proc. No.	Gas			Totals[b]		
		M	EM	N	M	EM	N
Isotopic uranium	RAD0100				X		
Isotopic uranium	RAD0110				X		
Isotopic plutonium	RAD0010				X	X	
Isotopic thorium	RAD0080				X		
Gamma spectroscopy	RAD0140				X		
Plutonium 241						X	
Americium 241						X	
Neptunium 237						X	
Radium 226	RAD0050				X		
Radium 226	RAD0060				X		
Radium 228	RAD0040				X		
Technetium 99						X	
Strontium 90						X	
Radon 222/progeny			X			X	
Lead 210	RAD0070					X	
Polonium 210						X	
Gross alpha	RAD0130				X	X	
Gross beta	RAD0130					X	
VOC(GC/MS)	ORG0010				X		
VOC(P&T)	ORG0050				X		
SVOC(GC/MS)	ORG0060				X		
PCB/PEST	ORG0030				X		
TPH	CON0200				X	X	
GFAA metals	INO0010				X		
FLAME AA metals	INO0020				X		
ICP metals	INO0030				X		
Mercury(CVAA)	INO0040				X		
NO_3, NO_2, tot. nitrate	CON0040				X		
Fluoride	CON0300					X	
Chloride	CON0120					X	
Sulfate	CON0280					X	
Sulfide	CON0130					X	
Cyanide	CON0010				X	X	
Oil/grease	CON0180				X	X	
TOC	CON0080						
TC							
Asbestos							
TCLP	MISC0010						
Corrosivity	MISC0020						
Ignitability	MISC0030				X		
Reactivity	MISC0040				X		
Physical characteristics	GTT'S						
Totals		0	1	0	23	18	0

[a] X = needed procedure; may require modifications to existing procedures.

[b] Assumes multiple matrix categories can be covered by one procedure.

- Completeness, representativeness, and comparability of data sets must be determined and meet requirements.
- Required site- and job-specific training for personnel must be provided and documented.
- Records administration, preparation, control, and retention requirements must be met.
- Documentation and drawing change control procedures must be followed at all times.

D.7.2 Elements of QA/QC

Proper sample custody, data validation and data management are elements essential to effective overall quality assurance. Data validation requires verifying that proper instrument calibration was performed and that appropriate corrective actions were taken to maintain sampling and analysis equipment in proper working order when they fail to meet operating specifications. These topics are discussed in depth in the SCQ, and reference must be made to that document when reviewing the FIPs. This section provides a brief overview of those requirements.

D.7.2.1 Sample Custody

Sample custody procedures must be in accordance with Section 7 of the SCQ. The key elements in this custody chain are:

- A bound field log or activity log to record daily activities,
- Proper sample identification and labeling,
- Sample chain-of-custody forms fully completed,
- A laboratory request-for-analysis form, and
- A sample disposition log.

D.7.2.2 Data Validation and Management

Numerical analysis, including manual calculations, mapping, and computer modeling, will be documented and subjected to a validation review. Records of numerical analyses must be legible and complete enough to permit reconstruction of the work by a qualified individual other than the originator. The Data Validation Plan, including the forms and records to be maintained, is described in Appendix D of the SCQ. The Data Management Plan is presented in Appendix F of the SCQ.

Data validation generally deals with two types of data: field generated or laboratory generated. Field data validation consists of checking that the associated project-specific plans have been followed and related activities have been appropriately documented. Laboratory data validation includes assessment of data package completeness and DQO compliance to ensure that data is generated to the specified ASLs. Checklists may be used to support data validation. Data management involves administering the complete data life cycle from initial planning through ultimate disposition. Some key areas include the following:

- Establishing DQOs,
- Preparing FIPs,
- Collecting the samples,
- Handling and transferring the samples,
- Analyzing samples and reporting data,
- Verifying and validating data,
- Placing the data in the data repository,
- Analyzing the data, and
- Archiving and storing the data.

D.7.2.3 Instrument Measurement and Calibration

Calibration procedures, frequency of calibration, and the associated documentation requirements are covered in Section 8 of the SCQ. Before any instrument is used for making measurements at the FEMP, it must be documented that the particular instrument has been calibrated against standards traceable to the National Institute for Standards and Technology

(NIST), EPA-certified standards, or if neither are available, the best quality standard that is obtainable.

Key information that will be specified in the FIP includes:

- A list of the field measurement and test equipment to be used, including type, manufacturer, and identification number,
- The proper calibration procedure or reference to its source,
- Reference standards and their traceability,
- The standards requested for the specific ASLs required,
- Maintenance and inspection requirements before use of the equipment,
- Required calibration frequencies, and
- Calibration log requirements.

D.7.2.4 Corrective Actions and Recommendations

The SCQ establishes quality assurance (QA) systems for dealing with two classes of problems: analytical/equipment and noncompliance. Analytical/equipment problems may occur during sampling, sample handling, sample preparation, laboratory instrumental analysis, and data review. Analytical/equipment problems are considered as deviations at the FEMP and must be reported and processed in accordance with Section 15 of the SCQ. A QA system has been established to report and evaluate deviations and to implement and verify corrective actions. This QA system currently is used for environmental surveillances (performance audits), audits (system audits), and other activities where deviations are identified. Subcontractors must either participate in the FEMP QA system, which is described in Sections 12 and 15 of the SCQ, or implement a QA system that meets all of the substantive FEMP requirements.

A deviation is a deficiency in characteristics, documentation, or procedures or a departure from a specified requirement that renders the quality of an item, datum, or activity unacceptable or indeterminate. When a deviation is observed, the initiator must document the violated requirement and complete Sections 1 and 2 of a deviation report (DR), Figure B-2

of the SCQ, and forward it to the designated FEMP QA project organization, where it will be handled according to the procedures of Section 15 of the SCQ.

Upon receipt of a DR, the cognizant QA organization will determine whether a significant adverse quality condition exists. If so, a corrective action report (CAR), Figure B-3 of the SCQ, must be issued and completion of the corrective action must be verified and documented. Also, a CAR is proposed when a noncompliance problem is identified (usually during audits).

Corrective action measures are required to rectify identified conditions that render the quality of the process or activity unacceptable or indeterminate. The need for corrective action is based on predetermined limits of acceptability. Any nonconformance (deviation) from established quality control (QC) procedures in the SCQ must be identified and corrected in accordance with the SCQ. Corrective action measures must be completed in an expeditious manner and verified as adequate as soon as practicable.

On-site/off-site laboratory corrective actions for deviations and nonconformances, evaluation of recurring deviations, and processing of variance requests must follow the guidance contained in Section 15 of the SCQ.

D.7.3 Data Quality Objectives

All CERCLA investigation activities must be conducted and documented in a manner that ensures that sufficient data of known quality are collected to support sound decisions concerning remedial action selection. To this end, DQOs have been specified for the OU3 data collection activities described in this SAP. The DQOs are qualitative and quantitative statements of the data required to support decisions affecting remedial response activities. A general summary of DQOs is presented here. Actual DQOs are provided in Section 4.2 of the OU3 work plan addendum.

DQO statements specify the type and quality of data required, assure the technical defensibility of the data, and influence risk assessment methodology and RAA development. The OU3 DQOs were derived from the data uses and data needs identified in Section 3 of the work plan addendum. They were influenced by the FEMP environmental setting and the nature and extent of contaminants within OU3, as described in Sections 2.3 and 2.4,

respectively, and developed in accordance with the SCQ eight-step process described in Section 4.2.

That DQO development process generated a logical set of decisions that determined whether measurements and collection of samples were necessary, and the types, locations, and quantities of samples to be collected. It also specifies analytical requirements, including precision, accuracy, comparability, completeness, and sensitivity of methods, and the overall measurement confidence levels required.

D.7.3.1 Problem Statement

Environmental concerns related to OU3 are defined in the form of a problem statement. Given applicable regulatory requirements and the existence of radiological and chemical contamination in OU3, the following must be achieved: (1) the risks from the radiological and chemical contamination in OU3 must be evaluated, and (2) through the remedial action, alternatives must be developed and evaluated that will mitigate or eliminate the risks.

While certain components are expected to be relatively free of contamination, the majority of OU3 components are known or suspected to contain radiological, chemical, and/or mixed contamination. Contamination is in a variety of forms (e.g., solid, liquid, powder/granular, solid/bulk) and degrees of containment (e.g., in sealed packages, in bulk containers, in process equipment/vessels, or uncontained in surface deposits).

The potential for both near-term and long-term human and ecological exposure exists through a range of exposure scenarios and pathways. These include direct on-site exposure (on-site workers or a member of the public in the site abandonment scenario) and release of contaminants with potential exposure off-site via several potential release mechanisms.

Remedial action objectives (RAOs) and preliminary remedial action alternatives (RAAs) are discussed in OU3 work plan addendum Sections 3.3 and 3.4, respectively. In addition to the no-action alternative, four RAAs were identified that fall into two broad categories: (1) in-situ control/decontamination/containment and (2) removal/disposal.

The intended uses of data gathered at OU3 include (1) assessing the nature of contamination at the site and the extent of potential problems resulting from past activities,

(2) evaluating the potential hazard to human health and the environment, (3) evaluating remedial actions and alternatives, (4) choosing and implementing preferred remedial alternatives, and (5) monitoring the effectiveness of the remedial alternatives.

D.7.3.2 Identification of a Decision that Addresses the Problem

In this step, a series of questions are designed to provide the necessary information with which to begin to formulate a strategy for addressing the problem. OU3 sampling and analysis activities will address these questions, which are based on the data needs associated with general planning, component characterization, risk assessment, compliance with ARARs, RAA evaluation, worker health and safety, and verification of attainment of remedial action objectives. The questions are as follows:

- What contaminants are present?
- Where are the contaminants located?
- What are the concentrations of the contaminants?
- What is the potential for human and environmental exposure to contaminants?
- What are the risks to people and the environment from these exposures?
- If the risks from exposure to the contaminants are unacceptable, then how can the risks be reduced to acceptable levels?
- What are the type and amounts of materials contaminated in OU3 (concrete, wood, steel, asbestos)?
- What is the depth of penetration of contaminants in various types of materials (surface or subsurface)?
- What is the amenability of the various materials to specific treatment technologies and decontamination measures?
- What cleanup goals are required to achieve protection of human health and the environment?
- If the risks must be reduced, what is the most cost-effective way to do so?

- Will remedial actions release contaminants, potentially resulting in exposure of the work force?
- What are the potential hazards and health risks to the work force?
- What levels of personal protective equipment are appropriate?

D.7.3.3 Identification of Inputs that Affect the Decision

The planning process identifies the variables and environmental characteristics that are relevant to the decision. The focus here is on those variables and characteristics that must be measured to provide the information necessary to support decision making. As a result of the complexity and variety of OU3 components, existing data (as presented in Section 2.4) are considered to be generally insufficient to adequately identify contaminants present, their locations, and their potential for release. Therefore, RI activities are proposed to answer these questions with the collection of data of appropriate quantity and quality. The following items represent key data inputs to decision making, and thereby control the sampling program to obtain the most useful and reliable information:

- Source term,
- Receptors,
- Transport and release,
- Data needed to model fate and transport of contaminants,
- Data needed to select the RAAs, and
- Data needed to evaluate the RAAs.

The diversity of OU3 components results in a significant number of specific data inputs to the questions identified in the preceding step. A review and assessment of existing OU3 data (Section 2.4) relative to current data needs was performed and data gaps were identified (Section 3). The range of anticipated sample types, media, and analyses are detailed in Section D.4.

D.7.3.4 Specification of the Domain of the Decision

The domain of the OU3 decisions and data collection activities is defined by the conceptual model discussed in Section 3.1 of the work plan. The conceptual model identifies and characterizes the following aspects of OU3: the contaminant sources, release mechanisms, transport and affected media, and potential exposure modes and receptors. All decisions will be made and all data collection activities will occur within the domain defined by the conceptual model for both risk assessment and RAA development.

D.7.3.5 Development of Logic Statements

The purpose of this step is to integrate output from the previous steps into a single line of reasoning specifying how data will be summarized and used to make the decision. Quantitative criteria for determining appropriate actions are discussed.

The unique characteristics of OU3 components determine the manner in which assessment data will be summarized and compared to relevant criteria. The interpretation and use of OU3 data will include the following:

1. Contaminant concentrations, volumes, and total quantities will be used in transport and environmental pathway models that are used to predict potential exposures and risks for comparison to acceptable levels of exposure and risk.

2. Contaminant concentrations will be compared with risk-based target levels.

3. Exposure and risk targets will be applied both on a component level and OU3-wide level to ensure that no single component or component group exceeds the exposure/risk targets, and that OU3, when examined as a whole, does not exceed the exposure/risk targets. Exposures and risks from all sources and pathways will be summed and controlled on an OU3-wide basis. As such, individual source components will only contribute a portion of the total.

4. The nature, extent, and inventory of contamination associated components designated U1 (minimum uniqueness) can be inferred from

the characterization of a randomly selected component assumed to be representative of the category. In the case of more heterogenous component categories (U2), a judgmentally selected worst-case component can be characterized and used to infer the bounding characteristics of the other components. In the case of substantially unique components (U3), they must be individually characterized. In all cases, limited sampling should be conducted in the balance of components as is necessary to support sound inferences of their characteristics.

5. Data gathered will be used to estimate the type and amount of contamination and the type and amount of affected media. The choice of applicable remedial alternatives will be driven by these two estimates. In addition, the evaluation of on-site or off-site treatment may be driven by the quantity and nature of contaminated media. Cost, implementability, and technical feasibility of the various potential remedial alternatives must be accurately evaluated during the FS. In order to adequately evaluate these factors, the type and amount of contamination and type and amount of affected media must be accurately estimated.

6. Allowable action levels determined by the risk assessment and ARARs will also affect the choice of remedial alternatives. Treatability studies and bench-scale testing of the various remedial alternatives must confirm that the alternatives meet allowable action levels.

7. Accurately determining the extent of contamination will be crucial in determining the applicable remedial alternatives with respect to porous building materials such as concrete. If the contamination is only surficial, then surface washing or possibly spalling of the concrete may be sufficient to achieve the action levels required by the risk assessment.

D.7.3.6 Establish Constraints on Uncertainty

Objectives for controlling decision errors should be stated as limits on the acceptable probability of making an incorrect decision based on the study findings. The limits on

uncertainty should be based on careful consideration of the consequences of incorrect conclusions. This process should define false positive and false negative errors for the decision, describe scenarios in which each type of error might take place, and determine if false positives or false negatives are of greater concern.

Potentially large degrees of uncertainty are inherent in the assessment of potential human health and environmental risk, evaluation and selection of remedial alternatives, or evaluation of compliance with ARARs. As the uncertainty increases, it erodes the level of confidence associated with decisions made regarding acceptability of potential risks, compliance with contamination standards, or the potential costs and effectiveness of a remedial alternative. Efforts to control and reduce uncertainty at OU3 will be guided by the objective of avoiding or limiting the frequency of decision errors, both false positive and false negative.

Both false-negative and false-positive errors are undesirable; however, because the potential consequences of false-negative errors include additional, and potentially unacceptable, health risk, the reduction of false-negative errors is controlling. Therefore, OU3 data collection activities will be conducted in a manner that minimizes data uncertainty and provides an acceptable level of decision confidence. This will be accomplished through compliance with specific criteria for data quality and data quantity. These criteria address data precision, accuracy, representativeness, completeness, and comparability. The FEMP requirements for these parameters are described in Sections 4 and 14 of the SCQ and are summarized below.

Precision — Acceptable ranges of relative percent difference are specified for each analysis and ASL. Range analysis will be used to evaluate the precision of radiological data derived from methods for which performance data are not available. Range analysis results must fall within three standard deviations of the mean to be considered "under control."

Accuracy — Acceptable ranges of percent recovery are specified for each procedure and ASL. Range analysis will be used to evaluate the accuracy of radiological data. Range analysis results must fall within three standard deviations of the mean to be considered "under control."

Representativeness — To be considered adequately representative, the collected data must be sufficient to reduce the probability of a false-negative or a false-positive error to 10%

each. In other words, the true mean value falls within the two-sided 80% confidence bounds around the sample mean.

Completeness — Completeness will be at least 90% for OU3 data.

Comparability — Comparability will be considered to have been achieved through the use of standard procedures and trained field and laboratory personnel.

D.7.3.7 Optimize Design for Obtaining Data

This step addresses mechanisms for optimizing data collection efforts by identifying the most efficient way that can be expected to achieve the desired constraints on uncertainty. For example, on the basis of the estimated contaminant variabilities and distributions, what is the lowest cost sampling and analysis plan that will achieve the desired data and constraints on uncertainty (i.e., how many samples will be collected, how will the locations be chosen)?

The number of samples that need to be collected are determined with the approaches and protocols described in Sections D.3 and D.5, respectively. The approaches and protocols justify the sampling locations and sample numbers in the absence of available data. Selection of specific locations and numbers of samples is influenced by data collected during ongoing activities, screening activities (e.g., radiological contamination surveys), and process knowledge. In situations where available data are extensive, statistical techniques may be useful in determining the additional data required.

Statistical analyses will be used to guide the planning, performance, and validation of measurements and sampling. The locations of samples to be used in making statistical inferences about contamination levels and extent will only be selected in a random, or systematic/random manner to ensure they are representative and free from bias. Additional samples will be collected, as necessary and appropriate, from locations selected on the basis of judgment or process knowledge. These samples will be used to investigate locations of specific interest or uniqueness, and may include areas of known contamination. Data obtained from such samples are an important element of the sampling program and may also be used to make inferences about OU3 component contamination levels. However, these judgmental samples will be distinguished from the randomly located samples and cannot be included in the quantitative statistical analyses.

D.7.3.8 Summary

With the information developed in the preceding seven steps, appropriate ASLs are specified on the basis of the intended use of the data. The ASLs necessary to achieve the required data quality encompass ASLs A through D. Levels A and B will be used to the greatest extent in evaluating the level and extent of contamination through direct field measurements of radiological contamination. All laboratory analyses will, as a minimum, be conducted at ASL C to supplement the ASL A and B analyses on specific samples collected to quantify individual contaminants. At least one of the samples collected from each source area within components designated S3 will be analyzed at ASL D and validated to provide highest quality data to confirm the less expensive, but more extensive, lower-level analyses. This approach will provide the level of confidence necessary to determine the contaminants present at or near the sources. Quality control checks will be as specified for each ASL according to the FEMP-specified analytical protocols. Analytical sensitivity will be in accordance with the specifications of Table A.2-3, Appendix A, of the SCQ.

D.8 OPERATIONAL PLAN, SCHEDULE, AND PERSONNEL RESOURCES

As a basis for the development of a comprehensive sampling program schedule for the OU3 RI/FS field program, a series of assumptions were made on the time required for elements of the effort. The assumptions provide a systematic basis for evaluation of sampling time needs on the basis of all information currently available about each of the OU3 components. Component level I and II groupings, uniqueness ranking, interim facility use, significance ranking, and removal action plans have all been evaluated with respect to their impact on the scheduling of RI/FS sampling for a component (Section 4.3). Sample requirements for each component are a direct result of information needs for each component, as reflected in the sampling protocols of Section D.5. The following sections provide a list of the key assumptions made in the schedule development (Section D.8.1); a summary discussion of the sample quantity estimates (Section D.8.2); the level III schedule for field operations (Section D.8.3), and the personnel resources to be utilized for field implementation (Section D.8.4). All of the following information is based on preliminary approximations of time and materials and will be refined as more information becomes available.

D.8.1 Component Sampling Assumptions

The initial baseline assumed that each analytical support level (ASL) A/B sample/measurement would take 0.5 hour to perform (based on the experience of the field teams at the FEMP). This baseline was then compared to each protocol to establish realistic estimates for calculation of approximate person-hours for all sampling.

Activities at each sample/measurement location were assumed to include all radiological measurements (alpha and beta-gamma radiation surveys, swipes for removable contamination, gamma ray measurements, etc.) and chemical measurements (HNu, XRF, etc.). For ASL C and D samples, ASL A and B measurements will be performed before collection of sample material. Sample material for radiological and chemical analyses will be collected at the same time and same location.

Application-specific assumptions resulting from review of the protocols against the baseline assumptions are provided in Table D.18. The ASL A/B column designates durations in hours for collection of measurements within each protocol; "ASL C/D Discrete" refers to individual sample locations, while "ASL C/D Composite" refers to collection of multiple samples from different locations being composited for one sample.

D.8.2 Sample Quantity Estimates

For each OU3 component, level I and II groupings and U,F,S ranks have been utilized in conjunction with the feature-specific sampling protocols (Section D.5) to estimate the number of each type of measurement and sample needed to fully characterize the component. A spreadsheet approach was utilized to track the individual and overall results of the protocol requirements. More than 30,000 measurements at ASLs A and B (alpha radiation measurements, beta-gamma radiation measurements, and swipes for removable radioactive and chemical materials) were determined to be potentially necessary to fully characterize the operable unit. Approximately 30,000 person-hours of technician time have been estimated for the ASLs A and B effort. However, because of the extensive radiation control programs at the FEMP, some of the required measurements may already have been performed. The assumptions made in arriving at the total number of samples are discussed below.

TABLE D.18 Field Sampling Technician Time

Protocol	ASL A/B (hours)	ASL C/D (hours)	
		Discrete	Composite
Building walls (below 8 ft)	0.5	4.0	8.0
Building walls (above 8 ft)			
Group 1A (40% of surface above 8 ft)	2.0	4.0	8.0
Group 1B (assumes offices with limited ceiling heights)	0.5	4.0	8.0
Group 1C (50% of surface above 8 ft)	2.0	4.0	8.0
Group 1D (20% of surface above 8 ft)	2.0	4.0	8.0
Building floors	0.5	4.0	8.0
Machinery	1.0	4.0	
Vessels	1.0	4.0	
Pipelines (soils or residues)	1.0	4.0	
HVAC	1.0	4.0	
Liquid and sand filters	0.5	4.0	
Containers and containerized waste	1.0	8.0	
Transfer equipment	1.0	4.0	
Surface impoundments	1.0	4.0	
Waste piles	0.5	4.0	
Pads and pavement	0.5	4.0	

The sampling approaches outlined by the protocols were individually applied to all of the components. For each component, assumptions were made estimate the sample quantities. For floors and walls, actual component dimensions were used to calculate numbers of samples given the sampling frequency outlined by the protocol. Follow up ASL A and B measurements at locations above decision levels (DLs) or action levels (ALs) were assumed to be required on a frequency of 10% of all samples for walls. For floors, S1 components were assumed to have 10% of the sample measurements above the AL, while S2 and S3 components were assumed to have 20% above the DL. Additionally, if radiation data exist for the component, those data were assumed to characterize the walls and floors to the extent that follow-up ASL C and D sample locations can be determined. Therefore, no ASL A and B measurements will be collected in these components.

For machinery in components with calculated floor areas, one piece of equipment was assumed for every 1,000 ft^2. For the administration buildings (level I/II, 1/A), one piece of equipment was assumed every 5,000 ft^2. The different assumptions were based on the lack of process equipment in the administration buildings.

Vessels were assumed to be located in only process and process support buildings. Each component was assessed individually for an approximate number of vessels and groups of vessels. These estimates were incorporated into the calculations for the number of samples. Sumps within structures and facilities were assumed to be located every 5,000 ft^2. The quantity of sumps were assessed on a site-wide basis.

For pipes, lines, pumps, and valves, the lineal footage of pipes and lines was assumed to be equal to the perimeter of the component. For outside pipes and lines, a site-wide value was estimated. Similar to pipes and lines, lineal footage for HVAC equipment and duct work was assumed to be equal to the perimeter of the component.

The quantity of liquid filters was assumed (on the basis of process knowledge) to be a total of 30 units on the site. This value was used to calculate the quantity of samples on the basis of the protocols.

The non-RCRA and RCRA drums and product inventory were assumed to be characterized through continuation of existing and ongoing site programs. The mobile (sea-land) containers were assumed to have 1,000 measurements for a conservative estimate.

Transferring, handling, and sampling equipment was assumed to exist in six facilities and two outside equipment areas based on process knowledge. The facilities are Plant 1, Plant 2/3, Plant 4, Plant 5, Plant 6, and Plant 8. For each of the eight components identified, 200 lineal feet of equipment was assumed.

No assumptions were made concerning the basins and ponds. The quantity of samples was calculated from the dimensions of the ponds and basins. For waste piles, the dimensions of each pile were used to calculate the quantity of measurement and sampling locations. For pads and pavements, the sampling approach outlined in the protocols was used to calculate quantities of samples based on area dimensions.

More than 3,200 ASL C and D samples will also be required and include solid and liquid samples removed from floors, walls, soils, vessels, and other features. In general, these samples will require significantly more time and effort to collect than the ASL A and B measurements. Access to residues and contaminated areas will require additional precautions in preparation for sampling and sample collection. To complete this sampling effort, nearly 15,000 person-hours of ASL C and D field sampling effort is estimated. Significant additional resources will also be required to support the field crews in preparation of access documents, preparation of equipment for sampling, verification of sampling locations, verification of sample quality, sample tracking, and other tasks.

The overall program will require significant levels of analytical (laboratory) support as well. For the 3,200 plus samples submitted to the labs, multiple analytes may be requested. Samples may be submitted for radiological, inorganic, or organic constituent analysis. As an example, within radiological analyses, over 20 separate analytes may be requested, and not all of these can be determined by a single analytical method. In addition, QA/QC samples will add approximately 1,500 ASL B, C, and D samples to the totals. The result is a need for several specialized labs or one comprehensive lab facility. In either case, a very complicated data management, tracking, and validation program results. Since laboratories provide the results of analyses and the necessary documentation to support the ASL requirements of the sample, laboratory capacity can be a constraint to the overall RI/FS field program schedule. For OU3, laboratory capacity may present a constraint to the overall schedule, but this is unknown at this time.

D.8.3 Field Schedule

On the basis of the assumptions detailed in Section D.8.1, the schedule assumptions below, and the total of each sample type estimated for each component, the total number of person-hours associated with field technician efforts has been estimated at nearly 45,000. Table D.19 details the sample numbers by sample type and the total person-hours by sample type for each of the OU3 components. The duration of sampling in the field will be based on the total number of field technicians that are (and can be reasonably) assigned to this task. The duration also includes the time required to receive results from the laboratories, the data validation effort, and an in-house review period for the overall data package.

The field activities assume the use of a field force of 80 sampling technicians divided into four crews; 55 support positions are planned to support the sampling technicians, for a total of 135 persons in the RI/FS field force. Office staff will require 35-40 personnel. Support positions include survey, health and safety, sample coordinator, and management. Additional assumptions affecting the schedule of field activities are listed below:

- Additional characterization may be required as a result of unexpected conditions or contaminants that have not been included in schedule planning.
- Time required to mobilize the work force necessary to complete the effort has been assumed to occur before the field activities, and assumes that hiring by the field start date (January 1, 1993).
- National laboratory capacity to support the FEMP OU3 RI/FS as scheduled is assumed to exist.
- Laboratory turn-around time is assumed to be 120 days or less (per the Amended Consent Agreement schedules).
- Sampling teams are supported by others to the extent that sample technicians can sample in an uninterrupted mode throughout the duration of the RI/FS field program.

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TABLE D.19 Estimated Sample Quantities and Person-Hours by Components

Component	Component Designation	Total Samples			Total Person-Hours		
		ASL A/B	ASL C	ASL D	ASL A/B	ASL C	ASL D
Preparation Plant	1 A	406	77	0	812	1,275	0
Plant 1 Storage Shelter	1 B	147	0	0	249	0	0
Plant 1 Ore Silos	1 C	59	16	2	119	381	32
Ore Refinery Plant	2 A	375	86	4	751	1,587	72
General/Refinery Sump Control Building	2 B	21	8	0	43	130	0
Bulk Lime Handling Building	2 C	8	6	0	16	96	0
Metal Dissolver Building	2 D	19	18	4	39	394	72
NFS Storage & Pump House	2 E	22	6	0	40	125	0
Cold Side Ore Conveyor	2 F	75	2	0	151	32	0
Hot Side Ore Conveyor	2 G	75	2	1	151	32	16
Conveyor Tunnel (From Plant 1)	2 H	10	1	1	21	16	16
Maintenance Building	3 A	29	9	0	58	146	0
Ozone Building	3 B	11	0	0	23	0	0
NAR Control House	3 C	19	0	0	39	0	0
NAR Towers	3 D	65	18	0	131	387	0
Hot Raffinate Building	3 E	55	17	4	110	316	72
Harshaw System	3 F	34	9	0	69	202	0
Refrigeration Building	3 G	10	0	0	21	0	0
Refinery Sump	3 H	33	0	0	67	0	0
Combined Raffinate Tanks	3 J	81	23	0	163	496	0
Old Cooling Water Tower	3 K	4	2	0	6	35	0
Electrical Power Center Building	3 L	65	7	0	101	123	0
Green Salt Plant	4 A	629	175	8	1,258	3,259	136
Plant 4 Warehouse	4 B	77	0	0	155	0	0
Plant 4 Maintenance Building	4 C	29	9	0	59	146	0
Metals Production Plant	5 A	803	212	8	1,607	3,915	136
Plant 5 Ingot Pickling	5 B	45	0	0	74	0	0
Plant 5 Electrical Substation	5 C	21	3	0	35	40	0
West Derby Breakout/ Slag Milling	5 D	109	0	0	178	0	0
Plant 5 Filter Building	5 E	56	0	0	102	0	0
Plant 5 Covered Storage Pad	5 F	131	0	0	221	0	0
Plant 5 Ingot Storage Shelter	5 G	43	6	0	68	95	0
Metals Fabrication Plant	6 A	884	261	10	1,769	4,909	168
Plant 6 Covered Storage Area	6 B	54	7	0	85	104	0
Plant 6 Electrostatic Precipitator (South)	6 C	11	6	0	18	98	0
Plant 6 Electrostatic Precipitator (Central)	6 D	2	3	0	4	49	0
Plant 6 Electrostatic Precipitator (North)	6 E	11	6	0	18	98	0
Plant 6 Salt Oil Heat Treat Building	6 F	22	0	0	44	0	0
Plant 6 Sump Building	6 G	103	0	0	191	0	0
Plant 7	7 A	168	51	3	337	928	48
Plant 7 Overhead Crane	7 B	3	0	0	7	0	0
Recovery Plant	8 A	368	143	10	736	2,949	168
Plant 8 Maintenance Building	8 B	14	6	0	28	108	0
Rotary Kiln/Drum Reconditioning	8 C	332	0	0	614	0	0
Plant 8 Railroad Filter Building	8 D	2	0	0	4	0	0
Drum Conveyor Shelter	8 E	10	0	0	21	0	0
Plant 8 Old Drum Washer	8 F	3	1	0	7	16	0
Special Products Plant	9 A	283	101	6	566	1,978	104
Plant 9 Sump Treatment Facility	9 B	14	0	0	29	0	0
Plant 9 Dust Collector	9 C	3	1	0	7	16	0
Plant 9 Substation	9 D	32	3	0	50	48	0
Plant 9 Cylinder Shed	9 E	4	0	0	7	0	0

TABLE D.19 (Cont'd)

Component	Component Designation	Total Samples			Total Person-Hours		
		ASL A/B	ASL C	ASL D	ASL A/B	ASL C	ASL D
Electrostatic Precipitator	9 F	11	6	0	18	98	0
Boiler Plant	10 A	140	0	0	280	0	0
Boiler Plant Maintenance Bldg.	10 B	22	0	0	44	0	0
Wet Salt Storage Bin	10 C	19	0	0	34	0	0
Cont. Oil/Graphite Burn Pad	10 D	132	5	1	147	79	16
Service Building	11	296	38	0	593	644	0
Main Maintenance Building	12 A	404	84	0	809	1,413	0
Cylinder Storage Building	12 B	29	0	0	53	0	0
Lumber Storage Building	12 C	35	0	0	65	0	0
Pilot Plant Wet Side	13 A	64	58	8	129	1,286	136
Pilot Plant Maintenance Bldg.	13 B	18	7	0	36	117	0
Sump Pump House	13 C	5	5	0	10	91	0
Pilot Plant Thorium Tank Farm	13 D	40	8	2	81	192	40
Administration Building	14 A	137	0	0	275	0	0
Building 14 EOC Generator Set	14 B	3	0	0	7	0	0
Laboratory	15	553	128	4	1,106	2,180	72
Main Electrical Station	16 A	400	1	0	801	16	0
Electrical Substation	16 B	50	1	0	101	16	0
Electrical Panels & Transformer	16 C	3	0	1	7	0	16
Main Electrical Switch House	16 D	50	1	0	101	16	0
Main Electrical Transformers	16 E	3	0	1	7	0	16
Trailer Substation #1	16 F	3	0	1	7	0	16
Trailer Substation #2	16 G	3	0	1	7	0	16
BDN Surge Lagoon	18 A	112	3	1	225	48	16
General Sump	18 B	61	0	0	123	0	0
Coal Pile Runoff Basin	18 C	63	3	0	127	48	0
Biodenitrification Towers	18 D	48	0	0	97	0	0
Storm Water Retention Basin	18 E	189	0	0	379	0	0
Clearwell Pump House	18 G	8	0	0	17	0	0
BDN Effluent Treatment Facility	18 H	16	0	0	27	0	0
Methanol Tank	18 J	4	1	0	9	24	0
Low Nitrate Tank	18 K	56	3	0	113	48	0
High Nitrate Tank	18 L	56	3	0	113	48	0
High Nitrate Storage Tank	18 M	4	0	0	9	0	0
Main Tank Farm	19 A	28	0	0	57	0	0
Pilot Plant Ammonia Tank Farm	19 B	8	0	0	17	0	0
Tank Farm Control House	19 C	22	0	0	38	0	0
Old North Tank Farm	19 D	40	8	0	81	192	0
Pump Station & Power Center	20 A	33	0	0	56	0	0
Water Plant	20 B	28	0	0	56	0	0
Cooling Towers	20 C	6	3	0	9	53	0
Elevated Potable Storage Tank	20 D	4	0	0	9	0	0
Well House #1	20 E	7	0	0	13	0	0
Well House #2	20 F	7	0	0	13	0	0
Well House #3	20 G	7	0	0	13	0	0
Process Water Storage Tank	20 H	4	0	0	9	0	0
Gas Meter Building	22 A	10	0	0	17	0	0
Storm Sewer Lift Station	22 B	6	0	0	12	0	0
Truck Scale	22 C	17	0	0	30	0	0
Scale House & Weigh Scale	22 D	1	0	0	3	0	0
Utility Trench to Pit Area	22 E	15	1	1	31	16	16
Meteorological Tower	23	3	0	0	7	0	0
Railroad Scale House	24 A	7	0	0	12	0	0
Railroad Engine House	24 B	45	6	0	71	108	0
Chlorination Building	25 A	3	0	0	7	0	0
M.H.#175/Eff. Line/Sampling Bldg.	25 B	4	0	0	9	0	0

TABLE D.19 (Cont'd)

Component	Component Designation	Total Samples ASL A/B	Total Samples ASL C	Total Samples ASL D	Total Person-Hours ASL A/B	Total Person-Hours ASL C	Total Person-Hours ASL D
Sewage Lift Station Building	25 C	11	0	0	19	0	0
U.V. Disinfection Building	25 D	5	0	0	11	0	0
Digester & Control Building	25 E	54	0	0	109	0	0
Sludge Drying Beds	25 F	12	3	1	24	48	16
Primary Settling Basins	25 G	31	3	1	62	48	16
Trickling Filters	25 H	8	2	2	17	38	40
Pump House-HP Fire Protection	26 A	38	0	0	65	0	0
Elevated Water Storage Tank	26 B	4	0	0	9	0	0
Main Electrical Strainer House	26 C	7	5	0	12	90	0
Security Building	28 A	56	0	0	112	0	0
Human Resources Building	28 B	32	0	0	65	0	0
Guard Post on South End of 'D' St.	28 C	2	0	0	3	0	0
Guard Post on West End of 2nd St.	28 D	3	0	0	6	0	0
Chemical Warehouse	30 A	152	0	0	305	0	0
Drum Storage Warehouse	30 B	9	0	0	19	0	0
Old Ten Ton Scale	30 C	17	0	0	24	0	0
Engine House/Garage	31 A	61	14	0	123	225	0
Old Truck Scale	31 B	17	0	0	24	0	0
Magnesium Storage Building	32 A	99	0	0	181	0	0
Building 32 Covered Loading Dock	32 B	20	0	0	36	0	0
Pilot Plant Annex	37	57	60	8	115	1,347	136
Propane Storage	38 A	18	0	0	31	0	0
Cylinder Filling Station	38 B	4	0	0	7	0	0
Incinerator Building	39 A	31	15	0	63	256	0
Waste Oil Decant Shelter	39 B	19	6	0	36	96	0
Incinerator Sprinkler Riser House	39 C	4	0	0	7	0	0
Sewage Treatment Plant Incinerator	39 D	15	0	2	19	0	32
Rust Engineering Building	45 A	40	9	0	80	142	0
Utility Shed East of Rust Trailers	45 B	3	0	0	6	0	0
Heavy Equipment Building	46	89	0	0	179	0	0
Six to Four Reduction Facility #2	51	432	0	0	687	0	0
Health & Safety Building	53 A	139	20	0	279	337	0
In-Vivo Building	53 B	15	0	0	31	0	0
Six to Four Reduction Facility #1	54 A	60	55	6	121	1,202	104
Pilot Plant Shelter	54 B	97	10	0	163	156	0
Pilot Plant Dissociator Shelter	54 C	34	6	0	54	103	0
Slag Recycling Building	55 A	30	10	0	61	161	0
Slag Recycling Pit/Elevator	55 B	5	5	0	11	93	0
CP Storage Warehouse	56 A	61	13	0	122	208	0
Storage Shed (West)	56 B	9	0	0	15	0	0
Storage Shed (East)	56 C	15	0	0	25	0	0
Quonset Hut #1	60	154	9	0	273	143	0
Quonset Hut #2	61	82	6	0	147	104	0
Quonset Hut #3	62	82	6	0	147	104	0
KC-2 Warehouse	63	641	31	0	1,064	509	0
Thorium Warehouse	64	575	27	3	955	498	48
(Old) Plant 5 Warehouse	65	426	18	3	734	313	48
Drum Reconditioning Building	66	32	12	4	64	230	72
Plant 1 Thorium Warehouse	67	153	11	3	258	208	48
Pilot Plant Warehouse	68	38	12	3	76	230	48
Decontamination Building	69	102	9	0	186	146	0

TABLE D.19 (Cont'd)

Component	Component Designation	Total Samples ASL A/B	Total Samples ASL C	Total Samples ASL D	Total Person-Hours ASL A/B	Total Person-Hours ASL C	Total Person-Hours ASL D
General In-Process Warehouse	71	137	32	0	274	518	0
Drum Storage Building	72	39	5	0	67	85	0
Fire Brigade Training Center Bldg.	73 A	19	0	0	28	0	0
Fire Training Pond	73 B	111	3	1	223	48	16
Fire Training Tank	73 C	4	0	0	9	0	0
Fire Training Burn Trough	73 D	4	1	0	9	24	0
Confined Space Burn Tank	73 E	4	0	0	9	0	0
Plant 2 East Pad	74 A	71	7	1	93	116	16
Plant 2 West Pad	74 B	142	13	0	185	200	0
Plant 8 East Pad	74 C	142	13	0	185	200	0
Plant 8 West Pad	74 D	142	13	0	185	200	0
Plant 4 Pad	74 E	213	18	1	277	284	16
Plant 7 Pad	74 F	242	13	0	285	200	0
Plant 5 East Pad	74 G	71	7	1	93	116	16
Plant 5 South Pad	74 H	49	4	0	59	66	0
Plant 6 Pads	74 J	71	7	1	93	116	16
Plant 9 Pad	74 K	213	18	1	277	284	16
Building 65 West Pad	74 L	484	23	0	569	368	0
Building 64 East Pad & R.R. Dock	74 M	484	23	0	569	368	0
Building 12 North Pad	74 N	169	9	0	199	150	0
Decontamination Pad	74 P	710	57	1	921	920	16
Plant 8 Old Metal Dissolver Pad	74 Q	45	5	2	52	73	32
Plant 8 North Pad	74 R	146	8	2	168	132	32
Building 63 West Pad	74 S	59	5	2	69	82	32
Plant 1 Storage Pad	74 T	4,840	220	0	5,681	3,584	0
Pilot Plant Pad	74 U	363	18	0	427	284	0
Laboratory Pad	74 V	292	14	2	335	216	32
Finished Products Warehouse(4A)	77	110	0	0	221	0	0
D & D Building(Under Constr.)	78	79	0	0	123	0	0
Plant 6 Warehouse	79	98	21	0	197	336	0
Plant 8 Warehouse	80	247	14	0	408	227	0
Plant 9 Warehouse	81	54	13	0	109	201	0
Receiving/Incoming Mat'ls. Insp.	82	76	0	0	152	0	0
Clearwell Line	88	5	1	1	11	16	16
Parking Lot	89	2,510	0	0	4,962	0	0
Skeet Range Building	90	4	0	0	9	0	0
Railroad Tracks	G-001	130	0	0	197	0	0
Roads	G-002	238	0	0	360	0	0
Storm Sewer System	G-003	500	30	10	1,001	480	160
Sumps	G-004	250	51	0	501	1,224	0
Dikes	G-005	500	100	0	1,001	2,400	0
Utility Lines	G-006	1,000	0	0	2,001	0	0
Underground Storage Tanks	G-007	12	2	0	25	58	0
Aboveground Storage Tanks	G-008	1,000	200	0	2,001	4,800	0
Process Trailers	G-009	1,960	0	0	1,961	0	0
Non-process Trailers	G-010	1,960	0	0	1,961	0	0
Pipe Bridges	G-011	500	0	0	1,001	0	0
Drums (Non-RCRA)	G-012	0	0	0	0	0	0
RCRA Drums	G-013	0	0	0	0	0	0
Inventory	G-014	0	0	0	0	0	0
Mobile Containers (Sea-Land)	G-015	1,000	0	0	0	0	0
East of Plant 2	P-001	2	0	0	2	0	0
South of Plant 8 (West)	P-002	1	0	0	2	0	0
South of Plant 8 (Mid)	P-003	1	0	0	2	0	0
South of Plant 8 (East)	P-004	6	0	0	6	0	0

TABLE D.19 (Cont'd)

Component	Component Designation	Total Samples			Total Person-Hours		
		ASL A/B	ASL C	ASL D	ASL A/B	ASL C	ASL D
South of Bldg. 80	P-005	12	0	0	12	0	0
West of Plant 5	P-006	4	0	0	4	0	0
West of 7 Plex (North)	P-007	2	0	0	3	0	0
Covered West of 7 Plex (South)	P-008	3	0	0	4	0	0
North of Plant 9 (Near Basin)	P-009	1	0	0	1	0	0
Covered Dirt Pile between R.R. track #6 and #9	P-010	39	0	0	40	0	0
Construction rubble pile East of coal pile run off basin	P-011	1	0	0	2	0	0
East of coal pile run off basin	P-012	1	0	0	2	0	0
Rock salt pile South of Bldg. 61	P-013	4	0	0	4	0	0
Sand piles South of Bldg. 61	P-014	4	0	0	4	0	0
Covered East of Bldg. 56	P-015	29	0	0	29	0	0
Gravel North of Bldg. 56	P-016	5	0	0	6	0	0
Copper metal scrap pile	P-017	750	3	1	751	48	16
Coal pile	P-018	44	2	0	45	32	0
Third Street dirt pile	P-019	69	3	1	70	48	16
Partially covered along Track #11	P-020	32	0	0	33	0	0
Southwest corner of lab	P-021	3	0	0	3	0	0
North of Bldg. 67	P-022	12	0	0	12	0	0
Scrap metal pile	P-023	333	3	1	334	48	16
NW rubble piles	P-024	139	0	0	139	0	0
Outside Equipment Storage Area	P-025	80	0	0	81	0	0
Tension Support Structure #1	TS-001	39	0	0	79	0	0
Tension Support Structure #2	TS-002	39	0	0	79	0	0
Tension Support Structure #3	TS-003	15	0	0	31	0	0
Totals		36,504	3,026	147	56,571	56,845	2,472

- C/D sample locations are based on review of A/B measurements.
- Data validation and data entry are assumed to require four full-time equivalents for the duration of the field program.
- Technician training personnel are available and training will be complete before sample collection begins.
- Database is ready for data entry upon initiation of sample collection.
- Budgets are sufficient to support activities as scheduled.

D.8.4 Personnel Resources

This section discusses the number and type of personnel identified for the implementation of the OU3 RI/FS field program. The program will be planned and implemented with the organizational structures identified in Section D.2. Implementation activities have been grouped for discussion into the following categories: field program implementation planning, procedure development, and field activities.

D.8.4.1 Field Program Implementation Planning

Initial planning for the implementation of the OU3 field characterization has been completed to support schedule development and summarization in this document. Additional detailed planning is underway to identify specific job classifications and organizational structures to be employed. This activity will utilize approximately four full-time equivalents (FTEs), which will continue as project oversight throughout the implementation.

D.8.4.2 Procedure Development

Approximately 110 procedures (analytical laboratory and field sampling procedures) have been identified as additional requirements to support the OU3 RI/FS. A team of 8 to 10 engineers and technical writers will draft the procedures during the period before initiation of field sampling. The procedures will be reviewed, approved, and incorporated into the Sitewide CERCLA Quality Assurance Project Plan (SCQ). This task will require approximately four full-time equivalents (FTEs).

D.8.4.3 Field Activities

As indicated in the previous section, a field force of 80 sampling technicians has been assumed for the project. The technicians will work as four crews of 20 persons, divided further into teams. The size of each team will be determined as appropriate for the activity once the field implementation has begun; however, a baseline assumption of two-person teams for ASL A & B samples/measurements and four-person teams for ASL C & D samples has been made.

The sampling/measurement crews will consist of technicians, fully trained and tested in the implementation of the field sampling procedures identified in Section D.6. Crew members will also have received a full complement of site and job-specific safety training and orientation and will have completed all applicable regulatory-based training requirements before initiating the field work.

In addition to the field crews, approximately 50 additional individuals are to be used as a support matrix for the field crews. This group includes data entry clerks, secretarial support, quality control/quality assurance technicians, data validators, trainers, drafters, health and safety engineers, scheduling, engineering, and supervision.

Before measurement and sampling of a component begin, detailed plans for sample number and location will be developed by a field implementation procedure (FIP) development group. This group will function during most of the field program and will consist of approximately 10 FTEs.