

Rocky Flats Environmental Technology Site

MAN-077-DDCP

THE D&D CHARACTERIZATION PROTOCOL

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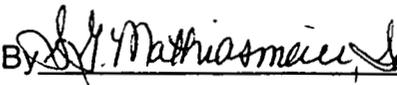
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EXECUTIVE SUMMARY

Kaiser-Hill Company, L.L.C. (K-H), the U.S. Department of Energy/Rocky Flats Field Office (DOE/RFFO), the Colorado Department of Public Health and Environment (CDPHE), and the U.S. Environmental Protection Agency (EPA) agree that building and facility characterization needs to be consistent when applied throughout the decommissioning program. To support this effort, the EPA Data Quality Objectives (DQO) process will be applied to the characterization process across the Special Nuclear Materials (SNM) Consolidation, and Deactivation, Decontamination and Decommissioning (D&D) Program.

This Rocky Flats Environmental Technology Site (RFETS or Site) D&D Characterization Protocol provides an overview of the characterization process, the requirements, and general guidance that **SHALL** be implemented when conducting characterizations within Type 1, 2 and 3 facilities. The NUREG 1575, Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), issued in December 1997, and this document describe the key D&D characterization phases; describe the DQOs for the various phases; and present the independent verification and validation, quality assurance and data review requirements. This document is to be used in conjunction with the Facility Disposition Program Manual; and the Site-Wide Reconnaissance Level Characterization and Pre-Demolition Survey Plans when preparing project-specific characterization reports to comply with the Rocky Flats Cleanup Agreement (RFCA).

ABBREVIATIONS/ACRONYMS

ACM	Asbestos-containing material
ASME	American Society Mechanical Engineers
CBDPP	Chronic Beryllium Disease Prevention Program
CCR	Code of Colorado Regulations
CDPHE	Colorado Department of Public Health and the Environment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CHWA	Colorado Hazardous Waste Act
CFR	Code of Federal Regulations
D&D	Decontamination and Decommissioning
DCGL	Derived Concentration Guideline Level
DDCP	D&D Characterization Protocol
DER	Duplicate Error Ratio
DOE	U.S. Department of Energy
DOP	Decommissioning Operations Plan
DPP	Decommissioning Program Plan
DQA	Data Quality Assessment
DQO	Data Quality Objectives
EDD	Electronic Data Deliverable
EPA	U.S. Environmental Protection Agency
ER	Environmental Restoration
FDPM	Facility Disposition Program Manual
HASP	Health and Safety Plan
HRR	Historical Release Report
HSA	Historical Site Assessment
IM/IRA	Interim Measure/Interim Remedial Action
IPC	In-Process Characterization
ISM	Integrated Safety Management
IWCP	Integrated Work Control Program
K-H	Kaiser-Hill Company, L.L.C.
LCSD	Laboratory Control Sample Duplicates
LLMW	Low-Level Mixed Waste
LLW	Low-Level Waste
LRA	Lead Regulatory Agency
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MDC	Minimum Detectable Concentration
NIST	National Institute of Standards and Technology
NRA	No Radioactivity Added
NVLAP	National Voluntary Laboratory Accreditation Program
PARCC	Precision, Accuracy, Representativeness, Completeness, and Comparability
PATS	Plant Action Tracking System
PCB	Polychlorinated Biphenyl/PDS

**ABBREVIATIONS/ACRONYMS
(Continued)**

PDS	Pre-Demolition Survey
PDSP	Pre-Demolition Survey Plan
PDSR	Pre-Demolition Survey Report
PE	Performance Evaluation
PQL	Practical Quantitation Limit
QA	Quality Assurance
QA/QC	Quality Assurance/Quality Control
QAPjP	Quality Assurance Project Plan
QAP	Quality Assurance Program
QC	Quality Control
RBE	Radiological Building Engineer
RCM	Radiological Control Manual
RCRA	Resource Conservation and Recovery Act
RFCA	Rocky Flats Cleanup Agreement
RFETS	Rocky Flats Environmental Technology Site
RFFO	Rocky Flats Field Office
RIRs	Radiological Improvement Reports
RLC	Reconnaissance Level Characterization
RLCP	Reconnaissance Level Characterization Plan
RLCR	Reconnaissance Level Characterization Report
RPD	Relative Percent Difference
RSP	Radiological Safety Practices
SAP	Sampling and Analysis Plan
SNM	Special Nuclear Materials
SOP	Standard Operating Procedure
SOW	Statement of Work
TRU	Transuranic
TSCA	Toxic Substances Control Act
TSDF	Treatment, Storage, and Disposal Facility
UCL	Upper Confidence Level
V&V	Verification and Validation
WAC	Waste Acceptance Criteria
WSRIC	Waste Stream Residue Identification and Characterization

1.0 INTRODUCTION

The Rocky Flats Cleanup Agreement (RFCA, July 1996) establishes the regulatory framework for cleanup and closure of the Rocky Flats Environmental Technology Site (RFETS). Facility disposition is an integral part of RFCA that requires the development and implementation of a facility characterization program at RFETS. Facility characterization is the process of identifying the physical, chemical, and radiological hazards associated with a building or building cluster. Information gathered during characterization will be used to support facility disposition, including selection of decommissioning alternatives and the development of project-specific documentation.

1.1 APPLICABILITY AND USE

This Protocol applies to all Site employees and subcontractors performing facility characterization across the SNM Consolidation, Deactivation, Decontamination and Decommissioning Program. All organizations conducting SNM consolidation, deactivation, decontamination and decommissioning activities **SHALL** comply with the requirements in this Protocol, including implementation of the EPA Data Quality Objectives (DQO) process to determine and interpret characterization needs. **Any changes or revisions to this Protocol SHALL be approved by the Kaiser-Hill Company, L.L.C. (K-H), Manager for Decontamination and Decommissioning (D&D) Program Office and the DOE. Major revisions will be transmitted to CDPHE and EPA Region VIII for concurrence.**

This Protocol identifies mandatory elements and requirements by using the word "**SHALL**." Additionally, the Protocol uses the word "**Should**" to indicate a recommendation that is based on standards and good business practices. The word "**may**" is used when permission is granted rather than constituted as a requirement.

1.2 PURPOSE AND OBJECTIVE

The purpose of this D&D Characterization Protocol (DCPP) is to provide the framework for facility characterization, which provides the data to evaluate the radiological, chemical and physical hazards associated with facilities, classify decommissioning waste streams, and define management options for facility disposition.

The objective is to provide direction for a compliant, consistent and systematic approach to characterizing hazards and classifying waste streams associated with facilities at the RFETS. Identified hazards will be used to establish controls for the protection of RFETS workers, the public and the environment.

1.3 SCOPE OF THIS DOCUMENT

This Protocol provides an overview of the characterization process, the requirements, and general guidance for characterizing facilities when developing D&D alternatives for

Type 1, 2 and 3 facilities, as defined in the approved Decommissioning Program Plan (DPP). The process includes the following characterization phases:

- Scoping characterization;
- Reconnaissance Level Characterization (RLC);
- In-Process Characterization (IPC);
- Pre-Demolition Survey (PDS); and
- Post-Demolition Survey.

Details on implementing characterization requirements are provided in the following documents:

- Appendix C of this Protocol for DQOs for In-Process Characterization (IPC);
- Appendix D of this Protocol for Site-Wide Reconnaissance Level Characterization (RLC); and
- Site-Wide Pre-Demolition Survey Plan (PDSP).

Characterization **SHALL** be accomplished through the implementation of this program, which is aligned with the Environmental Protection Agency (EPA) Data Quality Objectives (DQO) process, and the application of approved and accepted characterization practices and methods.

This Protocol was developed to be consistent with the references cited in Section 9.

1.4 FACILITY CHARACTERIZATION DOCUMENT ROADMAP

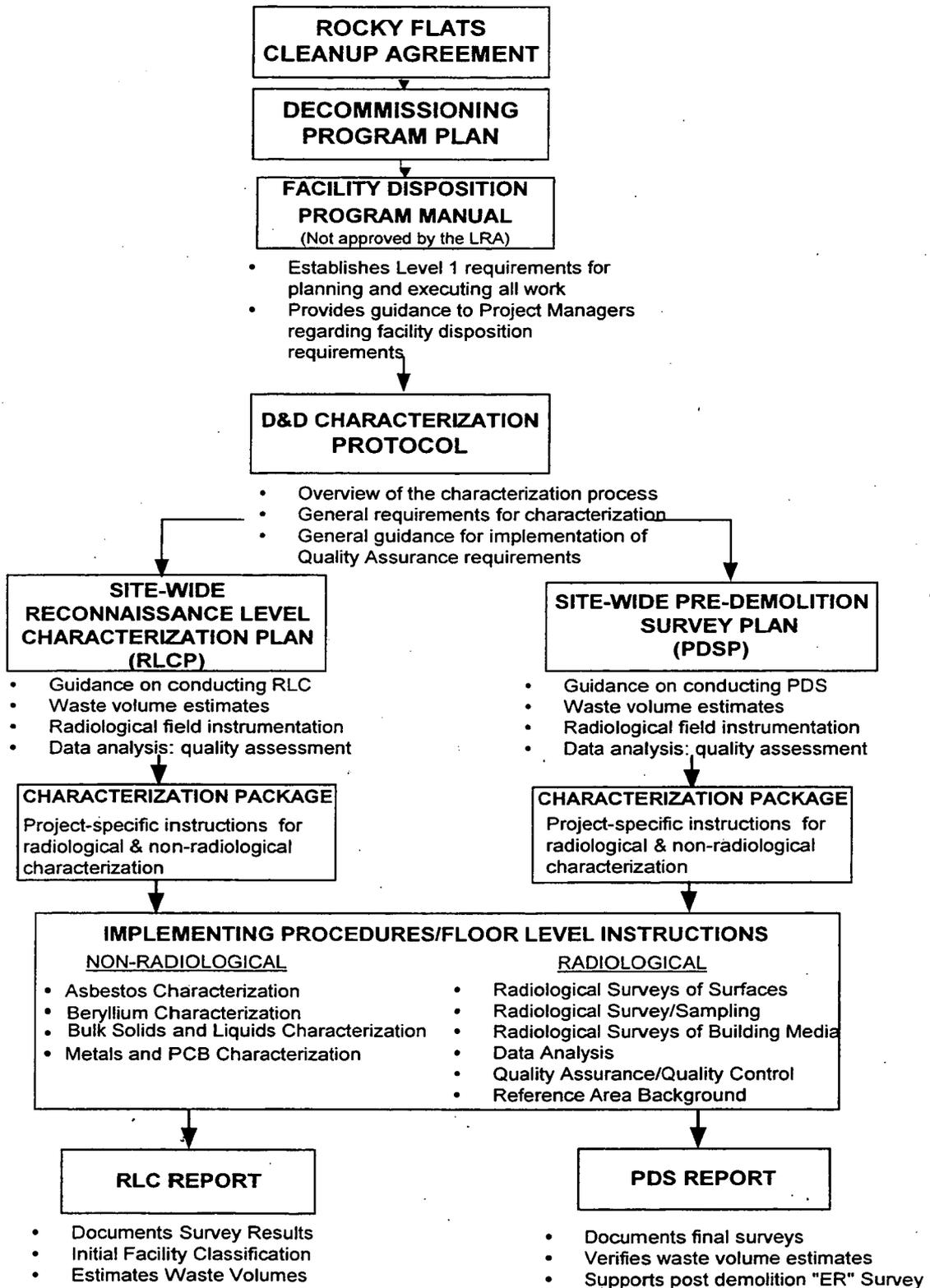
The Facility Disposition Program Manual (FDPM) establishes the RFETS requirements for planning and executing the facility disposition process. (This Manual is an internal Kaiser Hill Program Manual used by Project Managers as a guide in planning for facility disposition. This Manual is not approved by the LRA.) Facility characterization is conducted at the onset of a project, during strip-out and removal of equipment and prior to demolition in order to assess the potential for contamination and to determine the unknowns. This Protocol provides the requirements and guidance for conducting facility characterization as described in Figure 1.1. In addition, there are two plans written in accordance with this Protocol which address the types of characterization conducted. These Plans are the Site-Wide Reconnaissance Level Characterization Plan (RLCP), implemented during the Phase I Planning of a project, and the Site-Wide Pre-Demolition Survey Plan (PDSP), implemented prior to facility demolition. The data and reports resulting from these activities **SHALL** be documented in the RLC and the PDS Reports. These reports **SHALL** be included in the project-specific administrative record file.

Instructions for implementing RLC, IPC and PDS on a project-specific basis **SHALL** be documented in project-specific characterization packages. These packages provide specific survey, scan and sampling instructions, including number and location of surveys, scans and media samples. In addition, Technical Procedures/Floor

Instructions have been written to address how specific radiological and non-radiological constituents are to be characterized. During facility characterization, the instructions included in the characterization package and these procedures **SHALL** be followed per Figure 1.1.

In addition to the characterization procedures, the RFETS procedures and programs that control work **SHALL** be implemented. Primarily, the Integrated Work Control Program (IWCP) is used to control work and ensure that site procedures and programs are incorporated into all phases of characterization. An IWCP package **SHALL** be developed for each characterization phase. The package **SHALL** include project-specific activities and steps, activity-specific controls, and approvals. Characterization packages **SHALL** be included in the IWCP packages. These IWCP packages will ensure that work is conducted in a manner safe to the worker and environment. Refer to the IWCP to ensure that all characterization is planned and conducted in accordance with the IWCP Manual. Section 7.4 of this manual provides additional detail on work control processes.

FIGURE 1.1 FACILITY CHARACTERIZATION REQUIREMENTS AND GUIDANCE



2.0 OVERVIEW OF THE CHARACTERIZATION PROCESS

Characterization is the process of identifying the chemical and radiological hazards associated with a facility. The following five characterization phases are used:

1. Scoping Characterization;
2. Reconnaissance Level Characterization (RLC);
3. In-Process Characterization (IPC);
4. Pre-Demolition Survey (PDS); and
5. Post-Demolition Survey, as required.

This section presents an overview of the first four phases. Post-demolition surveys are not discussed because 1) very few, if any, post-demolition surveys will be needed, and 2) if one is required, a project-specific characterization package will likely be required.

Through the characterization process, each RFETS facility is "classified or typed" based on the level of potential or existing radiological and/or hazardous substance contamination. The DPP identifies three "types" of facilities:

- **Type 1** facilities are considered "free of contamination."
- **Type 2** facilities are without significant contamination or hazards, but in need of decontamination.
- **Type 3** facilities have significant contamination and/or hazards.

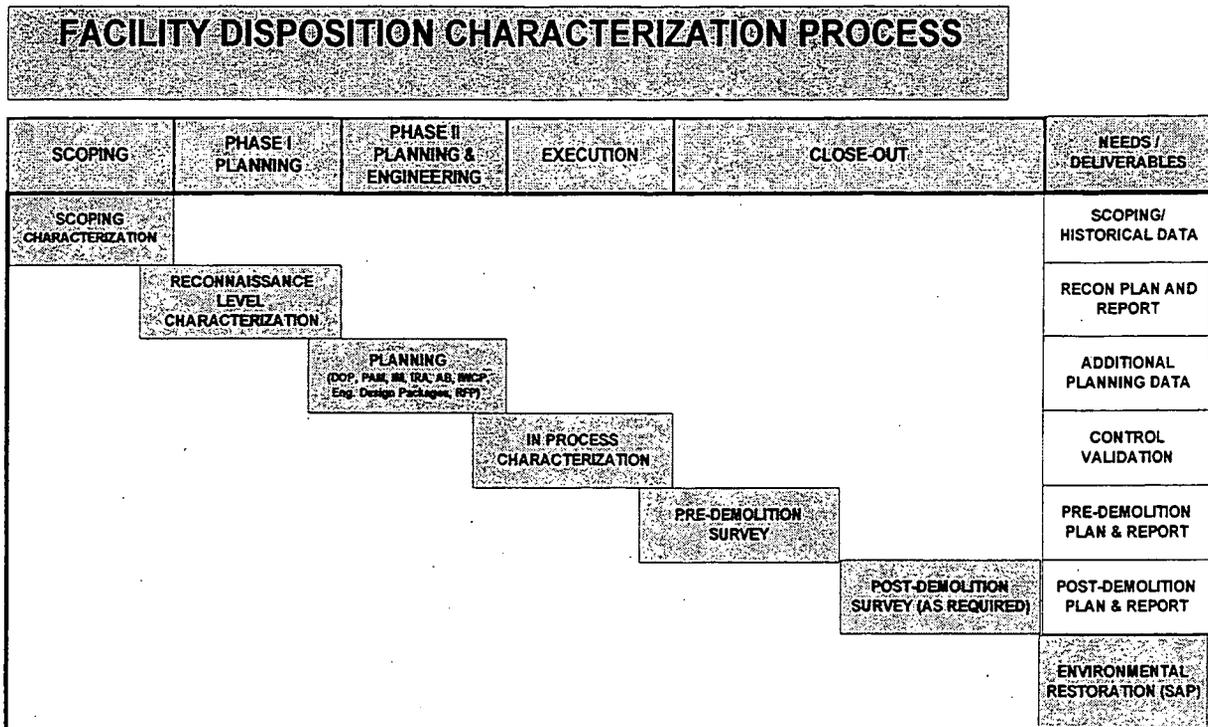
Appendix A provides a graphic presentation of the RFETS Characterization Process. Appendix B contains a logic diagram for determination of facility "type" and relation to the RFETS Characterization Process and development of documents. Figure 2.1 summarizes the five phases of the characterization process. In addition, the following subsections contain discussion of each phase of the characterization process.

Some terms used in this document are used in the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM; NUREG 1575). Other terms are not used in MARSSIM but are equivalent to MARSSIM terms. Some key terms and their MARSSIM equivalents are presented below.

- | | |
|---|--|
| • Type 1 Facility | Class 3 Facility |
| • Type 2 Facility | Class 2 Facility |
| • Type 3 Facility | Class 1 Facility |
| • Reconnaissance Level Characterization | Scoping Survey/Characterization Survey |
| • In-Process Characterization | Remedial Action Support Survey |
| • Pre-Demolition Survey | Final Status Survey |

A glossary of other key terms is presented in Section 11 of the RLCP (Appendix D).

FIGURE 2.1 FACILITY DISPOSITION CHARACTERIZATION PROCESS



2.1 SCOPING CHARACTERIZATION

The Scoping Characterization phase establishes the initial project scope and anticipated facility "type". The project scope includes identifying the physical boundaries of the areas to be characterized. The boundaries may include a cluster of related buildings, a single building, or a room/area within a building. Establishment of the facility type requires information regarding building hazards, including physical, chemical and radiological hazards.

The Historical Site Assessment (HSA) is an important component of scoping because it consolidates the existing facility historical information. The HSA **SHALL** include the following minimum information:

- Identification of the potential, likely, or known sources of contamination, including history and nature of material/substance storage, use, spills, and waste handling;
- Inventory of material types and volume estimates;
- A preliminary assessment of contaminant migration;
- Information that may be useful in other characterization phases; and
- A recommendation on whether and what type of further action is warranted (e.g., characterization, decontamination, special handling).

Scoping provides a basis for preliminary evaluations of decommissioning efforts and aids in identifying the need for more extensive RLC and IPC surveys. The result of this

analysis will provide the information necessary to determine an initial facility "type" or a modification to the type. Results of the scoping characterization **SHALL** be incorporated into the RLC Report (RLCR).

Data used for scoping characterization **SHALL** be qualified relative to their use and purpose within the characterization planning effort. The "data" of interest include historical and current data, as applicable. Adequacy and limitations of the data **SHALL** be documented in the RLCR. Data quality **SHALL** be addressed relative to DOE quality requirements cited in Sections 7 and 8 of this document, including DOE Order 414.1 and 10 CFR 830.120, Quality Assurance.

2.2 RECONNAISSANCE LEVEL CHARACTERIZATION (RLC)

RLC is project-specific and provides an overall assessment of the contamination, hazards, and other conditions associated with each building. The RLC is conducted to establish a preliminary estimate of the type and volume of contamination, to identify safety hazards present at the facility, and to "type" the facility. The RLC **SHALL** meet or exceed the requirements of RFCA, Attachment 9. The RLC **SHALL** obtain sufficient data to establish the basis for planning disposition. The RLC applies to Type 1, 2 and 3 facilities, and **SHALL** be conducted in accordance with the RFETS Reconnaissance Level Characterization Plan for D&D Facilities (refer to Appendix D).

This phase includes the review of project-specific information gathered during scoping characterization to identify data gaps and determine the need for additional sampling/surveys. If data gaps are identified during the RLC process, additional sampling/surveys **SHALL** be conducted by implementing the RLCP, which includes guidance on characterizing specific contaminants. Characterization instructions **SHALL** be documented in an RLC characterization package. Results **SHALL** be documented in the RLCR. If data gaps are not identified, additional sampling/surveys are not required, and the RLCR is prepared. This report identifies the proposed facility type to the Department of Energy (DOE) and is provided to the Lead Regulatory Authority for concurrence.

Because Type 1 Facilities should be free of contamination, RLC for Type 1 facilities **SHALL** be designed and conducted to meet the DQOs for the PDS. After a facility is determined to be a Type 1 facility (that is, following the LRA's concurrence on the RLCR), no further characterization will be required under RFCA.¹

¹ This does not mean that no additional characterizations will be done for Type 1 facilities. In accordance with Section 2.2 of the *Decommissioning Program Plan*, the DOE may choose to remove materials containing polychlorinated biphenyls (PCBs) and asbestos pursuant to other laws which regulate DOE actions independently from RFCA. In the event the decision is made to remove these materials, DOE will conduct characterizations required under the relevant regulations.

RFETS approach to conducting RLC is presented in the Reconnaissance Level Characterization Plan for D&D Facilities (Appendix D). This Plan gives RLC implementation guidance, and details how to consistently conduct RLC in a compliant, technically defensible, and cost-effective manner.

2.3 IN-PROCESS CHARACTERIZATION (IPC)

IPC is performed during project strip-out and/or decontamination activities for Type 2 and 3 facilities. This phase of characterization is used to:

- Validate project plans and engineering alternatives presented in the decommissioning decision document;
- Develop IWCPs and related health and safety controls;
- Identify additional radiological, chemical and safety hazards that may be uncovered during facility strip-out and decontamination;
- Confirm the adequacy of decontamination ;
- Determine residual levels of contamination ;
- Guide pre-demolition survey planning; and
- Ensure that adequate data are obtained for waste management and transportation purposes.

Characterization instructions **SHALL** be summarized in an IPC characterization package. Refer to Appendix C for applicable DQOs identified for IPC. Results **SHALL** be summarized in the PDS Report (PDSR).

2.4 PRE-DEMOLITION SURVEY (PDS)

This characterization phase is used to verify that decommissioning objectives, including decontamination, have been met before building disposition. For example, the PDS is used to ensure that the building surfaces and/or structures meet applicable release criteria for radiological and non-radiological constituents, and to verify residual levels of radiological and non-radiological contamination. For Type 1 facilities, the PDS is conducted as part of the RLC per Section 2.2. All release criteria must be met. For Type 2 and 3 facilities, PDS is performed before building disposition. Decommissioning objectives are presented in the CERCLA facility-specific decommissioning decision document (refer to the DPP). PDS requirements are presented in the PDSR. Characterization instructions **SHALL** be documented in a PDS characterization package. Results, including demonstration that decision document objectives have been met, **SHALL** be documented in the PDSR for Type 2 and 3 facilities. For Type 1 facilities, the results of the PDS **SHALL** be included in the RLCR.

PDSs will focus primarily on radiological characterization. Characterization of non-radiological (chemical) hazards, such as beryllium, will be conducted during RLC and

IPC. Confirmation that related objectives have been met will be conducted during IPC and PDS, as necessary and will be documented in the PDS report.

Prior to PDSs, cross-contamination controls **SHALL** be established to ensure that areas do not become contaminated and that PDS data remain valid. If controls are not in place, areas could be contaminated prior to, during and after PDSs by adjacent activities and by traffic going through the areas. Such contamination or the potential for contamination would invalidate PDS data.

2.5 DATA ASSESSMENT

Characterization data assessments **SHALL** be conducted to evaluate whether the data gathered during all characterization phases meet the objectives of this Protocol and to ensure that the data are sufficient to assure compliance. Assessments include verification and validation (V&V) and data quality assessment (DQA). V&V determines how well characterization packages were followed and if measurement systems performed in accordance with specified criteria. DQA determines if the data are of the right type, quality and quantity to support their intended use. These steps assure that requirements prescribed in the RLC and the PDS Plans were implemented correctly, and that the data gathered during characterization was performed within established quality control requirements. Section 8.0 describes the quality assurance data review process and defines the requirements associated with data V&V per this Protocol.

2.5.1 Independent Verification and Validation (IV&V)

DOE may elect to have an "independent V&V" performed on data gathered during characterization. Such an assessment will involve verifying that work activities were performed in accordance with approved plans and procedures, including those governing field measurements, sample collection, laboratory analysis, and quality assurance. IV&V will also ensure that the PDS characterization package was based on the Site-Wide PDSP and its DQOs. IV&V results should be incorporated into the PDSR.

DOE's decision as to whether or not to perform IV&V and the extent of the IV&V will be based upon criteria such as experience with similar facilities including lessons learned, building-specific issues such as levels of contamination following decontamination, the potential environmental and liability concerns, and stakeholder/ regulator input to the RFCA decision document or RFCA decision. Decisions as to what facilities will undergo IV&V will be determined using the consultative process.

3.0 REPORTING REQUIREMENTS

The RLCR and PDSR **SHALL** provide an analysis of the characterization/survey results and summarize the hazards and risks associated with them. These reports, described below, document the process knowledge and history (HSA) and/or characterization survey results that will enable project personnel to develop and confirm disposition decisions (e.g., recycle, reuse or disposal of building components). Results will determine how the components (e.g., walls, floors, ceilings and fixed equipment) should be segregated and managed (e.g., pursuant to all applicable waste management regulations and requirements).

3.1 RECONNAISSANCE LEVEL CHARACTERIZATION REPORT (RLCR)

The characterization results for Type 1, 2 and 3 facilities result in, a RLCR. The RLCR **SHALL** provide an analysis of the characterization results and summarizes the hazards and risks associated with the facility, including the nature and extent of radiological and chemical contamination, the presence of physical hazards, and an estimate of the types and volumes of wastes to be managed. Results of the scoping characterization **SHALL** also be incorporated into the RLCR. Based on an assessment of radiological and chemical contamination, the facility will be classified pursuant to the DPP. Compliance with data quality and review requirements **SHALL** also be documented, as described in Section 8. The report **SHALL** provide information in adequate detail to allow DOE and the LRA to determine if the facility is free of contamination or exhibits significant contamination or hazards, as required by Attachment 9 of the RFCA. An outline for the RLCR is presented in the RLCP.

3.2 PRE-DEMOLITION SURVEY REPORT (PDSR)

The documentation of PDS results in a RFCA-mandated report for Type 2 and 3 facilities. The PDSR **SHALL** provide data on the nature and extent of radiological and chemical contamination after strip-out and decontamination. Results of IPC characterizations **SHALL** be documented in this report. Compliance with data quality and review requirements **SHALL** also be documented, as described in Section 8. The PDSR will demonstrate that cleanup and decontamination goals in the decision document have been met. It **SHALL** also document that building components may be free-released, or **SHALL** indicate if and where any residual contamination remains. An outline for the PDSR is presented in the PDSP.

4.0 KEY REGULATIONS, REQUIREMENTS AND GUIDANCE

This section provides an overview of the key, high-level regulations and requirements that drive decisions for both radioactive and non-radioactive contaminants. These regulations and requirements apply to all phases of the facility characterization program and are applicable to each and every facility at the RFETS. The regulations and requirements include applicable DOE orders, and State and Federal regulations, which are briefly discussed below and identified in Table 4.1. These requirements, however, are not all inclusive. Other requirements include DOT regulations and the waste acceptance criteria of individual waste disposal facilities. Requirements are incorporated into the DQOs, as inputs to the decisions and as specific decision rules (refer to Section 5.0 of this document and to DQOs presented in the RLCP, Appendix C of this document, and the PDSP).

RADIOLOGICAL CONTAMINANTS

DOE Order 5400.5, Radiation Protection of the Public and Environment, provides the guidance and direction for release of material and personal property. Contamination thresholds are established for radiological survey measurements for transuranics, natural occurring thorium, natural occurring uranium, tritium, and other beta-gamma emitters. These thresholds are the same as those contained in NRC Regulatory Guide 1.86.

DOE No-Radioactivity-Added (NRA) Waste Verification Program (EG&G, 1993) provides the guidance and direction for the release of volume contaminated materials, i.e., concrete, cinder block, pavement, etc. Contamination thresholds are compared with limits in DOE Order 5400.5 (DOE, AME: TAD: PPP: 02637, April 23, 1998, Application of Surface Contamination Guidelines from DOE Order 5400.5).

Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) (DOD/DOE/NRC, 1997) provides the guidance and direction used at RFETS for conducting Pre-Demolition Surveys regarding free-release of structures. Sections of MARSSIM which apply to Site Closure are:

- **Section 3, Historical Site Assessment**, describes the historical review process;
- **Section 4, Preliminary Survey Considerations**, describes decommissioning criteria, background reference areas, survey units and quality control;
- **Section 5, Survey Planning & Design**, describes the design of the final status survey, how the results of the survey are evaluated, and how they are documented;
- **Section 6, Field Measurement Methods and Instrumentation**, describes Data Quality Objectives, measurement methods, detection instrumentation and data analysis;
- **Section 7, Sampling and Preparation for Laboratory Measurements**, describes Data Quality Objectives and sampling and analysis requirements for laboratory support.

- **Section 8, Interpretation of Survey Results**, describes the data quality assessment process and the statistical tests which apply; and
- **Section 9, Quality Assurance and Quality Control**, describes quality assurance planning, data verification and validation.

HAZARDOUS WASTE

6 CCR 1007-3, Parts 261 and 268, provides the guidance and direction for evaluating waste streams as hazardous waste, i.e., contain listed or exhibit a characteristic of a hazardous waste, or mixed waste, i.e., hazardous waste with radiological contamination.

HAZARDOUS SUBSTANCES

40 CFR 302.4 lists hazardous substances and reportable quantities that must be considered during facility characterization and decontamination, and reported to the waste disposal facilities.

POLYCHLORINATED BIPHENYLS (PCBs)

40 CFR 761 provides direction for evaluating PCB contamination. **40 CFR 257.5 through 257.30** and **40 CFR 258** provide guidance for disposal of PCB Bulk Product Waste.

BERYLLIUM

10 CFR 850 provides direction for evaluating beryllium contamination. Letter dated January 4, 2001, Mr. Joe Legare, DOE, to Mr. Steve Gunderson, CDPHE, and Mr. Tim Rehder, EPA, provides further guidance on implementing 10 CFR 850.

ASBESTOS

40 CFR 763 and **5 CCR 1001-10** contain guidance and direction for evaluating waste. **29 CFR 1926.1101** contains guidance for the management of materials during decommissioning and demolition activities for worker protection.

Table 4.1 provides a summary of the key regulations and requirements and what phase in the characterization program they apply.

TABLE 4.1 KEY REGULATIONS, REQUIREMENTS AND GUIDANCE

Phase of Characterization	Radiological	Hazardous Waste	Hazardous Substances	PCBs	Beryllium	Asbestos
Scoping	MARSSIM Section 3.4	6 CCR 1007-3, Parts 261 and 268	40 CFR 302.4	40 CFR 257.5 through 257.30; 40 CFR 258; 40 CFR 761	6CCR 1007-3, Part 261, 10 CFR 850, and DOE letter	40 CFR 763 and 5 CCR 1001-10
Reconnaissance Level	DOE Order 5400.5	6 CCR 1007-3, Parts 261 and 268	40 CFR 302.4	40 CFR 257.5 through 257.30; 40 CFR 258; 40 CFR 761	6CCR 1007-3, Part 261, 10 CFR 850, and DOE letter	40 CFR 763 and 5 CCR 1001-10
	DOE No-Rad-Added Program					
In-Process	DOE Order 5400.5	6 CCR 1007-3, Parts 261 and 268	40 CFR 302.4	40 CFR 257.5 through 257.30; 40 CFR 258; 40 CFR 761	6CCR 1007-3, Part 261, 10 CFR 850, and DOE letter	40 CFR 763 and 5 CCR 1001-10
	DOE No-Rad-Added Program					
Pre-Demolition Survey	DOE Order 5400.5	6 CCR 1007-3, Parts 261 and 268	40 CFR 302.4	40 CFR 257.5 through 257.30; 40 CFR 258; 40 CFR 761	6CCR 1007-3, Part 261, 10 CFR 850, and DOE letter	40 CFR 763 and 5 CCR 1001-10
	DOE No-Rad-Added Program					
	MARSSIM Sections 4.0 - 9.0					

5.0 OVERVIEW OF THE DATA QUALITY OBJECTIVE (DQO) PROCESS

Establishing characterization requirements **SHALL** identify the data required to support disposition decisions. This section describes the EPA DQO process, which **SHALL** be applied to facility characterization at RFETS. Implementing this process helps determine the data needs of each D&D project, evaluate whether existing data are useful, and optimize the number and types of additional measurements taken and analyses completed.

A means to ensure adequate data quality is adherence to this characterization protocol, as well as the RLCP and the PDSP, throughout the facility disposition process. Characterization results will be used to support various decommissioning decisions, such as technology selection, alternative development, material release, and waste management. Results will also be used by other organizations in making decisions associated with occupational safety, industrial hygiene, environmental protection, regulatory compliance, etc. Therefore, decommissioning project personnel **SHALL** provide characterization results to all appropriate Kaiser-Hill (K-H) Team organizations.

5.1 DQO PROCESS

The DQO process is a systematic approach to ensure that data are acquired and evaluated according to their intended use. Coupled with verification and validation (V&V), DQOs establish a framework providing for technically sound decisions. The DQO process involves the following seven steps:

1. State the Problem;
2. Identify the Decision;
3. Identify the Inputs to the Decision;
4. Define the Boundaries of the Decision;
5. Develop the Decision Rule;
6. Specify Tolerable Limits on Decision Errors; and
7. Optimize the Design for Obtaining Data.

The following sections apply the DQO process to the RFETS Characterization Program associated with D&D activities.

The Problem

The initial problem is that "definitive" quantities and "types" of contaminated media, materials, equipment, and structures are not known and must be determined before an approach for facility disposition and the management of waste streams can be determined. Surveys/samples must be taken prior to demolition to properly characterize materials to determine appropriate management of materials and/or equipment resulting from the decommissioning process.

The Decision

Because decommissioning decisions determine data needs, the decisions must be clear and well defined. Key examples of critical technical decisions include:

- Determining whether materials, media, or fixed equipment within the facility are contaminated or not contaminated.
- Determining the wastestream categories that will result from disposition and associated quantities. The categories may include radioactive (low-level and transuranic) waste, hazardous waste, PCB and asbestos waste, mixed waste, and sanitary waste.

Inputs to the Decision

Inputs to the decisions include both qualitative and quantitative data. Qualitative information typically consists of historical data, process knowledge derived from operating records and interviews, and data derived from visual observation of a building's equipment and materials. Quantitative data may be produced from analytical data, field surveys, and/or analysis of samples. Other inputs to the quantitative decision may include the following:

- Method-specific sensitivities (e.g., detection limits or minimum detectable activities);
- Error tolerances associated with the measurements (e.g., accuracy and precision); and
- Action levels (e.g., regulatory thresholds from RFETS free-release criteria or RFCA).

The WAC and associated implementing procedures are typically the drivers for decision inputs where data will be used to characterize waste streams destined for a particular TSDF (e.g., Waste Isolation Pilot Plant, Nevada Test Site, Envirocare or USA Waste). Data for use in setting DQOs will be radionuclide- and chemical-specific.

Decision Boundaries

Decision boundaries include the geographic area(s), volume(s), and temporal boundaries of the characterization activity. Temporal boundaries generally refer to frequency of data collection, the period of time a standard/regulation cannot be exceeded, and the period of time over which data should be averaged. Other boundaries include the sample population of interest and any constraints on the data collection.

Decision Rules

Decision rules are a series of "if-then" statements developed to establish the basis on which decisions are made. Decision rules must be based on objective, reproducible, and measurable criteria, and must be consistent with information developed during the first four steps of the DQO process. All decision rules should be considered prior to finalizing the characterization plan.

Tolerable Limits on Decision Errors

The level of acceptable uncertainty associated with characterization results must be established prior to characterization. Acceptable false positive and negative errors generally range from 1% to 10%, and **SHALL** be stated in the characterization packages.

This level of uncertainty is used to determine the number of samples to be taken. The less error that is acceptable, the more samples will be collected. The number of required samples can be calculated based on guidance in the following documents: Data Quality Objectives (EPA QA/G-4, 1994), MARSSIM (Section 5.5.2.3, "Contaminant Not Present - Determining Number of Data Points for Statistical Tests") and/or Cost Benefit Enhancements (DOE/EM-0316, 1996).

Optimization of Sampling Design

The DQOs may be modified to reflect visual observations, data gaps, and professional judgment. If data gaps are identified as the project progresses or new information becomes available, additional sampling may be necessary. The sampling design is modified and optimized until the required, minimum confidence level is achieved for the project. The design may go through several iterations of optimization, depending on the sample data available and the inferences made from each unique sample set.

5.2 APPLICATION OF DQOs TO THE D&D CLOSURE PROGRAM

DQOs **SHALL** be selected, refined as necessary, and incorporated into characterization packages based on the type of facility being decommissioned and the phase of decommissioning. Type 1 facilities **SHALL** be subjected to a RLC which meets the requirements of a PDS before being dispositioned. Type 2 and 3 facilities **SHALL** be subjected to RLC, IPC, and PDS, with each phase of characterization using a different set of DQOs. Refer to the DQOs in the RLCP (Section 2.0), PDSP (Section 2.0), and Appendix C of this Protocol.

Data sets from previous characterizations serve as a key input to each characterization phase and its related set of DQOs. Such data can significantly assist in focusing the next characterization phase, thereby resulting in time and cost savings. The usability of

previous data will depend on their quality. If the data were not collected under a quality program and/or cannot be validated as accurate, they **"cannot and will not"** be used.

6.0 SAMPLING AND ANALYSIS

The DQO process will identify sampling and analysis needs. If existing data or process knowledge are not available to support a D&D decision, sampling and analysis are required. This section provides an overview of the sampling requirements for the non-radioactive contaminants, and the methods required to determine the chemistry of the samples. These methods **SHALL** be implemented following determination of the project-specific DQOs. For radiological field measurement methods and instrumentation, radiological sampling, and the preparation of radiological samples for laboratory measurements refer to Appendix C of this Protocol, and the RLCP and PDSP for further guidance.

6.1 ASBESTOS

Materials potentially containing asbestos **SHALL** be categorized and sampled per 40 CFR 763.86 and 5 CCR 1001-10, by a CDPHE-Certified Asbestos Inspector. The presence of asbestos (i.e., > 1% by volume) **SHALL** be determined at a laboratory with asbestos accreditation (NIST and NVLAP). The acceptable asbestos characterization method is EPA 600/R-93/116.

6.2 POLYCHLORINATED BIPHENYLS (PCBs)

Materials and media potentially contaminated with PCBs **SHALL** be categorized per 40 CFR 761. If material meets the definition of PCB Bulk Product Waste, it may be disposed of at a facility that is permitted, licensed, or registered by a State to manage municipal solid waste subject to 40 CFR 258, or non-municipal, non-hazardous waste subject to 40 CFR 257.5 through 257.30. For most bulk product wastes, implementing this strategy precludes the need for PCB characterization prior to or during facility disposition, as long as restrictions outline in 40 CFR 761.62 regarding their disposal are met. However, notification to the disposal facility is required at least 15 days in advance of shipping wastes to the facility if that disposal facility does not possess a commercial PCB storage or disposal approval. If some construction debris (e.g., concrete) is to be recycled on-site, the paint on the material **SHALL** be sampled and analyzed, as appropriate, to determine if the material is subject to regulations governing PCB bulk product waste.

Management strategy for PCB remediation waste will be determined on a case-by-case basis. If PCB contamination is suspected, or if a PCB spill is discovered that has not been cleaned up, the area will be treated as directed by the most recent versions of 40 CFR 761 through 766. For each planned cleanup, PCB regulations under TSCA will be evaluated as potentially applicable or relevant and appropriate requirements (ARARs), including the disposal options for PCB remediation waste listed under 40 CFR 761.61.

The analytical method **SHALL** have a practical quantitation limit (PQL) of less than 50% of the regulatory threshold that applies to the particular type of waste. SW-846

Methods 4020 and 8082 satisfy this criterion.

6.3 HAZARDOUS WASTE AND SUBSTANCES

Materials and media potentially contaminated with hazardous waste and substances **SHALL** be characterized using process knowledge and/or analyzed for compounds and elements in accordance with 6 CCR 1007-3, Parts 261 and 268 (for hazardous waste), and 40 CFR 302.4 (for hazardous substances). Analytical methods **SHALL** have PQLs at levels better than 50% of the regulatory thresholds. The SW-846 methods or equivalent industry-proven methods **SHALL** be used for analyses as specified in the receiving site's WAC and waste analysis plan.

6.4 BERYLLIUM

Media potentially contaminated with beryllium **SHALL** be characterized using process knowledge and/or chemical analysis of smear samples. Samples **SHALL** be analyzed by EPA SW-846 methods (6010B, with total digestion by 3052, 3050B, or 3051 depending upon the matrix) or equivalent, such as OSHA Method ID-125G for flame atomic absorption spectroscopy, or OSHA Method 125-G for inductively coupled plasma spectroscopy. The PQL will be less than or equal to one half the beryllium investigation level of $0.1 \mu\text{g}/100 \text{ cm}^2$, i.e., less than $0.05 \mu\text{g}/100 \text{ cm}^2$.

7.0 QUALITY ASSURANCE AND QUALITY CONTROL

This section defines the requirements and controls that are employed and implemented by K-H to conduct facility characterization with adequate technical defensibility, and provides a roadmap of the applicable documents, procedures, and standards. Quality assurance/quality control (QA/QC) criteria listed in this section supplement the K-H *Quality Assurance Program* (QAP) by emphasizing requirements applicable to planning and implementation of facility characterization. The application and implementation of these criteria **SHALL** be consistent with the graded approach. In practical terms, the graded approach requires selective application of QA/QC requirements commensurate with their importance to safety and project objectives.

7.1 PERSONNEL TRAINING & QUALIFICATION

All personnel conducting surveys or performing activities described in this document **SHALL** receive training and qualify in the procedures performed. The extent of training and qualification should be proportional to the education, experience, and proficiency of the individual, and the scope, complexity, and nature of the activity. Training should be designed to achieve initial proficiency and to maintain that proficiency over the course of the survey process or other activity. Records of training, including testing to demonstrate qualification, must be documented.

Training requirements are presented in 1-10000-TUM, Training User's Manual, Site *Radiological Control Manual* (RCM; Chapter 6, Parts 2, 3, and 4). Relevant training material is presented in specific characterization procedures referenced in this Protocol, the RLCP, and the PDSP.

7.2 QUALITY IMPROVEMENT

Quality improvement **SHALL** be realized through use of a systematic means of identifying, tracking, and correcting issues (deficiencies, nonconformances, issues, etc.). The extent of causal analysis and corrective action **SHALL** be commensurate with the significance of the failure or problem. Lessons learned **SHALL** be communicated to staff from management where appropriate. Documents referenced to support the implementation of quality improvement requirements are identified below:

Site Corrective Action Requirements Manual (1-MAN-012-SCARM)
Site Integrated Oversight Manual (1-MAN-013-SIOM)
Site Lessons Learned/Generic Implications Requirements Manual ,
1-S27-ADM-16.18)
Radiological Improvement Reports (1-H02-HSP-3.02)
Stop Work Action (1-V10-ADM-15.02)
Occurrence Reporting Process (1-D97-ADM-16.01)
Performance Indication and Trend Analysis (1-E93-ADM-16.18)

Control of Non-conforming Items (1-A65-ADM-15.01)
Control of Waste Nonconformances (2-U76-WC-4030)
RFETS Radiological Control Manual (Site RCM)

7.3 DOCUMENT CONTROL, RECORDS & DATA MANAGEMENT

The document control process is described in procedure MAN-063-dc, *Document Control Program Manual*. Essential policies, plans, procedures, decisions, data, and transactions of the project **SHALL** be documented to an appropriate level of detail. Records **SHALL** be maintained in accordance with 1-V41-RM-001, *Records Management Guidance for Records Sources*. Documents and records that must be placed in the CERCLA administrative record **SHALL** be dispositioned in accordance with 1-F78-ER-ARP, *CERCLA Administrative Program*.

7.4 WORK PROCESS

All characterization activities **SHALL** be executed using the RFETS *Integrated Work Control Program (IWCP)*. The IWCP requires the preparation of work packages that provide work control and incorporate the *Integrated Safety Management (ISM)* principles. The ISM principles ensure workers are involved in the planning, hazard identification, and implementation of the demolition activities. The IWCP review process evaluates the activity, hazard identification, mitigation measures and compliance with the authorization basis documents.

7.4.1 Survey/Sample Handling and Custody Requirements

Samples **SHALL** be managed to ensure there is an accurate record of sample collection, transport, analysis, and disposal to ensure that samples are neither lost nor tampered with and that the sample analyzed is traceable to a specific location in the field. A chain-of-custody form **SHALL** be completed for all samples and included as part of the characterization documentation as required by RSP-16.03, CAS-SOP-003 and laboratory analysis procedures. Survey packages and associated data **SHALL** be protected as specified in Site RCM Article 775 when not in use. If a survey was not completed, for example, by the end of the surveyor's shift, the surveyor's records **SHALL** be completed to the extent the survey was performed, and the subsequent surveyor **SHALL** start new records to complete the balance of the survey.

7.4.2 Analytical Methods Quality Control Requirements

Sample analysis **SHALL** be performed as specified in the Statement of Work for Analytical Measurements modules. Laboratory sample QC checks will include, as appropriate, interlaboratory comparison studies (single- or double-blind standards), performance evaluation standards, laboratory control samples, laboratory duplicates, preparation blanks, trip blanks, field blanks, and duplicate samples.

7.4.3 Field Survey/Sampling Quality Control Requirements

The number of QC measurements is determined by the degree to which assurance is needed for adequate control of the measurement process. The process is simplified when the scope of the survey is narrowed to a single method, crew, or laboratory. Similarly, the number of required QC measurements increases proportionately with the number of samples or surveys and as action levels approach a given instrument's detection limit. To establish the overall precision, or reproducibility of scans and surveys, replicate, or duplicate, measurements **SHALL** be acquired at a minimum percentage of the non-QC scans/surveys. The minimum number of required QC surveys **SHALL** be determined as specified in the RLCP and PDSP.

Replicate surveys **SHALL** be performed with a different instrument and by a different surveyor than the one who performed the initial survey. This method provides an estimate of instrument and surveyor precision. The replicate survey results should be clearly marked to show that they are QC surveys and should reference the initial survey for comparison.

7.4.4 Transuranic Waste Management QA/QC Requirements

The applicability of facility characterization data for waste characterization **SHALL** be assessed and included in the project-specific waste management plan. For example, Transuranic (TRU) waste will need to be characterized in accordance with the *USDOE Carlsbad Area Office Quality Assurance Program Document*, CAO-94-1012. The data collected during facility characterization may be used as characterization data for the TRU waste, but the verification and validation of that data **SHALL** meet the requirements established by the *TRU Waste Management Manual*, 1-MAN-008-WM-001 and the *WIPP Isolation Pilot Project Transuranic Waste Characterization Program Quality Assurance Project Program Plan*, 95-QAPJP-0050.

7.5 DATA COLLECTION DESIGN

The requirements and rationale of the design for the collection of characterization data **SHALL** be derived from the quantitative outputs of the DQO Process. The PDS data are considered critical because they are required to achieve project objectives or limits on decision errors. Therefore, the level of QA/QC is more stringent for a PDS than that of RLC or In-Process surveys. The design assumptions are specified in the RLCP and PDSP.

7.5.1 Computerized Systems (Software/Hardware)

Design-control of computerized systems **SHALL** be commensurate with the hazards associated with the process for which the computer system controls. Software used in

characterization activities should be designed and validated in accordance with ASME-NQA-1-1994, Part II. Systems controlling critical health and safety processes **SHALL** be verified and validated as prescribed in either the Health and Safety Plan (HASP) or the RSPs and **SHALL** simulate working conditions prior to usage in real settings. Such systems **SHALL** also be tested periodically to ensure functionality as defined in the Site RCM or HSP. Computerized systems used for measurements **SHALL** be calibrated via system calibrations, i.e., while integrated with the relevant transducers. Computerized systems used for data reduction and analysis **SHALL** be controlled to ensure traceability of changes made to original data and allow independent peer reviewers to relate inputs to outputs

7.6 PROCUREMENT

Quality requirements **SHALL** be delineated in procurement and subcontract documents. All Statement of Work (SOW) distributed by companies at RFETS **SHALL** be reviewed by quality assurance representatives to ensure that adequate quality controls/ requirements are imposed on the subcontractor. Ongoing oversight of the subcontractor **SHALL** be performed to ensure that these controls are implemented. Procurement requirements are implemented through the following documents:

- Procurement System Manual
- Acquisition Procedure for Requisitioning Commodities and Services (IW36-APR-111).

7.7 INSPECTION & ACCEPTANCE TESTING

All characterization measurement results **SHALL**, at a minimum, be identified by actual result (not <MDC – minimum detectable concentration), date, instrument, location, type of measurement, and surveyor. Characterization data **SHALL** be reported with gross measurement results, reduced measurement results, and all associated parameters and calculations (e.g., model identification and parameter inputs and outputs) required to verify the reduced result. For final reporting purposes, survey and sample results **SHALL** be rounded and reported to significant figures that are consistent with the accuracy and precision associated with the specific measurements or calculations.

Calibration and maintenance of instrumentation **SHALL** be consistent with MARSSIM guidance; Any deviations from MARSSIM **SHALL** be documented and technically justified in the characterization survey reports.

7.7.1 Inspection/Maintenance/Testing of Instrumentation

Inspection, maintenance, and calibration of radiation instrumentation **SHALL** be performed as specified in the Site RCM Chapter 5 Part 6. Applicable calibration procedures identified include:

- 4-PRO-S86-ALPHA-HPI-3420, Calibration of the Electra with the Dual Scintillation Probe
- 4-177-HPI-2000, Calibration of the Ludlum Model 12-1A Count Rate Meter with Air Proportional Probe
- 4-C66-HPI-3410, Calibration of the Bicron Frisk Tech with a B-50 Beta Probe; and
- 4-C67-HPI-3411, Calibration of the Bicron Frisk Tech with a A-100 Alpha Probe.

All calibrations **SHALL** comply with the requirements of ANSI-N323, American National Standard Radiation Protection Instrumentation Test and Calibration, Portable Survey Instruments, as required by the Site RCM. Instrumentation not addressed in the referenced procedures **SHALL** be maintained in accordance with MAN-092-M&TE, Measuring and Test Equipment Management Manual.

If actual field conditions during characterization differ significantly from calibration conditions or assumptions, an additional calibration or performance check for the instrument(s) in the anomalous field condition(s) is required. The resulting accuracy and precision of the instrument **SHALL** be proven to be within "industry-accepted" tolerances, or within acceptable total uncertainties relative to the survey unit's derived concentration guideline level (DCGL) and final survey unit decisions. Correction factors, with acceptable technical basis may be used for measurement conversions. Recalibration is required if an instrument fails a performance check or if it has undergone repair or modification that could affect its response.

For portable instrumentation, calibrations should account for the substrate of concern (e.g., concrete, steel, roofing) or appropriate correction factors developed for the substrates relative to the actual calibration standard substrate. This is necessary because of significant adsorption and backscatter of alpha and beta emitters. Conversion factors developed during the calibration process should be for the same counting geometry as during the actual use of the detector.

Calibrations normally challenge the instruments at a number of different levels over the operating range. Since the range for the PDS will be much narrower, the calibration ranges may be reduced accordingly to improve accuracy. However, multipoint calibrations (three or more points per instrument range) are still required.

Calibration sources **SHALL** be traceable to the National Institute of Standards and Technology (NIST). Where NIST-traceable standards are not available, standards obtained from an industry recognized organization (e.g., the New Brunswick Laboratory for various uranium standards) **SHALL** be used.

7.8 MANAGEMENT AND INDEPENDENT ASSESSMENTS

Management assessments **SHALL** be planned, scheduled and performed by project management to assess an organization performing work to determine if the objectives,

goals and processes are adequate. Management assessment **SHALL** be documented through reports, internal memoranda, or other suitable reporting means.

Independent assessments **SHALL** be performed by personnel who are not directly responsible for the work to establish whether the prevailing management structure, policies, practices, procedures and data are adequate for ensuring that the quality of the results based on the risk and performance indicators needed are obtained. Deficiencies **SHALL** be identified, tracked and closed in accordance with the *Site Corrective Action Requirements Manual*. Assessment requirements are implemented through the documents identified below:

- Kaiser-Hill Management Assessment Program (3-W24-MA-002)
- Site Integrated Oversight Manual (1-MAN-013-SIOM)
- RFETS Radiological Control Manual (Site RCM)
- Radiological Assessments (RMRS/OPS-PRO.150)

8.0 DATA REVIEWS

Data collected during characterization **SHALL** be reviewed prior to incorporation into final reports to determine usability and compliance with RFCA and minimum quality requirements. Collectively, data review includes verification, validation (V&V, respectively), and quality assessment of the data. Precision, accuracy, representativeness, completeness, comparability and sensitivity (PARCCS) are specific aspects of the data review that are summarily covered by the data review process. Radiological data collected during the reconnaissance level and the in-process characterization **SHALL** also be reviewed according to the Radiological Control Manual and Radiological Safety Practices Procedures as applicable. Radiological data gathered during pre-demolition surveys **SHALL** be reviewed according to MARSSIM. Further detail is provided in the RLCP and PDSP.

8.1 DATA VERIFICATION AND VALIDATION (V&V)

Verification **SHALL** be performed on sets of data produced by the project on which decisions are based. Validation **SHALL** be performed on minimum percentages of data/data packages as stipulated in project-specific sampling and analysis plans. Analytical data **SHALL** be verified and validated according to RFETS Analytical Services Division guidelines (General Guidelines for Data Verification and Validation, DA-GR01-V1).

8.1.1 Data Verification

Verification ensures that data produced and used by the project are *documented and traceable* per applicable quality requirements. For example, verification ensures that requirements relative to the data produced by the project are satisfactory with respect to quantity, types, and format of data specified in the applicable planning documents and data packages.

Every RLC and PDS report **SHALL** document assessment of the entire data set used for decisions as defined in the DQO section. A section of the report **SHALL** explain the steps and criteria used for data verification and validation, including qualified and rejected data, and a summary table of all methods used, real samples, and QC samples. All data should be verified.

8.1.2 Data Validation

In contrast to data verification, data validation is an in-depth technical review of the data that determines whether characterization was performed within quality control requirements and tolerances. Depending on the project and the critical nature of samples, a percentage of the entire data may be validated, so long as the percentage is representative. For example, validation percentages should include the following:

- Results from all laboratories used during the project;
- Results from samples collected by each subcontractor and/or representative of each of the project subcontractor's work;
- Results from each medium sampled; and
- Results from each analytical method used.

A validation rate of greater than or equal to 25% is currently used at the RFETS, based on acceptance of previous work plans by EPA Region VIII and CDPHE. A lower validation rate may become acceptable to the agencies; however, depending on the number of critical samples or surveys for a given project, higher frequencies of validation may be desired for higher confidence. MARSSIM Appendix N also provides guidance for data validation.

8.1.2.1 Precision

Precision measures the reproducibility of measurements. It is defined as the degree of mutual agreement among independent measurements as the result of repeated application of the same process under similar conditions. Analytical precision is the measurement of the variability associated with duplicate (two) or replicate (more than two) analyses. The laboratory control sample duplicates (LCSD) **SHALL** be used to determine the precision of the analytical method.

Overall project precision is the measurement of the variability associated with the entire sampling and analysis process within the project. It is determined by analysis of duplicate or replicate field samples and measures variability introduced by both the laboratory and field operations. Field duplicate samples and matrix duplicate spiked samples **SHALL** be analyzed to assess overall project and laboratory precision, respectively.

The precision measurements **SHALL** be determined using the relative percent difference (RPD) between the sample results and the duplicate error ratio (DER). RPD values are determined for non-radiological measurements, and DER values are used for radiochemistry measurements.

DER values, in contrast to strictly deterministic relative percent differences in measurements, consider uncertainty associated with both measurements, as well as the single reported values. Such a comparison is statistical in nature, and has associated statistical confidence built into the comparison that is chosen by the decision-maker (e.g., comparison with a selected z-score that corresponds to a 95% confidence). Other controls that define the precision include control or tolerance charting (daily minimum) at a plus or minus threshold for radiological surveys.

8.1.2.2 Accuracy

Accuracy is a measurement of how closely the measured value corresponds to the true value, and includes components of random uncertainty and systemic error. Therefore, accuracy reflects the total uncertainty associated with a measurement.

Analytical accuracy **SHALL** be measured by comparing the percent recovery of analytes (spiked into a laboratory control sample duplicate) to a control limit. For volatile and semivolatile organic compounds, surrogate compound recoveries **SHALL** also be used to assess accuracy and method performance for each sample analyzed. Analysis of performance evaluation (PE) samples **SHALL** also be used to ensure quality control for atypical contaminants or radionuclides of concern, or when interference is an issue. Accuracy **SHALL** be calculated and qualified for each D&D QA sample batch, and the associated sample results **SHALL** be interpreted by considering these specific measurements and other qualitative considerations. Measurement uncertainties, both quantitative and qualitative, **SHALL** be reported for all data sets used in decision-making (see MARSSIM, Section 6.8).

8.1.2.3 Representativeness

Representativeness means the degree to which the data accurately and precisely represent a characteristic of a population parameter, variation of a property, a process characteristic or an operational condition. Representativeness is a qualitative parameter focused on the proper design of the sampling program.

Objectives for representativeness are defined for each sampling and analysis task and are a function of the investigative objectives. Representativeness **SHALL** be achieved through use of the standard field, sampling, and analytical procedures. Representativeness **SHALL** also be determined by appropriate program design, with consideration of elements such as sample locations, matrix and sample type, and number of samples.

8.1.2.4 Completeness

To produce credible and defensible data sets for decision-making, the data must be complete relative to the original sample plan(s). Therefore, completeness **SHALL** be calculated and reported for each method, matrix and analyte combination. The number of valid results divided by the number of possible individual analyte results, expressed as a percentage, will determine the completeness of the data set. For completeness requirements, valid results **SHALL** be all results not rejected due to inadequate quality control. The percentage requirements for completeness **SHALL** be 100% for critical samples and 90% for the project as a whole. For any instances of samples that could not be analyzed for any reason (e.g., holding time violations in which re-sampling and analysis were not possible, samples spilled or broken, etc.), the numerator of the

calculation **SHALL** become the number of valid results minus the number of possible results not reported. The formula for calculation of completeness is presented below.

$$\% \text{ completeness} = \frac{\text{Number of valid results}}{\text{Number of planned results}} \times 100$$

Where absolute regulatory requirements for sample set completeness are undefined, statistical methods for evaluating completeness of data sets **SHALL** be applied, such as those methods described in MARSSIM (Section 9) (DOE/DOD/NRC, 1997), EPA G-4 (EPA, 1994) and G-9 (EPA, 1996). These methods include use of:

- Power curves relative to hypothesis testing;
- Analysis of means and variabilities relative to regulatory action levels;
- Evaluation of outliers and dispersion;
- Transformations; and
- Tests on distributional assumptions.

If other scientifically recognized methods for evaluating sample sets are implemented, the methods and results **SHALL** be included in the corresponding final report.

8.1.2.5 Comparability

Comparability is the confidence with which one data set can be compared to another data set. One of the objectives of characterization is to produce comparable data. The number of matrices that are sampled and the range of field conditions encountered are considered in determining comparability. Comparability **SHALL** be achieved by using standard methods for sampling and analysis, reporting data in standard units, normalizing results to standard conditions, and using standard and comprehensive reporting formats. Complete field documentation using standardized data collection forms **SHALL** support the assessment of comparability. Analysis of PE samples and reports from audits **SHALL** also be used to provide additional information for assessing the comparability of analytical data produced among subcontracting laboratories. Historical comparability **SHALL** be achieved through consistent use of methods and documentation procedures throughout the project.

8.2 DATA QUALITY ASSESSMENT (DQA)

DQA is a scientific and statistical evaluation that determines if the data are of the right type, quality, and quantity to support their intended use, which in this case, is to make decisions regarding D&D. More specifically, the DQA is an evaluation of the data specifically with respect to the project's DQOs and action levels, and could, as

applicable, encompass statistical methods as described in EPA QA/G-9. Although some data assessment will be performed before or in parallel with data V&V (i.e., confirmation), the DQA **SHALL** not be final until V&V are complete. This restriction is necessary since the data assessment assumes that the individual data constituting statistics and parameters are satisfactory for their intended purpose and based on quality requirements.

The DQA process, as defined by EPA QA/G-9 (EPA, 1996) and MARSSIM (NUREG-1575) constitutes the guidance for assessing the quality of data. MARSSIM addresses DQA in Section 8.0 and more specifically in Table 2.3 and Appendices E and I. The assessment **SHALL** include evaluating sample quantities, and sources and magnitudes of uncertainty relative to tolerances allowed in the DQO process, as guided by the RLCP and the PDSP, including both systematic and random sources of error. The G-9 process consists of the following five steps:

1. Review DQOs;
2. Conduct preliminary data review;
3. Select statistical test;
4. Verify assumptions of the statistical test; and
5. Draw conclusions from the data.

9.0 REFERENCES

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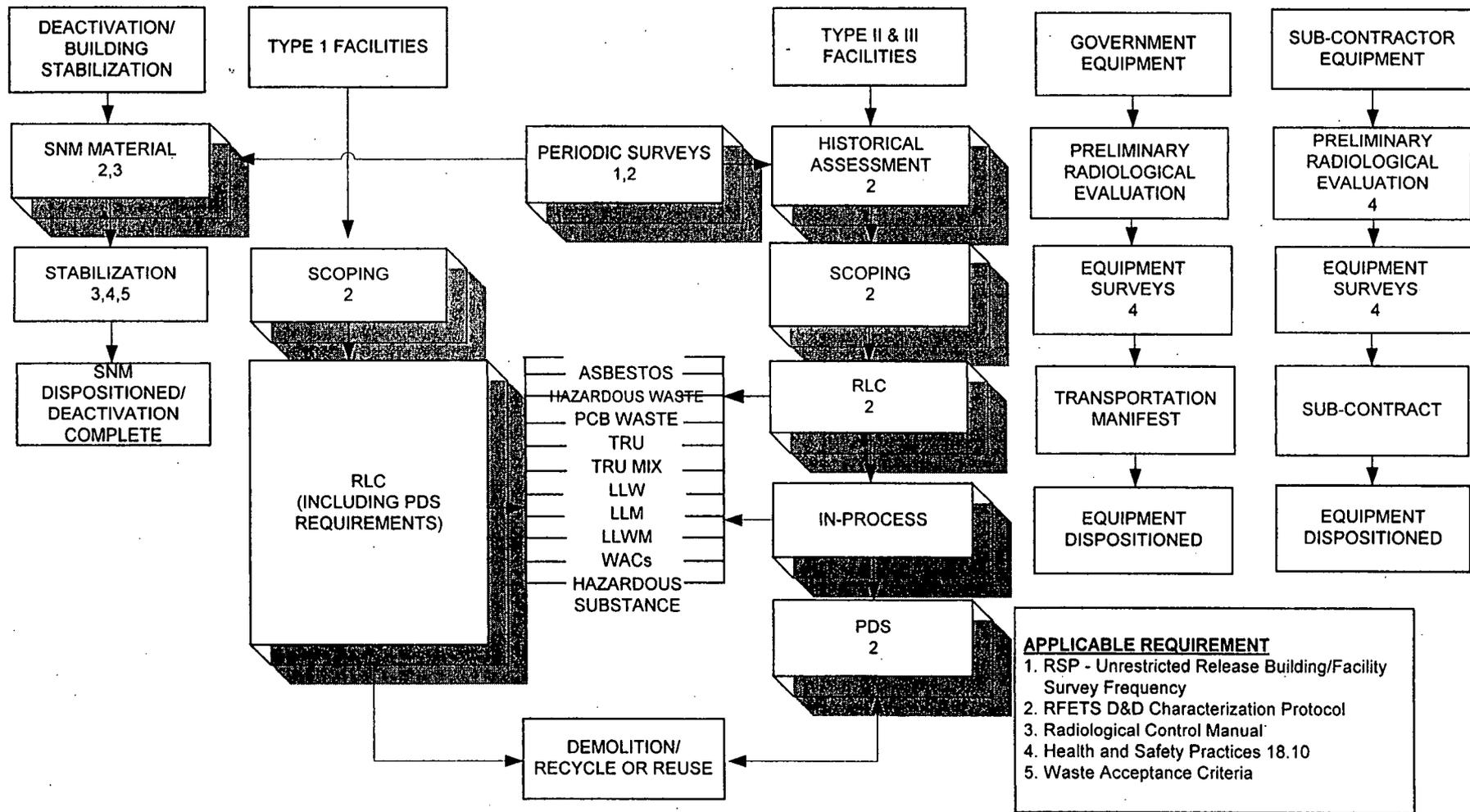
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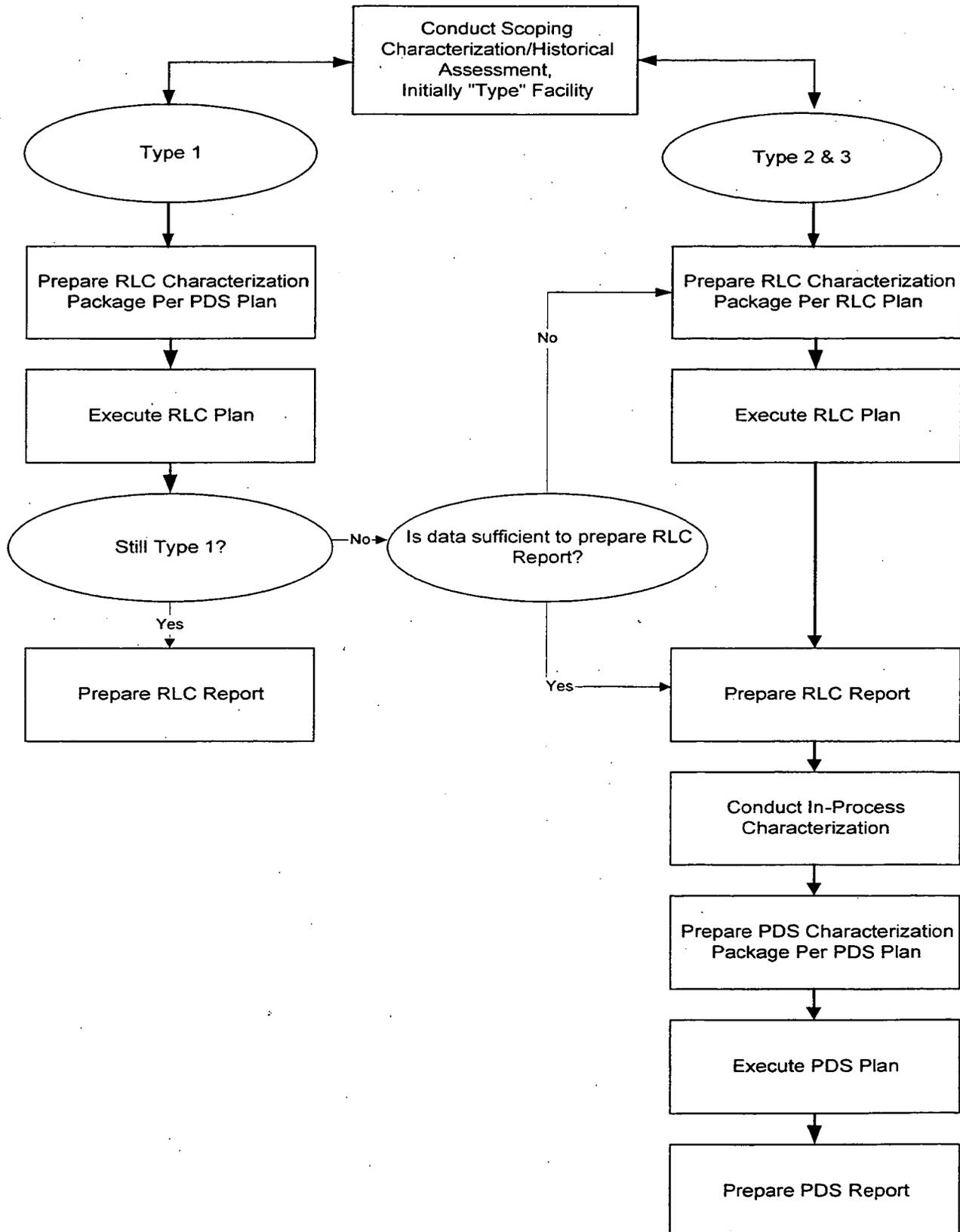
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Appendix A The RFETS Characterization Process



Appendix B The D&D Characterization Process Logic Diagram



APPENDIX C

DQOs FOR IN-PROCESS CHARACTERIZATION

The following sections outline the DQO process for performing In-process Characterization.

The Problem

The problem involves characterizing the nature and extent of radiological and hazardous substance contamination in order to 1) evaluate required extent/methods of disposition; 2) estimate approximate volumes of sanitary, low-level (LLW), low-level mixed, transuranic (TRU), transuranic-mixed, other hazardous waste, hazardous substance and PCB, beryllium, and asbestos waste generated during the D&D process; 3) evaluate on-going decommissioning activities; 4) identify additional radiological, chemical and safety hazards that may be uncovered during facility strip-out and decontamination; 5) confirm the adequacy of decontamination; 6) determine residual levels of contamination; and 7) provide input to the pre-demolition (final) survey design.

The Decision

The critical decision is determining what health and safety controls need to be established and what regulatory category (RCRA, etc.) should be assigned to the various waste streams (refer to section 5.1) generated during decommissioning. Characterization data evaluation will involve assessing if enough validated data exists to adequately describe the nature and extent of contamination.

Inputs to the Decision

The inputs to the decision include the RLC and IPC data and information generated from previous activities (e.g. scoping characterization, etc.), as well as the decision document action levels, unrestricted release criteria, transportation requirements, waste management regulations, pollution prevention/waste minimization criteria, ALARA, and WAC.

Decision Boundaries

The decision boundaries are the spatial confines of the selected survey area(s).

Decision Rules

This section develops the rules from which decisions are made concerning characterization data. There are some very specific rules related to individual

contaminants of interest. The following are general guidelines for decision rule development:

- If there is an inventory/estimate of remaining materials, media, equipment, floors, walls and ceilings within the facility, no inventory/estimates are necessary; otherwise, inventory/estimates are necessary.
- If materials are found to be non-radioactive, non-hazardous, non-beryllium contaminated, non-TSCA and non-ACM, then material can be free-released, and reused, recycled or disposed of as sanitary waste.

Radionuclides

- If all radiological survey and scan measurements are below the surface contamination guidelines provided in DOE Order 5400.5 (Radiation Protection of the Public and Environment; see Table 7-1), and if all radiological sample measurements are below the volume contamination thresholds provided in the No-Rad-Added Verification (NRA) Program (refer to Kaiser-Hill letter to DOE, RFFO, Application of Surface Contamination Guidelines from Department of Energy Order 5400.5 - WAH-064-98, March 10, 1998), the related volume of material is considered not radiologically contaminated.
- If any radiological survey and scan measurement exceeds the surface contamination thresholds provided in DOE Order 5400.5, the associated surface area is considered radiologically contaminated.
- If any radiological sample measurement exceeds the volume contamination threshold provided in the NRA Program (refer to Kaiser-Hill letter to DOE, RFFO, Application of Surface Contamination Guidelines from Department of Energy Order 5400.5 - WAH-064-98, March 10, 1998), the associated volume is considered radiologically contaminated.
- If any radiological sample measurement (or disposal unit volume) exceeds 100 nanocuries per gram of transuranic material, the associated volume is considered transuranic (TRU) waste.

Hazardous Waste

If decommissioning waste is mixed with or contains a listed hazardous waste, or if the waste exhibits a characteristic of a hazardous waste, then the waste is considered RCRA-regulated hazardous waste in accordance with 6 CCR 1007-3, Parts 261 and 268.

Hazardous Substances

If material contains a listed hazardous substance above a decision document action level and/or the CERCLA reportable quantity (40 CFR 302.4), the material is subject to CERCLA regulation (i.e., remediation and/or notification requirements).

Beryllium

If surface concentrations of beryllium are equal to or greater than $0.2 \mu\text{g}/100 \text{ cm}^2$, the material is considered beryllium contaminated per 10 CFR 850.

PCBs

- If material contains PCBs from the manufacturing process at concentrations ≥ 50 ppm, the material is considered PCB Bulk Product Waste and subject to the requirements of 40 CFR 761.
- If PCB contamination from a past spill/release is suspected, or if a PCB spill is discovered that has not been cleaned up, the associated material is considered PCB Remediation Waste and subject to the requirements of 40 CFR 761. PCB remediation waste includes: materials disposed of prior to April 18, 1978, that are currently at concentrations ≥ 50 ppm PCBs, regardless of the concentration of the original spill; materials which are currently at any volume or concentration where the original source was ≥ 500 ppm PCBs beginning on April 18, 1978, or ≥ 50 ppm PCBs beginning on July 2, 1979; and materials which are currently at any concentration if the PCBs are spilled or released from a source not authorized for use under 40 CFR 761.
- If a waste or item contains PCBs in regulated concentrations, the waste or item is classified as PCB-regulated material and subject to the requirements of 40 CFR 761.

Asbestos

If any one sample of a sample set representing a homogeneous medium results in a positive detection (i.e., $>1\%$ by volume), then material is considered ACM (40 CFR 763 and 5 CCR 1001-10).

Tolerable Limits on Decision Errors

Acceptable false positive and false negative errors for calculating the number of samples required for chemical characterization range from 1% to 10%, unless superceding regulations dictate otherwise. No statistically based sample sets are

required for radionuclides; therefore, decision errors do not apply. Decision error does not apply to asbestos sample sets per 40 CFR 763. Results are compared with the action levels on a sample-by-sample basis.

Optimization of Plan Design

Discretionary radiological surveying, scanning and sampling will be conducted on remaining floors, walls and ceilings as necessary to classify floors, walls and ceiling as radiologically or not radiologically contaminated for subsequent design of the PDS. The following criteria **SHALL** be used in developing IPC characterization packages:

- Radiological field measurement methods and instrumentation are described in Section 6 of MARSSIM.
- Radiological sampling and preparation for laboratory measurements are described in Section 7 of MARSSIM.
- For materials, media, equipment, floors, walls, and ceilings being released as low level and/or TRU waste, radiological surveys/samples **SHALL** be taken per Site Procedure 1-PRO-079-WGI-001, Waste Characterization, Generation and Packaging.
- If radiological surveys/scans/samples are required for materials, media and equipment for release as non-radioactive waste, then radiological surveying, scanning, and sampling should be conducted per the requirement in the RFETS HSP 18.10, Radioactive Material Transfer and Unrestricted Release of Property and Waste.
- If RCRA, TSCA, Be or asbestos survey/samples are required for materials, media, equipment, floors, walls and ceilings, refer to Section 6.0 of this Protocol.

APPENDIX D

RECONNAISSANCE LEVEL CHARACTERIZATION PLAN FOR D&D FACILITIES

REVISION 0

April 23, 2001

April 23, 2001

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ABBREVIATIONS/ACRONYMS

ACM	Asbestos-containing material
AHERA	Asbestos Hazard Emergency Response Act
ALARA	As Low As Reasonably Achievable
ANSI	American National Standards Institute
ARAR	Applicable or Relevant and Appropriate Requirements
ASTM	American Society for Testing Materials
Be	Beryllium
CBDPP	Chronic Beryllium Disease Prevention Program
CCR	Code of Colorado Regulations
CDPHE	Colorado Department of Public Health and the Environment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cm	Centimeter
D&D	Decommissioning and Decontamination
DDCP	Decontamination and Decommissioning Characterization Protocol
DCGL _W	Derived Concentration Guideline Level – Wilcoxon Rank Sum Test
DCGL _{EMC}	Derived Concentration Guideline Level – Elevated Measurement Comparison
DER	Duplicate Error Ratio
DOE	U.S. Department of Energy
dpm	Disintegrations Per Minute
DPP	Decommissioning Program Plan
DQA	Data Quality Assessment
DQOs	Data Quality Objectives
ER	Environmental Restoration
EPA	U.S. Environmental Protection Agency
FDPM	Facility Disposition Program Manual
HCA	High Contamination Area
IH	Industrial Hygiene
IPC	In-Process Characterization
K-H	Kaiser-Hill Company, L.L.C.
JHA	Job Hazard Analysis
LAB	Local Area Background
LBP	Lead Based Paint
LCS	Lab Control Samples/Spikes
LDR	Land Disposal Restrictions
LKBA	Location of Known Beryllium Areas
LLMW	Low-Level Mixed Waste
LLW	Low-level Waste
LRA	Lead Regulatory Agency
m	Meter
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MDA	Minimum Detectable Activity
MDC	Minimum Detectable Concentration
MDCR	Minimum Detectable Concentration Rates

ABBREVIATIONS/ACRONYMS (cont'd)

mg/L	Milligram/Liter
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NIST	National Institute of Standards and Technology
NORM	Naturally Occurring Radioactive Material
NRA	No Radioactivity Added
NVLAP	National Voluntary Laboratory Accreditation Program
OSHA	Occupational Safety and Health Administration
PARCC	Precision, Accuracy, Representativeness, Completeness, and Comparability
PCBs	Polychlorinated Biphenyls
pCi	Picocurie
PDS	Pre-Demolition Survey
PID/FID	Photoionization Detector/Flame Ionization Detector
ppb	Parts per Billion
PPE	Personal Protective Equipment
ppm	Parts per Million
Pu	Plutonium
PLM	Polarized Light Microscopy
PQL	Practical Quantitation Limit
QA	Quality Assurance
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RE	Radiological Engineers
RFCA	Rocky Flats Cleanup Agreement
RFETS	Rocky Flats Environmental Technology Site
RFFO	Rocky Flats Field Office
RLC	Reconnaissance Level Characterization
RLCP	Reconnaissance Level Characterization Plan
RLCR	Reconnaissance Level Characterization Report
RPD	Relative Percent Difference
RSC	Removable Surface Contamination
RSD	Relative Standard Deviation
RSP	Radiological Safety Practice
SME	Subject Matter Expert
SCMs	Surface Contamination Monitors
SOW	Statement of Work
SVOC	Semi-Volatile Organic Compound
TCLP	Toxicity Characteristic Leaching Procedure
TRU	Transuranic
TSC	Total Surface Contamination
TSCA	Toxic Substances Control Act
UCL	Upper Confidence Level
U	Uranium
µg	Microgram
VOC	Volatile Organic Compound

ABBREVIATIONS/ACRONYMS (cont'd)

WAC	Waste Acceptance Criteria
WGP	Weapons Grade Plutonium
WSRIC	Waste Stream Residue Identification and Characterization

1.0 INTRODUCTION

Reconnaissance Level Characterization (RLC) is a critical phase of facility disposition, as described in the Rocky Flats Environmental Technology Site (RFETS) *Facility Disposition Program Manual (FDPM)* and the RFETS *D&D Characterization Protocol (DDCP; K-H, 1999)*. The objective of RLC is to provide an initial assessment of the contamination, hazards, and other conditions associated with a facility. Such an assessment will enable project personnel to initially "type" facilities, identify decommissioning approaches and technologies, develop worker health and safety controls, estimate waste volumes by waste types, prepare sound decision documents for regulatory agency review and approval, and support the design of in-process and pre-demolition characterization.

RLC is generally conducted during or after facility deactivation and prior to major strip-out activities. In-process characterization (IPC) is performed during strip-out activities to identify additional hazards; refine waste volume estimates; and provide information needed to establish activity-specific environmental, safety and health controls. IPC is also conducted to determine the type and extent of decontamination required and to verify that decontamination has achieved the applicable performance specifications. Pre-demolition characterization is conducted prior to demolition to ensure that facilities have been sufficiently decontaminated to meet free-release criteria and/or to enable compliant waste management.

This document provides a streamlined approach for the performance and documentation of RLC surveys, such that the end user can easily retrieve and interpret the data. Specifically, the end user (i.e., the facility decommissioning project manager) **SHALL** use this document to prepare a project-specific RLC characterization package, which **SHALL** contain facility contaminants of concern, historical data to be used, and data gaps to be filled, including the location and number of surveys and samples to be taken, and survey grids to be used. The availability and clarity of RLC data are crucial in planning for decommissioning, as poor planning can result in the identification of unexpected contamination during the pre-demolition survey (PDS) or development of insufficient worker health and safety controls.

1.1 Applicability

This Plan applies to all Site employees and subcontractors performing facility characterization. The requirements in this Plan **SHALL** be used for all facility RLC. **Any changes or revisions to this Plan SHALL be approved by the Kaiser-Hill Company, L.L.C. (K-H), Manager for the Decontamination and Decommissioning (D&D) Program Office and the DOE.**

1.2 Purpose

This *Reconnaissance Level Characterization Plan (RLCP)* presents RFETS' approach to conducting RLC, gives RLC implementation guidance to decommissioning project managers, and details how to consistently conduct RLC in a compliant, technically

defensible, and cost-effective manner. Details include radiological and chemical characterization, radiological field instrumentation, laboratory analysis, data analysis and quality assessment, quality assurance and control, and RLC documentation. Effective and efficient implementation of RLC supports the goals of the *Rocky Flats Cleanup Agreement* (RFCA; DOE/RFFO, CDPHE, EPA, 1996) and RFETS' closure plans.

1.3 Characterization Scope

As stated in RFCA Attachment 9, the scope of RLC is to define the physical, radiological and chemical condition of facilities, including the nature and extent of contamination, physical hazards, obstacles, and other conditions that could affect decommissioning activities. Data are required for all facility areas and features, including:

- Floors, slabs and foundations
- Walls (interior and exterior)
- Ceilings and roofs
- Doors, door and window frames
- Molding, stairs and railings, heating, ventilation and air conditioning (HVAC) systems
- Lighting and electrical systems
- Piping and conduit
- Fixed equipment.

For Type 1 facilities, the RLC **SHALL** meet the requirements of the RFETS Pre-Demolition Survey Plan. Adherence to these requirements will result in data that will allow a Type I facility to be reused or managed as sanitary waste without further characterization.

Data **SHALL** be obtained using approved and accepted characterization practices and methods. All characterization needs, including RLC needs, **SHALL** be identified through implementation of the U.S. Environmental Protection Agency (EPA) data quality objective (DQO) process as defined in Section 5.0 of the RFETS D&D Characterization Protocol (MAN-077-DDCP). The process to identify characterization needs and specifications includes defining the problem that requires data and the decisions to be made, identifying inputs to the decision and the decision boundaries, developing the decision rules, setting acceptable error tolerances, preparing the characterization design, and optimizing the design as additional information becomes available.

1.4 Data Life Cycle

Results of scoping characterization, which precedes RLC and includes historical site assessment and facility walkdown, **SHALL** be evaluated during RLC planning to identify data gaps that need to be filled during RLC. If data gaps are identified through the DQO process, additional sampling/surveys are conducted. If data gaps are not identified, additional sampling/surveys are not conducted, and an RLC report (RLCR) is prepared per Appendix B. The RLCR will identify the proposed facility type, based on identified

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radiological and chemical hazards. Results from RLC also will be used to design in-process characterization and the pre-demolition survey. Refer to Section 2.0 of the RFETS D&D Characterization Protocol for additional information on the various characterization phases.

2.0 DQO'S FOR RECONNAISSANCE LEVEL CHARACTERIZATION (RLC)

This section defines the DQOs for RLC. These DQOs should be used verbatim in the preparation of project-specific characterization packages. If modification is warranted, justification for each modification **SHALL** be documented in the characterization package and in the RLCR.

If contamination is encountered during characterization of a Type 1 facility, the facility may need to be re-typed (refer to the RFETS Decommissioning Program Plan). If the facility is re-typed as a Type 2 or 3, characterization requirements **SHALL** then be modified per the D&D Characterization Protocol, Appendix B.

2.1 The Problem

The problem involves characterizing the nature and extent of radiological and chemical contamination, hazards, and other conditions associated with a facility. Such an assessment will enable project personnel to 1) provide the data needed to confirm or revise the facility typing; 2) identify decommissioning approaches and technologies; 3) develop worker health and safety controls; 4) estimate approximate volumes of sanitary, low-level (LLW), low-level mixed, transuranic (TRU), transuranic-mixed, other hazardous waste, hazardous substance, and PCB, beryllium, asbestos wastes generated during the decommissioning process; 5) estimate the volume and types of recycled materials; and 6) provide input to the design of in-process and pre-demolition survey characterization.

2.2 The Decision

The critical decision is to determine if the contamination and hazards are consistent with the preliminary facility typing, and to confirm or revise the waste estimates. Additionally, the data will be evaluated to determine how much, if any, additional characterization will be needed during in-process characterization.

2.3 Inputs to the Decision

The inputs to the decision include the RLC data and information generated from previous characterization activities (e.g., scoping characterization, etc.), as well as the decision document action levels, unrestricted release criteria, transportation requirements, waste management regulations, pollution prevention/waste minimization criteria, ALARA, and WAC.

All data used for RLC, including data from previous characterization (scoping characterization), **SHALL** meet minimum quality requirements for RLC. Adequacy and limitations of the data **SHALL** be documented in the RLCR. Data quality **SHALL** be addressed relative to DOE quality requirements cited in Sections 7 and 9 of this document, including DOE Order 414.1 and 10 CFR 830.120, Quality Assurance.

2.4 Decision Boundaries

The decision boundaries are the spatial confines of the selected survey area(s). Interior and exterior surfaces are included, including those below grade. Boundaries may be further defined in RFCA decision documents.

Note: RLC may not involve surveying and sampling in High Contamination Areas and Airborne Radioactivity Areas, and inside tanks and other equipment. However, these areas, and tanks and equipment **SHALL** be characterized via historical and process knowledge. They will also be surveyed and sampled, as needed, during in-process characterization and the PDS. (These areas should no longer be posted as High Contamination Areas and Airborne Radioactivity Areas during PDS. All contamination should have been removed by then.)

2.5 Decision Rules

Radionuclides

- If all radiological survey and scan measurements are below the surface contamination guidelines provided in DOE Order 5400.5 (Radiation Protection of the Public and Environment; see Table 7-1), and if all radiological sample measurements are below the volume contamination thresholds provided in the No-Rad-Added Verification (NRA) Program (refer to Kaiser-Hill letter to DOE, RFFO, Application of Surface Contamination Guidelines from Department of Energy Order 5400.5 - WAH-064-98, March 10, 1998.), the related volume of material is classified as not radiologically contaminated.
- If any radiological survey or scan measurement exceeds the surface contamination guidelines provided in DOE Order 5400.5, the related surface area is classified as radiologically contaminated.
- If any radiological sample measurement exceeds the volume contamination guidelines provided in the NRA Program (refer to Kaiser-Hill letter to DOE, RFFO, Application of Surface Contamination Guidelines from Department of Energy Order 5400.5 - WAH-064-98, March 10, 1998), the associated volume is classified as radiologically contaminated.
- If any radiological sample measurement (or disposal unit volume) exceeds 100 nanocuries per gram of transuranic material, the associated volume is classified as transuranic (TRU) waste.

Hazardous Waste

If decommissioning waste is mixed with or contains a listed hazardous waste, or if the waste exhibits a characteristic of a hazardous waste, then the waste is classified as hazardous waste in accordance with 6 CCR 1007-3, Parts 261 and 268.

Hazardous Substances

If material contains a hazardous substance above a decision document action level and/or the CERCLA reportable quantity (40 CFR 302.4), the material is subject to CERCLA regulation (i.e., remediation and/or notification requirements).

Beryllium

If surface concentrations of beryllium are equal to or greater than $0.2 \mu\text{g}/100 \text{ cm}^2$, the material is considered beryllium contaminated per 10 CFR 850.

PCBs

- If material contains PCBs from the manufacturing process at concentration ≥ 50 ppm, the material is classified as PCB Bulk Product Waste and subject to the requirements of 40 CFR 761.
- If PCB contamination from a past spill/release is suspected, or if a PCB spill is discovered that has not been cleaned up, the associated material is classified as PCB Remediation Waste and subject to the requirements of 40 CFR 761. PCB remediation waste includes: materials disposed of prior to April 18, 1978, that are currently at concentrations ≥ 50 ppm PCBs, regardless of the concentration of the original spill; materials which are currently at any volume or concentration where the original source was ≥ 500 ppm PCBs beginning on April 18, 1978, or ≥ 50 ppm PCBs beginning on July 2, 1979; and materials which are currently at any concentration if the PCBs are spilled or released from a source not authorized for use under 40 CFR 761.
- If a waste or item contains PCBs in regulated concentrations, the waste or item is classified as PCB-regulated material and subject to the requirements of 40 CFR 761.

Asbestos

If any one sample of a sample set representing a homogeneous medium results in a positive detection (i.e., $>1\%$ by volume), then material is classified as Asbestos Containing Material (ACM; 40 CFR 763 and 5 CCR 1001-10).

2.6 Tolerable Limits on Decision Errors

Acceptable false positive and false negative errors for calculating the number of samples required for chemical characterization generally range from 1% to 10%, unless superceding regulations dictate otherwise. Other limits may be used, if agreed to by the D&D Projects and Construction Organization, the Project Manager, DOE and the Lead Regulatory Agency (LRA). Decision error does not apply to asbestos sample sets per

40 CFR 763. Results are compared with the action levels on a sample-by-sample basis.

Sampling design error for radiological sampling will be controlled by requiring a minimum number of uniformly distributed ($n=30$) and biased surveys ($n=10$) to be performed in each survey area. In addition, surface area size limits are assigned for survey areas based on contamination potential.

2.7 Optimization of Plan Design

The following criteria provide potential areas for optimization of the RLCP:

- If additional data (radiological, chemical, and asbestos) are not required to make decisions, then RLC surveys/sampling are not required.
- If chemical or asbestos surveys/samples are required for materials, media, equipment, or interior and exterior building surfaces, refer to Section 4.0 of this document, and Section 6.0 of the DDCP.
- If radiological surveys/samples are required for materials, media, equipment, or interior and exterior building surfaces, then the following requirements apply:
 1. A minimum number of uniformly distributed and biased measurements (refer to Appendix A) must be collected.
 2. A minimum number of biased samples must be collected (if surface media or volumetric contamination are suspect.)
 3. Radiological field measurements must be performed in accordance with approved RFETS site procedures and this document.
 4. Radiological sampling and preparation for laboratory measurements must be performed in accordance with approved RFETS site procedures and this document.

3.0 RADIOLOGICAL CHARACTERIZATION

If radiological data gaps are identified during the DQO process, additional RLC surveys and/or sampling **SHALL** be conducted per this RLCP. RLC surveys **SHALL** provide an overall assessment of the radiological hazards associated with each facility. Each facility will be typed based upon the level of potential or existing radiological material. The scope of the RLC survey will be based on the facility type, scoping characterization results, and process knowledge. RLC surveys will be performed on a graded approach for all facilities.

3.1 Survey Design

RLC survey measurements **SHALL** be conducted in accordance with approved procedures and specific survey instructions provided in survey packages (per PRO-475-RSP-16.01, Radiological Survey/Sampling Package Design, Preparation, Control, Implementation and Closure). Removable and total activity measurements for both alpha and beta/gamma contamination, and surface scans **SHALL** be performed in accordance with Radiological Safety Practices procedure 3-PRD-165-RSP-07.02 Contamination Monitoring Requirements. Media and volumetric sampling **SHALL** be performed in accordance with CAS-SOP-003, Sampling for Waste Characterization.

A sufficient number of measurements **SHALL** be collected in order to fulfill the RLC objectives of adequately characterizing the nature and extent of radiological contamination (see Appendix A). The measurements will be systematic in nature (uniformly distributed), and biased. Appendix A delineates the administrative limits that are placed on 1) the survey area size and 2) the minimum number of measurements required. The objective of these administrative limits are to 1) provide consistency in RLC design among different facilities and 2) assure that a sufficient number of measurements are collected to adequately characterize the area. A minimum of 30 uniformly distributed measurements are required based on the Central Limit Theorem, which states that as the number of measurements from a population increases, the sample approaches a normal distribution. A minimum of 10 biased measurements are required as an administrative limit to assure that biased sampling is included as part of the survey design. Note that the requirements delineated in Appendix A, represent **MINIMUM** requirements, and may be increased if deemed necessary. The measurements **SHALL** be obtained by conducting surveys using approved methods and techniques such as surface scans, direct and removable surface activity measurements, and media or volumetric samples.

A major consideration in survey design is the method detection limit, which directly affects the usability of the data because results near the detection limit have a greater possibility of false negatives and false positives. Results near the detection limit have increased measurement uncertainty. All reported RLC data **SHALL** provide or reference the basis for the calculated detection limit (Minimum Detectable Concentration or equivalent).

All areas within facilities may not have the same potential for contamination, and therefore, will not require the same level of survey coverage to meet the DQO process. The results of the scoping characterization will be used to aid in the design of the RLC survey.

Facilities have been initially typed as Type 1, Type 2, or Type 3 facilities and are included in the FDP. Facilities will be further designated into survey areas during the design of the RLC survey. A survey area is a general term referring to any portion of a facility. For example, a survey area could be a group of facilities, a single facility, or one or more rooms within a facility. Survey areas will be delineated based on contamination potential, considering historical information and current radiological postings. Radiological Engineers (REs) will be responsible for dividing their respective facility into appropriate survey areas. All facilities will be divided into surveys areas as described in Appendix A, Radiological Summary Table.

3.2 Survey Instructions

Survey instructions **SHALL** be documented in individual survey packages for each survey area. Survey packages are prepared prior to the performance of RLC surveys, and **SHALL** contain the instructions, survey maps, and other necessary information to direct the performance of surveys. The survey instructions **SHALL** specify the minimum number, type and location of required survey measurements, and the amount of surface area contained within each survey area. Survey instructions **SHALL** be specified on established forms and placed in the survey package.

The preparation of a survey package is a dynamic and interactive process. As a result, flexibility is required to permit survey personnel and supervision to resolve the various situations that may arise. To ensure data collection is optimized, all survey areas **SHALL** be walked down as a part of the survey package development. Copies of all survey data collected during the performance of the RLC survey **SHALL** be included in the respective survey package.

3.2.1 Measurement Locations

Measurement locations **SHALL** be identified to provide a method of referencing survey results to survey area locations. RLC measurement locations should be identified on the facility surfaces using self-adhesive labels, or equivalent. The labels, or equivalent, should be annotated with the corresponding survey map reference location number. Since PDS measurement locations will also be identified on the facility surfaces using self-adhesive labels, or equivalent, the RLC labels should be unique relative to the PDS labels (e.g., different colored labels).

RLC survey measurement locations **SHALL** be uniformly distributed throughout the survey area. Additional biased survey measurement locations, above the minimum required measurements, may be selected based on RE judgement. Biased survey measurement locations should be determined based on unusual appearance, relative locations to high contamination areas, high potential for residual activity, or general supplemental information that may warrant additional characterization measurements.

3.2.2 Survey Maps

Survey maps **SHALL** be used to define the boundaries of survey areas and to document measurement locations. Survey maps should be prepared for specific survey areas to identify structures, systems or equipment. RLC survey maps do not need to be scaled, nor do grid overlays need to be used.

A unique reference location number **SHALL** identify survey measurement locations on survey maps. The numbering convention will allow the survey data to be easily referenced to survey points identified on the survey maps.

3.2.3 Surface Scans

Scanning surveys **SHALL** be performed to screen areas to search for areas above the average release limits ($DCGL_w$) and to detect localized areas above the maximum release limit ($DCGL_{EMC}$). The scanning methods utilized (instrument and survey technique) **SHALL** be designed to detect at, or below, the derived activity guideline level elevated measurement concentration ($DCGL_{EMC}$) values. If an area of elevated activity ($> DCGL_{EMC}$ or applicable action level) is identified during the scan of a survey area, the location **SHALL** be marked and surface activity measurements for removable and total activity **SHALL** be collected at that location in addition to the prescribed set of uniformly distributed measurements for the survey area (per PRO-475-RSP-16.01, *Radiological Survey/Sampling Package Design, Preparation, Control, Implementation and Closure*).

Automated surface contamination monitors (SCMs) may be utilized for scanning surveys (in lieu of conventional instruments), provided the detection sensitivity does not exceed the $DCGL_{EMC}$.

The minimum scan requirements are defined in Appendix A.

3.2.4 Surface Activity Measurements

Surface activity measurements **SHALL** be taken at measurement locations based upon current radiological postings of the area and the size of the area being surveyed. Specific guidance regarding the location and number of measurements **SHALL** be provided in survey package instructions. The set of surface activity measurements **SHALL** consist of total and removable measurements, at each measurement location. Instruments utilized for the detection of total and removable surface activity **SHALL** have a minimum detectable activity (MDA) no greater than the RLC $DCGL_w$ (although the target MDA will be 50% of the $DCGL_w$). Both positive and negative measurement results **SHALL** be recorded. If RLC surveys are being used for planning Type 1 Facility pre-demolition surveys, then actual RLC values (positive and negative) **SHALL** be recorded.

Measurements that are flagged as exceeding the associated action level or release criteria **SHALL** be verified by the cognizant radiological engineer to represent ACTUAL DOE-added contamination (versus naturally-occurring material or statistical anomalies) prior to the decision-making process.

Automated surface contamination monitors (SCMs) may be utilized for total surface activity surveys, provided the detection sensitivity does not exceed the DCGL_w (or target MDA of 50% of DCGL_w).

Refer to Appendix A for minimum total and removable surface activity measurement requirements.

3.2.5 Surface Media Sampling

Surface media samples (e.g., paint, flooring material, roofing material, sediment, etc.) **SHALL** be collected for analysis as part of biased sampling measurements if the historical assessment or data indicate that such samples are warranted. Such samples may be collected in drain receptacles, sumps, other catchments, crevices, and wherever contamination may have migrated and not have been detected. These samples **SHALL** be analyzed for alpha and beta-gamma emitting radionuclides. No minimum number of samples is required, however, the goal of media sampling during the RLC phase is to determine if contamination exists in media or underneath media, and the spatial distribution of the contamination. Sampling is NOT required if it has already been determined that the paint or surface media from the wall or area will be removed during D&D. The quantity and distribution of the media samples should be such that, if contamination above the RLC DCGL_w is not identified, then no further media sampling is required during the PDS phase. If media contamination is identified during the RLC phase, then additional media sampling may be warranted during the IPC phase. RE judgement **SHALL** be used to determine the number of biased samples and the sample locations for each survey area.

Before obtaining media samples, the sample location **SHALL** be surveyed for total and removable surface activity. If the surface contains removable contamination, then the surface **SHALL** be decontaminated prior to media sampling. After media samples are collected, the sample location **SHALL** be re-surveyed for total and removable surface activity. The results of the post-media sampling survey will assist in determining if contamination exists under the media. To perform a representative post-media sampling total surface activity survey, the size of the media sample should be at least as large as the detector probe face.

To reduce sampling analysis costs, samples from areas that have similar contamination potentials may be composited. For example: if three samples are taken on a wall that has the same contamination potential, then the three samples may be composited. Media samples from a high contamination potential floor should not be composited with a low contamination potential wall. Care should be used when evaluating which samples to composite to ensure the RLC DQOs are satisfied.

3.2.6 Volumetric Sampling

It is generally assumed that if there is no contamination on building surfaces, and there is no evidence of a potential route for the spread of contamination into subsurface media (e.g. cracks, crevices, etc.), then there is no reason to suspect volumetric contamination below the surface. It is also generally assumed that if contamination is found on building surfaces, contamination levels will be highest on the surface and decrease as surface material is removed. Therefore, it is not anticipated that volumetric samples will be routinely required during the RLC phase, however, there may be circumstances that are identified during the scoping characterization that may warrant volumetric sampling.

If a potential pathway for volumetric contamination exists, or if the historical assessment or data indicate that volumetric sampling is warranted, then volumetric samples (e.g., concrete or cinderblock core bore samples) **SHALL** be collected for analysis as part of biased sampling measurements. Such samples should be collected at areas where contamination may have migrated into base materials (below surface media), and should be designed to determine the extent and depth of contamination. For example, volumetric samples should be required in rooms that have a history of repeated, contaminated liquid spills and the surfaces are cracked. These samples **SHALL** be analyzed for alpha and beta-gamma emitting radionuclides. If volumetric samples are obtained, no minimum number of samples is required. RE judgement **SHALL** be used to determine the number of biased samples and the sample locations for each survey area.

To reduce sampling analysis costs, samples from areas that have similar contamination potentials may be composited, given that the sample design for composite samples must account for the fact that dilution can occur if excess "clean" material is composited with contaminated material. Specific volumetric media sampling instructions **SHALL** be provided in survey package instructions, as necessary.

4.0 CHEMICAL CHARACTERIZATION

The characterization practices outlined in Sections 4.1 through 4.5 are specifically designed to provide waste characterization and occupational hazard information in support of activities to facilitate RFETS building disposition. If data gaps involving the non-radiological contaminants addressed below are identified during the DQO process, characterization **SHALL** be conducted per this RLCP. Characterization **SHALL** address all potential hazardous wastes and hazardous substances pursuant to the decision rules specified in Section 2.5, even though only the most common contaminants are addressed below.

To protect the health and safety of sampling and analysis team members, all sampling **SHALL** undergo a Job Hazard Analysis (JHA). These analyses, conducted by Industrial Hygiene (IH), outline potential hazards involved with sampling activities, describe proper Personal Protective Equipment (PPE), and outline safety precautions to be utilized during the specified sampling activities. Additionally, a structural engineer **SHALL** be consulted if there are any concerns about the structural integrity or stability of any building being characterized prior to entry or sampling. As necessary, the RE **SHALL** prepare an as low as reasonably achievable (ALARA) job review to direct this activity. All high contamination and airborne radioactivity areas **SHALL** be characterized using process knowledge and historical information.

Prior to planning of sampling and analysis, it is highly recommended that reviews of anticipated disposal sites be conducted so that the analytical data necessary to meet the receiving facility's disposal requirements are generated in one sampling event. In this fashion, sampling and analysis events would be minimized.

4.1 Lead and Other RCRA Metals

All materials, equipment, or media suspected of containing lead and/or other RCRA metals (e.g., construction materials such as shielding, and surfaces potentially containing residue from metal chemical processes, treatment, or spills) **SHALL** be managed as hazardous waste, unless either process knowledge or analytical data establish that the materials are not hazardous waste. Samples of paint chips, concrete, wall-board and other materials may be taken as necessary to support waste characterization or IH concerns.

Historical data such as the Waste and Environmental Management System, Waste Stream and Residue Identification and Characterization (WSRIC) reports, maintenance records, blueprints, as-built drawings, specifications, and emergency response documents **SHALL** be consulted to determine if processes involving RCRA metals have been conducted in the area being characterized. If so, specific packages **SHALL** be developed for sampling to determine whether contamination occurred.

In general, porous materials in contact with RCRA-listed or -characteristic waste or with hazardous material **SHALL** be subjected to total and/or Toxicity Characteristic Leaching Procedure (TCLP) analysis. For example, processes involving metal-based oxidants for

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control of algal and fungal growth (e.g., hexavalent chromium compounds) may have been conducted in water holding tanks or treatment facilities. If no information is available about levels of potential residues, then a minimum of three samples of media potentially in contact with the metal contaminant plus a duplicate **SHALL** be taken for TCLP analysis. Scrap metal bound for recycling will generally not be sampled since they are not subject to RCRA limits. However, sampling may be conducted to obtain information for worker protection prior to D&D operations (e.g., torch cutting of pipes). If materials are located in a RCRA unit and will be included under RCRA closure activities, they will be characterized under a RCRA closure plan and subject to RCRA performance standards. In some circumstances, such as for IH requirements, identification of RCRA-listed constituents, or determination of underlying hazardous constituents under RCRA, a total metals analysis may be performed on media to provide characterization information.

4.1.1 Sample Types and Locations

A physical tour of each building **SHALL** be conducted, entering every accessible area and room that is not a high contamination or airborne radioactivity area, looking for suspect (or affected) materials that may indicate through historical data or based on the inspector's experience, the presence of lead or other RCRA metals. A suspect list **SHALL** be generated, along with estimated quantities. Generic types of materials potentially containing lead and other RCRA metals include but are not limited to the following:

- paints and coatings, characterized by color, texture, and luster
- gloveboxes and associated shielding equipment
- piping
- solder joints for piping and electrical components
- plates, bars, brackets, and shields
- lead fills in walls
- skirting
- additives (e.g., in plaster)
- areas in which chemical processes, treatment, or storage involving metals or metal compounds are known or suspected to have taken place (e.g., hexavalent chromium treatment).

Bulk lead is expected to be a common form of lead generated during D&D efforts. In general, TCLP analysis of lead in this form yields a result greater than the 5.0 mg/L regulatory level listed under 6 CCR 1007-3, Part 261, and the lead must be treated as RCRA waste under hazardous waste number D008. Sampling and TCLP analysis of this form of waste stream is considered excessive for purposes of designating the waste as hazardous, based on reliable process knowledge that indicates the waste is hazardous. As a result no sampling of the bulk lead is necessary for determination of the related waste as hazardous.

For media other than paint or coatings where lead or metals contamination is suspected based on color, age, or other characteristics, core or grab samples **SHALL** be taken for TCLP analysis by a method described in the *Bulk Solids and Liquids Characterization Procedure* (PRO-488-BLCR) or the *Metals and PCB Characterization Procedure* (PRO-487-MPCR). A minimum of three samples plus a duplicate **SHALL** be taken. The decision to take judgement samples or random samples will be made by the field manager and the subject matter expert (SME) involved with the project. The locations of the random samples **SHALL** be determined by generation of a grid as described below in Section 4.3.1.

Alternatively, a representative sample that is a physical average of the entire batch **SHALL** be subjected to TCLP analysis, and the resultant value compared to the regulatory level given by 6 CCR 1007-3, Part 261.

Dust sampling **SHALL** be required in areas where surfaces coated with lead-based paint are severely cracked or deteriorated, or a significant hazard of worker exposure to lead-containing dust exists, as determined by the IH. A minimum of three samples and a duplicate **SHALL** be taken. The decision to take biased samples or random samples will be made by the field manager and SME involved in the project. The locations of the random samples **SHALL** be determined by generation of a grid as described below in Section 5.3.1.

Lead exposure potentials may become acute during stripout. For example, when metal pipes or shielding must be cut or torched, or where paint is removed, additional sampling will be required to provide appropriate data for purposes of worker safety and waste characterization.

Special considerations for lead paints and coatings

RFETS has determined, using process knowledge and site-specific analytical measurements, that painted surfaces, including floors, walls and ceilings, in most areas have metal concentrations below the toxicity characteristic values stipulated in 6 CCR 1007-3, Part 261, and therefore do not require sampling (*Environmental Waste Compliance Guidance No. 27, Lead Based Paint (LBP) and LBP Debris Disposal*). However, painted surfaces in high contamination areas (HCAs) may exceed the toxicity characteristic values and **SHALL** be managed as hazardous waste unless verifying analytical data are obtained. For HCA sampling, each surface with a different paint type (as categorized by color, texture and lustre) **SHALL** have two samples taken by the method described in the *Metals and PCB Characterization Procedure* (PRO-487-MPCR), with the second sample considered a duplicate for evaluation of overall project precision.

Sampling of lead levels in paints and settled dust may be required for assessment of IH issues, such as work practices, engineering controls, and decisions on PPE. This is particularly important in areas where lead-coated surfaces are to be scraped, scabbled, torched, or otherwise disturbed in such a way as to cause lead particles or dust to potentially become airborne. In addition to lead-based paint, zinc-based rust inhibitors

applied to steel I-beams also contain lead, and may be a source of potential airborne lead during decommissioning, removal, or demolition of structures. In all cases, the Project Manager, with IH support as needed, **SHALL** ensure that all requirements in the Occupation Safety and Health Administration (OSHA) Lead Standard (29 CFR 1926.62) for lead measurements and worker safety are met in these instances.

Paints may also need to be sampled and analyzed to determine how to manage scabbled paint residues (e.g., as hazardous waste).

4.1.2 Sampling Methodologies

All samples **SHALL** be collected by the method appropriate to the type and location of the suspected metal contamination, as described in the Metals and PCB Characterization Procedure. When TCLP is used, EPA SW-846, Method 1311 **SHALL** be employed for sample preparation. EPA SW-846 specifies details and methods for the determination of lead and other metals, including cadmium, chromium, zinc and arsenic, in solids. These sampling procedures include:

- **Coring.** Coring will be the preferred method for bulk sampling. Coring techniques are described in the Bulk Solids and Liquids Characterization Procedure (PRO-488-BLCR), and are based upon American Society for Testing and Materials (ASTM) Method E1729-95, "Standard Practice for Field Collection of Dry Paint Samples for Lead Determination by Atomic Spectrometry."
- **Paint chip analysis.** The technique for removal of paint chips utilizing a chisel, putty knife, blade, etc., is described in the Metals and PCB Characterization Procedure (PRO-487-MPCR), and is based upon American Society for Testing and Materials (ASTM) Method E1729-95, "Standard Practice for Field Collection of Dry Paint Samples for Lead Determination by Atomic Spectrometry".

Each sample **SHALL** be described in the sampling log with respect to location, sample source (i.e., floor, table, glovebox, etc.), and paint color, if applicable, in such a way that it is uniquely identified for follow-up sampling if needed.

4.2 VOCs and SVOCs

Volatile organic compound (VOC) and semi-volatile organic compound (SVOC) contamination, if present, is expected to be confined to localized areas surrounding locations where such chemicals were used, stored or spilled, particularly in enclosed spaces, or absorbed into porous media. Even though the contaminants are by definition volatile, they may remain present in porous media for a significant length of time, particularly if the surface has been painted or if other activities have taken place which might impede volatilization and dispersal.

Historical records **SHALL** be consulted to discover whether use or storage of VOCs/SVOCs occurred in the building, which specific VOCs/SVOCs were used, where within the building these activities took place, and whether spills have been recorded or suspected. A physical tour of the building **SHALL** be carried out, entering every

physically accessible area and room that is not a high contamination or airborne radioactivity area, and noting areas suspected of VOC/SVOC contamination. A list **SHALL** be generated, along with an estimate of the size of the area likely to be involved.

Several VOCs are classified as listed or characteristic wastes under RCRA. If characteristic contaminants are suspected, intrusive samples **SHALL** be conducted as described for TCLP analysis. If wastes are suspected to contain a listed VOC or SVOC, or if land disposal restrictions (LDRs) must be addressed, intrusive samples **SHALL** be collected for total analysis.

4.2.1 Sample Types and Locations

During the physical tour of the building, particular attention **SHALL** be paid to storage cabinets, enclosed spaces, tanks, equipment or pipes likely to contain solvents and areas of staining on the floor, particularly on porous surfaces into which VOCs/SVOCs may have penetrated. If leaking containers are present, the identity of their contents **SHALL** be noted, and an estimate of the volume of the spill **SHALL** be made if possible.

Suspect areas and materials may be screened with a photoionization detector and flame ionization detector (PID/FID) for detectable organic vapor concentrations, operated in accordance with Procedure F0.15, *Photoionization Detectors and Flame Ionization Detectors*. It is important to note that PID/FID do not detect all VOCs/SVOCs. In cases that require opening an enclosed space, vat, pipe, or piece of equipment, IH **SHALL** ensure that proper safety precautions are met to avoid worker exposure, asphyxiation danger, or fire/explosion hazard.

If VOC/SVOC contamination is deemed likely, an investigation of historical records and process knowledge **SHALL** be undertaken to determine the likelihood that the contaminant is a RCRA listed or characteristic material. If the identity of the contaminant cannot be definitely established as a RCRA listed or characteristic material, or if RCRA listed or characteristic materials are found to have been used or stored in the area, sampling **SHALL** be undertaken as in Section 4.2.2. For spills on porous materials, core or grab samples **SHALL** be taken for either total or TCLP analysis (as appropriate depending upon whether the suspect spill is a listed or characteristic waste, respectively) by a method described in the *Bulk Solids and Liquids Characterization Procedure* (PRO-488-BLCR). A minimum of three samples and a duplicate **SHALL** be taken. The decision to take biased samples or random samples will be made by the field manager and the SME involved in the project. The locations of the random samples **SHALL** be determined by generation of a grid as described below in Section 4.3.1.

Alternatively, a representative sample **SHALL** be subjected to TCLP or total analysis, and the resultant value compared to the regulatory level given by 6 CCR 1007-3, Part 261.

4.2.2 Sampling and Analysis Methodologies

For spills on porous materials, a minimum of three intrusive samples and a duplicate **SHALL** be taken by a method appropriate to the medium upon which the spill has occurred. For liquids, a sample representative of the liquid **SHALL** be taken. For spills upon non-porous materials, an appropriate sampling procedure **SHALL** be developed and implemented, based on the specific situation, under IH supervision. Due to potential risks of flammability and explosion, IH **SHALL** determine proper safety precautions. Sampling **SHALL** be carried out by a method described in the Bulk Solids and Liquids Characterization Procedure, PRO-488-BLCR.

When TCLP is used, the EPA SW-1311 preparation method **SHALL** be employed. Samples **SHALL** be analyzed according to the EPA SW-846 Method 8260B for total VOCs, Method 8270C for total SVOCs, or industry-proven equivalent methods.

4.3 Beryllium

All facilities **SHALL** be evaluated for potential beryllium (Be) contamination. The evaluation will be based on historical and process knowledge, and sampling and analysis as necessary.

Historical records **SHALL** be consulted to determine whether Be activities or storage are known to have occurred at the building being characterized and, if so, in which rooms or areas activities or storage took place. This determination **SHALL** include consulting the Location of Known Beryllium Areas (LKBA) and the Chronic Beryllium Disease Prevention Program (CBDPP). The LKBA does not specifically address locations of beryllium storage. For example, when beryllium materials were consolidated for removal from Bldg. 779, beryllium materials were found in 16 rooms not previously identified. It is also important to consider proximity to buildings that may be Be contaminated, nearby individual hazardous substance sites (IHSSs) that may contain Be, and possible cross-contamination from contaminated workers. The CBDPP surveys have included the following:

- Random, statistically-based surface contamination surveys of readily accessible surfaces;
- Biased surface contamination surveys of readily accessible surfaces in rooms where beryllium activities are known to have occurred; and
- Breathing zone air samples in areas known or suspected to have Be surface contamination levels in excess of $0.2 \mu\text{g}/100 \text{ cm}^2$.

The CBDPP surveys historically did NOT address less accessible surfaces important for D&D considerations, such as horizontal surfaces of ductwork and hoods, light fixtures, rafters, ledges, and other surfaces not readily accessible to traffic and cleaning (e.g., between equipment). Because workers may be exposed to airborne Be during stripout of these surfaces and because data are needed for characterization, further Be swipe samples **SHALL** be taken as necessary to adequately characterize all surfaces.

RFETS has determined, using process knowledge, that the majority of beryllium (Be) dust, particles, scrap, and other products of Be metal processing carried out at RFETS do not meet the criteria for a RCRA hazardous waste. However, some Be powder in the form of a product of a chemical process (P015 listed under RCRA) was used on-site. If it can be proven and documented through historical records and process knowledge that a material is in fact contaminated with this P-listed form, the material **SHALL** be considered hazardous waste.

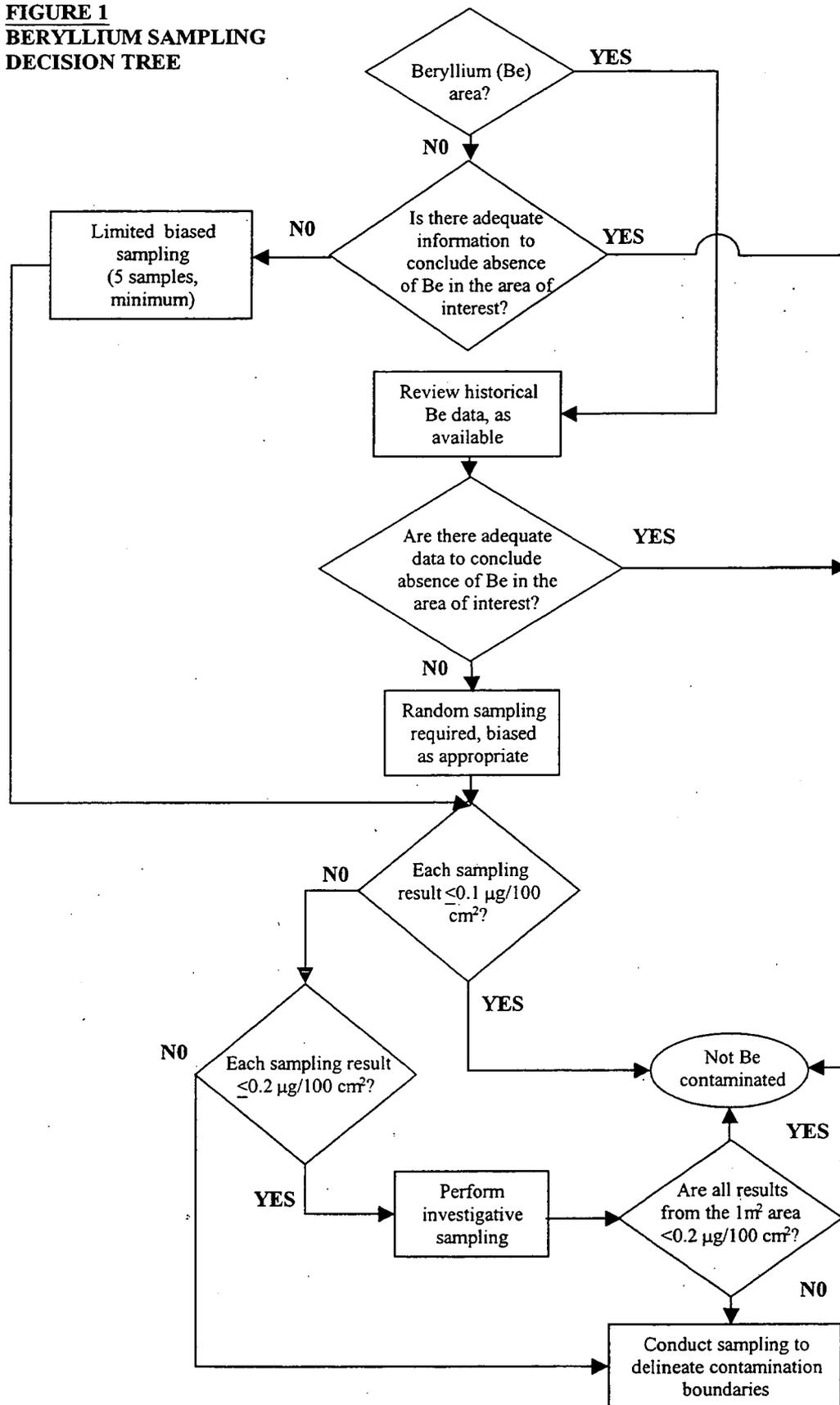
4.3.1 Sample Types, Quantities and Methodologies

Consistent with the DOE graded-approach, buildings or rooms within buildings with a higher probability of contamination will have a higher number of samples taken within them, whereas buildings or rooms with less risk will have correspondingly fewer samples taken. The decision tree for Be sampling is shown in Figure 1, Beryllium Sampling Decision Tree. The sample requirements will depend on whether the area of interest is a beryllium area (i.e., Beryllium-Regulated Areas, Beryllium-Contaminated Areas, Beryllium Contamination within Internal Systems, or areas of known historical beryllium activity) or not.

If an area of interest is not within a beryllium area, as defined above, it must have adequate supporting historical/process knowledge before the area is concluded as not (Be) contaminated. A minimum of five (5) judgemental (biased) samples (smears), per area of interest, **SHALL** be acquired to characterize the area or building. Areas with the highest potential for Be contamination, which would serve as suitable locations for biased samples, include but are not limited to:

- Around or on equipment that could have processed Be;
- Areas where Be waste could have been placed in containers, repacked, or bagged out;
- Ventilation dead zones where settling of airborne materials could have occurred (e.g., horizontal surfaces of ductwork and hoods, light fixtures, rafters, and high ledges);
- Areas along room exhaust paths including in front of room air exhaust filters;
- Areas that are hidden or difficult to access and not normally cleaned, particularly areas between walls and equipment; and
- Traffic areas traversed by Be workers.

FIGURE 1
BERYLLIUM SAMPLING
DECISION TREE



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Beryllium areas or areas that were historically designated as beryllium areas must also have adequate analytical data to support conclusions of no beryllium contamination. If historical data are not adequate, random sampling **SHALL** be conducted. Biased samples may be taken based on IH discretion..

The sampling technique **SHALL** depend upon the nature of the surface to be surveyed. Non-porous surfaces **SHALL** be sampled by swipe surveys as described in the Beryllium Characterization Procedure (PRO-536-BCPR). An area of 100 cm^2 **SHALL** be swiped using Whatman 41 filter papers or equivalent. The filter paper **SHALL** then be placed in a glassine bag. The surface sample number **SHALL** be written on the bag. Porous surfaces **SHALL** be sampled using a micro-vac technique as described in the Beryllium Characterization Procedure (PRO-536-BCPR). The sampling tool **SHALL** be a battery- powered air sampling pump with a 25 mm mixed cellulose ester filter media cassette attached. A section of Tygon tubing **SHALL** be attached to the upstream side of the cassette and facilitate pickup of all loose dust in the grid area. Each sample **SHALL** be documented as to location, and the cassette **SHALL** be labeled with an identifying number and sealed.

Intrusive media sampling (i.e., coring, scraping, etc.) for Be is not necessary unless the contamination is suspected to be a constituent of the material's matrix.

The sample number **SHALL** be documented on the chain-of-custody form. The sample location may be photographed with a sample photo identification card in the focus area documenting the sample number and date, and orienting the viewer to the sample location with an arrow.

Media potentially contaminated with beryllium **SHALL** be characterized using process knowledge and/or chemical analysis of smear samples. Samples **SHALL** be analyzed by EPA SW-846 methods (6010B, with total digestion by 3052, 3050B, or 3051 depending upon the matrix) or equivalent, such as OSHA Method ID-125G for flame atomic absorption spectroscopy, or OSHA Method 125-G for inductively coupled plasma spectroscopy. The PQL will be less than or equal to one half the beryllium investigation level of $0.1 \mu\text{g}/100 \text{ cm}^2$, i.e., less than $0.05 \mu\text{g}/100 \text{ cm}^2$.

If any single measurement equals or exceeds the investigation level of $0.1 \mu\text{g}/100 \text{ cm}^2$, but does not exceed $0.2 \mu\text{g}/100 \text{ cm}^2$, then a minimum of four additional biased measurements **SHALL** be acquired to characterize the area of interest. All measurements **SHALL** be compared with the unrestricted release level of $0.2 \mu\text{g}/100 \text{ cm}^2$. This allows for additional sampling at the discretion of sampling personnel to better define the potential for contamination. As an example, if more than one measurement exceeds the investigation level, then more than four additional biased measurements **SHALL** be acquired. If all measurements are less than the unrestricted release level, the area is considered non-beryllium contaminated. If any measurement exceeds the unrestricted release limit of $0.2 \mu\text{g}/100 \text{ cm}^2$, further sampling **SHALL** be required to define the boundaries of contamination.

4.3.2 Statistical Basis for Random Samples

Given the sample size determined for a room, a set of randomly generated coordinates **SHALL** be used to locate each sample in the room. Coordinates **SHALL** be generated before sampling activities commence. Samples **SHALL** be taken in the indicated area on the horizontal surface(s) where Be could have settled. In instances where a sample location falls in an area containing equipment, the outer surfaces of equipment and the floor **SHALL** be sampled (if the floor is accessible). Equipment is defined as tables, pipes, light fixtures, glovebox tops, file cabinets, drums, crates, and other process equipment. Each sample taken at a location **SHALL** be described in the sampling log with respect to both location and sample source (i.e., floor, table, glovebox, etc.) in such a way that it is uniquely identified for follow-up sampling if needed.

The total number of samples **SHALL** be determined by the size of the area. One sample **SHALL** be collected for every 100 square feet up to 1,000 square feet (or ten samples). No matter how small the room is, a minimum of five random samples **SHALL** be collected. An additional sample **SHALL** be collected for every additional 200 square feet over 1,000 square feet up to 5,000 square feet total, and then one additional sample for every 500 square feet with a maximum of 75 samples per area. For example, in a room with 200 square feet, 5 random samples **SHALL** be collected.

4.4 Polychlorinated Biphenyls (PCBs)

Historical data such as maintenance records, specifications, and emergency response documents **SHALL** be consulted to determine if PCBs or potentially PCB-containing substances were used in the area being characterized. Particular attention **SHALL** be paid to records of spills.

A physical tour of the building, entering every accessible area and room that is not a high contamination or airborne radioactivity area, **SHALL** be undertaken, and any equipment potentially containing PCBs (e.g., electrical and hydraulic such as PCB-containing ballasts in fluorescent lighting) and any evidence of spills or staining associated with the equipment **SHALL** be noted. A list **SHALL** be generated, along with estimated quantities. All painted surfaces **SHALL** be noted, including the color of paint and age of the facility to determine if surfaces are subject to regulations governing PCBs (i.e., PCBs were not used after 1978). IH **SHALL** evaluate individually any situation involving sampling of PCBs or potential PCB-containing materials and **SHALL** ensure that proper worker protection is achieved.

4.4.1 Sample Types and Locations

Decisions as to whether sampling of various materials is required **SHALL** be based in part on the designated waste stream, in addition to IH concerns regarding worker safety. Federal regulations regarding characterization of a potential PCB waste stream are complex and are governed by the classification of the waste. A building walkdown **SHALL** be conducted to assess types of materials potentially containing PCBs, which include but are not limited to the following:

- Hydraulic fluid
- Oils
- Transformers
- Capacitors
- Fluorescent light ballasts
- Gaskets in potential PCB-containing systems
- Paints, coatings, and sealants
- Areas of a known or suspected PCB spill, or staining near a PCB-containing system.

Following the building walkdown, PCBs **SHALL** be categorized into the classifications outlined in subsequent sections. Where doubt exists as to the potential classification of a type of PCB-containing material, 40 CFR 761 should be consulted directly.

4.4.1.1 PCB Bulk Product Waste

Some materials may be classified as PCB Bulk Product Waste, which is defined by 40 CFR 761.3 as waste derived from manufactured products containing PCBs in a non-liquid state and at a concentration at time of designation for disposal of greater than or equal to 50 ppm. These materials need not be sampled as long as restrictions regarding their disposal are met, as outlined in 40 CFR 761.62. These materials and restrictions include but are not limited to:

- Applied dried paints, coatings, and sealants. These may be disposed of at a facility that is permitted, licensed or registered by a State to manage municipal solid waste subject to 40 CFR 258, or non-municipal, non-hazardous waste subject to 40 CFR 257.5 through 257.30.
- Fluorescent light ballasts containing PCBs in the potting material are segregated from those that do not, and both types of ballasts are sent offsite for recycling.

If some construction debris (e.g., concrete) is to be recycled on-site, the paint on the material **SHALL** be sampled and analyzed to determine if the material is subject to regulations governing PCB bulk product waste.

4.4.1.2 PCB Remediation Waste

Buildings where PCB use occurred, but for which there are adequate inspection records, operational records, and administrative records that indicate no PCB spill has occurred, or if such did occur, was cleaned up to meet standards in 40 CFR 761, need not be sampled. In situations for which adequate information does not exist, a small-scale survey **SHALL** be performed, with three biased samples and a duplicate taken at locations biased toward probable contamination areas.

If such surveys indicate PCB contamination, or if a PCB spill is discovered that has not been cleaned up, the area **SHALL** be treated as directed by 40 CFR 761. Management strategy for PCB remediation waste **SHALL** be determined on a case-by-case basis in consultation with the LRA and EPA.

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Process knowledge and historical documentation are vital for this process, since decision thresholds vary depending upon the date of the spill. For example, the criteria for PCB remediation waste (i.e., potentially containing PCBs from historical releases; defined by 40 CFR 761.3), include:

- Materials where the original source was ≥ 500 ppm PCB beginning on April 18, 1978, or ≥ 50 ppm PCB beginning on July 2, 1979;
- Materials disposed of prior to April 18, 1978, that are currently ≥ 50 ppm PCBs regardless of the concentration of the original spill.

Sampling of the area may include application of the Midwest Research Institute grid procedure described in *Verification of PCB Spill Cleanup by Sampling and Analysis* (EPA-560/5-85-026) and *Field Manual for Grid Sampling of PCB Spill Sites to Verify Cleanup* (EPA-560/5-86-017).

The number of samples required by the Midwest Research Institute grid procedure depends upon the size of the spill area, and the documents above should be consulted for exact requirements concerning hexagonal grid designs, layout for irregularly shaped areas, number and spacing of samples, etc. In general, for a sampling area of < 50 ft², 7 samples are required; for 51 to 400 ft², 19 samples are required; and for > 400 ft², 37 samples are required.

Additionally, for purposes of decontamination or removal, PCB remediation waste **SHALL** be further categorized into: non-porous surfaces, porous surfaces, liquid, and bulk PCB remediation waste (which includes soil and sludge and is not to be confused with PCB bulk product waste), as per 40 CFR 761.61.

4.4.1.3 PCB Items

A PCB Item is defined as any PCB Article, PCB Article Container, PCB Container, PCB Equipment, or anything that deliberately or unintentionally contains or has as a part of it any PCBs, and includes transformers and capacitors. If encountered during PDS, these items **SHALL** be characterized prior to removal based upon the PCB content detected in the dielectric fluid, or on surface swipes, or by process knowledge.

4.4.1.4 Other PCB Wastes

While less likely to be encountered during PDS, other classes of PCB waste exist and **SHALL** be recognized if encountered, for example:

- PCB liquids include PCB-containing transformer oils and hydraulic oils. If encountered, the PCB concentration **SHALL** be determined prior to disposal per 40 CFR 761.50 and 761.60.
- PCB radioactive waste refers to PCBs that also contain source, special nuclear, or byproduct material subject to regulation under the Atomic Energy Act of 1954, as

amended, or naturally-occurring or accelerator-produced radioactive material. This waste **SHALL** be managed in accordance with 40 CFR 761 per the requirements of the specific category of radioactive waste.

4.4.2 Sampling and Analysis Methodologies

The following sampling techniques **SHALL** generally be applied to PCB sampling, subject to stipulations in 40 CFR 761. The EPA documents *Verification of PCB Spill Cleanup by Sampling and Analysis* (EPA-560/5-85-026) and *Field Manual for Grid Sampling of PCB Spill Sites to Verify Cleanup* (EPA-560/5-86-017) should be consulted in detail before any sampling begins. A subject matter expert should be consulted before any PCB sampling is initiated.

In general, the following standards apply to PCB media sampling:

- For non-porous surfaces, wipe sampling will be carried out as described in the *Metals and PCB Characterization Procedure* (PRO-487-MPCR).
- For porous surfaces into which a PCB spill could migrate, sampling will be carried out as described in the *Metals and PCB Characterization Procedure* (PRO-487-MPCR).

To assess material/media against the appropriate regulatory threshold for PCB-contaminated media (40 CFR 761.125), a laboratory method will be used to quantify PCB concentrations. The SW-846 analytical Method 4020 *Screening for PCBs by Immunoassay* is appropriate for non-aqueous liquids (or soils), whereas Method 8082 *PCBs by Gas Chromatography* is recommended under other circumstances.

The analytical method **SHALL** have a practical quantitation limit (PQL) of less than 50% of the regulatory threshold which applies to the particular type of waste. Methods 4020 and 8082 satisfy this criterion.

4.5 Asbestos

All surfacing material and thermal insulation materials potentially containing asbestos **SHALL** be sampled for asbestos per 40 CFR 763.86 and 5 CCR 1001-10 by a Certified Asbestos Inspector. The presence of asbestos (i.e., greater than 1% by volume) **SHALL** be determined by a certified laboratory with asbestos accreditation (NIST and NVLAP) using Method EPA 600/R-93/116. Point counting will be required when polarized light microscopy (PLM) results on asbestos range between 0 and 1%. All analytical and quality specifications are specified in RFETS Analytical Services Division contractual statements of work for laboratories.

Building records (e.g., blueprints and specifications) will be consulted to document use of asbestos in construction or remodeling of the building under characterization. Maintenance and asbestos abatement records, blueprints, as-built drawings, specifications, and emergency response documents are examples of the data used.

A physical tour of the building, entering every accessible area and room that is not a high contamination or airborne radioactivity area, **SHALL** be undertaken, and notation made of suspect or affected materials that indicate through either historical data or the asbestos inspector's experience the presence of asbestos in building materials. A list **SHALL** be generated that includes estimated quantities. A Certified Asbestos Inspector may assume that a material is asbestos until proven otherwise.

4.5.1 Sample Types and Locations

Sample locations **SHALL** be selected randomly according to how each represents a homogeneous material. Since homogeneous areas are located throughout the building, the representation and number of samples is the driving factor rather than the exact location of the sample in each room. The generic categories of materials to be sampled for asbestos are listed below:

- Thermal systems (e.g., pipe insulation)
- Walls (that may be transite)
- Surfacing materials (e.g., fireproofing, ceiling texture, mastic, and caulking)
- Miscellaneous (e.g., floor tiles, ceiling panels).

Non-suspect (or unaffected) materials are those traditionally made of wood, glass or metal. However, the inspector **SHALL** suspect the adhesives that have been applied to secure non-suspect materials to the substrate.

The number of asbestos samples to be collected for each homogeneous area is outlined in EPA 40 CFR 763.86. This section of the Asbestos Hazard Emergency Response Act (AHERA) provides requirements for asbestos building inspections. Sample quantity **SHALL** be decided first by a material's physical condition of friability, then by its general category. Friable materials are those that are capable of being crumbled or reduced to powder by hand pressure.

Thermal systems insulation, such as that found on pipes or ducts, friable or non-friable, requires a minimum of three samples per homogeneous area, one sample from patches less than six linear or square feet (lf or ft²), and one from cementitious or "mudded" fittings. Each mechanical system, such as hot and cold domestic water, may have several homogeneous areas. Each **SHALL** be sampled accordingly.

Only friable surfacing materials, such as fire-proofing or ceiling texture, **SHALL** have a nine-section grid applied to a blueprint of the area, and samples **SHALL** be acquired from the center of randomly selected grids. If the homogeneous area of friable surfacing material is less than 1,000 ft², three samples are needed; if between 1,000 and 5,000 ft², five samples are needed; and if the area is over 5,000 ft², seven samples are needed. Grid spacing is only required for friable surfacing materials, which may include drywall joint compound if suspected by the inspector.

Miscellaneous materials, such as floor and ceiling tiles or cementitious board ("Transite") will be sampled according to the inspector's discretion, as outlined in 40

CFR 763.86 (c&d). For the purpose of this survey and based on the inspector's experience and discretion, a minimum of one sample of each suspected material in this category **SHALL** be acquired.

Sampling for asbestos in building materials is a destructive method that may release a small quantity of dust. Although material samples are to be collected from inconspicuous areas, proper safety precautions **SHALL** be taken to prevent the spread of suspect materials.

Settled dust sampling for asbestos will be used as an optional aid to assessment of IH issues such as work practices, engineering controls, and PPE that would be used in the decommissioning, removal or demolition of structures.

4.5.2 Sampling Methodologies

Bulk sampling for asbestos **SHALL** be performed as described in the *Asbestos Characterization Procedure* (PRO-563-ACPR) using destructive techniques, and requires the acquisition of a representative sample of the material down to the substrate. Each sample **SHALL** contain a minimum of one cubic centimeter of material to facilitate analysis and archival processes. Each sample should be acquired with the intent of assuring the quality, representativeness and safety of the process.

For bulk sampling, a polyethylene drop cloth or plastic bag **SHALL** be placed below the elevated sample areas, and the immediate sample area **SHALL** be dampened with a mist of water and surfactant. A sampling tool, such as a hammer and chisel, razor knife, or hole saw is selected, and the sample is collected down to the level of the substrate. During this process, the immediate surface **SHALL** be misted as necessary.

The acquired sample **SHALL** be placed in a sealable container, the container **SHALL** be sealed, and a pre-numbered label **SHALL** be placed on the container. The sample number label **SHALL** be placed on chain-of-custody papers, and the container **SHALL** be verified to be sealed. The sampling tool **SHALL** be thoroughly cleaned using a mister and wipes per AHERA, and the sample area **SHALL** be patched as needed.

The description and location **SHALL** be documented on a form, a sample label **SHALL** be placed on the form, and the location **SHALL** be documented on a blueprint, sketch or drawing of the area. The sample container, drop cloth, and immediate sample area **SHALL** be wet wiped, and the drop cloth **SHALL** be carefully folded into the center and placed in a bag, and the bag **SHALL** be sealed.

In the case of routine maintenance areas, a pre-numbered label **SHALL** be placed at the sample location. Labels may be placed on all sample locations. The sample location may be photographed with a sample photo identification card in the focus area documenting the sample number and date, and orienting the viewer to the location with an arrow. All used wipes, drop cloths, and PPE **SHALL** be added to the appropriate waste stream.

Settled dust sampling on horizontal surfaces **SHALL** be sampled as described in the *Asbestos Characterization Procedure* (PRO-563-ACPR) using a micro-vac technique. The sampling tool is a low volume battery powered air sampling pump calibrated at >2 liters per minute with a 25 mm MCE filter media cassette attached. A two-inch section of Tygon tubing is attached to the upstream side of the cassette and facilitates pickup of all loose dust in the grid area. Each sample **SHALL** be documented as to location, and the cassette **SHALL** be labeled with an identifying number and sealed. The sample number **SHALL** be documented on the chain-of-custody form. As above, the sample location may be photographed with a sample photo identification card in the focus area documenting the sample number and date, and orienting the viewer to the sample location with an arrow.

5.0 RADIOLOGICAL FIELD INSTRUMENTATION

For RLC, existing site instrumentation and techniques can be used to achieve the DQOs. However, other instrumentation may be proposed and used if approved by D&D Closure Projects. All radiological instrumentation **SHALL** be approved for use by the Site Radiation Instrumentation, Source, Device Committee before being used.

5.1 Detector Descriptions

Portable instrument surveys **SHALL** be performed using existing site instruments. Alpha surveys will typically be performed with the NE Electra with a DP6-BD or DP8 dual scintillation probe, or equivalent. Efforts are underway to add a database capability to the existing instrumentation or to substitute instrumentation that will automatically record location and measurement data. Automatic recording instruments are to be used in lieu of manual recording of survey data whenever possible. Swipes for removable contamination will be counted on the Tennelec low level alpha-beta system or equivalent. Equivalency in all cases will be determined by D&D Radiological Engineering personnel and documented appropriately.

If information on isotope identification is necessary, *in situ* alpha or gamma spectroscopy may be performed, using existing instruments and procedures (e.g. NaI(Tl) detector (FIDLER or equivalent)). This characterization is to qualify the area for elimination of various isotopes.

5.2 Detection Sensitivities

Detectors **SHALL** be selected to provide a minimum detectable activity (MDA) less than the $DCGL_W$ (for total and removable surveys, and radiochemical samples) and $DCGL_{EMC}$ (for scan surveys). The target MDA will be 50% of the $DCGL_W$ (refer to Section 3.2.4).

5.3 Minimum Detectable Concentration (MDC) Calculations

The critical level, L_c , is the net response level, in counts, at which a detector output can be considered above background. The MDC, in units of activity for a given area or volume, is the net radioactivity above the critical level that an instrument can be expected to detect 95 percent of the time. This value **SHALL** be used to determine the detection capability of an instrument. The MDC should not be underestimated, since this can result in release of material that exceeds a release limit.

5.3.1 Direct Measurement MDCs

For contamination detection instruments, in a stationary mode (e.g., Eberline BC-4, SAC-4, NE Electra, etc.), the following equation **SHALL** be used to determine the minimum detectable concentration:

$$(1) \quad MDC = \frac{2.71 + 3.29 \sqrt{R_b t_g \left[1 + \left(\frac{t_g}{t_b} \right) \right]}}{eff t_g}$$

where MDC = minimum detectable concentration
 R_b = background count rate (cpm)
 t_g = gross count time (minutes)
 t_b = background count time (minutes)
 eff = efficiency (c/d)

5.3.2 Scan Measurement MDC for Beta-Gamma Surveys

For a given probe area (100 cm² for the DP6-BD probe), the MDA **SHALL** be based on the minimum detectable count rate (MDCR) and instrument, surface, and surveyor efficiencies.

$$(2) \quad MDCR = d' \sqrt{b_i} \left(\frac{60}{i} \right)$$

where: d' = sensitivity index based on a correct detection rate and tolerance for false positives. For a continuous scan, these values are 90 percent and 10 percent, respectively, and d' equals 2.65.

b_i = the average number of background counts in the observation interval, i.e., $b_i = b \left(\frac{i}{60} \right)$ and b = background for one minute

i = the time interval during which the source is under the active area of the probe. This is assumed to be 1 s.

$$(3) \quad \text{Scan MDC} = \frac{MDCR}{\sqrt{e_{hf}} \text{ eff} \left(\frac{A}{100} \right) c}$$

where: e_{hf} = human factors efficiency, assumed to be 0.65.
 eff = instrument efficiency
 A = probe area
 c = other conversion factors.

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5.3.3 Scanning for Alpha Emitters

Since the time a contaminated area is under a probe varies and the background count rate of alpha instruments is typically less than 1 cpm, it isn't practical to determine a fixed alpha MDA for scanning. Instead, the probability of detecting an area of contamination **SHALL** be determined for a given scan rate. This assumes that a single count will cause the surveyor to stop and investigate further.

$$(4) \quad P_{n \geq 1} = 1 - e^{-\frac{GE d}{60 v}}$$

where: P = probability of observing at least one count
 G = contamination activity, release limit in dpm
 E = detector efficiency (4π)
 d = width of detector in direction of scan in cm
 v = velocity of scan in cm/s.

Once a count is recorded and the guideline level of contamination is present, the surveyor **SHALL** stop and wait until the probability of getting another count is at least 90% (MARSSIM, p. 6-48). The time interval **SHALL** be calculated by MARSSIM Equation 6-13:

$$(5) \quad t = \frac{13,800}{CAE_T}$$

where: t = time period for static count (s)
 C = release criteria (dpm/100 cm²)
 A = physical probe area (cm²)
 E_T = total efficiency

Some instruments (e.g. portable proportional detectors) may have background count rates on the order of 5 to 10 cpm. Thus, it would not be practical to require a surveyor to respond to a single observed count. For these instruments, the probability of getting two or more counts **SHALL** be calculated by MARSSIM Equation 6-14:

$$(6) \quad P(n \geq 2) = 1 - \left(1 + \frac{(GE_T + B)t}{60} \right) \left(e^{-\frac{(GE_T + B)t}{60}} \right)$$

where: P(n≥2) = probability of getting 2 or more counts during the time interval t
 B = background count rate (cpm)

All other variables are the same as for MARSSIM Equation 6-12.

5.4 Calibration and Maintenance

Instrument calibration and maintenance is critical because it affects the sampling results. Calibration/maintenance frequency is often established by the equipment manufacturer.

Calibration procedures **SHALL** be used for each radiological instrument type and **SHALL** include frequency of calibration. Current site protocol for calibration frequency of field survey instruments is detector-specific, and is delineated in 3-PRO-112-RSP-02.01, *Radiological Instrumentation*.

5.4.1 Calibration

Radiological instrument calibrations **SHALL** meet the following criteria:

- Meets the requirements contained in ANSI N323 for radiological instrumentation calibration.
- Calibrations must use National Institute of Standards and Technology (NIST) traceable sources.
- Calibration procedures must be used for each radiological instrument type and will include frequency of calibration, pre-calibration requirements, primary calibration requirements, periodic performance test requirements, calibration record requirements, and maintenance requirements.
- Functional tests are to be used to assess instrumentation designs that include alarms or that involve a process control. Functional tests must test all components involved in an alarm or trip function and performed at least annually.
- In unusual and limited situations it may be necessary to use an instrument in an application other than that envisioned by the manufacturer. Special calibrations are to be performed for use of instrumentation outside manufacturer's specifications. In such cases, the instrument is to be adjusted, calibrated, and labeled to identify the special conditions and used only under the special conditions for which it was calibrated.
- Instruments are to bear a label or tag with the date of calibration and date calibration expires.

5.4.2 Maintenance

A program for preventive and corrective maintenance of radiological instrumentation **SHALL** be established and documented. Preventive and corrective maintenance **SHALL** be performed using components and procedural recommendations at least as stringent as those specified by the manufacturer of the instrument. Radiological instruments **SHALL** undergo calibration prior to use following any preventive or corrective maintenance or any adjustment that voids the previous calibration. A battery change is not normally considered maintenance.

5.4.3 Calibration Facilities

Calibration facilities **SHALL** perform inspections, calibrations, performance tests, calibration equipment selection, and quality assurance in accordance with the recommendations of ANSI N323 and take the following actions:

- Locate activities in a manner to minimize radiation exposure to operating personnel and to personnel in adjacent areas.
- Minimize sources of interference, such as backscatter and non-ionizing radiation, during the calibration of instrumentation, and correct for interference as necessary.
- Operate in accordance with the referenced standards.
- Generate records of calibration, functional tests, and maintenance in accordance with the referenced standards.

5.4.4 User Requirements

Users **SHALL** return instruments to the Instrument Repair and Calibration Facility if any of the following conditions exist:

- Instrument is due for calibration.
- Instrument is physically damaged.
- Instrument fails performance test or operational check.
- Instrument is malfunctioning or responding abnormally.
- Instrument requires maintenance beyond what is specified on the Instrument Technical Specification Sheet.

Users **SHALL** report in writing to the Instrument Repair and Calibration Facility any change in an instrument status such as:

- Instrument is disposed of, declared surplus, or declared excess.
- Instrument is lost or destroyed.

Instruments used for monitoring and contamination control **SHALL** be:

- Periodically maintained and calibrated on an established frequency of at least once per year.
- Appropriate for the type(s), levels, and energies of the radiation(s) encountered.
- Appropriate for the existing environmental conditions.
- Routinely tested for operability.

6.0 LABORATORY ANALYSIS

Analysis of RLC samples **SHALL** be performed by laboratories approved by the RFETS Analytical Services Division. Laboratories **SHALL** perform work pursuant to requirements presented in the RFETS Statement of Work (SOW) for Analytical Measurements. This SOW defines requirements for the analysis of various parameters, including radiochemical, organic and metal, in samples collected at or related to the site. The SOW is composed of several modules. The General Laboratory Requirements Module, GR01, provides general technical and administrative requirements common to all analyses performed for the site. The General Requirements for Electronic Data Deliverables Module, GR02, provides requirements for the electronic delivery of data. Other SOW modules provide parameter-specific analytical, quality assurance/quality control, reporting, and general requirements specific to stated analytical tasks.

Where possible, SOW modules incorporate industry standard methods and protocols by reference. In some cases, requirements in these referenced methods are augmented or clarified by SOW modules. Typical references include EPA Contract Laboratory Program Statements of Work, EPA Test Methods for Evaluating Solid Waste (SW-846; EPA 1986), EPA methods for wastewater monitoring, and ASTM methods.

7.0 DATA ANALYSIS AND QUALITY ASSESSMENT

Radiological data **SHALL** first be reduced to perform comparisons with radiological limits. The quality of this transformed data **SHALL** then be assessed to assure that the data can be used for the RLC.

There are three types of radiological surveys/samples that will be discussed in this section: removable surface contamination (RSC) surveys, total surface contamination (TSC) surveys and media samples. The text will explain how radiological survey results are transformed from a gross instrument count to a net activity that can be used for comparisons with radiological limits. For media samples, the method for transforming a gross laboratory result to a net concentration of radioactive material will be discussed. The use of background survey/sample results will also be discussed.

The radiological limits or DCGL_w (Derived Concentration Guideline Level) **SHALL** be delineated for both surface contamination surveys and media samples. The DCGL_w, which is the radiological limit in terms of dpm/100 cm² for average contamination levels, is the level below which areas are considered sanitary waste or may be free released. The DCGL_{EMC}, which is the radiological limit in terms of dpm/100 cm² for maximum contamination levels (applies to an area not more than 100 cm²), is the maximum level below which areas are considered sanitary waste or may be free released. Areas that result in measurements in excess of these levels **SHALL** be further evaluated during IPC.

Finally, methods for assessing the quality of the radiological sample data will be discussed. Methods on data validation, data verification, data quality indicators and data quality assessment will be discussed.

Data reduction and analysis of non-radiological data remains consistent with the DDCP; no additional requirements apply uniquely to RLC.

7.1 Conversion of Radiological Measurements to Reporting Units

Radiological survey/sample results **SHALL** be converted from a gross count to a net concentration for the purpose of comparing with radiological limits. For surface contamination surveys, the radiological limits are prescribed in dpm/100cm². For media samples, the radiological limits can be based on a surface contamination limit in dpm/100 cm², a volumetric limit based on the MDC of the counting instrument, or a volumetric limit based on the 95 % confidence limit of the background range, if applicable.

The data conversion for surface contamination (total and removable) measurements **SHALL** be performed in accordance with RSP 7.02. The data conversion for samples **SHALL** also be performed in accordance with an approved RSP (based on the equation provided in Section 7.1.3).

7.1.1 Removable Surface Contamination (RSC)

RSC results **SHALL** be compared with an RSC limit ($DCGL_w$) that has the units of $dpm/100\text{ cm}^2$. RSC **SHALL** be measured in the field using a swipe technique that assesses the amount of loose radiological contamination over a 100 cm^2 area. Swipes **SHALL** be counted for both alpha and beta-gamma-emitting radioactive material. The RSC net result **SHALL** be calculated per RSP 7.02.

7.1.2 Total Surface Contamination (TSC)

TSC results **SHALL** be compared with the TSC $DCGL_w$ (for square meter average) and $DCGL_{EMC}$ (for 100 cm^2 maximum) that has the units of $dpm/100\text{ cm}^2$. Total surface contamination **SHALL** be measured in the field using portable radiation detection instrumentation. The probe from this instrumentation **SHALL** be placed next to an area where radioactive material may be present. Both alpha and beta-gamma-emitting radioactive material may be counted by the instrumentation.

The local area background (LAB) **SHALL** be subtracted from the instrument gross count rate. This subtraction is necessary since the surface contamination limits apply to the radioactive material present above background. If background were not subtracted from the instrument net count rate, the instrument gross count rate would be an overestimate of the amount of DOE-added radioactive material present.

If a beta/gamma survey is performed and indicates the presence of Naturally Occurring Radioactive Material (NORM), then an additional option exists to determine a statistically-based background value. This reference background **SHALL** be subtracted from the gross data result. The total surface contamination result **SHALL** be calculated per RSP 7.02.

7.1.3 Media and Volumetric Contamination

Media and volumetric contamination samples **SHALL** be analyzed by the same methods, and the offsite lab results **SHALL** be reported in pCi/gm . The use of the word "media" in the following section also refers to volumetric samples.

The media contamination results **SHALL** be compared with surface contamination limits in $dpm/100\text{ cm}^2$ (per 98-RF-00974, "Application of Surface Contamination Guidelines from Department of Energy Order 5400.5 - WAH-064-98"). This comparison is performed by converting the media sample results to a $dpm/100\text{ cm}^2$ value. This value is then compared with the TSC limit that has the units of $dpm/100\text{ cm}^2$. The media sample in $pCi/gram$ is converted to a $dpm/100\text{ cm}^2$ value per equation (7):

$$(7) \quad TSA = \frac{SR * SW * 2.22 * 100}{SA}$$

where: TSA = Total Surface Contamination (dpm/100cm²)
SR = Sample Result (pCi/gram)
SW = Sample Weight (grams)
2.22 = Conversion factor from pCi to dpm
SA = Sample Area (cm²).

If the data for the media being analyzed indicate the presence of NORM that is also a site contaminant of concern (e.g., U-238), then an additional comparison option exists to determine a statistically based background value.

7.2 Comparison with Radiological Limits

For Type 2 and 3 facilities the comparison of the measurement results against the DCGL values, as described in this section, provides the initial input to decommissioning planning, including initial waste volume estimates, areal extent of contamination, decontamination methods, etc. In these cases, RLC is not designed to demonstrate legal compliance (this step will be accomplished per the PDS). Thus, the conclusion reached during RLC **SHALL** be subject to further evaluation during IPC, except for Type 1 facilities when comparisons **SHALL** be used to make final removal/disposal decisions.

7.2.1 Surface and Media Contamination Limits

The DCGL_W and DCGL_{EMC} limits are based on the requirements in DOE Order 5400.5, *Radiation Protection of the Public and the Environment*. Surface contamination limits are based on Figure IV-1, *Surface Contamination Guidelines* from DOE Order 5400.5 as amended by DOE Memorandum entitled *Application of DOE 5400.5 Requirements For Release And Control Of Property Containing Residual Radioactive Material*, dated 11/17/95. The surface contamination limits to be used at RFETS are provided in Table 7-1.

When media sample results are converted to a dpm/100 cm² value, the converted sample result **SHALL** be compared with the "Total Average" surface contamination limit in Table 7-1.

7.2.2 Comparison with Surface Contamination Limits

To compare the survey result with the DCGL_W, the identity of the radionuclides in an area **SHALL** first be determined. The applicable "average total," "maximum total" and "removable" surface contamination limits from Table 7-1 **SHALL** then be used. These surface contamination limits are used for all TSC and RSC survey points. Both TSC and RSC survey results **SHALL** be assessed to disposition an area.

The comparisons performed in this section are to provide input on the initial D&D plans and methods, and therefore, do not include discussion of restricted release, recycling, or final survey.

At each survey point, the survey result for total contamination **SHALL** be compared directly with the average TSC limit. If all survey results are below the average TSC limit, the area **SHALL** be categorized as not radiologically contaminated. If any survey result is greater than the maximum TSC limit, the affected area **SHALL** be categorized as radiologically contaminated. If any survey result is greater than the average TSC but less than the maximum TSC limit, the 1 m² area around the survey point may be averaged for comparison purposes with the average TSC limit.

At each survey point, the survey result for RSC **SHALL** be compared directly with the RSC limit. If all survey results are below the RSC limit, the area **SHALL** be categorized as not radiologically contaminated. If any survey result is greater than the RSC limit, the area around that survey point **SHALL** be evaluated for decontamination or categorized as radiologically contaminated.

7.2.3 Comparison with Sample Contamination Limits

Sample (media or volumetric) results **SHALL** be compared with the surface contamination limits in dpm/100 cm² as follows:

- At each sample point, the sample result, converted to dpm/100 cm², will be compared with the DCGL_w. If all sample results are below the DCGL_w, the area may be initially categorized as sanitary waste or free released (**SHALL** be confirmed during PDS). If any sample result is greater than the DCGL_{EMC}, the area around that sample point will be evaluated for decontamination or categorized as LLW.

April 23, 2001

Table 7-1 Surface Contamination Guidelines

Radionuclides ^{2/}	Total Average ^{3/ 4/} (dpm/100 cm ²) ^{1/} (DCGL _w)	Total Maximum ^{4/ 5/} (dpm/100 cm ²) (DCGL _{emc})	Removable ^{4/ 6/} (dpm/100 cm ²) (DCGL _w)
Transuranics, I-125, I-129, Ra-226, Ac-227, Ra-228, Th-228, Th-230, Pa-231	100	300	20
Th-Natural, Sr-90, I-126, I-131, Ra-223, Ra-224, U-232, Th-232.	1,000	3,000	200
U-Natural, U-235, U-238 and associated decay products, 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. ^{7/}	5,000	15,000	1,000
Tritium ^{8/} (applicable to surface and subsurface.	Not Applicable	Not Applicable	10,000

1/ 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.

2/ 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. In addition, the limits for radionuclides specifically identified in the table (e.g. Ra-226) shall take precedent over generic categories (e.g. alpha-emitters).

3/ Measurements of average contamination should not be averaged over an area of more than 1 m². For objects of less surface area, the average should be derived for each such object.

4/ 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.

5/ The maximum contamination level applies to an area of not more than 100 cm². DOE 5400.5 Chg 2 IV-7

6/ The amount of removable material per 100 cm² 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 cm² 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.

7/ 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.

8/ Property recently exposed or decontaminated, should have measurements (smears) at regular time intervals to ensure that there is not a build-up of contamination over time. Because tritium typically penetrates material it contacts, the surface guidelines for Beta-Gamma emitters are not applicable to tritium. The DOE has reviewed the analysis conducted by the DOE Tritium Surface Contamination Limits Committee ("Recommended Tritium Surface Contamination Release Guides," February 1991), and has assessed potential doses associated with the release of property containing residual tritium. The DOE recommends the use of the stated guideline as an interim value for removable tritium. Measurements demonstrating compliance of the removable fraction of tritium on surfaces with this guideline are acceptable to ensure that non-removable fractions and residual tritium in mass will not cause exposures that exceed DOE dose limits and constraints.

7.3 Comparison with Chemical Limits (Decision Rules)

Hazardous Waste

The toxicity characteristic thresholds for hazardous waste (which address arsenic, barium, cadmium, lead, mercury, selenium, and silver) are specified in 6 CCR 1007-3, Part 261. If media exceed these thresholds, they **SHALL** be managed as hazardous waste. If any listed wastes, also stipulated in 6 CCR 1007-3, Part 261, are identified, the media **SHALL** be managed as hazardous waste.

Hazardous Substances

If material contains a hazardous substance above a decision document action level and/or the CERCLA reportable quantity (40 CFR 302.4), the material is subject to CERCLA regulation (i.e., remediation and/or notification requirements).

Beryllium

If detectable Be contamination can be shown through process knowledge to consist of Be powder (P015 under RCRA), then the contaminated materials **SHALL** be treated as RCRA waste, or else RFETS will propose release criteria for the material based upon surveys and available information.

For all other situations, if concentrations of Be in surface samples are equal to or greater than $0.2 \mu\text{g}/100 \text{ cm}^2$, the material **SHALL** be considered Be-contaminated but not subject to RCRA. It **SHALL** be labeled "Beryllium Waste", and levels **SHALL** be compared to the waste acceptance criteria of the disposal site to which it will be transported.

PCBs

Material/media potentially contaminated with PCBs **SHALL** be categorized per 40 CFR 761. If material meets the definition of PCB Bulk Product Waste, it may be disposed of at a facility that is permitted, licensed, or registered by a State to manage municipal solid waste subject to 40 CFR 258, or non-municipal, non-hazardous waste subject to 40 CFR 257.5 through 257.30. For most bulk product wastes, implementing this strategy precludes the need for PCB characterization prior to or during facility removal, as long as restrictions outlined in 40 CFR 761.62 regarding their disposal are met. However, notification to the disposal facility is required at least 15 days in advance of shipping wastes to the facility if that disposal facility does not possess a commercial PCB storage or disposal approval.

Management strategy for PCB remediation waste will be determined on a case-by-case basis. If PCB contamination is suspected, or if a PCB spill is discovered that has not been cleaned up, the area **SHALL** be treated in compliance with 40 CFR 761 through 762. For each planned cleanup, PCB regulations under TSCA **SHALL** be evaluated as potentially applicable or relevant and appropriate requirements (ARARs), including the disposal options for PCB remediation waste listed under 40 CFR 761.61.

Asbestos

If any one sample of a sample set representing a homogeneous medium results in a positive detection (i.e., greater than 1% by volume), then material **SHALL** be considered ACM; otherwise, the material **SHALL** be considered non-regulated ACM (per 40 CFR 763 and 5 CCR 1001-10). Industrial Hygiene and Safety practices are required for any ACM regardless of percent content per OSHA regulations.

7.4 Data Assessment

An assessment of all data collected during RLC **SHALL** be performed to assure that the data satisfies the objectives of the RLCP. The assessment involves three elements, all of which are performed in combination: verification, validation, and data quality assessment (DQA).

7.4.1 Data Verification

Data verification ensures that the requirements stated in the planning documents (e.g., RLCP, Radiation Safety Practices procedures) are implemented as prescribed. This means that deficiencies or problems that occur during implementation should be documented and reported. In addition, analytical and radiochemical samples are subject to the following reviews:

- Chain-of-Custody was implemented during sampling and analysis.
- Preservation and hold-times were within tolerance.

7.4.2 Data Validation

Data validation activities ensure that the results of data collection activities support the objectives of the RLC, or support a determination that these objectives should be modified. Data usability is the process of ensuring or determining whether the quality of the data produced meets the intended use of the data. Data verification compares the collected data with the prescribed activities documented in the RLCP and the Radiological Safety Practices procedures. Data validation is often defined by six data descriptors:

1. Reports to decision maker
2. Documentation
3. Data sources
4. Analytical method and detection limit
5. Data review
6. Data quality indicators

The decision maker or reviewer examines the data, documentation, and reports for each of the six data descriptors to determine if performance is within the limits specified in the RLCP developed during survey planning. Data collected should meet performance objectives for each data descriptor. If they do not, deviations should be

noted and any necessary corrective action performed. Corrective action should be taken to improve data usability when performance fails to meet objectives.

Formal validation of analytical data **SHALL** be performed at the following frequencies:

- ≤ 20 samples - 100%
- > 20 samples - 25%

The frequencies are established because 1) typical analytical batching is ≤ 20 samples each, 2) data packages are validated by sample batch, and 3) representativeness percentages may be difficult to justify with less than 20 samples.

7.4.2.1 Reports to Decision Maker

The cognizant individuals who will be performing the D&D planning, including decontamination methods, schedules, budgets, etc., **SHALL** be appropriately informed of the previous and current status of the area being characterized.

7.4.2.2 Documentation

The following documents **SHALL** be assessed: the completed RLC survey package and nonradiological characterization package, including the completed radiological survey forms and results, the final radiological sample data, nonradiological data, data handling records (e.g. chain-of-custody forms), and supporting documentation.

7.4.2.3 Data Sources

Data source assessment involves the evaluation and use of historical analytical data. Historical analytical data **SHALL** be evaluated for use before RLC surveys/samples are obtained. The use of historical analytical data will be evaluated with respect to RLCP requirements.

7.4.2.4 Analytical Method and Detection Limit

The selection of appropriate analytical and radiochemistry methods are important, as the methods determine components such as detection limits/ minimum detectable concentration and representativeness. Detection limits directly affect the usability of the data because results near the detection limit have a greater possibility of false negatives and false positives. Results near the detection limit have increased measurement uncertainty. All reported RLC data **SHALL** provide or reference the quantitative basis for the sensitivity specification (i.e., the calculated detection limits [method detection limits or minimum detectable concentrations]).

For the radiological RLC surface contamination surveys/samples, the detection limit **SHALL** be less than or equal to the $DCGL_W$. The detection limit target is 50 % of the

DCGL_w. However, data may be used to support the RLC if the detection limit meets the DCGL_w value.

For nonradiological instruments, PQLs **SHALL** be provided (based on formal PQL studies) with all results. PQLs **SHALL** be less than half the associated action level. Detection limits for nonradiological samples are established by contractual agreement between Kaiser Hill and RFETS Analytical Services Division and are stated in the RFETS Analytical Services Division Statement of Work.

7.4.2.5 Data Review

Data review begins with an assessment of the quality of the radiological survey/sample data and is performed by a professional with knowledge of the RLCP and applicable Radiological Safety Practices procedures. All radiological and nonradiological survey/sample data **SHALL** be reviewed.

7.4.2.6 Data Quality Indicators

The assessment of data quality indicators is significant to determine data usability. The principal data quality indicators are precision, bias, accuracy, representativeness, comparability, and completeness (PARCC). Of the six principal data quality indicators, precision and bias are quantitative measures, representativeness and comparability are qualitative, completeness is a combination of both qualitative and quantitative measures, and accuracy is a combination of precision and bias.

Typically, a complete PARCC analysis is not required for radiological surveys/samples at the RLC stage, and only the qualitative indicators of representativeness, comparability and completeness need to be addressed. A more extensive data validation will generally be performed for nonradiological data, as described in the Section 8.4 introduction, based on the objective of the survey.

The intent of this section is to describe each data quality indicator, and provide examples of how each indicator is measured. The requirements for each RLC **SHALL** be provided in the individual RLC characterization packages.

Precision

Precision is a measure of agreement among replicate measurements of the same property under prescribed similar conditions. The two basic activities performed in the assessment of precision are estimating the radionuclide concentration variability from the measurement locations and estimating the measurement error attributable to the data collection process. Precision can be measured through the following sample types:

- Lab Replicates (rads)
- Matrix Spike Duplicates (MSD)
- Field Duplicates
- Field Replicates (for scanning and direct measurements)

Precision can be quantified by at least two functions. The most typical measure for nonradiological analyses is the relative percent difference (RPD) term, whereas, because of the stochastic nature of radioactivity, a statistical measure is better suited for evaluating radiological reproducibility. This measure is referred to as the duplicate error ratio (DER). The equations for evaluating these two measures is provided below:

$$RPD = \frac{C_1 - C_2}{(C_1 + C_2)/2} * 100$$

where:

C₁ = first sample result (in terms of concentration)

C₂ = duplicate sample result (in terms of concentration)

$$DER = \frac{C_1 - C_2}{(\text{TPU}_{c1}^2 + \text{TPU}_{c2}^2)} * 100$$

where:

C₁ = first sample result (in terms of concentration)

C₂ = duplicate sample result (in terms of concentration)

TPU = total propagated uncertainty

Bias

Bias is the systematic or persistent distortion of a measurement process that causes errors in one direction. Bias can be measured through the following samples or methods:

- Analytical spike samples.
- Blanks
- Performance checks tracked with a control chart

Accuracy

Accuracy is a measure of the closeness of an individual measurement or the average of a number of measurements to the true value. Accuracy includes a combination of random error (precision) and systematic error (bias) components that result from performing measurements. To be accurate, data must be both precise and unbiased. Accuracy can be measured through the following samples or methods:

- Calibrations
- Lab control samples/spikes (LCS)
- Matrix spikes (MS)
- Relative standard deviation (% RSD)
- Blanks
- Chemical yields (rads)
- Counting time (rads)

- Sensor efficiency (rads)
- Correction for ingrowth daughters (rads)

Generally, the accuracy of radiological surveys **SHALL** be based on annual calibrations of instrumentation and daily source checks that perform within specified tolerances (e.g. +/- 20%), as specified in the Radiological Safety Practices (RSPs). Novel or prototypical instrumentation **SHALL** also demonstrate compliance with the specified tolerances in the RSPs.

Representativeness

Representativeness is a measure of the degree to which data accurately and precisely represent a characteristic of a population parameter at a sampling point. Representativeness is a qualitative term that should be evaluated to determine whether surveys/samples are collected in such a manner that the resulting data appropriately reflect the contamination present.

For the RLC, representativeness **SHALL** be assessed by assuring that the survey/sampling requirements of this Plan have been met. The surveys/samples obtained during the RLC **SHALL** be compared with the survey/sample requirements in this Plan. The impact of any discrepancies between the RLCP requirements and the actual survey/sample results **SHALL** be assessed.

Comparability

Comparability is the qualitative term that expresses the confidence that two data sets can contribute to a common analysis. Differences in data sets need to be evaluated to assure that the data sets may be used for a common goal. If historical data will be used to support the RLC, the historical data will be assessed with respect to current data requirements in this Plan. The comparability of the historical data set with the current data requirements will be assessed before the RLC is performed.

All data collected to support the RLC **SHALL** be collected per RSP procedures or other approved procedures (for nonradiological sampling) and will therefore be comparable. The comparability of all surveys/samples to support the RLC **SHALL** be assessed.

Completeness

Completeness is a measure of the amount of valid data obtained from the measurement system, expressed as a percentage of the number of valid measurements that should have been collected. Completeness is therefore a measure of the number of radiological surveys/samples obtained versus the number of radiological surveys/samples required per the RLCP.

Typically, 90% of the survey data required by this Plan are needed to meet completeness requirements for the RLC. Any deviation from this requirement **SHALL** be documented in the RLCP.

for Type 2 and 3 facilities there are no requirements for assessing the radiological survey/sample data in a graphical manner.

7.4.3.3 Select the Statistical Test

This section applies to nonradiological characterization data only. The statistical test performed to demonstrate compliance with the prescribed limits will be selected based on applicable guidance documents for regulatory requirements (see Section 10.0, References).

7.4.3.4 Verify the Assumptions of the Test

This section applies to nonradiological characterization data only. The assumptions applied in selecting the statistical test must be verified, and the data must be reviewed to assure that modifications to the statistical analysis are not warranted. This step involves the following three activities:

- Determine how the assumptions of the test will be verified (standard deviations, postings plots, histograms, power charts, etc.)
- Perform tests of the assumptions
- Determine corrective actions (if applicable)

7.4.3.5 Draw Conclusions from the Data

The conclusions of the statistical tests should support the objectives of the survey. The three activities involved with this step are:

- Perform the statistical tests
- Evaluate the tests and corresponding conclusions
- Evaluate the performance of the survey design for future use consideration

7.4.3 Data Quality Assessment

DQA is the scientific and statistical evaluation of data to determine if the data are of the right type, quality, and quantity to support their intended use.

There are five steps in the DQA Process:

1. Review the DQOs and survey design
2. Conduct a preliminary data review
3. Select the statistical test
4. Verify the assumptions of the statistical test
5. Draw conclusions from the data.

These five steps are presented in a linear sequence, but the DQA process is applied in an iterative fashion. The strength of the DQA process is that it is designed to promote an understanding of how well the data will meet their intended use by progressing in a logical and efficient manner.

Because no statistical evaluation of the radiological data is required for RLC, the DQA will be limited to steps 1 and 2, unless the facilities are Type 1 and PDS requirements are being met. A more extensive DQA also may be required for non-radiological sampling to satisfy regulatory requirements.

7.4.3.1 Review DQOs and Survey Design

The DQA process begins by reviewing the key outputs from the DQOs which are embodied in the RLCP. The RLCP provides the context for understanding the purpose of the data collection effort. It also establishes qualitative and quantitative criteria for assessing the quality of the data set for the intended use. The survey design in the RLCP provides important information about how to interpret the data. The RLCP and the survey design **SHALL** be reviewed before proceeding.

7.4.3.2 Conduct a Preliminary Data Review

In this step of the DQA process, a preliminary evaluation of the data set is conducted by calculating some basic statistical quantities and looking at the data through graphical representations. By reviewing the data both numerically and graphically, the "structure" of the data can be learned. This structure will identify appropriate approaches and limitations for data use.

The data may be examined statistically through calculating the mean, standard deviation, median, relative standing, central tendency, dispersion, shape, and association. The data may be examined graphically through the use of histograms, scatter plots, confidence intervals, ranked data plots, quantile plots, stem-and-leaf diagrams, spatial or temporal plots.

For the RLC, there are no requirements for assessing radiological survey/sample data statistically, unless the facilities are Type 1 and PDS requirements are being met. Thus,

8.0 SURVEY REPORTING

Upon completion of the RLC surveys, an RLCR **SHALL** be prepared per Appendix B. All results used to demonstrate that the facility meets the RLCP DQOs will be presented in the RLCR, including applicable results of the scoping characterization. In the RLCR, a summary of the measurement results and overall conclusions showing that the facility satisfies the RLCP DQOs will be provided. As applicable, a tabular data summary will present the results for each area characterized. This tabulation will identify the type and number of measurements performed, and the numerical results. For Type 1 facilities, the PDS results will be documented in the RLC Report. Based on an assessment of radiological and chemical contamination, the facility will be typed pursuant to the Decommissioning Program Plan (DPP).

8.1 Reporting Characterization Results

The documentation of RLC results is a RFCA-mandated report. This report **SHALL** present characterization results and summarize the hazards associated with the facility, including the nature and extent of radiological and chemical contamination, the presence of physical hazards, and the types and volumes of wastes to be managed. Compliance with data review requirements **SHALL** also be documented, as described in Section 7.4. The report should provide information in adequate detail to allow DOE to make a determination if the facility has significant contamination or hazards, as described in Attachment 9 of RFCA, and to type the facility as Type 1, 2 or 3.

8.1.1 Radiological Summaries

For each Type 1, Type 2, and Type 3 survey area, the number of measurements and the survey results **SHALL** be presented in tabular form. Graphical representation (e.g., posting plots, histograms, cumulative frequency distributions) may also be included with the tabular data, if such graphs are necessary to support data interpretation. For each type of surface contamination, measurements (total surface contamination, removable surface contamination, surface scans, and surface media sampling) will be reported in units of dpm/100cm². Media and volumetric sampling data will be reported in units of dpm/100 cm² or pCi/gram.

8.1.2 Chemical Summaries

The number of measurements and the applicable statistical distribution **SHALL** be presented in tabular form, with additional graphical representation if applicable. The chemical data should be reported in the following manner:

- TCLP measurements will be reported in mg/L.
- PCB measurements will be reported in parts per million (ppm) or parts per billion (ppb).
- Be measurements will be reported in micrograms.
- Asbestos measurements will be reported as an asbestos percentage.

9.0 QA/QC PROGRAM

Quality assurance (QA) and quality control (QC) procedures are performed during RLC implementation to collect information necessary to evaluate the results. Specifically, quality is an integrated system of management activities involving planning, QC, quality assessment, reporting, and quality improvement to ensure that a product or service meets defined standards of quality with a stated level of confidence. QC is the overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer. The details required to implement the program requirements for this plan are provided in Section 7 of the DDCP.

10.0 REFERENCES

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RFETS Beryllium Characterization Procedure, PRO-536-BCPR

RFETS Bulk Solids and Liquids Characterization Procedure, PRO-488-BLCR

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RFETS Photoionization Detectors and Flame Ionization Detectors, FO.15

RFETS Polychlorinated Biphenyls Management Plan, PRO-673-EWQA-1.5

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RFETS Radiological Survey/Sampling Package Design, Preparation, Control, Implementation and Closure, PRO-475-RSP-16.01

RFETS Sampling for Waste Characterization, CAS-SOP-003

11.0 GLOSSARY

Biased Sample – Located directly at a location suspected as being the site of a contamination or spill.

Biased Scan Surveys - Scan surveys that are performed at locations with the highest potential for contamination (e.g., horizontal surfaces, high traffic areas, floor corners, drains) based on professional judgment.

Bulk Sample – A sample of solid or liquid media or material for analysis.

Composite Sample - A sample that represents a large area. It may consist of several small samples from various locations which are contained in a manageable sample that is representative of the entire area.

DCGL_W - Derived Concentration Guideline Level - Contamination limit based on the assumption that the concentration of residual activity is evenly distributed over a large area.

DCGL_{EMC} - Derived Concentration Guideline Level - Contamination limit based on the assumption that the concentration of residual activity is distributed as small-elevated areas within a larger area.

Local Area Background - Background survey instrument readings taken at specific locations within a survey unit in order to determine actual contamination values in a more precise manner.

Measurement Location - A survey location where the typical set of total surface contamination and removable contamination measurements are obtained.

Minimum Detectable Activity - The minimum amount of activity that can be statistically detected above background with a 95 percent probability and with a maximum of 5 percent probability of falsely interpreting sample activity as activity due to background

Random Sample – Taken within predefined boundaries for definition of the population.

Survey Area - The most general category, comprised of surfaces to be further defined as one or more survey units, the bounds of which are defined by existing physical features such as walls, columns, beams etc.

Survey Design - The process of determining the type, location, number and density of radiological measurements to be taken for final survey

Survey Package - A collection of information in a standardized format for controlling and documenting field measurements taken for final survey. A survey package is prepared for each Survey Unit. The survey package typically includes the survey instructions, survey data sheets and grid maps.

Survey Point - A smaller subdivision within an area designated as a survey location where measurements are obtained. This area generally refers to the area covered by a detector probe or 100 cm² when a smear is obtained.

Survey Instructions - Written instructions which specify the type and number of measurements to be taken in a survey unit. Each survey package shall include survey instructions.

TCLP – Toxicity Characteristic Leaching Procedure; determines the mobility of organic and inorganic analytes present in liquid, solid, and multiphasic wastes.

12.0 APPENDICES

APPENDIX A
RADIOLOGICAL SUMMARY TABLE

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**APPENDIX A
 RADIOLOGICAL SUMMARY TABLE
 (MINIMUM MEASUREMENTS)**

Survey Area Description		Maximum Survey Area Size	Number of Surface Activity Measurements	Surface Scanning	Media & Volumetric Sampling	Isotopic Gamma Scans
Non -Contamination Areas, Radiological Buffer Areas, and Radioactive Material Areas (delineated based on expected levels of contamination)	Floors and Walls Below 2 meters	Up to 2000 m ² (based on floor area)	30 uniformly distributed measurement locations plus biased measurements at suspect locations	1 m ² at each measurement location, plus perform biased scans at biased locations	Biased samples may be collected based on RE judgement (to determine areal extent and depth of contamination)	Biased isotopic gamma scans may be collected based on RE judgement
	Ceilings and Walls above 2 meters	Up to 2000 m ² (based on ceiling area)	10 measurements at biased, accessible locations.	No scanning required unless contamination is discovered from surface activity measurements		
	Equipment	Up to 2000 m ² (based on floor area)	30 measurements at biased, accessible locations.	Biased scanning may be performed based on RCT and RE judgment		
	Exterior Walls and Roofs	Each Survey Area	30 uniformly distributed measurement locations plus biased measurements at suspect locations			
Contamination Areas and Fixed Contamination Areas (delineated based on expected levels of contamination)	Floors and Walls Below 2 meters	Up to 1000 m ² (based on floor area)	30 uniformly distributed measurement locations plus biased measurements at suspect locations.	1 m ² at each measurement location, plus perform biased scans at biased locations	Biased samples may be collected based on RE judgement (to determine areal extent and depth of contamination)	Biased isotopic gamma scans may be collected based on RE judgement
	Ceilings and Walls above 2 meters	Up to 1000 m ² (based on ceiling area)	10 measurements at biased, accessible locations.	No scanning required unless contamination is discovered from surface activity measurements		
	Equipment	Up to 1000 m ² (based on floor area)	30 measurements at biased, accessible locations.	Biased scanning may be performed based on RCT and RE judgment		
	Exterior Walls and Roofs	Each Survey Area	30 uniformly distributed measurement locations plus biased measurements at suspect locations			
High Contamination Areas and Airborne Contamination Areas (delineated based on expected levels of contamination)	No Surveys or Sampling Required					

Biased measurements should include high traffic areas such as building entrances, exits, and hallways; HVAC intakes and exhaust ducts; storage areas; areas of frequent personnel contact such as doors and door frames; and horizontal surfaces.

APPENDIX B
RECONNAISSANCE-LEVEL CHARACTERIZATION REPORT

RECONNAISSANCE-LEVEL CHARACTERIZATION REPORT

EXECUTIVE SUMMARY

INTRODUCTION

- Report Purpose
- Characterization Scope
- Report Content

OPERATING HISTORY AND PHYSICAL DESCRIPTION

SUMMARY OF CHARACTERIZATION ACTIVITIES

- Data Quality Objectives Used
- Radiological Characterization
 - Summary of Historical Data
 - Summary of RLC Data Collected
- Chemical Characterization
 - Summary of Historical Data
 - Summary of RLC Data Collected

HAZARDS

- Physical
- Radiological
- Chemical
 - Asbestos
 - Metals
 - VOCs/SVOCs
 - PCBs
 - Beryllium
 - Other Hazardous Wastes/Substances

DECOMMISSIONING WASTE TYPES AND VOLUME ESTIMATES

DATA QUALITY ASSESSMENT

FACILITY TYPING

REFERENCES

ATTACHMENTS

108/108