

**Waste Acceptance Criteria Compliance Plan for the
Environmental Management Disposal Facility
at the Oak Ridge Reservation,
Oak Ridge, Tennessee**



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**Waste Acceptance Criteria Compliance Plan for the
Environmental Management Disposal Facility
at the Oak Ridge Reservation,
Oak Ridge, Tennessee**

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United Cleanup Oak Ridge LLC
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CONTENTS

FIGURES.....	v
TABLES	v
ACRONYMS.....	vii
EXECUTIVE SUMMARY	ix
1. INTRODUCTION.....	1
1.1 OVERVIEW.....	1
1.2 BACKGROUND.....	4
1.3 SELECTED REMEDY	6
2. SCOPE AND PURPOSE	7
3. ROLES AND RESPONSIBILITIES.....	9
4. WAC COMPLIANCE PROCESS	13
4.1 ADMINISTRATIVE WAC	17
4.1.1 ARARs.....	17
4.1.2 Summary of Prohibited Waste Types	20
4.1.3 Physical Requirements	20
4.1.3.1 Free Liquids	20
4.1.4 RCRA Compliance Requirements.....	21
4.1.4.1 Listed Waste Restriction	23
4.1.4.2 Treated Waste Meeting RCRA LDRs.....	24
4.1.4.3 Management of Mercury-contaminated Waste.....	25
4.1.5 TSCA-Regulated Waste Determinations (PCBs/Asbestos).....	29
4.1.6 Waste Classification Requirements	30
4.1.7 Criticality Safety.....	32
4.2 ANALYTICAL WAC.....	33
4.2.1 Waste Concentration Limits (Step 1 – Screening Criteria)	34
4.2.2 EMDF Inventory Limits (Step 2 VWSF)	34
4.2.3 EMDF SOF Calculations (VWSF) and Inventory Tracking	35
4.2.4 Supplemental Analysis Risk Summary	35
4.2.5 EMDF Trigger Level Concentrations and Contingent Risk Management Activities..	37
4.2.6 Evaluation of Additional Contaminants or Waste-Stream Specific WAC	39
4.2.7 WAC Compliance Calculations and Tracking.....	39
5. WASTE COMPLIANCE REQUIREMENTS	41
5.1 CERCLA DOCUMENTATION	41
5.2 CHARACTERIZATION REQUIREMENTS.....	41
5.3 DATA COLLECTION REQUIREMENTS.....	45
5.3.1 Sampling Requirements and Strategies	46
5.3.1.1 Sample Designs.....	47
5.4 DATA QUALITY ASSESSMENT.....	49
5.5 WASTE PROFILES.....	51
5.6 BOUNDING PROFILES	54

6. QUALITY ASSURANCE.....	55
7. RECORDKEEPING.....	57
7.1 CERCLA DOCUMENTATION	57
8. REFERENCES.....	59
APPENDIX A. FINAL WASTE ACCEPTANCE CRITERIA.....	A-1
APPENDIX B. PROCESS FOR DEVELOPING NEW ANALYTICAL WAC.....	B-1
APPENDIX C. GENERAL GUIDANCE FOR DATA COLLECTION, DATA ANALYSIS, AND DEVELOPMENT OF SAMPLING PLANS	C-1
APPENDIX D. WASTE PROFILE TEMPLATE	D-1
APPENDIX E. EMDF WASTE ACCEPTANCE CRITERIA TRACKING REPORTING ANALYSIS CAPABILITY SYSTEM PENDING FINAL ANALYTICAL WAC	E-1
APPENDIX F. DEFINITIONS.....	F-1

FIGURES

Fig. 1. EMDF conceptual landfill design.....	1
Fig. 2. OREM waste disposal hierarchy.	3
Fig. 3. EMDF waste acceptance process.....	15
Fig. 4. RCRA analysis based/knowledge based hazardous waste determinations.....	22
Fig. 5. Disposition logic diagram for D&D of mercury (Hg) contaminated facilities.	27
Fig. 6. EMDF WAC contingency plan.	38
Fig. 7. DQO process.....	42
Fig. 8. Example conceptual site model for waste disposition.	43
Fig. 9. Data quality assessment process.	50
Fig. 10. EMDF waste profile approval process.	53

TABLES

Table 1. Crosswalk of principle roles and responsibilities	11
Table 2. Administrative waste acceptance criteria.....	18
Table 3. RCRA treated waste acceptable for disposal	24
Table 4. Tennessee LLW waste classification requirements	31
Table 5. Summary of calculated bathtub scenario risk for metals and radionuclides.....	37
Table 6. Confidence and coverage aspects for a statistical sample design of unlimited sample population	48

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ACRONYMS

ACM	asbestos-containing material
ADC	anomaly detection checklist
ADP	anomaly detection plans
ARAR	applicable or relevant and appropriate requirement
ASA	auditable safety analysis
CDS	controlled data set
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
<i>CFR</i>	<i>Code of Federal Regulations</i>
CSE	criticality safety evaluation
D&D	deactivation and demolition
DOE	U.S. Department of Energy
DQA	data quality assessment
DQO	data quality objectives
ELCR	Excess Lifetime Cancer Risk
EMDF	Environmental Management Disposal Facility
EMWMF	Environmental Management Waste Management Facility
EPA	U.S. Environmental Protection Agency
FFA	Federal Facility Agreement for the Oak Ridge Reservation
HI	hazard index
LDR	land disposal restriction
LLW	low-level (radioactive) waste
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
NNSA	National Nuclear Security Administration
NPL	National Priorities List
NRC	U.S. Nuclear Regulatory Commission
OREIS	Oak Ridge Environmental Information System
OREM	Oak Ridge Office of Environmental Management
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
PCB	polychlorinated biphenyl
PK	process knowledge
PWAC	physical waste acceptance criteria
QA	quality assurance
QAPP	quality assurance project plan
QC	quality control
RAWP	remedial action work plan
RCRA	Resource Conservation and Recovery Act of 1976
RI/FS	remedial investigation/feasibility study
ROD	record of decision
SAP	sampling and analysis plan
SOF	sum of fraction
SRC	site-related contaminant
SVOC	semi-volatile organic compounds
TCLP	Toxicity Characteristic Leachate Procedure
TDEC	Tennessee Department of Environment and Conservation
TRU	transuranic
TSCA	Toxic Substances Control Act of 1976
UCL	upper confidence limit
UCOR	United Cleanup Oak Ridge LLC

UHC	underlying hazardous constituents
UTL	nonparametric upper tolerance limit
VOC	volatile organic compounds
VWSF	volume-weighted sum of fractions
WAC	waste acceptance criteria
WACFACS	Waste Acceptance Criteria Forecasting Analysis Capability System
WAT	Waste Acceptance Team
WCP	waste acceptance criteria compliance plan
WGF	waste generation forecast
Y-12	Y-12 National Security Complex

EXECUTIVE SUMMARY

The recent focus of the U.S. Department of Energy (DOE) Oak Ridge Environmental Management (OREM) Program has been Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) demolition and soil remediation at facilities that have been contaminated by historical Manhattan Project and Cold War activities. These legacy facilities have been determined to no longer be necessary to support the Oak Ridge Reservation (ORR) mission, are costly to maintain, and are in differing stages of deterioration causing safety and environmental concerns. This cleanup mission is projected to take numerous years to complete and will result in large volumes of radioactive, hazardous, and mixed waste that will require disposal.

An onsite disposal alternative (specifically the design, construction, operation, and closure of the Environmental Management Disposal Facility [EMDF]) has been selected for the disposal of future, qualifying CERCLA-generated waste on the Oak Ridge National Priorities List (NPL) Site. The selected alternative meets the CERCLA threshold criteria and provides the best balance of the remaining CERCLA evaluation criteria. DOE has determined that the selected alternative satisfies the requirements of 40 *Code of Federal Regulations (CFR)* 300 Subpart E § 300.430 (f)(1)(ii) to (1) be protective of human health and the environment, (2) attain those applicable or relevant and appropriate requirements (ARARs) that are identified at the time of record of decision signature or provide grounds for invoking a waiver under 40 *CFR* 300.430(f)(1)(ii)(C), (3) be cost effective, and (4) use permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable.

Radiological and chemical releases from wastes disposed of in the EMDF and the potential risks to the public from such releases are mitigated by the disposal cell design that includes a robust wastewater treatment system. Additionally, the waste that will be accepted for placement is limited by a set of waste acceptance criteria (WAC). The overall WAC compliance process involves the completion of two distinct sets of requirements:

- **Administrative WAC** are requirements or standards of federal laws and promulgated state laws that are deemed applicable or relevant and appropriate to the hazardous substances, pollutants, or contaminants addressed by a cleanup action being taken under CERCLA agreements among the parties to the *Federal Facility Agreement for the Oak Ridge Reservation* (DOE/OR-1014; FFA), specifically those addressing prohibited wastes.
- **Analytic WAC** include concentration and inventory limits presented in the Record of Decision for Comprehensive Environmental Response, Compensation, and Liability Act Oak Ridge Reservation Waste Disposal at the Environmental Management Disposal Facility, Oak Ridge, Tennessee (DOE/OR/01-2794&D2/R2; ROD). As required by the ROD, a Supplemental Analysis for the Environmental Management Disposal Facility (UCOR-4853; Supplemental Analysis) was performed to evaluate a hypothetical scenario based on alternate assumptions on future landfill performance and exposure pathway. The analytical WAC will be evaluated on individual waste lots and their impact to the overall volume weighted sum-of-fractions for the entire disposal facility.

This *Waste Acceptance Criteria Compliance Plan for the Environmental Management Disposal Facility at the Oak Ridge Reservation, Oak Ridge, Tennessee* (WCP) applies to CERCLA waste generated by removal and remedial actions at Oak Ridge NPL for onsite disposal at EMDF. Offsite disposal or disposal at the Environmental Management Waste Management Facility (EMWMF), or disposal at the ORR Landfill is not included in this plan. Contaminated waste streams that are not able to meet onsite EMDF WAC and primarily uncontaminated waste streams that have alternative disposal options (offsite or the permitted ORR Landfill, respectively) are not included in this plan.

Operational-based constraints regarding debris sizing, waste preparations, shipments, and hours of operation will be established and managed in accordance with EMDF-specific operational plans and procedures. This encompasses critical physical WAC requirements and facility-specific demands, including DOE nuclear safety standards, which will be integrated into operational plans and personnel training to ensure the facility manages waste receipts in accordance with the safety envelope defined for a “radiological classification.” These operational demands will be cohesively managed to ensure waste can be safely received and disposed of using available equipment and provide daily protection to workers, the public, and the environment.

Best practices and lessons learned from the years of successful EMWMF operations have been incorporated into this plan to ensure the CERCLA waste is properly characterized, generated, shipped, received, managed, and safely disposed of while being protective of human health and the environment. Acceptance of waste under this WAC ensures that all regulatory agreements and risk-based performance criteria are attained during and throughout disposal operations. The WAC processes defined in this plan provide an auditable process to evaluate and accept waste for onsite disposal including the following:

- A framework to systematically analyze and evaluate CERCLA waste for safe and cost-effective onsite disposal thus significantly reducing risks associated with high volume of waste transportation to offsite disposal facilities
- Provides a means and method to analyze waste lots and determine site-related contaminant (SRCs) and their respective concentrations and the associated impacts.
- Requires calculation of performance-based metrics for each waste lot, evaluates its impact to overall cell contaminant loading, and maintains landfill inventory limits below acceptable risk levels
- Ensures all applicable land disposal restrictions (LDRs) are met
- Maintains quality records for waste traceability, acceptance, and placement
- Provides a process to calculate WAC concentrations for new radionuclides or chemicals, if necessary

1. INTRODUCTION

1.1 OVERVIEW

This Waste Acceptance Criteria Compliance Plan for the Environmental Management Disposal Facility at the Oak Ridge Reservation, Oak Ridge, Tennessee (WCP) presents the Waste Acceptance Criteria (WAC) for disposal of waste at the Environmental Management Disposal Facility (EMDF) as described in the Record of Decision for Comprehensive Environmental Response, Compensation, and Liability Act Oak Ridge Reservation Waste Disposal at the Environmental Management Disposal Facility, Oak Ridge, Tennessee (DOE/OR/01-2794&D2/R2; ROD).

The EMDF is an engineered disposal facility in Bear Creek Valley (Fig. 1) that will support the U.S. Department of Energy (DOE) Oak Ridge Office of Environmental Management's (OREM) mission to decommission and demolish facilities and conduct remedial cleanup actions on the Oak Ridge Reservation (ORR). The EMDF will accept only Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) waste that meet the WAC established by the EMDF ROD and this document.

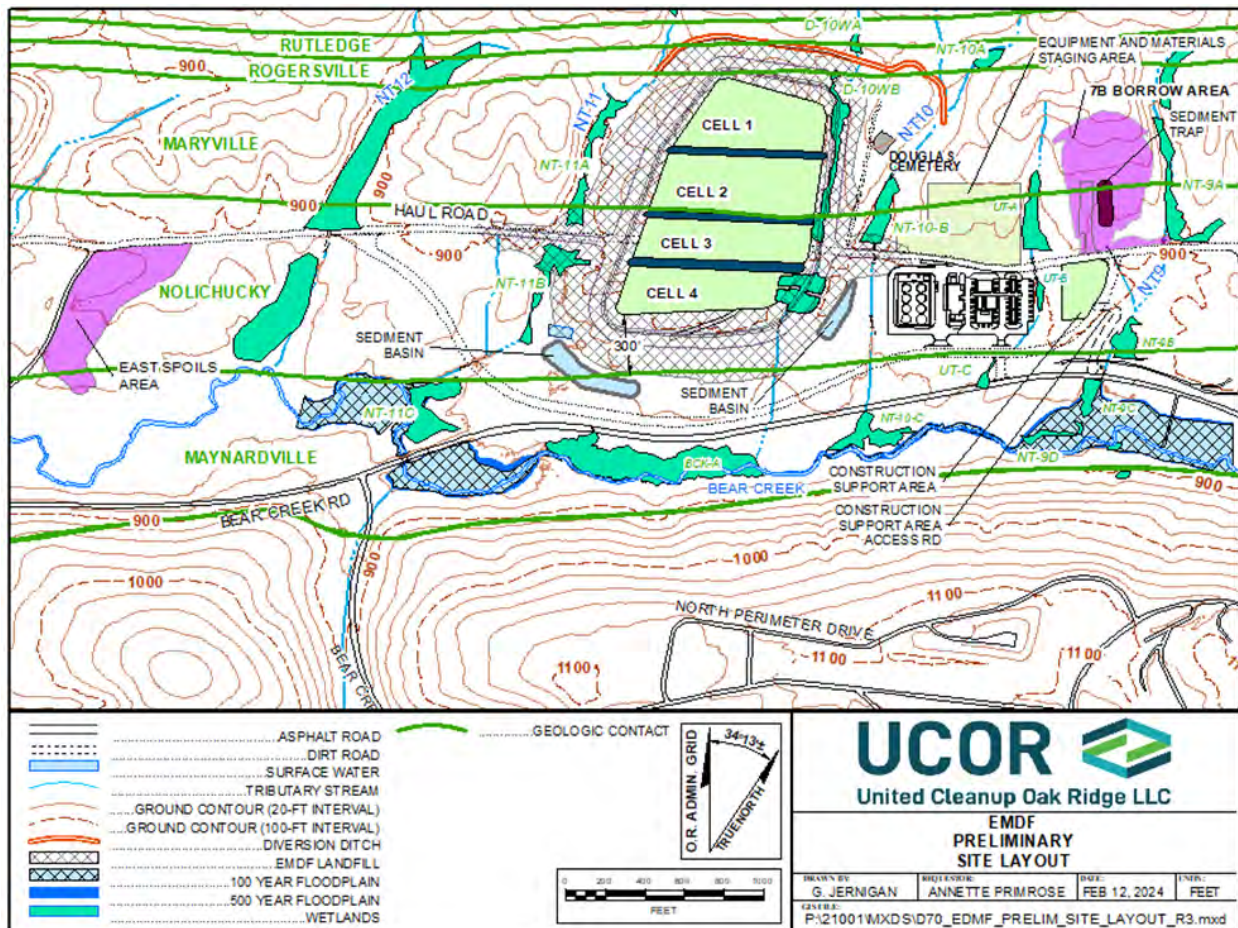


Fig. 1. EMDF conceptual landfill design.

Waste that is accepted for placement in EMDF is limited by WAC, which are divided into two categories: administrative and analytic. These criteria, summarized in Appendix A, Final Waste Acceptance Criteria, are derived from various constraints placed upon EMDF, such as specific risk limits or applicable or relevant and appropriate requirements (ARARs) and design elements in regulatory-based laws and guidance, as well as constraints on waste acceptance that are established through discussion among the parties to the *Federal Facility Agreement for the Oak Ridge Reservation* (DOE/OR-1014; FFA) and are documented in the ROD. The WAC are established to provide a complementary protective element of the EMDF disposal system that augments the other natural and engineered EMDF safety features to protect the public and environment over the long term after EMDF closure. As described in the ROD, the WAC consists of the following:

- **Administrative WAC** are requirements or standards of federal laws and promulgated state laws that are deemed applicable or relevant and appropriate to the hazardous substances, pollutants, or contaminants addressed by a cleanup action being taken under CERCLA agreements among the parties to the FFA, specifically those addressing prohibited wastes.
- **Analytic WAC** include concentration and inventory limits presented in the EMDF ROD. As required by the ROD, a *Supplemental Analysis for the Environmental Management Disposal Facility* (United Cleanup Oak Ridge LLC [UCOR]-5843; Supplemental Analysis) was performed to evaluate a hypothetical scenario based on alternate assumptions on future landfill performance and exposure pathways. The analytical WAC will be evaluated on individual waste lots and their impact to the overall volume weighted sum-of-fractions (VSWF) for the entire disposal facility.

In addition to the WAC requirements, operation-based constraints on the size, weight, dimensions, and similar physical characteristics of CERCLA waste, as well as safety basis radioactivity constraints are developed specifically for the EMDF and in compliance with safety basis guidance. These constraints will be established and formalized in EMDF plans and procedures to ensure acceptable waste can be safely received and disposed at EMDF. These operational constraints and limits are established to protect the workers during transportation, handling, and placement of waste into EMDF (i.e., during operations). These constraints are compliant with DOE Directives for the safe handling of low-level (radioactive) waste (LLW) and operations of an LLW disposal facility. The EMDF will be managed and operated as a “radiological facility” in accordance with the requirements of DOE Standard *Hazard Categorization of DOE Nuclear Facilities* (DOE-STD-1027-2018).

This WCP is a primary FFA document that provides details regarding the development of administrative and analytical WAC and the process for acceptance of waste at the EMDF. The application of these WAC limits were developed based on the ARARs and other agreements documented in the approved ROD that are described herein along with more extensive information regarding waste generation, characterization, waste profile development, waste acceptance, and tracking of the waste. The waste profile process will be followed that captures the required information and promotes a consistent approach in waste acceptance.

When planning disposal options for waste generated by cleanup activities, the OREM waste hierarchy (Fig. 2) is implemented that considers potential reuse or recycle options first, followed by disposal as a sanitary/industrial waste, followed by disposal in the onsite Environmental Management Waste Management Facility (EMWMF)/EMDF for high volumes of CERCLA waste and lastly offsite disposal is considered, if needed.

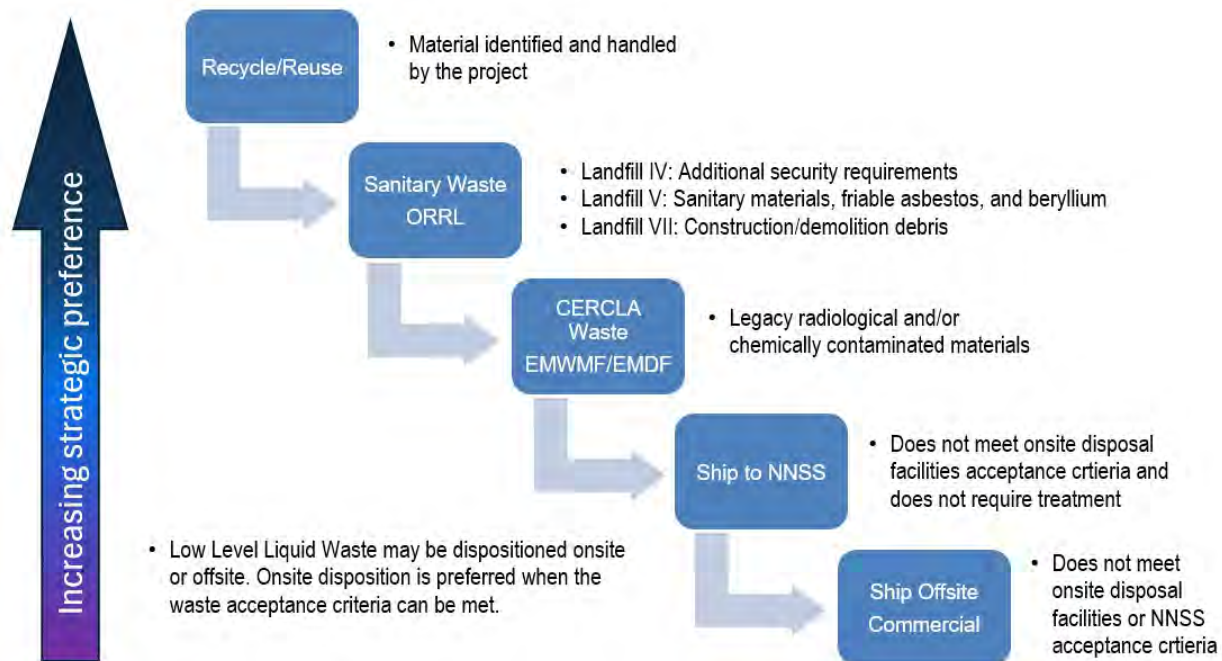


Fig. 2. OREM waste disposal hierarchy.

Characteristics of CERCLA waste streams proposed for disposal at EMDF were described in the *Remedial Investigation/Feasibility Study for Comprehensive Environmental Response, Compensation, and Liability Act Oak Ridge Reservation Waste Disposal, Oak Ridge, Tennessee* (DOE/OR/01-2535&D5; RI/FS) and summarized in the *Proposed Plan for the Disposal of Oak Ridge Reservation Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Waste* (DOE/OR/01-2695&D2/R1; Proposed Plan). A supplemental analysis was also performed as prescribed in the EMDF ROD to inform the EMDF design and WAC (UCOR-5843).

The total amounts (inventory) and concentrations of radioactivity in LLW and Resource Conservation and Recovery Act of 1976 (RCRA) treated waste accepted for disposal are the primary considerations for analysis of potential carcinogenic risk to human health posed by the remedy. Both inventory limits and waste concentration limits have been established for EMDF. Compliance with waste concentration limits is evaluated using a sum-of-fractions (SOF) approach applied to waste lots, while compliance with inventory limits is evaluated for the entire disposal facility using a VWSF.

Risks posed by non-radiological contaminants (e.g., heavy metals, mercury, organics, polychlorinated biphenyls [PCBs]) are managed by meeting ARARs for hazardous/toxic contaminants prior to land disposal. The waste generator must ensure generated hazardous waste is treated to meet RCRA land disposal restrictions (LDRs); this may include treatment followed by post-verification characterization for non-mercury hazardous waste, as required. In addition, trigger level facility average concentrations have been defined for total uranium and for mercury based on the toxicity projections reported in the EMDF Supplemental Analysis. EMDF trigger levels provide a basis for initiating an evaluation of additional risk management activities in the event that actual or forecast average concentrations of the total EMDF waste disposed to date approach the trigger level.

Included in this WCP are supporting documentation in the following appendices:

- Appendix A. Final Waste Acceptance Criteria

- Appendix B. Process for Developing New Analytical WAC
- Appendix C. General Guidance For Data Collection, Data Analysis, and Development of Sampling Plans
- Appendix D. Waste Profile Template
- Appendix E. EMDF Waste Acceptance Criteria Tracking Reporting Analysis Capability System
- Appendix F. Definitions

1.2 BACKGROUND

Waste disposed at EMDF will originate primarily from facility deactivation and demolition (D&D) or environmental remediation projects at the ORR, including the Y-12 National Security Complex (Y-12), Oak Ridge National Laboratory (ORNL), and Heritage Center (formerly East Tennessee Technology Park). All waste to be disposed at the EMDF will be generated from CERCLA remediation, removal, and/or investigation activities within the ORR as delineated in the ROD. Also as described in the ROD, waste associated within the ORR may be accepted with U.S. Environmental Protection Agency (EPA), Tennessee Department of Environment and Conservation (TDEC), and DOE participation during the evaluation process and the formation of project teams. Any candidate waste stream from the ORR will be evaluated through the CERCLA process. The proposed waste includes, but is not limited to, facility demolition debris (including structural steel and concrete), contaminated equipment, piping, asbestos-containing material (ACM), soil and other soil-like wastes, and other secondary waste including personal protective equipment and job control waste. EMDF will primarily accept bulk waste for direct disposal, but containerized LLW and RCRA treated waste may also be accepted for disposal. The volumes of waste and the levels of these contaminants are expected to be low and bounded by remedial action waste from Y-12 and ORNL.

Potential radiological and chemical contaminants were identified from existing characterization data and representative waste stream characterization data from similar waste disposed of at EMWMF. Wastes derived from CERCLA cleanup at Y-12 and ORNL are expected to contain a wide range of radionuclides. The primary radioactive contaminants in Y-12 waste streams are uranium and decay chain isotopes such as thorium and radium, whereas ORNL waste streams contain a greater variety of radionuclides, including fission products such as cesium 137 (Cs-137) and strontium 90 (Sr-90), and to a lesser extent fission products that are more mobile such as technetium 99 (Tc-99) and iodine 129 (I-129). Trace quantities of some transuranic (TRU) radionuclides (e.g., plutonium and americium) are also predicted in ORNL waste. This is important for estimating the EMDF radiological inventory because Y-12 waste accounts for approximately 70% of the forecasted waste volume and ORNL waste accounts for the remaining 30%. Due to these differences in waste volume and radiological characteristics, Y-12 waste accounts for most of the uranium activity in the expected EMDF inventory, whereas ORNL waste accounts for most of the expected total radionuclide curie inventory.

For the DOE-approved *Performance Assessment for the Environmental Management Disposal Facility at the Y-12 National Security Complex, Oak Ridge, Tennessee* (UCOR-5094/R2; PA), fate and transport modeling applied to a conservatively estimated radionuclide inventory was used to predict potential exposures (radiological dose) to future hypothetical receptors resulting from release or inadvertent intrusion, based on dominant contaminant transport and exposure pathways to the receptor. The process used to determine which radioisotopes to consider in the EMDF performance modeling began with identification and quantification of radioisotopes expected to be present in waste resulting from Y-12 and ORNL cleanup. This list of radionuclides was based on substantial historical and forecast information that included (1) EMWMF waste characterization data for previously generated and disposed (historical) Y-12 and ORNL waste lots; (2) data from detailed facility and environmental characterization studies; and (3)

data from the targeted D&D facilities, which included radionuclide quantities derived from various types of facility safety analyses and other sources.

The EMDF chemical contaminant inventory is likely to be dominated by metals, including common soil constituents such as iron, aluminum, calcium, magnesium, potassium, and sodium, as well as barium, chromium, lead, manganese, and uranium. Minor amounts of organic contamination, including PCBs, are anticipated to be similar to EMWMF waste lots. Other chemical contaminants include asbestos and beryllium; however, these contaminants have disposal requirements in ARARs and require operational procedures concerning packaging and labeling requirements. Many of these contaminants are a result of standard industrial materials inherent to materials of construction in facilities and former operations at Y-12 and ORNL.

Mercury contamination including liquid mercury is also present in a subset of the anticipated Y-12 waste streams because of past operations at specific mercury use facilities and to a lesser extent in ORNL waste streams. Visible recoverable liquid mercury and waste with sample results above mercury hazardous waste levels will be segregated and disposed of offsite. The remaining waste streams that are eligible for onsite disposal as nonhazardous waste will have been characterized with sample results that confirm the waste meets the toxicity characteristic levels as defined in 40 *Code of Federal Regulations (CFR)* 261.24 using the Toxicity Characteristic Leachate Procedure (TCLP) SW 846. Mercury-contaminated waste that is sampled and is not below 0.2 mg/L TCLP and visible recoverable liquid mercury will be collected and treated offsite. Refer to Section 4.1.4 for further explanation on the RCRA hazardous waste determination process. Acceptance of other hazardous and toxic contaminants is limited by ARARs and consensus of treatment among FFA parties; however, mercury hazardous [D009] waste is prohibited from disposal in EMDF even if treated to meet LDRs. RCRA listed hazardous waste is also administratively prohibited.

For non-radiological contaminants in EMDF waste other than mercury, no significant difference in inventory or average concentrations from EMWMF is expected. EMWMF has demonstrated maintaining a hazard index (HI) below 1 for non-carcinogens and the primary HI contaminants of concern have been lead, antimony, and molybdenum. For EMDF, the Y-12 and ORNL waste is not expected to have significantly higher concentrations of these contaminants. In addition, the Supplemental Analysis results suggest that no unacceptable hazardous or carcinogenic chemical risk is expected using EMWMF waste lot data to estimate EMDF non-radiological inventories. Therefore, there is a reasonable expectation that waste meeting RCRA LDRs can be safely disposed in EMDF without unacceptable risks from industrial chemical constituents.

RCRA hazardous waste requiring treatment to meet LDRs disposed at EMWMF to date accounts for less than 0.05% of the EMWMF total capacity. When RCRA hazardous wastes are identified at the generator site, the majority of these wastes are managed and profiled separately for offsite disposal so that the remaining bulk of the waste can be managed as LLW. Except for D009 (mercury characteristic waste), RCRA-treated waste may be considered when the implemented technology-based or performance-based treatment process has been approved and verified with FFA acceptance to meet LDR criteria.

PCB limits are provided by Toxic Substances Control Act of 1976 (TSCA) disposal requirements, whereby no PCB liquids are allowed for land disposal and are consistent with the prohibition of free liquids disposed in EMWMF and EMDF. PCB bulk product waste is authorized for disposal in a municipal waste landfill and PCB remediation waste, including contaminated equipment, is authorized for disposal in chemical waste landfills and RCRA Subtitle C landfills by regulations; therefore, these wastes are acceptable when properly characterized and profiled since EMDF is designed to meet the substantive chemical waste and Subtitle C landfill requirements.

1.3 SELECTED REMEDY

The selected remedy described in the ROD provides for construction in phases to include up to 2.2 million cubic yards of disposal capacity with multiple waste cells, a RCRA-compliant multi-layer liner system with a leachate collection/detection system to isolate waste from the environment, and a RCRA-compliant multi-layer cover system to reduce infiltration and isolate the waste from human and environmental receptors.

Surface water will be managed by diverting water around the facility. A liner and geologic buffer system will isolate the facility from groundwater. The geologic buffer layer will be in place under the landfill liner and above the seasonal high-water table of the uppermost unconfined aquifer or the top of the formation of a confined aquifer. The geologic buffer will consist of the geologic formation (i.e., in situ soil or rock) or compacted fill. A leachate collection system and other support facilities, including a liquid waste treatment system, will also be designed and constructed as part of EMDF. The final construction details will be included in a post-ROD remedial design report, a primary document that requires approval by FFA parties. Long-term monitoring and maintenance of EMDF to ensure the integrity of the facility and institutional controls to prevent access to waste in the future are also part of the selected remedy. DOE will maintain the EMDF, including active and passive institutional controls as required by the ROD, and will use monitoring and the CERCLA five-year review process to ensure that the disposal facility is protective during operations and in perpetuity post-closure.

2. SCOPE AND PURPOSE

This WCP has been developed to define the overall processes for ensuring that all regulatory agreements and risk-based performance criteria are attained before and throughout disposal operations. It also ensures the safe and efficient disposal of CERCLA waste in the EMDF. The processes are constructed to do the following:

- Define the requirements to characterize waste lots to determine contaminants, concentrations, and analyze waste lots to determine contaminants and corresponding concentrations while evaluating impacts to the overall disposal cell inventory
- Determine waste lot acceptance using concentration limit SOFs and EMDF inventory limits using VWSFs for current and future disposed waste
- Identify waste profile parameters and confirm waste acceptance for onsite disposal
- Ensure all applicable hazardous waste LDRs are met
- Perform and document required quality assurance (QA)/quality control (QC) measures

All waste to be shipped to the EMDF will be generated from CERCLA remediation, removal, and/or investigation activities within the onsite ORR as delineated in the EMDF ROD, or will be evaluated per the EMDF ROD and have EPA, TDEC, and DOE review and approval through the data quality objectives (DQO)/data quality assessment (DQA) process prior to shipment. This WCP is structured to include both administrative (regulatory-based agreements) and analytical requirements (performance-based agreements) to be met by the waste generator.

Specific CERCLA-driven plans will be developed through the remedial design/remedial action process (i.e., Remedial Action Work Plan [RAWP]). Characterization documents will also be required to demonstrate how each waste lot was characterized in accordance with the DQO process as described in *Guidance on Systematic Planning Using the Data Quality Objectives Process*, EPA QA/G-4; or an equivalent process. As the DQOs are approved and implemented, the characterization data becomes available and is analyzed so that proper waste determinations and disposal decisions are made with sufficient quality, confidence, and coverage. The characterization data is ultimately compiled and evaluated through the DQA process outlined in *Data Quality Assessment: A Reviewer's Guide* (EPA QA/G-9R).

NOTE: Both the DQO and DQA become the foundation of how each waste lot is evaluated and characterized while producing qualified data for the reporting of site-related contaminants (SRCs), including concentrations and impacts to the EMDF VWSF. A DQO must be presented to FFA parties and accepted prior to waste lot approval.

For remedial action projects generating waste that will be disposed of in the EMDF, CERCLA documentation and project-specific plans will incorporate, or otherwise be consistent with, the requirements of this WCP. Project-specific plans will define the scope of the project, including waste generation activities for facilities, slabs, subsurface features, and well-defined soil excavations including lateral and vertical boundaries. Planning documents including facility history and process knowledge (PK) are also used to support waste determinations, which may specify the composition of a waste stream or the scope of a given waste lot.

Planning documents shall also specify the anomaly detection process for the removal of waste requiring segregation and offsite disposal, while also ensuring no prohibited items or anomalous waste are included in the waste stream during waste generation. As described in anomaly detection plans (ADPs), known

anomalous wastes may require segregation before demolition or as part of removal/remedial action when not safely accessible. For example, anomalous waste such as recoverable liquid mercury will be detected through visual inspections or other means and segregated for offsite disposition. In other cases, anomalous waste may be segregated for additional characterization (i.e., waste piles) or treatment for separate consideration either for disposal in the EMDF or for other disposition. Known anomalous waste is identified in the DQA and presented to FFA parties prior to waste profile approval. ADPs are incorporated into the waste profile and included as part of work control during waste generation, waste loading, and waste disposal. These plans and associated anomaly detection checklists (ADCs) are integral to the overall waste certification process performed by the waste generator. ADPs and ADCs are tailored to each project and once approved in the waste profile are used to certify shipments or loads are in compliance with the associated approved waste profile.

The main purpose of the WCP is to provide waste generators with a roadmap to comply with the technical requirements while also meeting the terms and conditions under which the EMDF will accept waste. The waste profile format is also designed to capture essential data and information that assures compliance with all WAC.

These WCP objectives are tailored to also provide:

- Assurance that adherence to all administrative requirements will result in waste that is compliant with ARARs in the ROD, and from other agreements between DOE, EPA, and TDEC; otherwise referred to as “triparty agreement”
- Compliance with all applicable federal and state regulations, DOE Orders and authorizations, including requirements outlined in DOE O 435.1, *Radioactive Waste Management*; State of Tennessee hazardous waste regulations; and other relevant state and federal regulations
- Performance criteria are measurable (i.e., SOFs and VWSFs) and provide analytic criteria designed to meet risk parameters that are derived from the approved risk assessment model results provided in the ROD and other triparty agreements for the EMDF

Other facility-specific or landfill performance criteria such as auditable safety analysis (ASA)-derived WAC will be managed in accordance with DOE Orders and operational plans and procedures performed by the EMDF Operations. These criteria, derived from the facility safety and authorization basis documentation, will ensure the EMDF operates safely within the authorized safety envelope and as a “radiological facility” categorization. These criteria will be addressed separately with EMDF Operations; however, integration during the waste acceptance process will ensure all facility or performance-based WAC are met through disposal including any special handling/packaging or required radiological inventory management.

Physical waste acceptance criteria (PWAC) such as size, dimensions, weight, and final waste form will also be managed separately within operational plans and procedures, including technical information documents that describe the operational aspects of the facility including required packaging, transportation, radiological surveys, and shipping records, etc. In some cases, a PWAC variance may be necessary to manage a unique waste stream or item that requires special handling by EMDF Operations. Any PWAC that could impact an administrative requirement (e.g., free liquids, void spaces, containerized waste) will be addressed during waste acceptance including any mitigation steps that will be performed throughout disposal.

3. ROLES AND RESPONSIBILITIES

The EMDF Waste Acceptance Team (WAT) verifies that waste profiles developed by the generator are complete and adequately demonstrate that all relevant EMDF WAC are satisfied. Several different entities must be integrated in order for the waste approval and disposal process to function properly. DOE is accountable for WAC compliance as described in this document. DOE has delegated the responsibility to make waste acceptance decisions to its prime contractor, while DOE oversees and audits the waste acceptance process. EPA and TDEC are integrated into the process as stakeholders in each CERCLA project team. EPA and TDEC, along with DOE, review and approve the proposed scope of the CERCLA action with the associated characterization used for waste disposal at EMDF.

The EMDF WAT, composed of prime contractor personnel, is responsible for reviewing waste generator information and waste profiles to determine whether waste lots can be accepted for disposal and are the principal point of contact for EMDF compliance using this plan. The EMDF WAT operates independently from waste generating projects and executes their responsibilities without pressure regarding schedule or budget, while having direct access with various compliance organizations and DOE OREM site representatives for EMDF compliance issues. EMDF WAT will coordinate with EMDF Operations on any special handling requirements or nuclear safety limitations and incorporate any necessary operational actions required by the generator in the approval package. EMDF WAT provides independent oversight of generator compliance with the EMDF WAC in the form of surveillances and assessments with an emphasis on characterization, waste traceability, anomaly detection processes, and waste packaging and transportation. Results from assessments are reported to DOE OREM while any corrective actions assigned are tracked through completion.

A separate division of the prime contractor will operate and manage EMDF Operations including waste receipt, placement, compaction, environmental monitoring, and overall placement tracking of waste. EMDF Operations will manage the facility in accordance with safety basis requirements and operational plans and procedures, including monitoring contact water and leachate collection systems. EMDF Operations is also responsible for scheduling and receiving waste in accordance with approved documentation and verifying that all physical WAC are met. If waste is found not to comply with the EMDF WAC, including PWAC and the identification of anomalous waste, it will be the responsibility of the CERCLA project generating those wastes to correct the noncompliant condition. In some cases, the issue may be addressed by EMDF Operations with adequate documentation on the corrective action(s). EMDF Operations is also responsible for verifying that the waste is from an approved waste lot and that all required CERCLA project certifications have been made.

The FFA parties (DOE, EPA, and TDEC) oversee and audit waste generator projects, EMDF operations, and EMDF WAT, including decisions to authorize waste lots for disposal. The FFA parties are integrated into the various project teams and review and approve required CERCLA primary documents (e.g., RAWP, removal action report, technical memo, Phased Construction Completion Report [PCCR]). The FFA parties are also stakeholders in the DQO process and review and accept characterization plans such as sampling and analysis plans (SAPs) and QA project plans. Once the data are collected, compiled, and evaluated by the CERCLA project, the final characterization data are presented in a DQA. The DQA, once agreed to and approved by the applicable project team, provides the foundation and technical basis for waste profile characterization. After the DQA is approved, a controlled data set (CDS) is established, and the waste profile is completed. As the waste profile is developed and submitted, the EMDF WAT verifies that data is consistently and accurately used and presented in the waste profile so that defensible decisions are made for waste acceptance. These systematic reviews are conducted to ensure all stakeholders agree with characterization approaches while the resulting data is accurately reported to support regulatory determinations and represent waste lot contaminants. With FFA party agreement during the DQO/DQA processes, the EMDF WAT makes the final determination for waste lot approval. If approved, a formal waste profile approval package is then provided to all stakeholders and the waste generator.

CERCLA projects are responsible for complying with all WAC for wastes disposed of in the EMDF. This WCP will be utilized by waste generators at the ORR (including Heritage Center, Y-12, and ORNL) who are authorized under DOE OREM, National Nuclear Security Administration (NNSA), or Office of Science ORNL Site Office. FFA parties may approve CERCLA waste when approved in appropriate CERCLA documentation. CERCLA projects may include D&D, soil remediation, or prime contractors performing surveillance and maintenance on the ORR under CERCLA authority. Operational waste or non-CERCLA waste from active Y-12 and ORNL facilities are not forecasted or authorized for disposal at EMDF.

The EMDF WAT is responsible for approving all waste lots for disposal considering the following key information:

- All administrative WAC have been met
- Waste determinations are complete including RCRA/TSCA LDR compliance
- Characterization data is accurate, complete, and in compliance with the DQO/DQA processes
- Contaminant concentrations of the proposed waste lot are acceptable and within the analytical WAC limitations
- Remedial action boundaries and scope are well defined and anomalous waste detection processes are defined for implementation

The primary tool that will be used by the EMDF WAT to assess compliance with the analytical WAC requirements will be Waste Acceptance Criteria Forecasting Analysis Capability System (WACFACS).

Table 1 presents a crosswalk of DOE, prime contractors, and regulator roles and responsibilities.

Table 1. Crosswalk of principle roles and responsibilities

From \ To	CERCLA project (OREM prime contractor, NNSA contractor, Office of Science contractor)	EMDF Operations	EMDF WAT	DOE	TDEC and EPA
CERCLA project (OREM prime contractor, NNSA contractor, Office of Science contractor)	---	• Coordinate ASA with facility management and nuclear safety personnel • Submit EMDF Material Screen Calculation Worksheet • Comply with ASA and any UCD/USQD limitations • Submit PWAC variance • Submit RTSC • Coordinate shipments • Deliver waste as scheduled • Certify each shipment with ADC • Provide rad surveys, as applicable	• Prepare DQO, SAP, QAPP for review • Prepare RCRA and TSCA determinations • Prepare DQA for acceptance • Prepare waste lot profile • Prepare and implement ADPs • Certify each shipment with ADC	• Prepare and submit CERCLA documentation for approval • Manage and execute remedial action/D&D scope • Prepare DQO, SAP, QAPP for acceptance • Perform D&D and remedial action scope	• Prepare FFA primary documents for approval • Provide DQO/DQA for acceptance • Adhere to all applicable regulations and WCP requirements
EMDF operations	• Approve PWAC variances • Approve RTSC • Implement ASA and nuclear safety requirements • Approve EMDF Material Screen Calculation Worksheet • Accept and dispose of wastes • Verify physical WAC compliance • Track placement of waste • Provide summary of waste disposal volumes	---	• Evaluate ASA and other safety basis criteria • Approve ASA and nuclear safety/criticality documentation • Perform and report civil surveys of waste disposed • Confirm waste has proper approvals • Observe waste for potential anomalies • Track waste placement	• Maintain facility and nuclear safety related information • Address PWAC variances and evaluate equipment needs • Provide summary of waste disposal volumes • Cooperate with oversight activities	• Provide summary of waste disposal volumes • Participate in oversight activities • Provide monthly operational status • Coordinate on-site access to EMDF
EMDF WAT	• Provide waste acceptance guidance • Review DQO/DQAs • Provide WACFACS output • Review and approve waste lot profiles • Provide independent oversight of WAC compliance • Audit waste generation activities (i.e., treatment)	• Provide SRC information from waste profile • Assist with ASA and nuclear safety compliance • Provide profile approval package • Provide VWSF on EMDF inventory	---	• Support Project Team coordination • Provide waste profile for review prior to approval • Provide profile approval package • Maintain auditable VWSF on EMDF inventory • Propose new and changed WAC packages • Cooperate with oversight activities	• Support Project Team coordination • Provide profile approval package • Maintain auditable VWSF on EMDF inventory • Propose new or changed WAC packages • Participate in oversight activities
DOE	• Set project scope, funding, and schedule milestones • Review of CERCLA documentation • Accept DQO/DQA • Perform Assessments of profile process • Participate in Regulatory Project meetings	• Audit and oversee disposal activities.	• Manage EMDF WAC • Audit waste profiles prior to approval • Manage overall EMDF inventory limits • Audit and oversee WAC acceptance decisions including overall VWSF • Consider proposed WAC changes • Evaluate WLs with trigger level concerns	---	• Integrate Project Teams and ensure agreements are met • Submit CERCLA documents for approval • Propose sequencing and VWSF solutions • Evaluate WLs with trigger level concerns • Propose new WAC and WAC changes
TDEC and EPA	• Audit and oversee CERCLA activities and ensure TDEC/EPA regulations are met • Review and accept DQOs/DQAs • Approve CERCLA documents, as required • Audit and oversee waste generation activities	• Audit and oversee disposal activities	• Approve CERCLA FFA primary documents • Accept DQOs / DQAs including SAPs and QAPPs • Audit and oversee WAC acceptance and approval decisions • Approve new WAC and WAC changes	• Support Project Team decisions • Approve CERCLA documents • Approve new WAC and WAC changes	---

ADC = anomaly detection checklist
ADP = anomaly detection plans
ASA = auditable safety analysis
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
D&D = deactivation and demolition
DOE = U.S. Department of Energy
DQA = data quality assessment
DQO = data quality objectives
EMDF = Environmental Management Disposal Facility

EPA = U.S. Environmental Protection Agency
NNSA = National Nuclear Security Administration
OREM = Oak Ridge Office of Environmental Management
PWAC = physical waste acceptance criteria
QAPP = quality assurance project plan
RCRA = Resource Conservation and Recovery Act of 1976
RTSC= Readiness to Ship Checklist
SAP = sampling and analysis plan
SRC = site-related contaminant
TDEC = Tennessee Department of Environment and Conservation

TSCA = Toxic Substances Control Act of 1976
UCD = Unreviewed Change Determination
USQD = Unreviewed Safety Question Determination
VWSF = volume-weighted sum of fractions
WAC = waste acceptance criteria
WACFACS = Waste Acceptance Criteria Forecasting Analysis Capability System
WAT = Waste Acceptance Team
WCP = waste acceptance criteria compliance plan
WL = waste lot

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4. WAC COMPLIANCE PROCESS

The overall compliance objectives for meeting the EMDF WAC involve adhering to the administrative and analytical technical requirements or performance-based criteria. Foremost is the administrative WAC, which is derived from regulatory requirements, ARARs, and other CERCLA decision document agreements. Next, the analytical WAC is considered, which is derived from the CERCLA risk assessment modeling performed in support of the EMDF ROD remedial action objectives. Once the analytical WAC requirements are met, a waste profile is used to document overall compliance and provides the necessary information for final acceptance. EMDF Operations evaluates nuclear safety requirements (ASA, PWAC) and whether any special handling is required above normal operations within the established safety envelope.

The EMDF waste acceptance process depicted in Fig. 3 provides an overall illustration of the critical steps, essential documents, and the interfaces required for the CERCLA project during the development and approval of a waste profile. As profiles are developed and submitted, the WAT will evaluate and verify each waste lot meets both administrative and analytical WAC including remaining within the risk-based performance parameters (VWSF <1 for EMDF). Administrative WAC verification may involve the completion and verification of required treatment. Analytical WAC verification will involve a two-step process where concentration limits are confirmed to be below SOF <1, and EMDF inventory limits will be managed using a VWSF <1 for the entire EMDF disposal facility.

The primary unit of waste to be considered for WAC compliance determination is the waste lot. A waste lot can be all or some of the waste of a particular waste stream removed from a CERCLA site. The waste lot is defined in the CERCLA documentation with the DQO/DQA defining the waste characteristics used for acceptance. Initial screening of a waste lot may be required to ensure compliance with performance criteria. As the characterization data and regulatory waste determinations are completed, the waste profile process is followed and submitted while EMDF WAT completes its systematic review against the WAC. Once approved, an approval letter is issued to all stakeholders. By following the DQO/DQA process, characterization information is complete with concurrence by all stakeholders making the profile review a verification that all agreements have been satisfied with acceptable results.

The size of individual waste lots is generally determined by the extent to which the wastes are characterized and the similarity of the wastes across a facility or site. If there are clear spatial variations in contaminant concentrations within a given facility/site, several lots may be designated to distinguish waste with different contaminant loading. Also, even if a volume of waste does not have large variations in the contaminant concentrations, that waste may be divided into several lots for convenience in meshing the project's schedule with the production of its wastes. An example of this is a situation in which a project must demolish a facility and yet defer the slab and subsurface soils to different time and scope. In some cases, waste lots may defer specific waste streams and declare them as anomalous until such time the characterization of these elements is completed. In these situations, revisions can be made to the profile as more scope and data are verified, incorporated, and evaluated for acceptance.

When potentially anomalous waste is discovered at the waste generator site, this waste shall remain segregated until such time characterization is complete and has been verified through the DQO/DQA processes to meet the EMDF WAC disposal requirements. Otherwise, anomalous waste is segregated and disposed at an offsite treatment, storage, and disposal facility.

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EMDF Waste Acceptance Process

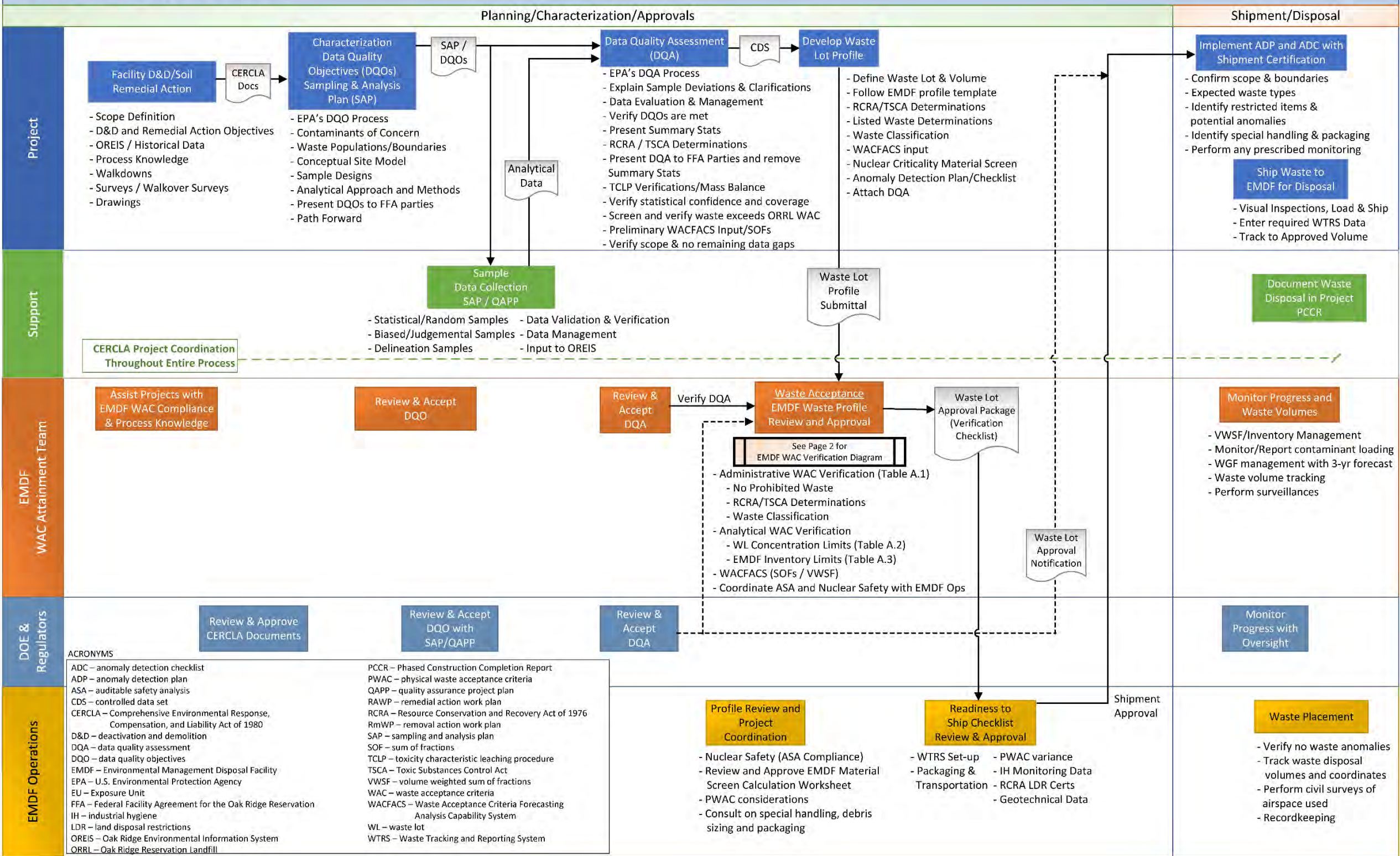


Fig. 3. EMDF waste acceptance process.

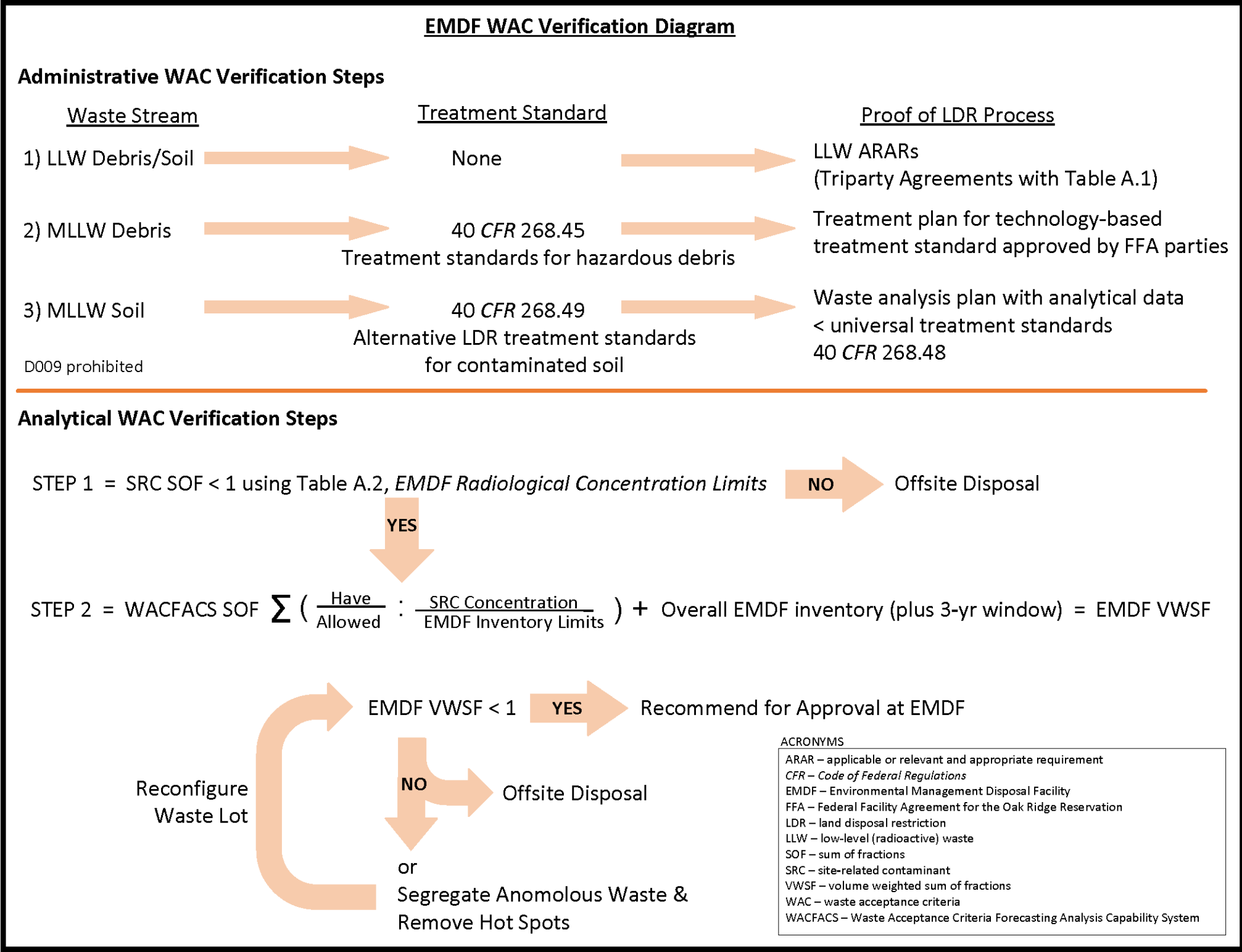


Fig. 3. EMDF waste acceptance process (cont.).

4.1 ADMINISTRATIVE WAC

4.1.1 ARARs

Administrative WAC include requirements or standards of federal laws and promulgated state laws that are deemed ARARs and govern the proper management and disposal of hazardous substances, pollutants, or contaminants being addressed by a CERCLA cleanup action. Administrative WAC are mandatory requirements derived from ARARs (included in Appendix A of the EMDF ROD) that satisfy design-based and other substantive, performance-based requirements, or agreements among the FFA parties (Table 2). Several of the administrative WAC are derived from RCRA and TSCA regulations. Both federal and state regulations apply and TDEC regulations have been cited when more stringent than federal regulations. Administrative WAC also include agreements among the FFA parties, specifically those addressing prohibited waste types. These administrative WAC were approved in the EMDF ROD and have been incorporated into the WAC for implementation.

EMDF, like EMWMF, will be designed and constructed to meet the substantive requirements of RCRA Subtitle C, Subtitle D, and TSCA, which will be the primary waste types expected to be generated in addition to radioactive waste. To be disposed in EMDF, hazardous waste must be treated to meet LDRs (ARARs) that may include either technology-based or performance-based treatment standards, with the exception of D009 mercury waste (see below). When using performance-based treatment technology, LDR numerical standards must be met. Because of the decision to build EMDF under the CERCLA regulatory process, only the substantive portions of these ARARs apply (e.g., numerical standards and performance-based metrics). Therefore, EMDF is not an administratively RCRA-permitted landfill under any of these regulations and is authorized to accept only waste generated under CERCLA actions on the ORR.

The Administrative WAC are summarized in Table 2. Agreements that address overall hazardous waste management strategy, including the D009 mercury management approach for the EMDF are further detailed in this plan.

Table 2. Administrative waste acceptance criteria

Waste prohibited or limited by definition or decision	Basis of prohibition/limitation
Waste must be generated as part of a CERCLA action on the Oak Ridge NPL Site. Waste generated at other sites within the State of Tennessee where contamination can be related to Oak Ridge NPL Site releases would require FFA party consideration and agreement.	Triparty agreement ^a
Transuranic waste (defined in 40 <i>CFR</i> 191.02), high-level waste (defined in 10 <i>CFR</i> 60.2), spent nuclear fuel (defined in 10 <i>CFR</i> 72.3), 11e(2) byproduct waste (defined in 10 <i>CFR</i> 20.1003), and/or greater than NRC Class C waste (defined in 10 <i>CFR</i> 61.55) are prohibited. These waste types are excluded from the definition of low-level waste (defined in TDEC 0400-20-11-.03[21]).	Triparty agreement ^a and regulatory definitions
RCRA-listed hazardous wastes are prohibited.	Triparty agreement ^a
Infectious/pathogenic wastes and pyrophoric/detonatable/explosive wastes are prohibited, as are wastes that could generate quantities of toxic gases/vapors/fumes.	Triparty agreement ^a TDEC 0400-20-11-.17(7)(a)(4) TDEC 0400-20-11-.17(7)(a)(5) TDEC 0400-20-11-.17(7)(a)(6)
Containerized compactible waste shall either have voids filled with non-compressible material (e.g., soil, grout), or be capable of being crushed by available landfill operations equipment. Non-crushable containers (B-25 boxes, etc.) shall have remaining voids filled with non-compressible material. Cardboard or fiberboard boxes shall not be used as containers for waste disposal.	Triparty agreement ^a TDEC 0400-20-11-.17(7)(b)(1) TDEC 0400-20-11-.17(7)(b)(3) TDEC 0400-20-11-.17(7)(a)(1)
Free liquids are prohibited; RCRA and TSCA waste packages shall have no free liquids.	40 <i>CFR</i> 761.75(b)(8)(ii) TDEC 0400-12-01-.06(14)(o)(3) TDEC 0400-20-11-.17(7)(a)(3)
Bulk liquids exceeding 500 ppm PCBs are prohibited. Bulk liquids containing PCBs at or below 500 ppm must be treated such that they no longer contains free liquids. PCB containers with PCB liquids between 50 ppm and 500 ppm are allowed with additional sorbent material included.	40 <i>CFR</i> 761.75(b)(8)(ii)
Bulk or non-containerized liquid hazardous waste or hazardous waste containing free liquids (whether or not sorbents are added) are prohibited.	TDEC 0400-12-01-.06(14)(o)(l)
Unless very small, containers must be either at least 90% full when buried in the landfill or crushed, shredded, or similarly reduced in volume to the maximum practical extent before burial in the landfill.	TDEC 0400-12-01-.06(14)(p)
Waste must not contain or be capable of generating quantities of toxic fumes or gases harmful to persons transporting, handling, or disposing the waste.	TDEC 0400-12-01-.06(2)(h)(2)

Table 2. Administrative waste acceptance criteria (cont.)

Waste prohibited or limited by definition or decision	Basis of prohibition/limitation
RCRA hazardous waste that is not treated to meet LDR treatment requirements or alternative treatment standards for hazardous debris or soil is prohibited from disposal. Treated RCRA hazardous waste with TCLP regulatory levels less than LDR treatment requirements (e.g., selenium) that do not meet the lower of the 40 <i>CFR</i> 261.24 regulatory level or LDR treatment requirement is prohibited from disposal (This is not applicable to mercury characteristic waste (D009) as generated – see exception in this table). Note: LDR requirements have associated numerical or technology standards that must be met prior to land disposal; see ARARs in Table A.3 and appropriate citations given there.	TDEC 0400-12-01-.10(3)(a) TDEC 0400-12-01-.10(3)(f)(1) TDEC 0400-12-01-.10(3)(j)(2) Triparty agreement^a
RCRA (D009) mercury characteristic hazardous waste, as determined by the method specified in 40 <i>CFR</i> 261.24, is prohibited from disposal.	Triparty agreement^a

Source: Table 2.6 of the EMDF ROD.

^a*Triparty agreement* refers to discussions held for the given prohibition/limitation and decisions/agreements reached among the three FFA parties regarding the specific WAC given here, which are documented by the approval of the *Record of Decision for Comprehensive Environmental Response, Compensation, and Liability Act Oak Ridge Reservation Waste Disposal at the Environmental Management Disposal Facility, Oak Ridge, Tennessee* (DOE/OR/01-2794&D2/R2).

ARAR = applicable or relevant and appropriate requirement
CERCLA = Comprehensive Environmental Response,
Compensation, and Liability Act of 1980
CFR = *Code of Federal Regulations*
DOE = U.S. Department of Energy
FFA = Federal Facility Agreement
LDR = land disposal restrictions
NPL = National Priorities List

NRC = U.S. Nuclear Regulatory Commission
PCB = polychlorinated biphenyl
RCRA = Resource Conservation and Recovery Act of 1976
ROD = Record of Decision
TCLP = Toxicity Characteristic Leaching Procedure
TDEC = Tennessee Department of Environment and Conservation
TSCA = Toxic Substances Control Act of 1976
WAC = waste acceptance criteria

4.1.2 Summary of Prohibited Waste Types

As described in the EMDF ROD, the following are the prohibited waste types:

- Non-CERCLA waste
- TRU waste: The concentration of alpha-emitting TRU nuclides with half-lives >20 years exceeding 100 nCi/g as defined in 40 *CFR* 191.02
- High-level waste (defined in 10 *CFR* 60.2), spent nuclear fuel (defined in 10 *CFR* 72.3), 11e(2) byproduct waste (defined in 10 *CFR* 20.1003)
- Waste greater than U.S. Nuclear Regulatory Commission (NRC) Class C waste (defined in 10 *CFR* 61.55 and TDEC 0400-20-11)
- RCRA listed waste – a no-longer contains determination may be considered when approved by TDEC
- Visible recoverable liquid mercury (D009 waste)
- Contaminated soils or debris that fails TCLP for D009 Mercury-contaminated hazardous waste – determined to fail 40 *CFR* 261.24 Toxicity Characteristic (TCLP Limit of 0.2 mg/L), even if treated to meet LDRs
- Waste containing or capable of generating harmful toxic gases, vapors, or fumes
- Pyrophoric materials
- Reactive waste (40 *CFR* and/or 49 *CFR*) including oxidizing agents in the form of powders or crystals
- Explosives (defined per 49 *CFR* 173.50)
- Ignitable waste (40 *CFR* and/or 49 *CFR*)
- Corrosive waste (defined per 40 *CFR* 261.22 and 49 *CFR* 173.136)
- Infectious waste and/or waste containing pathogens or other etiologic agents (defined per 42 *CFR* 72.3)
- Animal carcasses and other biological waste
- PCB waste not authorized for disposal in a State permitted non-hazardous waste landfill, chemical waste landfill, or RCRA Subtitle C permitted landfill
- PCB bulk liquids
- Liquid waste, except for the specific allowances identified in this document (see Section 4.1.3.1)
- Incompatible wastes - wastes, absorbent, stabilization media, or other additives that when comingled could result in an unstable waste form such as generation of extreme heat or pressure, fire or explosion, or violent reaction; produces uncontrolled toxic mists, fumes, dusts, or gases in sufficient quantities to threaten human health or the environment
- Compressed gases (defined per 49 *CFR* 173.115) including pressurized containers

4.1.3 Physical Requirements

4.1.3.1 Free Liquids

Free liquids are restricted based on waste classification. For LLW, the ARAR requires waste to have < 1% by volume free liquids. Potable water is typically applied during demolition and remedial action to minimize dust generation; therefore, liquids of this nature are acceptable. For treated RCRA hazardous waste, these final packages are confirmed to have no remaining free liquids.

For high moisture content waste streams such as sludge or sediment, free liquids as determined by EPA Method 9095B, “Paint Filter Liquids Test” (EPA 2004) shall be absorbed, stabilized, or otherwise removed from the waste to ensure the final waste form may be sufficiently compacted in the disposal cell. The waste generator shall document the basis for the type and volume of absorbent added as part of its documentation. High moisture waste stream shall be identified in the waste profile so that these conditions can be coordinated with EMDF Operations.

Residual liquids including residual oils in large debris items shall be adsorbed or removed to the maximum extent practicable by draining suspected liquids at low points and placing an adequate amount of absorbent in empty reservoirs and around each item. LLW equipment items shall be drained such that the amount of liquid does not exceed 1% of the waste item volume. The waste generator shall ensure that any absorbents used are non-biodegradable and specified for the liquid to be absorbed.

4.1.4 RCRA Compliance Requirements

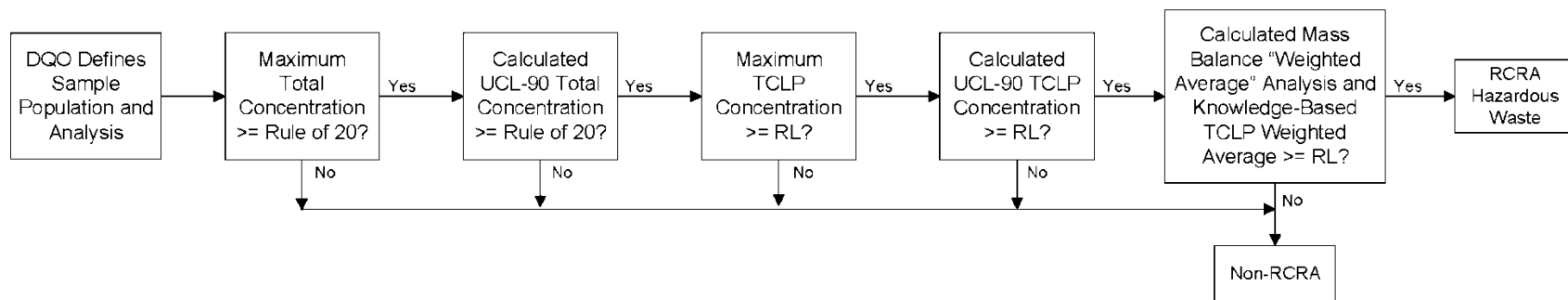
Waste lots require representative characterization following the DQO process including ensuring defensible regulatory waste determinations as required by RCRA hazardous waste regulations and regulatory guidance documents. Characterization data shall be collected in accordance with written SAPs, sample request forms, or similar documentation. The documentation shall specify the sample population and the sample design including representative and/or biased sampling methods. The waste generator shall utilize SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods*, for characterization of RCRA constituents and for demonstrating compliance with LDRs. Radiochemical analysis will be performed in accordance with approved SAPs and will conform to the performance-based criteria as described in *Department of Defense and Department of Energy Quality Systems Manual for Environmental Laboratories*, (QSM 6.0).

The conceptual site model in the DQO identifies all waste populations and resulting data shall be presented in the DQA. There may be situations where discrete items such as liquid mercury or areas require segregation and offsite treatment and disposal. These situations shall be clearly identified in the DQA including how waste segregation shall occur and how removal of these data may impact overall data representation for the EMDF waste lot. If specific items fail TCLP, then all like materials must be evaluated for segregation or verified as acceptable for disposal with the overall waste stream through sampling and analysis utilizing statistical and mass balance methods.

Chemical characterization will be based on meeting RCRA LDRs; therefore, both total concentrations and TCLP methods may be used to confirm RCRA-regulated constituents found in 40 *CFR* 261.24. RCRA characteristic determinations are primarily based on TCLP as defined by SW-846 Test Method 1311. PK may also be used when properly documented.

Figure 4 shows the approaches that may be used for a RCRA hazardous waste determination. For example, when using total concentrations, the Rule of 20 may be utilized to demonstrate the waste is non-hazardous if the total concentration value divided by 20 is less than the TCLP regulatory levels. This may be performed using the maximum concentration of a population or the 90% upper confidence limit (UCL-90) of the mean or through the use of documented mass balance weighted average calculations.

RCRA Analysis-Based/Knowledge-Based Hazardous Waste Determinations*



RCRA = Resource Conservation and Recovery Act of 1976

TCLP = Toxicity Characteristic Leaching Procedure

DQO = Data Quality Objectives

RL = Hazardous Waste Regulatory Limit – Ref: 40 CFR 261.24 Table 1 – Maximum Concentration of Contaminants for the Toxicity Characteristic

Rule of 20 Value = Maximum Theoretical Leachate Concentration (Totals (mg/kg) / 20) equivalent to TCLP concentration

UCL-90 = Upper Confidence Level on the Mean with 90% Confidence – Ref: EPA 530-D-02-002, RCRA Waste Sampling Draft Technical Guidance, Planning, Implementation and Assessment

* NOTE: Observed elementary mercury / liquid mercury equates to RCRA (D009).

Fig. 4. RCRA analysis based/knowledge based hazardous waste determinations

TCLP analysis for constituents identified in 40 *CFR* 261.24 shall be used when the Rule of 20 is exceeded. The UCL-90 TCLP concentration may also be used to represent a waste population or waste lot. Lastly, a weighted average of TCLP values may be used considering a mass balance approach. A combination of testing and knowledge may be used when evaluating whether a waste stream or waste lot exhibits a characteristic. Once the contaminants and their concentrations are known, knowledge (e.g., weight averaging) may be used to determine whether the debris is characteristic, per EPA guidance *Waste Analysis at Facilities that Generate, Treat, Store, and Dispose of Hazardous Wastes* – Final (EPA 530-R-12-001). Calculation approaches shall be documented with approval from qualified personnel and provided in the waste profile. Results of such calculations shall be presented in the DQA so that all final regulatory determinations have been shared with all stakeholders prior to final waste acceptance. Should waste fail TCLP and be determined to be hazardous, then the CERCLA project shall decide if treatment at the waste generator site prior to EMDF disposal is feasible. Waste treated to meet LDRs may be accepted for disposal except for D009 mercury hazardous waste.

Debris waste may be treated by meeting the Alternate Treatment Standards for Hazardous Debris listed in 40 *CFR* 268.45. This may include immobilization technologies such as macroencapsulation “application of surface coating materials such as polymeric organics (e.g., resins and plastic) or use of a jacket of inert inorganic materials to substantially reduce surface exposure to potential leaching media” or microencapsulation. In either case, the CERCLA project must use an FFA-approved technology-based treatment process or obtain FFA approval through the DQA process or other approved CERCLA documentation. The DQA shall identify the RCRA hazardous waste that requires treatment and provide the proposed treatment method. Treatment verification by qualified personnel shall occur before receiving authorization to dispose at EMDF.

For soil that may fail TCLP, these may be treated using performance-based treatment technologies including 40 *CFR* 268.49. Under these regulations, the waste generator may elect to comply with either the alternative soil treatment standards at 40 *CFR* 268.49 or the generic treatment standards at 40 *CFR* 268.40, which apply to all hazardous waste. The LDR alternative treatment standards require contaminated soils that will be land disposed to be treated to reduce concentrations of hazardous constituents by 90% or meet hazardous constituent concentrations that are 10 times the universal treatment standard, whichever is greater. The treatment approach shall be presented to the Project Team through an approved DQO that will include the information that is routinely generated and approved for non-CERCLA projects in a RCRA waste analysis plan as described at 40 *CFR* 264.13. The verification of meeting the performance-based numerical limits shall be presented in the waste profile and verified during waste acceptance. When meeting performance-based treatment technologies, the generator must also ensure that the applicable LDR treatment standard requirements in 40 *CFR* 268 are met, including standards for underlying hazardous constituents (UHCs), if applicable.

4.1.4.1 Listed Waste Restriction

Listed hazardous waste as defined by 40 *CFR* 261 is prohibited from disposal. This includes hazardous waste that is either mixed or derived from listed waste. The generator shall provide documentation on the non-listed waste determination in the waste profile or a similar process that has been reviewed and approved by authorized environmental compliance personnel. PK documentation requires a “good faith effort” including “due diligence” historical reviews described in regulatory Federal Register guidance. Because PK is critical in making a listed waste determination, the PK sources may include, but not limited to, the following:

- Accident and spill records
- Manifests, vouchers, bills of lading

- Storage records
- Material inputs, including safety data sheets, sales, and inventory records
- Historical sampling reports
- Manufacturing specifications
- Mass balance documentation
- Laboratory notes and batch records
- Process procedures, logs, and batch records
- Process design information, including classified design information
- Historical analytical data
- Interviews with persons knowledgeable of the waste (statements signed by the interviewer and interviewee)

In some situations, a “contained-in determination” for environmental media soils or sediment may be pursued to meet RCRA LDRs. The RCRA Contained-In Policy applies to contaminated media (soil or sediment) and secondary waste contaminated by environmental media and is administered and approved by TDEC. This policy applies to media that contain or have been assigned one or more listed hazardous wastes codes and the generator can demonstrate that the contaminated media is non-hazardous, meaning it no longer exhibits a characteristic and the concentration of hazardous constituents are below health-based levels and present in insignificant concentrations (e.g., risk-based evaluation). Contained-in determinations are made on a case-by-case basis and provided as part of the listed waste determination. These determinations are submitted to TDEC and must be approved before incorporation into the waste profile prior to approval.

4.1.4.2 Treated Waste Meeting RCRA LDRs

Table 3 provides the RCRA treatment methods that may be used to treat waste for disposal with the exception of D009 Mercury Hazardous Waste. One of these options will be selected in the waste profile and supported by approved documentation, including FFA approval of treatment technologies and performance-based limits for the final waste form.

Table 3. RCRA treated waste acceptable for disposal

Treatment Method	Required Documentation
Concentration-Based Treatment Standard including applicable UHCs (40 <i>CFR</i> 268.40)	• FFA-approved Treatment Plan with SAP or waste analysis plan • Empirical data demonstrating compliance with LDRs
Technology-Based Treatment Standard (40 <i>CFR</i> 268.42)	• FFA-approved technology-based treatment standard (i.e., macroencapsulation) • Verification of treatment by qualified personnel
Alternative Treatment Standards for Hazardous Debris (40 <i>CFR</i> 268.45)	• FFA-approved technology-based treatment standard (i.e., macroencapsulation) • Verification of treatment by qualified personnel
Alternative LDR Treatment Standards for Contaminated Soil (40 <i>CFR</i> 268.49)	• FFA-approved Treatment Plan with SAP or waste analysis plan including treatment reagents and material • Empirical data demonstrating compliance with LDRs and UHCs

CFR = Code of Federal Regulations
 FFA = Federal Facility Agreement
 LDR = land disposal restriction

RCRA = Resource Conservation and Recovery Act of 1976
 SAP = sampling and analysis plan
 UHC = Underlying Hazardous Constituents

4.1.4.3 Management of Mercury-contaminated Waste

DOE OREM has developed an overall mercury management approach to be implemented for ORR CERCLA projects to ensure alignment with regulatory requirements and programmatic goals, including safe and compliant disposal of associated waste at EMDF. To the extent practicable, all visible recoverable liquid mercury, including within mercury process equipment will be removed from the equipment at the point of generation and segregated for offsite disposal, subject to availability of a disposition pathway, as specified in project-specific CERCLA documentation. Visible recoverable liquid mercury and RCRA (D009) mercury characteristic hazardous waste is prohibited from onsite disposal; therefore, it requires segregation and offsite treatment and disposal.

To support these objectives, Fig. 5 provides an overall mercury disposition approach for mercury-use facilities. This process emphasizes steps during deactivation or pre-demolition activities where visible recoverable mercury is removed from equipment in place where feasible as a source separation step. However, the process also includes options for equipment removal with entrained mercury (e.g., gauges, thermometers) in place in the equipment. The mercury equipment that has been removed may be processed to recover the visible liquid mercury or the removed equipment could be shipped offsite for processing. These actions, including D009 waste determinations and segregation, shall be identified in project CERCLA documentation. Liquid mercury or mercury hazardous waste detection and removal may occur throughout the waste generation and disposal processes.

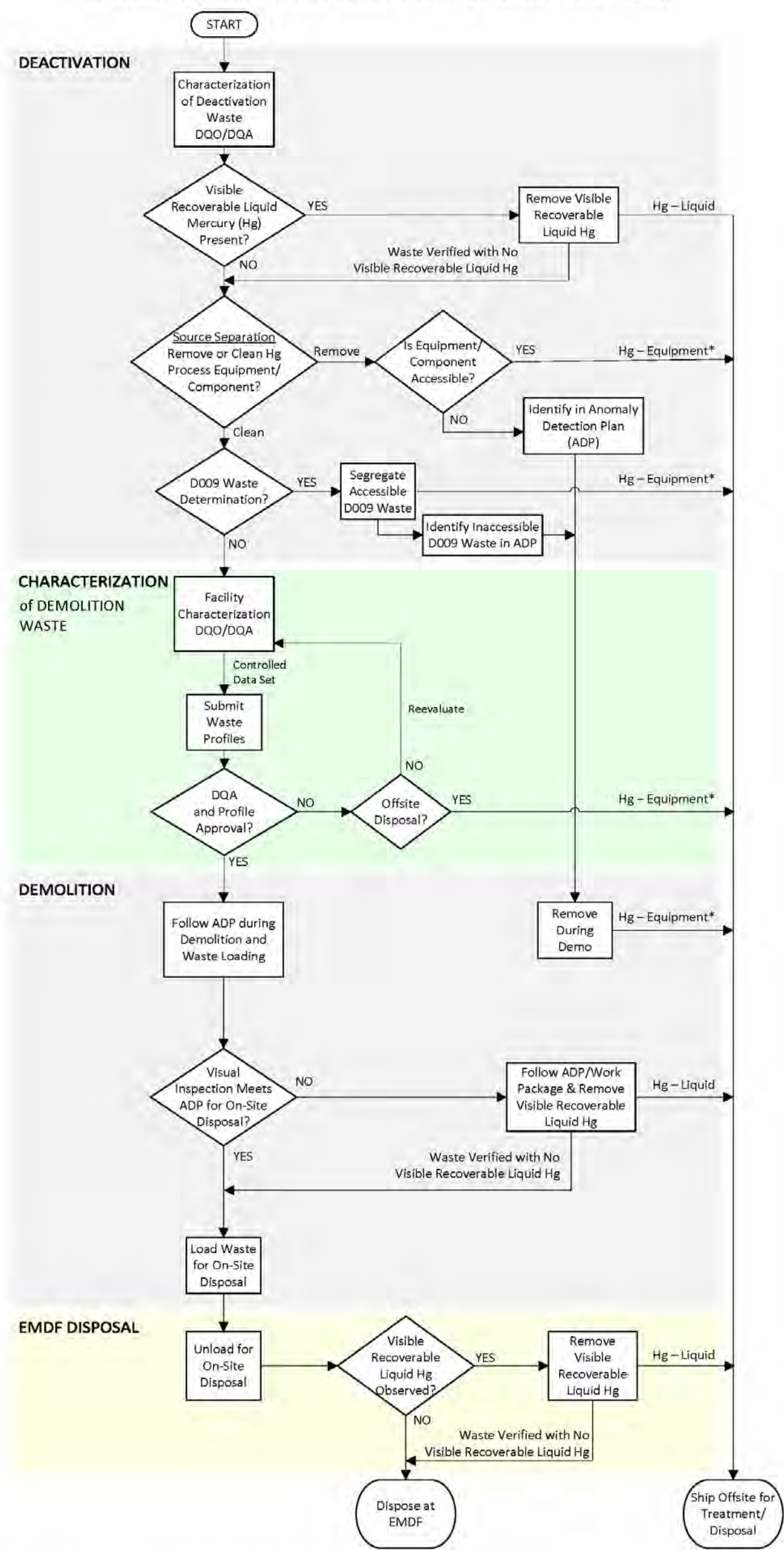
Following the DQO process, facility or soil characterization activities will identify the various sample populations (e.g., floors, walls, piping, equipment, or excavations), identify data gaps, and develop sample strategies and designs to include any residual mercury that could remain in the debris or soil. During the DQO process, any remaining mercury-contaminated equipment, piping, or facilities should be addressed including obtaining adequate samples to support compliant RCRA hazardous waste determinations. These attributes shall be addressed in the DQO/DQA workshops with consensus on the results.

Total mercury concentrations may be helpful for initial hazardous waste screening purposes and for remedial action soil evaluation purposes. Waste with potential elevated total mercury contamination levels shall have confirmatory TCLP data to compare with the regulatory limit. Waste that meets this limit may be accepted while also potentially containing residual mercury. As noted in the flow diagram, rigorous anomaly detection programs shall be implemented throughout the waste generation, waste loading, and disposal process. Any visible recoverable liquid mercury encountered during demolition or remedial action shall be remediated, removed, and segregated as hazardous waste in accordance with approved plans and procedures.

Due to prohibition of RCRA D009 hazardous waste (mercury characteristic hazardous waste), treatment of the waste is prohibited prior to final characterization and disposal. This would include any amalgamation, solidification, or stabilization processes (i.e., controlled low strength material) that may immobilize mercury contamination and other constituents in a matrix while decreasing the waste surface area and permeability.

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Disposition Logic Diagram for D&D of Mercury (Hg) Contaminated Facilities



* Segregated mercury equipment will be evaluated for onsite cleaning or offsite treatment/disposal.

Fig. 5. Disposition logic diagram for D&D of mercury (Hg) contaminated facilities.

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4.1.5 TSCA-Regulated Waste Determinations (PCBs/Asbestos)

ORR facilities (Heritage Center, Y-12, and ORNL) manage TSCA-regulated materials, including PCBs from historical uses or previous unauthorized spills. Because of the age of many ORR facilities and the varied uses for PCBs in gaskets, grease, building materials, and equipment, DOE self-disclosed unauthorized use of PCBs to EPA in the late 1980s for all three gaseous diffusion process facilities in Oak Ridge, Tennessee; Paducah, Kentucky; and Portsmouth, Ohio.

As a result, DOE Headquarters and EPA Headquarters adopted a compliance agreement known as the *Toxic Substances Control Act Uranium Enrichment Federal Facilities Compliance Agreement* (DOE 1992). Upon discovery of unauthorized use of PCBs at Y-12 and ORNL, in addition to the previously identified K-25 site, DOE ORR and EPA Region 4 adopted a compliance agreement for the Oak Ridge facilities known as the *Oak Ridge Reservation Polychlorinated Biphenyl Federal Facilities Compliance Agreement* (DOE 2018) with subsequent revisions. As a result of the compliance agreement, DOE and its prime contractor continue to notify EPA Region 4 when additional unauthorized uses of PCBs, such as PCBs in paint, adhesives, electrical wiring, or floor tile, are identified. For CERCLA actions, this notification process is routinely accomplished under the CERCLA documentation for demolition and remedial actions. Project-specific CERCLA documentation developed for building D&D and remedial actions with review and approval by EPA and TDEC include requirements to evaluate PCBs during characterization and reporting for onsite disposal.

PCBs shall be identified using knowledge and analysis-based determinations. PK shall be used when available to identify potential PCBs present as part of building materials and/or historical uses such as oils and lubricants. Information on historical spills may be used to make determinations, while historical data may also be used to represent waste with similar uses and construction. The waste generator may also use “as-found” concentrations in environmental media before any remediation or cleanup efforts. In situ sampling for “as found” determinations is useful for regulatory compliance determinations and understanding the extent of contamination. While liquids are not allowed for disposal in the EMDF, depending on the type of equipment, the drained equipment may be disposed of at EMDF in accordance with EPA’s PCB disposal regulations found in 40 *CFR* 761, Subpart D.

EMDF may accept non-liquid PCBs that are acceptable for disposal in municipal waste landfill (Subtitle D), chemical waste landfill (TSCA-PCB), or hazardous waste landfill (Subtitle C). The following categories of PCBs shall be identified on the waste profile when present:

- PCB Bulk Product – Non-liquid bulk waste or debris from the demolition of buildings and other man-made structures manufactured, coated, or serviced with PCBs. These include, but are not limited to, plastics (e.g., plastic insulation from wire or cable, radio, television and computer casings, vehicle parts, or furniture laminates); preformed or molded rubber parts and components; applied dried paints, varnishes, waxes or other similar coatings or sealants; caulking; adhesives; paper; and felt or fabric products such as gaskets. Fluorescent light ballasts containing PCBs in the potting material.
- PCB Remediation Waste – Debris or other environmental media (i.e., soil or sediments) contaminated by spills from regulated PCBs that have not been disposed of, decontaminated, or otherwise cleaned up in accordance with 40 *CFR* 761.62, “Disposal of PCB Remediation Waste.” Also includes environmental media contaminated by PCB paint chip releases into soils or sediments. Any person cleaning up and disposing of PCB Remediation Waste shall do so based on the “as found” total PCB concentration determined by approved EPA test methods.
- PCB articles – Small capacitors, hydraulic machines, contaminated electrical equipment, other PCB articles, and PCB light ballast with PCBs in non-leaking capacitors.

Prohibited PCBs

- No disposal of PCB liquids. All oils and liquids and other free flowing liquids have been drained from equipment / waste.
- PCB waste not authorized for disposal in RCRA Hazardous Waste Landfills.

4.1.6 Waste Classification Requirements

Another administrative WAC specified in Table 4, Tennessee LLW Waste Classification as found under TDEC Chapter 1200-2-11, *Licensing Requirements for Land Disposal of Radioactive Waste*. These requirements are derived from agreements with TDEC to use its LLW rules to guide acceptance of short-lived and long-lived radionuclides. This process involves determination of the TDEC waste classification by comparing the concentrations of specific radionuclides to the limits found in TDEC 1200-2-11-.17(6) that are equivalent to NRC's Waste Classification requirements under 10 *CFR* 61.55.

Determination of the classification of radioactive waste involves two considerations. First, consideration must be given to the concentration of long-lived radionuclides (and their short-lived precursors) whose potential hazard will persist long after such precautions as institutional controls, improved waste form, and deeper disposal have ceased to be effective. Second, consideration must be given to the concentration of shorter-lived radionuclides for which requirements on institutional controls, waste form, and disposal methods are effective. Other waste characteristics are defined in TDEC 0400-20-11.17(7), including additional ARARs that have been added, such as liquid, shall contain as little free standing and noncorrosive liquid as is reasonably achievable, but in no case shall the liquid exceed 1% of the volume.

If a waste lot does not contain any of the radionuclides listed in the tables below, it is Class A. Otherwise, it is governed by the following rules in TDEC 0400-20-11.17(6):

- If the concentration does not exceed the value in Column 1, the waste is Class A.
- If the concentration exceeds the value in Column 1 but does not exceed the value in Column 2, the waste is Class B.
- If the concentration exceeds the value in Column 2 but does not exceed the value in Column 3, the waste is Class C.
- If the concentration exceeds the value in Column 3, the waste is classified as Greater-Than-Class-C and is not generally acceptable for near surface disposal and prohibited from disposal at EMDF.
- For wastes containing mixtures of the nuclides listed in the table, the classification shall be determined by the SOF rule.

NOTE 1: For determining classification for waste that contains a mixture of radionuclides, it is necessary to determine the SOFs by dividing each radionuclide's concentration by the appropriate limit and adding the resulting values. The appropriate limits shall all be taken from the same column of the same table. The SOFs for the column shall be less than 1.0 if the waste class is to be determined by that column.

NOTE 2: To facilitate a waste lot evaluation to these limits, the concentration limits were transformed from Ci/m³ to pCi/g using the standard density of soil @1.7g/cc.

Table 4. Tennessee LLW waste classification requirements

Tennessee LLW classification of long-lived radionuclides for administrative WAC compliance ^a		
Radionuclide	Ci/m ³	pCi/g (assuming 1.7 g/cc)
¹⁴ C	8	4.7 x 10 ⁶
¹⁴ C in activated metal	80	4.7 x 10 ⁷
⁵⁹ Ni in activated metal	220	1.3 x 10 ⁸
⁹⁴ Nb in activated metal	0.2	1.2 x 10 ⁵
⁹⁹ Tc	3	1.8 x 10 ⁶
¹²⁹ I	0.08	4.7 x 10 ⁴
Alpha emitting transuranic nuclides with half-lives greater than five (5) years	100 nCi/g	1.0 x 10 ⁵
²⁴¹ Pu	3,500 nCi/g	3.5 x 10 ⁶
²⁴² Cm	20,000 nCi/g	2.0 x 10 ⁷

Tennessee LLW classification of short-lived radionuclides for administrative WAC compliance ^a						
Radionuclide	Column 1 (Class A limits)		Column 2 (Class B limits)		Column 3 (Class C limits)	
	Ci/m ³	pCi/g (assuming 1.7 g/cc)	Ci/m ³	pCi/g (assuming 1.7 g/cc)	Ci/m ³	pCi/g (assuming 1.7 g/cc)
Total of all nuclides with < 5-year half-life	700	4.1 x 10 ⁸	(¹)	(¹)	(¹)	(¹)
³ H	40	2.4 x 10 ⁷	(¹)	(¹)	(¹)	(¹)
⁶⁰ Co	700	4.1 x 10 ⁸	(¹)	(¹)	(¹)	(¹)
⁶³ Ni	3.5	2.1 x 10 ⁶	70	4.1 x 10 ⁷	700	4.1 x 10 ⁸
⁶³ Ni in activated metal	3.5	2.4 x 10 ⁷	700	4.1 x 10 ⁸	7000	4.1 x 10 ⁹
⁹⁰ Sr	0.04	2.4 x 10 ⁴	150	8.8 x 10 ⁷	7000	4.1 x 10 ⁹
¹³⁷ Cs	1	5.9 x 10 ⁵	44	2.6 x 10 ⁷	4600	2.7 x 10 ⁹

(¹) There are no limits established for these radionuclides in Class B or C wastes. Practical considerations, such as the effects of external radiation and internal heat generation on transportation, handling, and disposal, will limit the concentrations for these wastes. These wastes shall be Class B unless the concentrations of ⁶³Ni, ⁹⁰Sr, and ¹³⁷Cs determine the waste to be Class C.

^a Adopted from Tennessee LLW regulations [TN 1200-2-11-.17(6)]. Basically, concentration limits are applied using the SOF of radionuclide concentrations divided by the WAC concentrations. If the SOF for long-lived radionuclides is less than or equal to 0.1, it is designated as Class A for long-lived radionuclides. If the SOF for long-lived radionuclides exceeds 0.1, the wastes are Class C. If the long-lived radionuclide SOF exceeds one, the wastes are designated as GTCC. A separate SOF is then performed for short-lived radionuclides. If the SOF exceeds unity (1) for Class A, but is less than unity for Class B, the wastes are designated as Class B for short-lived radionuclides. If it exceeds unity for Class B but is less than unity for Class C, the wastes are designated as Class C. If it exceeds unity for Class C, the wastes are designated as GTCC. Wastes with both short- and long-lived radionuclides use the more restrictive classification (Class A < Class B < Class C < GTCC) as determined by the two SOF. GTCC wastes require approval by the FFA managers for disposal in the EMDF. If radioactive waste does not contain any nuclides in either table, it is Class A.

ARAR = applicable or relevant and appropriate requirement
 CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
 DOE = U.S. Department of Energy
 EMDF = Environmental Management Disposal Facility
 FFA = Federal Facility Agreement
 GTCC = greater-than-class-C
 LLW = low-level (radioactive) waste

ORR = Oak Ridge Reservation
 SOF = sum of fractions
 WAC = waste acceptance criteria

The EMDF Waste Profile provides an input table that performs the necessary calculations. The waste generator must ensure that the proper data is input and independently verified prior to submittal. For the EMDF, waste lots that are TDEC Class A, B, or C are considered acceptable for disposal in the EMDF. The waste profile shall identify the average concentrations used in the waste classification calculations in accordance with TDEC regulations.

4.1.7 Criticality Safety

The quantity of fissionable (fissile) material in a waste package shall be limited so that it remains subcritical during all phases of waste cell operations, including active waste disposal operations and inactive, post-closure periods. EMDF has evaluated disposal operations and the relevant EMDF process as they relate to criticality safety and shows that criticality is not credible for disposal of fissionable material that meets the EMDF WAC.

To evaluate each waste lot, the EMDF Material Screen Calculation Worksheet is provided in each waste profile (see Appendix D) to evaluate waste lots and screen out those that are below criticality thresholds meeting one of the following exemption criteria:

- Enrichment
- Mass/Volume
- Concentration/Mass
- Concentration

This screening worksheet is prepared by the waste generator and approved by EMDF Operations during the waste acceptance process. If one of the exemption criteria is not met, a waste lot may require its own nuclear criticality safety determination that will specify any special handling or packaging of waste or specific placement criteria performed by EMDF Operations. These activities are coordinated between the CERCLA project, EMDF nuclear safety personnel, EMDF WAT, and EMDF Operations. Any specific conditions as required by nuclear safety documentation will be incorporated into the waste profile and approval authorization.

Concurrence of FFA parties may also be required where special conditions (e.g., treatment, encapsulation, special handling) are necessary for a waste to meet criticality safety criteria. Waste packages containing fissionable nuclides, other than enriched uranium, will be evaluated on a case-by-case basis. Fissionable nuclides are listed in DOE Order 420.1, "Facility Safety," Table 4.3-1.

Any required criticality safety evaluation (CSE) for a given waste lot shall be performed in accordance with DOE Order 420.1, "Facility Safety," and DOE Standard STD-3007-2017, *Preparing Criticality Safety Evaluations at Department of Energy Nonreactor Nuclear Facilities (Invoked)*, and applicable American National Standards Institute standards.

The CSE shall consider the actual materials in the waste preliminary calculations shall evaluate whether an infinite array of waste packages would remain subcritical given the following conditions:

- Maximum reactivity of the fissionable material present is attained
- The most reactive credible configuration consistent with the chemical and physical form of the material (e.g., lumped source, cylindrical, sphere, dispersed)
- Moderation by water to the most reactive credible extent

- Full reflection of the neutrons

If preliminary calculations indicate a potential for criticality, calculations may consider more realistic conditions for the specific waste packages being evaluated. The CSEs shall clearly identify any assumptions and the basis for the modification. If the basis for modifying one of these assumptions relies upon operational restrictions by the EMDF Operations, the waste generator must demonstrate that the terms of the operational restriction have been negotiated with and accepted by the EMDF Operations. Examples of any special handling may include separate packaging such as supersacks or limiting the amount of material on the operating face of the disposal cell. Any costs associated with enforcing operational restrictions shall be negotiated between the CERCLA project and EMDF operations, and any related costs shall be borne by the CERCLA project.

4.2 ANALYTICAL WAC

Analytic WAC are numerical limits on concentrations or inventories (total amounts) of contaminants in the waste based on the criteria specified in the EMDF ROD. EMDF performance modeling (post-closure dose and risk analyses) is used to calculate analytic WAC that ensures robust, long-term protection of human health and the environment. The WAC are only one line of defense for the EMDF; engineered features using natural materials, CERCLA monitoring, and corrective actions (if needed) also all contribute to maintaining protectiveness of the facility. DOE will maintain the EMDF, including active and passive institutional controls as required by the EMDF ROD (Sect. 2.12.2.8) and will use monitoring and the CERCLA 5-year review process to ensure that the disposal facility is protective during operations and in perpetuity post-closure.

The EMDF WAC include radionuclide inventory (total activity) and radioactivity concentration limits to address potential post-closure carcinogenic risk to human health. The WAC are based on post-closure performance modeling results presented in the PA (UCOR 5049). The PA for the EMDF was developed to demonstrate compliance with DOE requirements for protection of members of the public under DOE Order 458 and DOE Order 435.1. To augment the PA analysis, the EMDF ROD committed to additional post-closure risk analysis (Supplemental Analysis) under CERCLA to address carcinogenic and non-cancer risk from radionuclides and other constituents of potential concern that may be present in EMDF waste. The Supplemental Analysis results are documented in UCOR-5843 and have been used to inform the EMDF design and WAC.

The PA compliance demonstration is based on the estimated EMDF radionuclide inventory at closure described in the EMDF ROD (Section 2.12.2.3) and documented in detail in the EMDF PA. The basis for estimated average concentrations of other contaminants is described in the EMDF Supplemental Analysis. The estimated average radionuclide concentrations for the PA were biased toward high values to manage uncertainty, and the overall projected waste volumes included a 25% contingency to further account for uncertainty and incorporate conservatism in the projected inventory. The dose projections based on the estimated EMDF inventories are used to back-calculate protective WAC tied to specific regulatory targets.

The results of the PA were used to derive activity concentration limits (maximum allowable waste lot average concentrations) for 61 radionuclides based on an inadvertent intruder scenario and chronic intrusion dose limits (EMDF ROD Sect. 4.2.1). Waste concentration limits are based on exposure due to a hypothetical receptor drilling into the waste from 100 to 1,000 years post-closure. PA results for the environmental release (to groundwater) scenario were used to calculate radionuclide inventory limits (maximum EMDF facility average concentrations at closure, EMDF ROD Sect. 4.2.2) that meet NRC performance objectives (critical organ dose criteria) identified as ARAR (TDEC 0400-20-11-16(2) [10 *CFR* 61.41]) for EMDF. The EMDF inventory limit calculations include potential exposures occurring up to 1,000 years post-closure. These dose-based concentration and inventory limits meet CERCLA

carcinogenic risk criteria based on approximate dose-risk relationships, as noted in the EMDF ROD, Sect. 2.12.2.

The limits for individual radionuclides are applied as SOF constraints on waste lot acceptance (concentration limits) and total EMDF contaminant inventories at closure, as described below in Sect. 4.2.3. In addition, trigger level concentrations for total uranium and mercury have been defined based on the Supplemental Analysis results. These trigger levels provide a basis for future adoption of additional risk management activities in the event that actual or forecast average concentrations of EMDF waste in-place begin to approach the trigger level. The additional risk management activities will be contingent on the EMDF inventories in place, remaining available EMDF airspace, and the estimated characteristics of EMDF waste yet to be generated at the time the trigger levels are reached. Contingent risk management activities are discussed below in Sect. 4.2.5.

4.2.1 Waste Concentration Limits (Step 1 – Screening Criteria)

Results from the human intrusion scenario analysis provide waste lot concentration limits for the 53 radionuclides modeled (after screening) in the PA and for eight additional radionuclides. This analysis of a maximally exposed individual is similar to analyses performed by the NRC in developing LLW classification limits. The waste lot concentration limits are applicable to individual waste lots, but not to the landfill inventory as a whole. The intrusion-based WAC protects human health in the case of future hypothetical inadvertent intrusion into the disposal facility by drilling a well through the EMDF cover system and into the waste and then tilling the excavated waste into a garden near the disposal facility. The primary exposure pathways include food ingestion and external exposure to contaminated soil, but not consumption of well water.

Table A.2 of Appendix A provides the EMDF inadvertent intrusion-based concentration limits or the NRC Class C concentrations 10 *CFR* 61.55. For each radionuclide, the more restrictive of these two values is given in the table and thus represents either an administratively applied value (when the NRC Class C limit is more restrictive) or the analytical WAC limit if that concentration is more restrictive. Note these waste lot concentration limits alone do not dictate the total amount of a particular radionuclide allowed for disposal; the limits are not applied to the landfill as a whole and do not represent landfill inventory limits.

Because the waste contains multiple radionuclides it is necessary to calculate a sum of the ratios of the average concentration of each contaminant in a waste lot to its corresponding waste concentration limit and then to sum these fractions to determine the aggregate effects of all waste contaminants on a hypothetical inadvertent human intruder. Using the average concentration reported for each radionuclide, waste exceeding these concentration limits ($SOF > 1$) would be considered Greater-Than-Class-C waste and will not be accepted for disposal at EMDF.

Table A.2 in Appendix A, EMDF Concentration Limit SOF is completed by the waste generator to determine if the waste is eligible for disposal and further analysis.

4.2.2 EMDF Inventory Limits (Step 2 VWSF)

Results from the release to groundwater scenario analysis in the PA are used to calculate landfill inventory limits based on the EMDF remedial action objectives identified in the EMDF ROD. These inventory limits are the maximum total radioactivity values that meet dose-based ARAR, based on the PA modeling inputs and assumptions. The PA results show that out of 42 radionuclides modeled (after screening), only tritium (H-3), carbon-14 (C-14), and Tc-99 have the potential to contribute to risk within the 1,000-year post-closure compliance period. The resulting risk-informed EMDF inventory limits for these three radionuclides are presented in Table A.3 of Appendix A. The C-14 inventory limit in Table

A.3 is based on the highly conservative PA assumption that the C-14 partition coefficient (K_d) value is zero. Newly available laboratory measurements of C-14 K_d values for samples of soil and saprolite derived from the Maryville Limestone and Nolichucky Shale at the EMDF site (SRNL-STI-2025-00096) justifies using a higher (non-zero) K_d value for C-14, which would support a calculated analytic C-14 inventory limit higher than the value from the EMDF ROD and Table A.3. In accordance with the approved EMDF ROD, new and emerging information may be used to modify analytical WAC limits following the guidelines in Appendix B, and such changes would require FFA approval prior to implementation.

4.2.3 EMDF SOF Calculations (VWSF) and Inventory Tracking

Application of EMDF inventory limits for waste contaminants (Table A.3 of Appendix A) is also based on a SOF analysis, which considers the presence of multiple contaminants to limit the total quantities disposed in the landfill as a whole and thereby ensures that the performance objectives are met. The disposal cell will ultimately contain waste from multiple projects, each having different contaminants and volumes, requiring the calculation of VWSF for the landfill as a whole. WACFACS will be the tool for calculating waste lot SOFs, VWSF, and overall EMDF inventory.

The VWSF for the landfill as a whole at closure, based on the landfill inventory limits, will not exceed 1 (unitless). The inventory limits derived for EMDF are based on the design waste volume capacity at closure, but VWSF may be calculated based on the cumulative total waste volume accepted for placement at any time prior to closure as a means of tracking contaminant inventories. Initially, the projected inventory is used to demonstrate that WAC compliance will be achieved. The actual inventory, as it is realized, will be tracked throughout operations relative to inventory limits through the VWSF analyses. A 3-year projection of waste volumes and SOFs will be used, along with the volumes and SOFs of materials already placed in the cell, to track EMDF inventory for WAC compliance. Other time periods of interest may be used for planning purposes and to ensure safe and effective management of contaminant inventories throughout the period of landfill operations. Maintaining the VWSF at or below 1 for the entire facility will ensure that contaminant inventories remain below the EMDF limits and that the CERCLA risk range is met at closure.

4.2.4 Supplemental Analysis Risk Summary

The EMDF Supplemental Analysis is a risk assessment that evaluates long-term protectiveness of the landfill for a beyond-design facility performance scenario (leachate accumulation on the liner that causes release at the surface) coupled with exposure of a residential receptor living adjacent to the disposal facility. The release scenario is inconsistent with the expected future performance of the EMDF liner and cover systems, as explained in Section 2 of UCOR-5843 and provides a highly pessimistic (conservative) estimate of potential future human health impacts. The Supplemental Analysis evaluated cancer and non-cancer risk associated with radionuclides and toxic metals.

The Supplemental Analysis calculated exposure point concentrations for groundwater and surface water based on estimated average EMDF waste contaminant concentrations, assumed cover and liner system water/leachate fluxes, and a simplified water and solute mass balance. The calculated groundwater and surface water concentrations are the basis for evaluating health risks to humans potentially exposed to contaminated groundwater as a drinking water source; ingestion of homegrown fruits, vegetables, poultry, and eggs using groundwater for irrigation and watering; and ingestion of fish from Bear Creek. The exposure scenario and risk calculations are described in detail in Section 4 of UCOR-5843.

To evaluate the range of potential risk, the Supplemental Analysis considered a bounding case (zero liner leak) and two representative liner performance cases in which the liner transmits to the subsurface either

50% or 90% of the cover infiltration volume. The corresponding average surface leachate release volume is equal to 100%, 50%, or 10% of the selected cover infiltration rate (0.53 gallons per minute). The zero liner leakage condition is included as a limiting case to bound the leachate release volume and resulting risk associated with the selected post-closure cover performance level.

A brief summary of the Supplemental Analysis risk results is provided in the following paragraphs and in Table 7. Additional detail is provided in UCOR-5843.

For the 13 metals evaluated, the cumulative risk is dominated by the water ingestion/inhalation/immersion pathway (54%) and the produce ingestion pathway (38%), as indicated in the upper portion of Table 7. The total HI for metals exceeds 1 for the zero liner leak condition but the risk is acceptable ($HI < 1$) for the other three liner performance scenarios evaluated, as indicated in the lower portion of Table 7. The top metals contributing to the total toxicity risk are uranium, mercury, manganese, and antimony for the water ingestion pathway and uranium, boron, and antimony for the produce ingestion pathway (refer to Table 7 in UCOR-5843). The liner performance scenario has a large effect on the HI because the groundwater release pathway that dominates the total risk is proportional to the surface leachate release volume (Table 7).

For radionuclides, the cumulative Excess Lifetime Cancer Risk (ELCR) decreases from $1.4E-04$ to $3.7E-05$ from the zero liner leak scenario to the 50% leak and higher K_d scenario (Table 7, lower portion). The cumulative ELCR is dominated by the fish ingestion pathway and the water ingestion/inhalation/dermal exposure (81% and 12% respectively) for the zero liner leak scenario (Table 7, upper portion). The produce ingestion pathway contributes 7% of the total ELCR for the zero liner leak scenario. Sr-90 and uranium and plutonium isotopes count for most of the groundwater pathways risk, and the total groundwater release pathway risk is less than $3.0E-05$ for all of the liner scenarios evaluated (refer to Table 8 in UCOR-5843).

The fish ingestion risk is primarily due to C-14, Pu-238, Pu-239, and Pu-240 because of the high bioconcentration factor default values applied by the calculations for carbon and plutonium. As a measure of sensitivity to the applied bioconcentration factor value for the radionuclide risk, the last row of Table 7 shows the total cancer risk assuming only 10% of the calculated C-14, Pu-238, Pu-239, and Pu-240 fish ingestion contribution. These values are equally likely to be representative of Bear Creek impacts and are all on the order of $1.0E-05$ ELCR.

In contrast to the metals toxicity HI, the total ELCR for radionuclides does not vary significantly among the three liner performance scenarios because of the simplifying assumption that the surface water release pathway (fish ingestion) that dominates the total risk is independent of liner performance. The scenario that assumes a 50% liner leak along with higher K_d values results in a lower ELCR because both the groundwater and surface water pathway risk are proportionally reduced (Table 7).

The Supplemental Analysis shows that the estimated EMDF radionuclide inventory generally meets the CERCLA risk range for the release and exposure scenario analyzed. The Supplemental Analysis considered the potential non-cancer risks associated with the presence of toxic metals (e.g., uranium and mercury) and found the projected risks (HI) are within acceptable ranges. Therefore, no specific analytical WAC limits are warranted for metals toxicity other than the protective limits provided in EPA's RCRA LDRs that are universally used for disposal of waste into both Subtitle D and Subtitle C landfills. In conclusion, the Supplemental Analysis informs this WCP by showing that toxicity (HI) for the estimated metals inventory and ELCR for the radiological inventory is acceptable. The proposed trigger levels for mercury and uranium are related to the Supplemental Analysis results, as explained in Sect. 4.2.5.

Table 5. Summary of calculated bathtub scenario risk for metals and radionuclides

Cumulative Risk Contributions by Release & Exposure Pathway (zero % liner leak)					
	Water Ingestion +Inhalation +Dermal	<u>Groundwater Release</u>			<u>Surface Water Release</u>
		Produce Ingestion	Poultry Ingestion	Egg Ingestion	Fish Ingestion
Metals HQ (child) by pathway	0.84	0.60	0.01	0.01	0.10
Percent total HI by pathway	54%	38%	0.8%	0.6%	6%
Radionuclides ELCR by pathway	1.65E-05	1.02E-05	2.19E-07	1.87E-07	1.12E-04
Percent total ELCR by pathway	12%	7.3%	0.16%	0.13%	81%
Total Risk for Alternative Liner Performance Scenarios					
	Zero % Liner Leak	50% Liner Leak	90% Liner Leak	50% Liner Leak, higher K_d	
Metals HI (child)	1.56	0.84	0.25	0.37	
Radionuclides ELCR	1.39E-04	1.26E-04	1.15E-04	3.74E-05	
Percent total ELCR Fish Ingestion	81%	87%	96%	84%	
Total groundwater pathway ELCR + 10% of Fish Ingestion for C-14, Pu-238, -239, -240	4.04E-05	2.71E-05	1.61E-05	9.80E-06	

HQ = hazard quotient

HI = hazard index

ELCR = excess lifetime cancer risk

^a higher K_d values applied for all radionuclides and metals

4.2.5 EMDF Trigger Level Concentrations and Contingent Risk Management Activities

EMDF trigger levels provide a basis for initiating evaluation of the need for additional risk management activities in the event that actual or forecast average concentrations of the total EMDF waste disposed to date begin to approach the trigger level. Trigger concentration levels have been defined for total uranium and for mercury based on the toxicity projections reported in the EMDF Supplemental Analysis. The trigger level for total uranium is 800 mg/kg, and for mercury the trigger level is 1000 mg/kg. The trigger levels are based on multiples of the estimated inventories used for the Supplemental Analysis risk projections. Those estimated inventories resulted in acceptable toxicity risk levels based on the release and exposure assumptions applied in the Supplemental Analysis. Based on current inventory estimates, average uranium and mercury concentrations of EMDF waste lots are not expected to exceed the assigned trigger levels.

If EMDF trigger levels are approached prior to EMDF closure, any additional risk management activities considered will be evaluated based on the current EMDF inventories in place, the remaining available EMDF airspace, and the estimated characteristics of EMDF waste yet to be generated at the time the trigger levels are likely to be reached.

Figure 6. describes the process for addressing EMDF trigger levels with FFA parties.

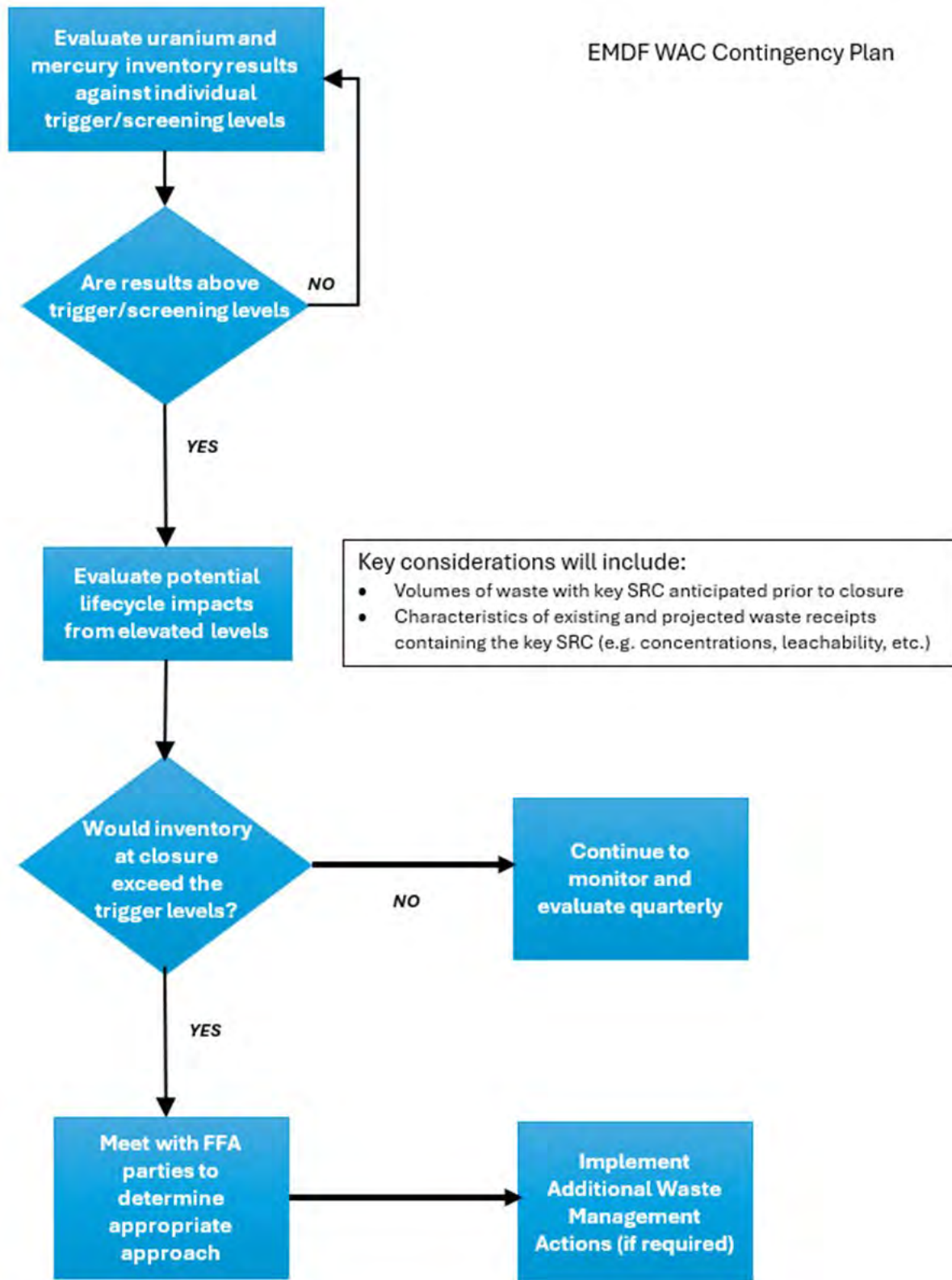


Fig. 6. EMDF WAC contingency plan.

4.2.6 Evaluation of Additional Contaminants or Waste-Stream Specific WAC

In the PA, extensive analyses were performed to identify all potential radioactive SRCs in environmental media across the ORR. However, as cleanup activities progress, additional contaminants may be identified in waste streams for which WAC limits have not been developed. It is the waste generator's responsibility to review its SRCs against the list of radionuclides for which analytic WAC have been approved. A listing of all approved WAC is provided in Appendix A (Table A.2); an up-to-date listing is maintained by the EMDF and will be maintained on the facility's webpage. If the waste generator identifies a radionuclide or chemical SRC for a waste lot that has not been previously evaluated and for which no LDR exists, then it is the generating project's responsibility to contact the EMDF WAT and request an evaluation. Since FFA parties must approve all performance evaluations and any revised or new analytic WAC, advanced notification is advised. Guidance has been provided in Appendix B on the process of evaluating any new EMDF contaminants. This appendix describes the evaluation needed for newly identified contaminants, and how any additional WAC will be calculated by the EMDF WAT using the same codes and procedures that were used to develop the WAC given in the EMDF ROD. Other codes and procedures may also be considered if they are proven to be equivalent and are approved by the FFA parties.

In unique situations, waste stream-specific WAC may be calculated based on reduced leachability of the waste form relative to soil leachability and may be considered on a case-by-case basis using guidelines provided in Appendix B. One specific case in which this may apply would be when waste-stream-specific measurements of solid-to-liquid partition coefficients (K_d) values are available; these measurements would then be applied using the analytic WAC modeling process in Appendix B. In such cases, new or waste-lot-specific analytic WAC may be developed to ensure that the waste being placed at EMDF will not pose a risk to the public beyond that allowed in the EMDF ROD. In cases where treatment of radionuclides is used to justify an increased waste-stream-specific WAC, the treatment chosen must be demonstrated as being effective for the duration of the unacceptable hazard of the radionuclide as defined by the risk goals of the EMDF ROD.

4.2.7 WAC Compliance Calculations and Tracking

All SRCs are used in the analytical WAC calculation, and a specific statistical goal of 95% confidence and 80% power (i.e., a 5% chance of a false negative and a 20% chance of a false positive) is assigned to account for uncertainty. As SRCs are identified and reported, they must be measured against the analytical WAC in simple relationship of concentration versus limit. Each waste lot is evaluated individually and using a volume-weighted total concentration for the disposal facility otherwise referred to as a VWSF. The EMDF WAT shall evaluate each waste lot on its own merits as well as ensuring that the VWSF is less than 1 for EMDF. This is achieved by calculating concentrations against waste already placed in the cell, including operational clean fill, the waste lot under consideration, and the projected waste over the subsequent 3 years. VWSF calculations require 90% confidence and 90% power; therefore, contaminant and volume uncertainties are considered and evaluated. If during a waste lot assessment, the VWSF cannot be adequately assessed as less than 1, then the waste lot will not be considered without further segregation.

In cases where the VWSF marginally exceeds 1 using in-cell VWSFs, the waste lot SOF, and the 3-year forecasted VWSF, it may still be desirable to dispose of that waste lot as proposed. In such cases, the EMDF WAT will propose a variance to DOE and, if DOE concurs, will seek a variance with the FFA managers to verify if that waste lot can be accepted as proposed.

The primary tool to ensure analytic WAC compliance is WACFACS, described in detail in Appendix E. This calculational spreadsheet is similar to the WACFACS used for EMWMF. An SRC inventory is a relationship of volume-weighted concentrations over the overall mass of waste in the disposal cell. WACFACS is a Monte Carlo statistical analysis program designed to calculate expected values and

uncertainties of SOFs and VWSFs. It is through the application of this tool that compliance with the analytical WAC and VWSF for the entire landfill will be demonstrated.

WACFACS uses a variety of input parameters to perform its calculations. Waste volume data are verified with a project determination of the relative confidence in the values reported in the Waste Generation Forecast (WGF). Projects will assign high, moderate, or low confidence in the certainty of these volumes. Additionally, WACFACS requires estimates of expected average concentrations for each SRC along with confidence limits for those average values. The specific DQA techniques to be used for developing contaminant concentration input parameters for WACFACS is based on EPA guidance and is described in detail in Appendix C.

The DQO/DQA process provides the framework for the identification and quantification of all SRCs. This includes all contaminants based on PK and analytical data regardless of whether they have an analytical WAC or not. The DQO/DQA process ensures that any data gaps are identified and fulfilled so that the waste lot may be fully characterized and evaluated for acceptance. Analytical data are acquired through controlled processes including SAPs or sample requests using guidance given in Appendix C. All SRCs are reported, quantified, and tracked and can be reported during the EMDF life cycle. Analytical data sets (referred to as CDS) are evaluated for the appropriate data distribution, and appropriate descriptive statistics are calculated for use by WACFACS.

VWSFs are calculated using three sets of information including actual as-disposed volumes of waste disposed in EMDF, along with known SRC concentrations, forecasted waste volumes with proxy SRC concentrations from the WGF within the three year window, and estimated waste volumes and concentrations of any waste lots under consideration for disposal.

Soil and debris waste streams will be sequenced to the maximum extent practicable based on funding and project schedules. Soil waste streams will be used for debris compaction and void space filler when available. In some cases, clean fill is acquired by EMDF Operations to meet waste compaction requirements or for other operational covers for open work faces to mitigate possible wind-born releases or planned intermediate soil layer for construction stability considerations. Clean fill is not included in the calculation of waste lot SOFs. However, volumes of clean fill, as needed for EMDF operational purposes, will be included in the calculation of VWSFs of in-cell material.

5. WASTE COMPLIANCE REQUIREMENTS

5.1 CERCLA DOCUMENTATION

Projects sending waste to EMDF must be conducted under CERCLA from sites on the Oak Ridge Reservation or be an approved CERCLA offsite National Priorities List (NPL) site contaminated from DOE operations, and waste must be managed using the appropriate CERCLA documentation. Each project sending waste to EMDF must provide reference to the applicable documentation demonstrating it is appropriate for disposal at EMDF.

Projects are tasked with providing analytical data with sufficient quality and quantity to support defensible decision making throughout the CERCLA process. Per Appendix I-14 of the FFA, if environmental samples are to be collected to determine acceptability for disposal at the designated facility, (e.g., EMDF), and to support development of the waste profile, waste characterization assessment meeting(s) (DQO and DQA) will be held with EPA and TDEC to reach agreement on the scope of sampling and acceptability of disposal at EMDF.

Project scoping and DQO workshops assist DOE and the respective Project Team (i.e., stakeholders) while the DQA with FFA parties provide DQO workshop dates, as well as a summary of key DQO developments, data needs, and characterization decisions as agreed upon by FFA parties. DQA workshops are essential to demonstrate that all DQOs have been met while also showing a summary of results and impacts against EMDF performance criteria.

5.2 CHARACTERIZATION REQUIREMENTS

One of the more fundamental aspects of WAC compliance is the ability to collect appropriate data, analyze it in a consistent and rigorous manner, and formulate plans to mitigate any data insufficiencies. Generators shall collect data using the DQOs process as described in *Guidance on Systematic Planning Using the Data Quality Objectives Process* (EPA QA/G-4) or an equivalent process. The DQO process is a strategic planning approach based on the scientific method that is used to prepare for a data collection activity. The DQO process is used to establish performance or acceptance criteria, which serve as the basis for designing a plan for collecting data of sufficient quality and quantity to support the goals of the activity. The DQO process evaluates available characterization data, PK, and end use of the data for which the samples are to be collected, establishes the quality level that data must meet to support waste management decisions, and identifies potential data gaps.

The DQO process involves identification and participation of stakeholders (i.e., FFA parties) with consensus reached on the planned implementation of characterization. The DQO process consists of seven iterative steps that are documented in Fig. 7. While the interaction of these steps is portrayed in the figure in a sequential fashion, the iterative nature of the DQO process allows one or more of these steps to be revisited as more information on characterization is obtained. DQOs may be approved individually or within CERCLA documents.

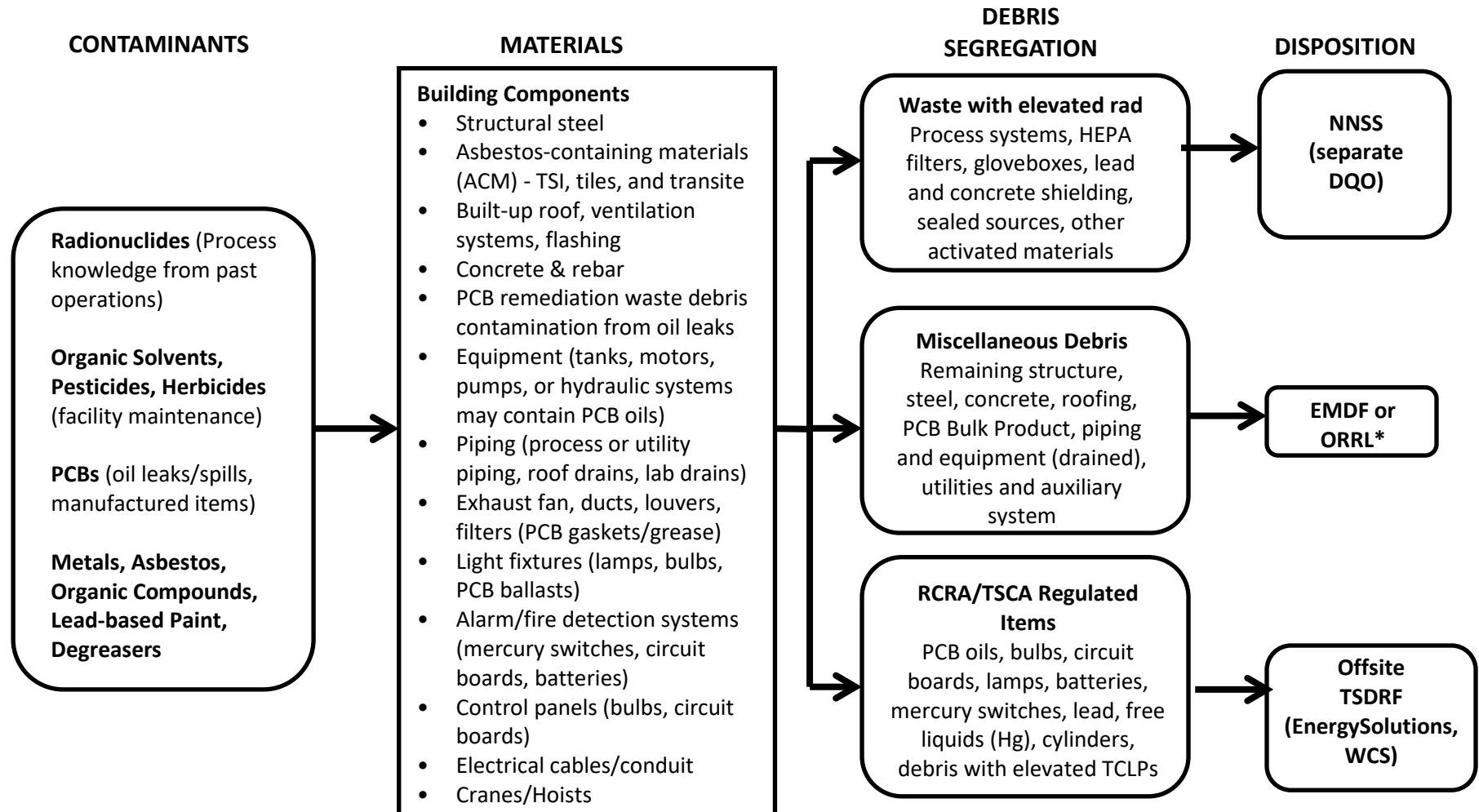


Fig. 7. DQO process.

This final step of the DQO process results in a sampling design for generating data to fill identified data needs to meet the target disposal facility WAC. Data quality information needed as input in the sampling design process derives mainly from the DQO process and includes the following:

- Purpose of data collection, that is, hypothesis testing (evidence to reject or support a finding that a specific parameter exceeds a threshold level, or evidence to reject or support a finding that the specified parameters of two populations differ), estimating a parameter with a level of confidence, or detecting hot spots
- Target population and spatial/temporal boundaries of the study
- Statistical parameters of interest, such as mean, median, percentile, trend, slope, or percentage
- Limits on decision errors and precision, in the form of false acceptance and false rejection error rates and the definition of the gray region

A conceptual site model is a useful tool developed during the DQO that provides a summary of site or project's physical, chemical, and radiological processes that determine how SRCs (otherwise referred to as contaminants of concern) move from their sources through and into environmental media such as building materials, slabs, soil, filter media, etc. For large complex projects, the CSE is an essential tool for summarizing processes, principle SRCs, sample populations, and planned disposition. An example CSE is provided in Fig. 8.



* PCB Remediation waste is not permitted at ORRL but is allowed for disposal at EMDF.

DQO = data quality objective
 EMDF = Environmental Management Disposal Facility
 ORRL = Oak Ridge Reservation Landfill
 NNSS = Nevada Nuclear Security Site

PCB = polychlorinated biphenyl
 RCRA = Resource Conservation and Recovery Act of 1976
 TCLP = Toxicity Characteristic Leachate Procedure

TSCA = Toxic Substances Control Act of 1976
 TSDRF = treatment, storage, disposal, recycling facility
 WCS = Waste Control Specialists

Fig. 8. Example conceptual site model for waste disposition.

Efforts are made during the early planning stages of characterization to identify and group unique sample populations, and the CSE pictorially represents all these aspects and logically groups waste streams to provide a context for the development of a sampling and analysis approach and overall characterization strategy for waste disposition.

Developing and refining the project's objectives are an integral part of the DQO process. The objectives shall be stated and appropriate DQO summary forms or a checklist provided if available. DQOs are typically prepared in a presentation format, and workshops are held with FFA parties so that a consensus can be obtained on the overall sample design, analytical methods, and QC requirements that are consistent with the project objectives as stated below:

- Identify the regulatory requirements (or other drivers for sampling) and DQOs.
 - Note: DQOs for removal actions and D&D projects are not always equivalent to DQOs for waste management and disposition.
- Define project DQOs based on intended use of the data.
- Describe all the anticipated uses for analytical data.
- Include the appropriate DQO summary forms or checklists, if available.

Site-related Contaminants

An SRC is a chemical or radionuclide that has a WAC limit and is present in a waste lot in concentrations that are above background. Refer to Appendix C, Guidance for Data Collection, Data Analysis, and Formulation of Sampling Plans for additional guidance on SRC reporting including how to interpret laboratory data flags or validation codes. In some cases, non-detects may be screened out based on the rate of detection. These rules follow EPA's *Risk Assessment Guidance for Superfund* (EPA 1989).

Additionally, WACFACS requires not only estimates of expected average concentrations for each analytic WAC constituent, but also confidence intervals for those average values. The specific DQA techniques to be used for developing contaminant concentration input parameters for WACFACS is based on EPA guidance and is described in detail in Appendix C. The overall process starts with an assessment of what data is available and usable, including proxy values for qualified analytical data. Incomplete data for SRCs are noted as data gaps in the DQO. Analytical data sets are then evaluated for the appropriate data distribution, and appropriate descriptive statistics are calculated for use by WACFACS.

Waste streams having activity concentration of radionuclides in the final waste form at 1% or greater of the total activity shall be reported. Radionuclides may be eliminated as contaminants of concern with short half-lives (i.e., < 5 years). Waste with TRU constituents that exceed 1 nCi/g require rigorous characterization to assess TRU waste criteria and waste classification requirements.

SOFs are calculated for all SRCs with analytic WAC limits in Tables 5 and 6 as discussed previously. Constituents that do not have concentration or inventory limits are excluded from EMDF inventory SOF calculations; however, all radionuclides shall be reported based on reporting requirements. Other SRCs are those associated with RCRA LDR and TSCA disposal compliance requirements. Data requirements for LDR and disposal compliance can be found in RCRA and TSCA regulations and supporting guidance. All chemical and radiological SRCs are reported in the waste profile summary statistics so that EMDF operations can assess the ASA-derived WAC limits and specify if any special handling provisions are warranted.

The waste generator shall characterize waste with sufficient accuracy to determine correct regulatory categorization, segregation, treatment, and final categorization for disposal. The waste generator shall ensure characterization methods and procedures employed identify the chemical, physical, and radiological characteristics of the waste during each phase of the waste management process starting at the point of generation. The generator shall ensure adequate characterization data exists to accurately represent the waste contents and contaminant concentrations for the final waste form. The CERCLA project shall use documented characterization protocols (e.g., sampling technique, measurement method, PK basis) to obtain data to complete a waste profile. Secondary wastes, such as associated used equipment, personal protective equipment, job control waste, or plastic sheeting disposed with the primary waste stream, are not required to be characterized separately; however, secondary wastes shall be considered in the overall waste volume of the respective waste lot.

All characterization techniques used shall be documented with qualified peer reviews prior to use. Analytical techniques shall be identified in the DQOs and reported through the DQA process and approved by the respective FFA project teams prior to presenting in a waste profile. Alternative radiological characterization approaches including nondestructive assay, dose-to-curie, and other modeling programs may be considered when presented in the DQA when intrusive samples are not feasible or attainable.

Characterization of waste may include PK, historical data and/or intrusive sampling; however, these data shall be developed through the DQO process and shared with appropriate FFA Project Team. Empirical data shall be prioritized over PK for chemical characterization of wastes when making RCRA/TSCA determinations.

Chemical characterization will be based on RCRA/TSCA LDR sampling requirements. Both total concentrations and TCLP concentrations may be provided in the waste profile in accordance with profile instructions and waste determinations. Based on historical data and PK some TCLP parameters may not be necessary (i.e., herbicides or pesticides). The DQO shall define what chemical analyses are required for the waste profile.

Additional useful guidance for properly characterizing wastes for chemical and radioactive content can be found in the following documents:

- UCOR-4187, Waste Certification Plan
- UCOR-4188, Waste Characterization Plan
- UCOR-4189, Quality Assurance Plan for Environmental Characterization and Monitoring
- UCOR-4191, Radiological Quantification Guidance
- PROC-ES-1000, Waste Generator's Guide to Disposing of Waste at the EMWMF
- PROC-ES-1000, Process for Obtaining Characterization and Analytical Support
- PROC-TR-4551, Radiological Characterization of Surface Contaminated Objects

5.3 DATA COLLECTION REQUIREMENTS

To determine whether a waste constituent is an SRC, data for the constituent must be available and representative of the wastes to be disposed. The sources of this data can be analytical data from past CERCLA investigations, which are typically found in the Oak Ridge Environmental Information System (OREIS), or from other investigations such as sampling done to support early removal actions or remedial designs. Data can also be anecdotal, such as from PK associated with a facility or site, or from established

relationships of contaminants (e.g., the absence of Cs-137 and Sr-90 being used as an indication of the absence of all fission products).

Also, analytical data from similar sites or processes may be used as anecdotal evidence to gauge the potential presence and concentration for waste constituents that do not have site analytical data, and to determine whether waste is potentially acceptable for disposal at the EMDF. Such proxy data may be used when identified and qualified as such in the DQO. For example, data representing SRCs in similar building materials may be considered (e.g., PCB Bulk Product data, metals, materials of construction).

Definitive PK may be sufficient to justify the elimination of a waste constituent as an SRC without the need for analytical data. In cases where PK is less certain, a combination of PK and limited analytical data may be sufficient. In either case, the justification for such determinations should be stated explicitly in a DQO, SAP, or another remedial action project CERCLA document.

Once data is gathered, there are often factors that complicate the evaluation of this existing information relevant to determining WAC compliance. For instance, analytical data may exist, but they may have been derived from samples outside of the planned area of excavation or they may not exist for all areas of planned excavation. Also, sampling efforts to support CERCLA site investigations often involve the collection of biased samples to identify and bound site conditions instead of being tailored at determining site average concentrations of a waste lot. Finally, data may not be available for all WAC constituents, which would indicate a data gap that must be filled prior to waste acceptance for disposal.

The collection of analytical characterization data shall be performed in accordance with approved SAPs, sample request forms, or similar documentation. The documentation shall specify the specific waste stream or bounded sample population, representative sampling method, biased or judgmental method, measurement method, and applicable procedures.

The generator shall utilize SW-846 for characterization of RCRA/TSCA constituents and for demonstrating compliance with LDRs. DOE Consolidated Audit Program-accredited laboratories shall be used for characterization. The waste generator shall consider using validated data for RCRA and PCB determinations by following quality assurance project plan (QAPP) guidelines for the CERCLA project. Data validation shall be performed by technically qualified personnel who are independent of those performing the analyses.

Visual inspections may also play a part in biased samples. For example, if a sticky, oily or greasy residue is present, PCBs, and confirmation TCLP samples may be added to the analysis group for that location. PCB results for oil from equipment and stained areas will determine “as found” concentrations and whether PCB remediation waste is present.

Target detection limits are intended to be at or below regulatory levels or WAC. Every effort should be made to meet these limits. Actual detection limits may be sample-specific, especially in the case of samples having complex matrices, but the data measurement objective is to obtain data with detection limits adequate to satisfy the target reporting limit. The QAPP shall include additional QA/QC details on analytical laboratory requirements.

5.3.1 Sampling Requirements and Strategies

Sampling strategies and techniques shall be presented in the DQO. SAPs are developed and implemented, and results documented in the DQA. The sample design is a primary product resulting from the application of the DQO process. The SAP, QAPP, and DQO collectively address the following information:

- DQOs for regulatory compliance and meeting target disposal facility WAC
- Sampling design (statistical, random, stratified random, biased/judgmental, etc.)
- Sample confidence and coverage (e.g., applicable procedures, sample count, and types)
- Analytes and reporting limits
- Analytical methods
- Laboratory requirements
- QC requirements
- Data review, evaluation, and management
- Variances or deviations
- Applicable tables and references

The sampling design addresses all concerns and aspects related to the collection of samples. Maximum use of reference to the QAPP is encouraged and descriptions of supplemental information, site-specific details, maps, conceptual site model (if applicable), and new information shall be addressed in the DQO package.

Sampling Methods

Sampling requirements, including the number and type of samples specified to be collected, shall be sufficient to achieve the identified quality objectives that are addressed in the SAP and DQO. The use of statistical methods is dependent upon the WAC requirements; therefore, sampling design, methods, and objectives shall be discussed in project DQOs.

Sampling procedures are designed to reduce variability between sampling events and obtain representative samples, thereby maintaining consistent quality during all sampling activities. Additional sampling guidance is available in *EPA Guidance on Choosing a Sampling Design for Environmental Data Collection for Use in Developing a Quality Assurance Project Plan* (EPA QA/G-5S). Additional guidance and standard practices on sampling approaches and methods are available from EPA and other guidance documents. Alternate sampling strategies and methods must be reviewed and approved by the appropriate project and functional representatives.

Characterization of some waste streams may include conducting radiological surveys based on the *Multi-Agency Radiation Survey and Site Investigation Manual* (DOE et. Al 2000; MARSSIM). Planning for these surveys is usually outside the scope of the SAP, but may be documented in a separate survey plan when a MARSSIM-type survey is used for disposition of waste. Radiological surveys including walkover surveys may be used for identification of sample locations including biased or judgmental samples.

5.3.1.1 Sample Designs

The sampling designs should include enough samples to provide defensible data for waste management decisions. The number of samples depends on the number of unique populations of waste to sample, and an assessment of the number of random or statistically based sample designs or biased/judgmental samples needed for each population.

Random or statistically based sample designs

Nonparametric upper tolerance limits (UTLs) on the maximum concentrations are applicable to statistical sample designs. The statistical sampling design uses a nonparametric UTL on the largest order statistic (i.e.,

maximum) to determine the number of samples to collect from a population. This method does not require existing knowledge of the data or its statistical distribution. The approach has both confidence and coverage attribution. The coverage of UTL is the percentage of the population distribution that the largest order statistic (i.e., maximum) collected from the samples will bound. The confidence of a UTL is how confident one is that the specified order statistic bounds the percentile of the population distribution. The confidence can be found by: $(1 - \alpha) \times 100\%$ where α is the Type I error rate ($0 < \alpha < 1$).

Confidence is the statement that one is $100(1 - \alpha) \%$ confident that the maximum concentration bounds a specified portion of the population where $\alpha = \text{Type I error rate}$ for $0 < \alpha < 1$. For example, if the project selects $\alpha = 0.05$, then the UTL will have 95% confidence.

Coverage (p) is $100p\%$ of the population that the UTL bounds where $0 < p < 1$. For example, if the project selects $p = 0.90$, then the UTL bounds at least 90% of the contaminant distribution of the population.

The minimum confidence and coverage required for a stand-alone waste population is 95% confidence and 80% coverage, thus 14 samples would be required to estimate concentrations for EMDF compliance. For waste that requires more rigor in the evaluation (RCRA LDRs or analytical WAC concerns), higher coverage may be necessary. The definition of waste populations during the planning and CSE development becomes critical to the overall number of samples. Grouping of waste populations shall be logical and aligned with PK and the potential for similar contamination levels. Removal of samples from a planned waste population shall be done in concurrence with the project statistician and presented in the DQA, as appropriate. The confidence/ coverage for the UTL can be simplified in Table 8 for a given unlimited sample population:

Table 6. Confidence and coverage aspects for a statistical sample design of unlimited sample population

Percent Confidence	Percent Coverage							
	80	85	90	95	97	99	99.5	99.9
80	8	10	16	32	53	161	322	1609
85	9	12	19	37	63	189	379	1897
90	11	15	22	45	76	230	460	2302
95	14	19	29	59	99	299	598	2995
97	16	22	34	69	116	349	700	3505
99	21	29	44	90	152	459	919	4603
99.5	24	33	51	104	174	528	1058	5296
99.9	31	43	66	135	227	688	1379	6905

Other sample designs may consider stratified random designs or judgmental samples. Stratified random sampling designs may be desired to preferentially select sample locations from materials or areas with higher expected levels of contamination. For example, each section of a population (e.g., floors, walls, slab) could be subject to 100% radiological survey and visual inspection; therefore, providing 100% coverage of the population with the hotspots/stained areas to be identified for sampling.

Biased or Judgmental Samples

Biased data may exist that appropriately bounds the maximum concentration of a significant SRC. Biased data may also skew the statistical parameters in an overly conservative manner. When this occurs, the effects of the biased data must be evaluated. If the incorporation of biased data does not materially affect the calculations of SOF (i.e., the contaminant represents a small fraction of the analytic WAC even using the biased data), then the biased data can be accepted as representative of the wastes. However, if the

incorporation of biased data significantly impacts the SOF calculations, additional data that is representative of the expected wastes to be generated may be required. If the waste appears to be likely candidates for EMDF disposal, then sampling plans for these wastes should also include the collection of unbiased samples for the contaminants of interest. The goal for collecting these additional samples is the determination of representative average concentrations of waste contaminants contributing significantly to the SOFs. Professional judgment should always be used to develop an efficient sampling design, whether that design is judgmental or probability based.

A combination of statistical (random) and judgmental sampling is usually implemented to characterize diverse waste streams under a single waste lot. This process provides a representative average concentration for a given SRC, while also bounding the maximum level of contamination. Sample designs are presented in the DQO and implemented and resulting data are presented in the DQA.

Field sampling cannot always be completed as planned. Projected sample locations may be inaccessible, and, in some cases, the proposed media cannot be located or has been dispositioned offsite. All documentation regarding variances and sample deviations should be addressed in the DQA for completeness. This will help achieve confidence in the samples collected in accordance with the SAP and the project-specific DQOs.

The type and frequency of QC samples along with the parameter of interest, action levels, and/or limits should be included. Pertinent QA/QC acceptance limits and criteria shall be stated in the project QAPP. SAPs incorporate sources of uncertainty: sampling uncertainty (e.g., field duplicates, randomized and statistical samples), laboratory uncertainty (e.g., laboratory duplicates, matrix spike/matrix spike duplicates), and systematic uncertainty (e.g., access and safety issues).

5.4 DATA QUALITY ASSESSMENT

Once characterization activities are completed and resulting data have been evaluated and summarized, the DQAs are prepared and presented to FFA parties. The DQA presentations are considered workshops with an open forum with the goal of obtaining a consensus on the data gathered to represent a waste lot. The primary purpose of the DQA is to demonstrate how all the DQOs were met or provide explanation of any deviations and evaluate the overall usability of the data.

The DQA process steps are shown in Fig. 9. Applicable aspects of the DQA will be completed in accordance with EPA guidance, *Data Quality Assessment: Statistical Methods for Practitioners* (EPA QA/G-9S).

The output of the DQA process should provide the answers to the following basic questions:

- Are the samples collected representative?
- Are the analytical data of the type, quality, and quantity to support their use?
- Can a defensible decision be made using the data?

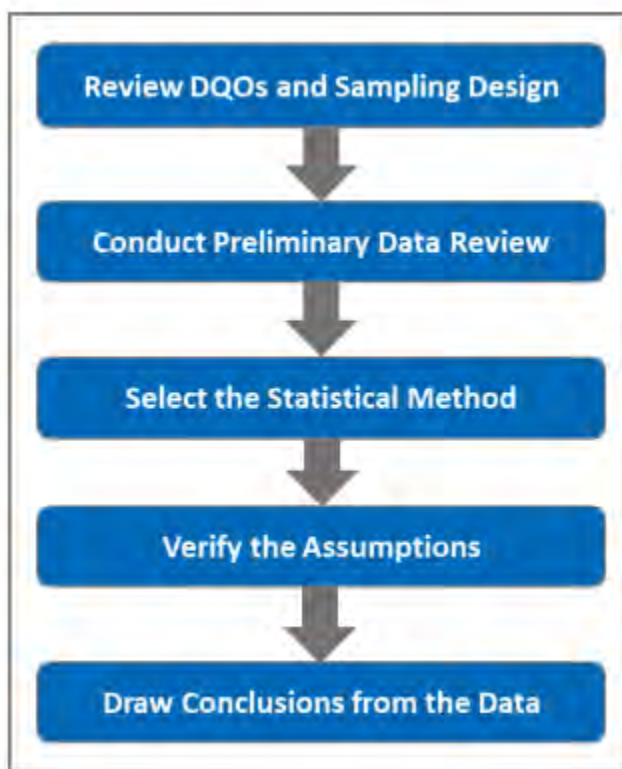


Fig. 9. Data quality assessment process.

Analyses may include various statistical and numerical algorithms. Preliminary inspection will identify any analyte concentrations that exceed expected values (e.g., background and/or existing concentrations) for SRCs for which tests were performed, identify potential outliers and extreme values in data sets, and determine whether data sets are significantly different from background or some of the results of preliminary data assessment. In extreme cases, resampling and/or reanalysis by the analytical laboratory may be necessary.

Analytical data review results in the assignment of qualifiers or “flags” to individual test results. Qualifiers are assigned both by laboratory analysts and data validators and indicate specific information about the associated data.

Both types of qualifiers are explained and tracked in project records and electronically. All characterization data is tracked and managed in a Sample Management Office approved data management system.

DQAs combine all available data and summarize how the analytical data is used for waste characterization while meeting EMDF WAC requirements including regulatory determinations and resulting waste lot SOFs. The DQA presentation includes summary statistics on all applicable waste populations and combines all the data together, resulting in a CDS that is then used for waste profile purposes. Once the DQA is approved, the waste profile may be completed, and the EMDF WAT will verify that the appropriate data within the CDS is properly used in waste profile calculations.

Statistical summaries of the sampling results collected are generated after data verification, validation (if performed), and data reduction following these rules:

- Summary statistics should include the detection frequency, minimum detected result, mean of the detected results, maximum detected, UCL-90, UCL-95, etc. and other statistical parameters for all constituents analyzed.
- Duplicates – The larger of a detected duplicate and its associated detected regular sample is retained in the reduced data set for conservativeness. If a duplicate or its associated regular result was detected, while the other result was not detected, the detected result will be retained in the reduced data set. If neither the duplicate nor its associated regular result was detected, then for radionuclides, the largest non-detect is retained, while for chemicals, the smallest non-detect is used.
- The detection limit for radiological non-detect results are used in statistical calculations.
- Results may be further evaluated and compared to the WAC for EMDF to demonstrate compliance.

Data Management

For the DOE-OREM prime contractor, the Sample Management Office data management system (i.e., Phoenix database) will be used for sample planning, generating chain of custody records and sample labels, sample tracking, and a repository for sample results. Other DOE contractors will use their own data management process approved by DOE. The laboratory will provide analytical results in electronic and hard-copy format. The hard-copy format may be provided by PDF file. Analytical data will be subject to contract compliance verification and validation as prescribed by the project's QAPP. The QAPP and other analytical master specifications for analytical laboratory services will provide other relevant information on data management, deliverables, and review.

Each laboratory data deliverable will undergo 100% contract compliance verification to ensure that basic contractual requirements have been met. Contract compliance screening will include verification that all requested analyses are reported and that hard copy and electronic results are consistent. Discrepancies will be corrected and documented. Analytical data validation will be in accordance with applicable procedures, and data qualifiers will be assigned to the data based on the findings. All data will be managed in a data management system that provides organization, integrity, security, traceability, and consistency for environmental measurements data generated from environmental restoration and monitoring projects. The data qualifiers will be entered into the data management system (i.e., Phoenix database) from the validated hard copy and will serve to alert data users to uncertainties associated with the data. If data errors occur, then data validation may be increased based on the type and quantity of errors found.

5.5 WASTE PROFILES

CERCLA projects that generate waste shall complete a waste profile in accordance with the template and instructions provided in Appendix D. It is important that the scope of the waste lot and associated waste volumes are consistent with approved CERCLA documentation. Existing facility, waste stream, or site-specific data will be evaluated to determine if it contributes information that will improve the understanding and characteristics of the waste generated. Waste profiles may be broadly written to accommodate similar wastes from multiple buildings or exposure units. Each profile provides the acceptable range for chemical concentrations and radiological activity, and other limiting factors that are relevant to the waste stream. Waste profiles are established to ensure a consistent and defensible approach in demonstrating compliance with this EMDF WAC. Waste profiles will be maintained by the waste generator and EMDF WAT.

The waste profile information shall be consistent with the PK and the CDS that is approved during the DQA process, such that all inputs into the profile remain traceable and consistent with agreements reached by the CERCLA project teams. As part of the profile submittal, the waste generator must submit the CDS in a format specified by the EMDF WAT, along with its WACFACS submittal, so that input data may be

examined during profile review. In cases where additional data is collected after profile approval and/or bounding profiles are used, the CERCLA project shall consult with the EMDF WAT on the plan to update WACFACS. In cases where additional data is collected after profile approval, the data points that exceed the maximum may be considered as an adequate means to update the CDS and WACFACS. Alternatively, in cases where additional data is extensive and the waste profile has limited data representing the waste lot, then the entire new data set should be added to update the statistical evaluation of the waste lot.

Each profile is submitted to the EMDF WAT for review and approval. Each profile should be reviewed internally before formally submitting to EMDF WAT for accuracy and completeness. The EMDF WAT will review each profile to verify all characterization data is consistent with the information presented during the DQO/DQA process. Regulatory determinations and listed waste determinations shall be prepared with appropriate levels of reviews and approval by authorized personnel. All criteria must be fulfilled before a waste lot is approved. The EMDF WAT will use the Waste Lot Assessment Checklist to confirm all WAC requirements have been met.

For any specific waste lot evaluated by the EMDF WAT, the primary parameters of interest are the expected volume, the expected SOF, the expected VWSF, and their associated uncertainties. These parameters are calculated by WACFACS. Because one of the significant fundamental parameters upon which the VWSF calculations are based is the volume projections, it is important that the volumes input into WACFACS be the most recent and accurate predictions possible and that actual disposed volumes are within the expected range used for the waste lot approval. WACFACS input volumes should be drawn from the latest WGF data; if the project has produced more accurate volume estimates during the development of the waste profile, then the WGF should be updated to reflect these revisions prior to the submission of the final waste profile.

Once a waste lot is approved, it is still possible for actual field conditions to be significantly different from those assumed during the planning stages. Therefore, waste lot approvals will include the expected range of volumes to be disposed under that waste lot, expressed as the 5% lower confidence limit, the expected volume, and the 95% UCL of that volume range. If the actual volumes to be disposed at EMDF change significantly and exceed the approved UCL-95 volume, the waste generator must revisit its CERCLA documentation and revise the waste profile so that the SOFs can be recalculated to determine the impact on the VWSF. After analysis of the revised profile, the CERCLA project may be re-authorized to dispose of the higher volumes. If, however, the revised WACFACS adversely impact the VWSF, then appropriate mitigation measures will be considered, including the segregation of waste for offsite disposal. The EMDF WAT monitors actual waste volumes against approved waste volumes and notifies the project when the project is approaching the approved UCL-95 volume.

EMDF WAT will issue an approval package for waste profiles once acceptable. The approval package will clearly identify the CERCLA project (waste generator), WACFACS identification number, volume, and other information provided by the project. The approval package may contain conditions for approval or may indicate any required additional information necessary for approval of the waste lot. The approval package consists of a decision summary, key assumptions, and conditions of approval. Any proposed changes to waste delivery methods, waste generation methods, or waste screening methods must be reviewed by the EMDF WAT to determine whether any bases for approving the waste lot may have been impacted.

The overall EMDF WAT waste profile approval process is shown in Fig. 10 and will generally follow a pattern whereby the projects submit waste profile information for initial assessment, followed by closure of any remaining open issues. If no remaining open issues (to include data gaps) exist, approval can be granted on the basis that all WAC requirements are met. If data gaps exist, additional data must be gathered prior to evaluation of a waste lot profile for final approval. As noted in Fig. 10, the waste profile, including SRC summary statistics, is provided to both EMDF WAT and EMDF Operations. The SRC information in the

profile will be used by EMDF Operations to assess ASA nuclear safety requirements as well as nuclear criticality evaluations. These attributes will be assessed and any specific documentation or special packaging to meet EMDF Operations safety criteria will be addressed during comment resolution. Any specific limitations or specific actions required by the CERCLA project will be provided to EMDF WAT and these requirements will be identified in the waste profile approval package. The general flow of documentation for waste profile review and approval is provided below:

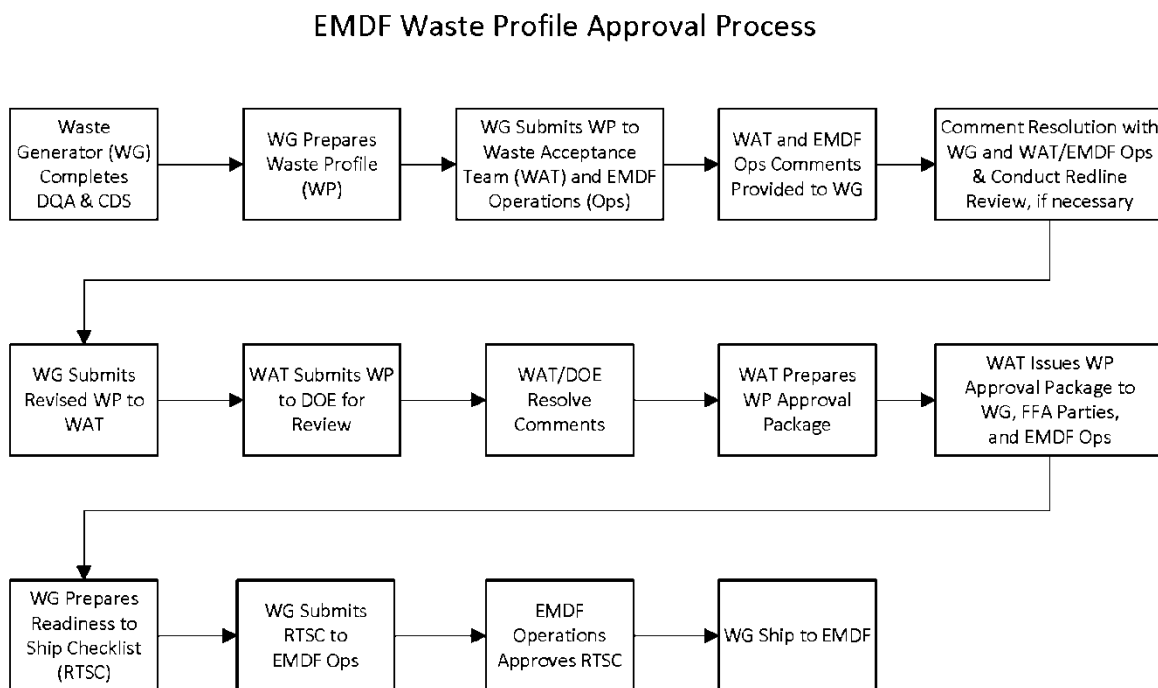


Fig. 10. EMDF waste profile approval process.

The waste generator shall submit documentation for appropriate state or federal regulatory agency approved RCRA treatability variance(s), risk-based disposal approval(s), contained-in determination(s), and determination(s) of equivalent technology with the wastes profile, if applicable.

In rare cases, two or more approved waste lots from a single CERCLA project must be shipped in a single conveyance as commingled waste. In these instances, the CERCLA project must specify the strategy for commingling waste lots within the associated CERCLA documentation. Individual waste lots will still be required to be approved on their own merits, even if they are to be commingled with other waste lots during shipment to EMDF. The CERCLA project authorizing commingled waste shipments must detail the strategy that will be used to assemble the data from each approved waste lot into a single waste-disposal proxy lot under which the commingled wastes will be shipped. These details will be presented in the DQA.

Revisions may be submitted for profiles when additional data is collected for waste not previously covered in the profile. Revisions may also occur when additional data is collected and a new SRC is identified or an exceedance in a SRC has occurred. Review of revised waste profiles follow the same process as original profiles but may only involve minor changes.

Anomaly Detection Plans

EMDF waste generators are required to develop and properly implement waste ADPs for each waste lot. It is imperative that the waste delivered to EMDF remain consistent with the scope boundaries and characterization parameters provided in the respective waste profile, including compliance with the WAC or special handling conditions. ADPs are summary level plans that reference specific actions taken or will be taken throughout waste generation. ADCs are formalized in the waste profile and provide field indicators along with a waste certification statement so that waste generators may certify each shipment meets the waste profile and ADP requirements. ADPs and ADCs must remain consistent with the current revision of the waste profile and waste lot approval letter. The ADP/ADC guidelines are presented in waste profile instructions in Appendix D.

Both the ADP and the ADC are specific to each waste lot profile and must be used to train project field personnel on the types of wastes or field conditions that may indicate potential waste anomalies including prohibited waste items or containers. When specific quantitative screening criteria are deemed necessary during waste-generation activities (such as radiological dose rate measurements, non-destructive assay measurements, or chemical instrumentation), these data acquisition methods and performance criteria will be finalized during the DQO/DQA process.

5.6 BOUNDING PROFILES

Bounding profiles may be appropriate for sites or projects with diverse contamination across multiple exposure units. These may be developed for lower volume SOFs such that a large volume of waste may be included in the profile. Bounding profiles shall provide data from representative sites and facilities such that the DQO/DQA may be approved as representative yet bounding for key parameters such as radionuclide concentrations.

6. QUALITY ASSURANCE

Remedial action project subcontractor QA plans will establish and provide specific QA procedures and associated documentation requirements for all project-specific aspects of the WAC, including the following:

- Waste characterization bases, including PK, existing analytical data, and the results of any sampling and analysis performed
- TCLP testing and other requiring testing and treatment for LDR compliance, if required
- Field observation logs documenting waste generation activities, including waste treatment or actions taken to address any anomalies found

The quality of waste approval decisions is also guaranteed by adherence to this WCP and the use of regulator-approved guidance documents to supplement this plan. Examples of such regulatory guides are the DQO and DQA guidance documents, and EPA's *Risk Assessment Guidance for Superfund* (EPA 1989).

In addition, the CERCLA project will prepare auditable records of its QA activities. QA activities will include project oversight observations and auditing of waste generation activities, the EMDF WAT independent approval of waste lots for disposal, and any other Performance/Quality Assurance Group independent internal or external audits.

Whenever DOE or regulatory agency oversight observations are submitted, either as less formal day-to-day interactions or more formal audits, these observations will be formally tracked to closure.

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7. RECORDKEEPING

7.1 CERCLA DOCUMENTATION

Several records will support the waste acceptance process. The records may have other uses as well, but their presence in the operating facility files will be necessary to document the process. The specific forms of the records and the procedures for their completion will be prescribed in implementing procedures. Records documenting the acceptance of each waste lot will be retained including the ADCs.

Shipments from waste lots will be tracked “cradle to grave.” That is, each shipment will have a separate record from the time it is generated (usually when it is removed from its original location at the CERCLA site) to its placement in the EMDF. If waste lots are mixed during disposal in the EMDF (for example, if contaminated soil is used as bedding or cover for debris waste), that mixing will appear implicitly in the operating facility records because both waste lots will be shown to have been disposed in the same location.

Waste shipment records will at a minimum contain the following information:

- The waste lot from which the shipment came and a sequential numbering of each shipment
- The volume of the waste being shipped in the conveyance
- The average and UCL95 SRC concentrations assigned to the waste lot
- Date and time the wastes left the CERCLA site

Once the EMDF Operations receives the waste shipment, additional information will be added to the waste shipment documentation, including, but not limited to, the following:

- Date and time the wastes were received at the EMDF
- Confirmation that the waste lot number corresponds to an approved waste lot
- Confirmation that physical WAC requirements were met
- Identification of where the shipment was placed in the EMDF

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8. REFERENCES

- 15 USC § 2601 et seq., *Toxic Substances Control Act of 1976*, Washington, D.C.
- 42 USC § 2011, et seq., *Atomic Energy Act of 1954, as amended*.
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- DoD/DOE QSM 6.0, *Department of Defense and Department of Energy Quality Systems Manual for Environmental Laboratories*, 2023, Washington, D.C. December.
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- DOE 2004, *Nuclear Waste Policy Act, as Amended, with Appropriations Acts Appended*, U.S. Department of Energy, Office of Civilian Radioactive Waste Management Washington, D.C. March.
- DOE 2018, *Compliance Agreement between the United States Department of Energy and the United States Environmental Protection Agency Region 4* also known as *The Oak Ridge Reservation Polychlorinated Biphenyl Federal Facilities Compliance Agreement*, ORR-PCB-FFCA, Washington, D.C. October.
- DOE et. al. 2000., *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*, NUREG-1575, Rev. 1 / EPA 402-R-97-016, Rev.1 / DOE/EH-0624, Rev. 1, U.S. Department of Defense, U.S. Department of Energy, U.S. Environmental Protection Agency, U.S. Nuclear Regulatory Commission, Washington, D.C., August.
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- DOE/OR/01-2535&D5. *Remedial Investigation/Feasibility Study for Comprehensive Environmental Response, Compensation, and Liability Act Oak Ridge Reservation Waste Disposal*, Oak Ridge, Tennessee, 2017, U.S. Department of Energy, Oak Ridge Office of Environmental Management, Oak Ridge, TN, February. [Note: erratum issued January 2018.]
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- DOE-STD-3007-2017, *Preparing Criticality Safety Evaluations at Department of Energy Nonreactor Nuclear Facilities (Invoked)*, 2017.
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- EPA QA/G-5S, *Guidance on Choosing a Sampling Design for Environmental Data Collection for Use in Developing a Quality Assurance Project Plan*, 2002.
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- EPA QA/G-9S, *Data Quality Assessment: Statistical Methods for Practitioners*, 2006.
- Public Law 102-579. S.1671 - 102nd Congress (1991-1992): *Waste Isolation Pilot Plant Land Withdrawal Act*. Library of Congress, 30 October 1992.
- SRNL-STI-2025-00096, Revision 0. *¹⁴C Distribution Coefficient and Mineralogy of Subsurface Sediments Collected from the Proposed Site of the Environmental Management Disposal Facility*, H. Gonzalez-Raymat and K. A. Hill. May 2025.
- TDEC 0400-12-01-.06, *Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities*, 2023, Tennessee Department of Environment and Conservation, Nashville, TN.
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- UCOR-4188, *Waste Characterization Plan*, latest revision.
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- UCOR-5096, *Composite Analysis for the Environmental Management Waste Management Facility and the Environmental Management Disposal Facility, Oak Ridge, Tennessee*, latest revision.
- UCOR-5843, *Supplemental Analysis for the Environmental Management Disposal Facility*, latest revision.
- UCOR PROC-ES-1000, *Waste Generator's Guide to Disposing of Waste at the EMWMF*, latest revision.
- UCOR PROC-ES-1000, *Process for Obtaining Characterization and Analytical Support*, latest revision.
- UCOR PROC-TR-4551, *Radiological Characterization of Surface Contaminated Objects*, latest revision.

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APPENDIX A. FINAL WASTE ACCEPTANCE CRITERIA

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Table A.1. Administrative waste acceptance criteria (WAC) for Environmental Management Disposal Facility (EMDF)

Waste prohibited or limited by definition or decision	Basis of prohibition/limitation
Waste must be generated as part of a CERCLA action on the Oak Ridge NPL Site. Waste generated at other sites within the State of Tennessee where contamination can be related to Oak Ridge NPL Site releases would require FFA party consideration and agreement.	Triparty agreement ^a
Transuranic waste (defined in 40 <i>CFR</i> 191.02), high-level waste (defined in 10 <i>CFR</i> 60.2), spent nuclear fuel (defined in 10 <i>CFR</i> 72.3), 11e(2) byproduct waste (defined in 10 <i>CFR</i> 20.1003), and/or greater than NRC Class C waste (defined in 10 <i>CFR</i> 61.55) are prohibited. These waste types are excluded from the definition of low-level waste (defined in TDEC 0400-20-11-.03[21]).	Triparty agreement ^a and regulatory definitions
RCRA-listed hazardous wastes are prohibited.	Triparty agreement ^a
Infectious/pathogenic wastes and pyrophoric/detonatable/explosive wastes are prohibited, as are wastes that could generate quantities of toxic gases/vapors/fumes.	Triparty agreement ^a TDEC 0400-20-11-.17(7)(a)(4) TDEC 0400-20-11-.17(7)(a)(5) TDEC 0400-20-11-.17(7)(a)(6)
Containerized compactible waste shall either have voids filled with non-compressible material (e.g., soil, grout), or be capable of being crushed by available landfill operations equipment. Non-crushable containers (B-25 boxes, etc.) shall have remaining voids filled with non-compressible material. Cardboard or fiberboard boxes shall not be used as containers for waste disposal.	Triparty agreement ^a TDEC 0400-20-11-.17(7)(b)(1) TDEC 0400-20-11-.17(7)(b)(3) TDEC 0400-20-11-.17(7)(a)(1)
Free liquids are prohibited; RCRA and TSCA waste packages shall have no free liquids.	40 <i>CFR</i> 761.75(b)(8)(ii) TDEC 0400-12-01-.06(14)(o)(3) TDEC 0400-20-11-.17(7)(a)(3)
Bulk liquids exceeding 500 ppm PCBs are prohibited. Bulk liquids containing PCBs at or below 500 ppm must be treated such that they no longer contains free liquids. PCB containers with PCB liquids between 50 ppm and 500 ppm are allowed with additional sorbent material included.	40 <i>CFR</i> 761.75(b)(8)(ii)
Bulk or non-containerized liquid hazardous waste or hazardous waste containing free liquids (whether or not sorbents are added) are prohibited.	TDEC 0400-12-01-.06(14)(o)(l)
Unless very small, containers must be either at least 90% full when buried in the landfill or crushed, shredded, or similarly reduced in volume to the maximum practical extent before burial in the landfill.	TDEC 0400-12-01-.06(14)(p)
Waste must not contain or be capable of generating quantities of toxic fumes or gases harmful to persons transporting, handling, or disposing the waste.	TDEC 0400-12-01-.06(2)(h)(2)

Table A.1. Administrative WAC for EMDF (cont.)

Waste prohibited or limited by definition or decision	Basis of prohibition/limitation
RCRA hazardous waste that is not treated to meet LDR treatment requirements or alternative treatment standards for hazardous debris or soil is prohibited from disposal. Treated RCRA hazardous waste with TCLP regulatory levels less than LDR treatment requirements (e.g., selenium) that do not meet the lower of the 40 <i>CFR</i> 261.24 regulatory level or LDR treatment requirement is prohibited from disposal (This is not applicable to mercury characteristic waste (D009) as generated – see exception in this table). Note: LDR requirements have associated numerical or technology standards that must be met prior to land disposal; see ARARs in Table A.3 and appropriate citations given there.	TDEC 0400-12-01-.10(3)(a) TDEC 0400-12-01-.10(3)(f)(1) TDEC 0400-12-01-.10(3)(j)(2) Triparty agreement^a
RCRA (D009) mercury characteristic hazardous waste, as determined by the method specified in 40 <i>CFR</i> 261.24, is prohibited from disposal.	Triparty agreement^a

Source: Table 2.6 of the EMDF ROD.

^a*Triparty agreement* refers to discussions held for the given prohibition/limitation and decisions/agreements reached among the three FFA parties regarding the specific WAC given here, which are documented by the approval of the *Record of Decision for Comprehensive Environmental Response, Compensation, and Liability Act Oak Ridge Reservation Waste Disposal at the Environmental Management Disposal Facility, Oak Ridge, Tennessee* (DOE/OR/01-2794&D2/R2).

ARAR =applicable or relevant and appropriate requirement
CERCLA = Comprehensive Environmental Response,
Compensation, and Liability Act of 1980
CFR = *Code of Federal Regulations*
DOE = U.S. Department of Energy
FFA = Federal Facility Agreement
LDR = land disposal restrictions
NPL = National Priorities List

NRC = U.S. Nuclear Regulatory Commission
PCB = polychlorinated biphenyl
RCRA = Resource Conservation and Recovery Act of 1976
ROD = Record of Decision
TCLP = Toxicity Characteristic Leaching Procedure
TDEC = Tennessee Department of Environment and Conservation
TSCA = Toxic Substances Control Act of 1976
WAC = waste acceptance criteria

Table A.2. Summary of EMDF radiological concentration limits

**EMDF Waste Concentration Limits
Waste Lot SOF**

Waste Lot:				
Radioisotope	Average Concentration pCi/g	Waste Lot Conc. Limit (pCi/g)	Average Concentration SOF	Basis
Ac-227		1.30E+06	-	Intruder analysis
Am-241		1.00E+05	-	Class C limit
Am-243		1.00E+05	-	Class C limit
Ba-133		5.50E+07	-	Intruder analysis
Be-10		6.00E+06	-	Intruder analysis
C-14		3.10E+04	-	Intruder analysis
Ca-41		2.30E+06	-	Intruder analysis
Cd-113m		4.50E+06	-	Intruder analysis
Cf-249		7.90E+04	-	Intruder analysis
Cf-250		1.00E+05	-	Class C limit
Cf-251		1.00E+05	-	Class C limit
Cl-36		6.60E+02	-	Intruder analysis
Cm-243		1.00E+05	-	Class C limit
Cm-244		1.00E+05	-	Class C limit
Cm-245		1.00E+05	-	Class C limit
Cm-246		1.00E+05	-	Class C limit
Cm-247		6.80E+04	-	Intruder analysis
Cm-248		1.60E+04	-	Intruder analysis
Co-60		4.70E+09	-	Intruder analysis
Cs-137		2.30E+05	-	Intruder analysis
Eu-152		3.60E+06	-	Intruder analysis
Eu-154		6.30E+07	-	Intruder analysis
H-3		5.70E+08	-	Intruder analysis
I-129		6.10E+03	-	Intruder analysis
K-40		1.80E+04	-	Intruder analysis
Mo-93		5.50E+04	-	Intruder analysis
Nb-93m		1.60E+10	-	Intruder analysis
Nb-94		1.60E+04	-	Intruder analysis
Ni-59		7.60E+07	-	Intruder analysis
Ni-63		6.40E+07	-	Intruder analysis
Np-237		1.00E+05	-	Intruder analysis
Pa-231		4.10E+04	-	Intruder analysis
Pb-210		2.10E+04	-	Intruder analysis
Pd-107		1.90E+08	-	Intruder analysis
Pm-146		9.60E+09	-	Intruder analysis

Table A.2. Summary of EMDF radiological concentration limits (cont.)

Radioisotope	Average Concentration pCi/g	Waste Lot Conc. Limit (pCi/g)	Average Concentration SOF	Basis
Pu-238		1.00E+05	-	Class C limit
Pu-239		1.00E+05	-	Class C limit
Pu-240		1.00E+05	-	Class C limit
Pu-241		3.50E+06	-	Class C limit
Pu-242		1.00E+05	-	Class C limit
Pu-244		6.30E+04	-	Intruder analysis
Ra-226		8.80E+02	-	Intruder analysis
Ra-228		7.20E+08	-	Intruder analysis
Re-187		No limit		Intruder analysis
Se-79		6.40E+03	-	Intruder analysis
Sm-151		8.20E+08	-	Intruder analysis
Sn-121m		1.30E+07	-	Intruder analysis
Sn-126		1.20E+04	-	Intruder analysis
Sr-90		3.30E+05	-	Intruder analysis
Tc-99		4.80E+04	-	Intruder analysis
Th-228		No limit		Intruder analysis
Th-229		6.30E+04	-	Intruder analysis
Th-230		2.40E+03	-	Intruder analysis
Th-232		4.80E+03	-	Intruder analysis
U-232		1.20E+04	-	Intruder analysis
U-233		3.90E+04	-	Intruder analysis
U-234		3.90E+04	-	Intruder analysis
U-235		3.50E+04	-	Intruder analysis
U-236		4.50E+04	-	Intruder analysis
U-238		4.10E+04	-	Intruder analysis
Zr-93		1.60E+08	-	Intruder analysis

SOF Total* -

* If SOF Total exceeds 1, then waste lot is not eligible for disposal at EMDF.

^aLimits based on 1,000-year post-closure compliance period maximum annual intruder dose per DOE Order 435.1 chronic performance measure.

^bMaximum volume over which Waste Lot Concentration limits will be applied will be the largest expected waste lot volume containing that contaminant of concern.

^cEMDF intrusion-based activity concentration limits are adopted for radionuclides if those limits are lower than or equal to NRC Class C limits. The remaining radionuclides have waste lot concentration limits administratively set to NRC Class C limits.

DOE = U.S. Department of Energy

EMDF = Environmental Management Disposal Facility

NRC = U.S. Nuclear Regulatory Commission

SOF = sum of fractions

Table A.3. Summary of EMDF radiological inventory limits

Radioisotope	WAC inventory limit (Ci) ^a	WAC Concentration Limit (pCi/g) ^b	Basis
C-14	47.3 ^c	14.8	TDEC 0400-20-11-.16(2) [10 <i>CFR</i> 61.41] ARAR
H-3	3.31E+13	1.03E+13	
Tc-99	1070	335	

^aTotal activity inventory limits for H-3, C-14 and Tc-99 calculated assuming a bulk density of 1.9 g/cm³ (equivalent to a total landfill mass of 3.2E+12 g waste plus clean fill).

^b EMDF facility average concentration limit based on the design volume capacity of 2.2 million cubic yards.

^c The C-14 inventory limit in Table A.3 is based on the highly conservative PA assumption that the C-14 partition coefficient (K_d) value is zero. Laboratory measurements of C-14 K_d values for samples of soil and saprolite derived from the Maryville Limestone and Nolichucky Shale at the EMDF site (SRNL-STI-2025-00096) justifies using a higher (non-zero) K_d value for C-14, which would support a calculated analytic C-14 inventory limit higher than the value from the EMDF ROD and Table A.3. New and emerging information may be used to modify analytical WAC limits following the guidelines in Appendix B, and such changes would require FFA approval prior to implementation.

ARAR = applicable or relevant and appropriate requirement

CFR = Code of Federal Regulations

TDEC = Tennessee Department of Environment and Conservation

WAC = waste acceptance criteria

Table A.4. TDEC waste classification

Tennessee LLW classification of long-lived radionuclides for administrative WAC compliance ^a						
Radionuclide	Ci/m ³		pCi/g (assuming 1.7 g/cc)			
¹⁴ C	8		4.7 x 10 ⁶			
¹⁴ C in activated metal	80		4.7 x 10 ⁷			
⁵⁹ Ni in activated metal	220		1.3 x 10 ⁸			
⁹⁴ Nb in activated metal	0.2		1.2 x 10 ⁵			
⁹⁹ Tc	3		1.8 x 10 ⁶			
¹²⁹ I	0.08		4.7 x 10 ⁴			
Alpha emitting transuranic nuclides with half-lives greater than five (5) years	100 nCi/g		1.0 x 10 ⁵			
²⁴¹ Pu	3,500 nCi/g		3.5 x 10 ⁶			
²⁴² Cm	20,000 nCi/g		2.0 x 10 ⁷			
Tennessee LLW classification of short-lived radionuclides for administrative WAC compliance ^a						
Radionuclide	Column 1 (Class A limits)		Column 2 (Class B limits)		Column 3 (Class C limits)	
	Ci/m ³	pCi/g (assuming 1.7 g/cc)	Ci/m ³	pCi/g (assuming 1.7 g/cc)	Ci/m ³	pCi/g (assuming 1.7 g/cc)
Total of all nuclides with < 5-year half-life	700	4.1 × 10 ⁸	(¹)	(¹)	(¹)	(¹)
³ H	40	2.4 × 10 ⁷	(¹)	(¹)	(¹)	(¹)
⁶⁰ Co	700	4.1 × 10 ⁸	(¹)	(¹)	(¹)	(¹)
⁶³ Ni	3.5	2.1 × 10 ⁶	70	4.1 × 10 ⁷	700	4.1 × 10 ⁸
⁶³ Ni in activated metal	3.5	2.4 × 10 ⁷	700	4.1 × 10 ⁸	7000	4.1 × 10 ⁹
⁹⁰ Sr	0.04	2.4 × 10 ⁴	150	8.8 × 10 ⁷	7000	4.1 × 10 ⁹
¹³⁷ Cs	1	5.9 × 10 ⁵	44	2.6 × 10 ⁷	4600	2.7 × 10 ⁹
^a Adopted from Tennessee LLW regulations [TN 1200-2-11-.17(6)]. Basically, concentration limits are applied using the SOF of radionuclide concentrations divided by the WAC concentrations. If the SOF for long-lived radionuclides is less than or equal to 0.1, it is designated as Class A for long-lived radionuclides. If the SOF for long-lived radionuclides exceeds 0.1, the wastes are Class C. If the long-lived radionuclide SOF exceeds one, the wastes are designated as GTCC. A separate SOF is then performed for short-lived radionuclides. If the SOF exceeds unity (1) for Class A, but is less than unity for Class B, the wastes are designated as Class B for short-lived radionuclides. If it exceeds unity for Class B but is less than unity for Class C, the wastes are designated as Class C. If it exceeds unity for Class C, the wastes are designated as GTCC. Wastes with both short- and long-lived radionuclides use the more restrictive classification (Class A < Class B < Class C < GTCC) as determined by the two SOF. GTCC wastes require approval by the FFA managers for disposal in the EMDF. If radioactive waste does not contain any nuclides in either table, it is Class A.						
⁽¹⁾ There are no limits established for these radionuclides in Class B or C wastes. Practical considerations, such as the effects of external radiation and internal heat generation on transportation, handling, and disposal, will limit the concentrations for these wastes. These wastes shall be Class B unless the concentrations of ⁶³ Ni, ⁹⁰ Sr, and ¹³⁷ Cs determine the waste to be Class C.						

EMDF = Environmental Management Disposal Facility

FFA = Federal Facility Agreement

GTCC = greater-than-class-C

LLW = low-level (radioactive) waste

SOF = sum of fractions

TDEC = Tennessee Department of Environment and Conservation

WAC = waste acceptance criteria

APPENDIX B. PROCESS FOR DEVELOPING NEW ANALYTICAL WAC

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B.1. PROCESS FOR DEVELOPING ANALYTIC WAC FOR NEW SITE-RELATED CONTAMINANTS

Occasionally, contaminants may be identified in Comprehensive Environmental Response, Compensation, and Liability Act of 1980 waste that are not on the list of contaminants for which analytic waste acceptance criteria (WAC) have been calculated. Also, projects may, from time to time, desire to take waste lot-specific measurements of solid-to-liquid partition coefficients (K_d) to assess the waste's actual leaching potential relative to the assumed, conservative K_d values used to develop the final analytic WAC. In such cases, new analytic WAC must be developed to ensure that the waste being placed at the Environmental Management Disposal Facility (EMDF) will not pose a significant risk to the public.

This appendix describes how WAC will be calculated by the EMDF WAT using the same codes and procedures that were used to develop the WAC given in the *Record of Decision for Comprehensive Environmental Response, Compensation, and Liability Act Oak Ridge Reservation Waste Disposal at the Environmental Management Disposal Facility, Oak Ridge, Tennessee*, (DOE/OR/01-2794&D2/R2). Following this process will assure that any WAC developed for new contaminants, new input factors (e.g., K_d values) and assumptions, and waste-lot-specific WAC will have the same basis as the WAC given in Appendix A. However, other codes and procedures could be used if they are equivalent and are approved by the Federal Facility Agreement parties.

The steps described here are illustrated in Fig. B.1.

Step 1:

Assemble necessary contaminant-specific information to run the RESRAD screening model (screening groundwater model or SGW) and the EMDF Performance Assessment Base Case model (PABC). The development and application of the EMDF SGW and PABC are described in *Performance Assessment for the Environmental Management Disposal Facility at the Y-12 National Security Complex, Oak Ridge, Tennessee* (UCOR-5094/R2).

- Contaminant partition coefficients for the liner media beneath the waste, in the natural formations below the waste cell, and in various materials through which the leachate may travel on its way to the hypothetical future receptor.
- Plant and animal uptake transfer factors for use in calculating human uptakes from the food pathway.
- Risk (slope) factors relating human uptakes to incremental cancer risk.
- Reference doses.
 - In many cases values of the input parameters for a new site-related contaminants (SRCs) will be readily available. If not all necessary contaminant-specific information is available, consideration will be given to using information from another contaminant that can be a suitable surrogate for the new contaminant.

Step 2:

When information for the new contaminant has been assembled, for radionuclides the SGW model will be run using an estimated maximum EMDF facility average concentration as the modeled waste concentration. If the modeled peak dose within 10,000 years exceeds 0.4 mrem/yr then the PACB is run using a realistic estimated facility average concentration as the modeled waste concentration, and the peak modeled dose or carcinogenic risk within 1,000 years after facility closure can be used as the basis for the WAC calculation.

The RESRAD code provides a single radionuclide soil guideline (SRSG) based on a user-defined dose target. If the WAC for the new SRC is risk-based, the peak risk predicted by the PABC will be used to back-calculate the new analytic WAC.

Step 1:

Assemble contaminant specific information for RESRAD screening and PA base case models (K_d , transfer factors, estimated waste concentrations, risk and toxicity parameters, etc.)

Step 2:

Run EMDF PA screening groundwater model (SGW) using estimated maximum facility average waste concentration; document peak dose within 10,000 years post-closure.

Compare peak dose to screening criterion of 0.4 mrem/yr. For peak dose greater than 0.4 mrem/yr, proceed to WAC calculation using PA base case model (PABC)

Peak Dose $\geq$ 0.4 mrem/yr?

NO

No additional WAC

YES

Run EMDF PABC using realistic estimated facility average waste concentration. Based on the modeled peak dose or risk within 1000 years post-closure, use the dose-based RESRAD single radionuclide soil guideline or back-calculate a risk-based inventory limit (maximum allowable inventory or facility average concentration at closure)

Fig. B.1. Steps in developing a WAC for a new contaminant.

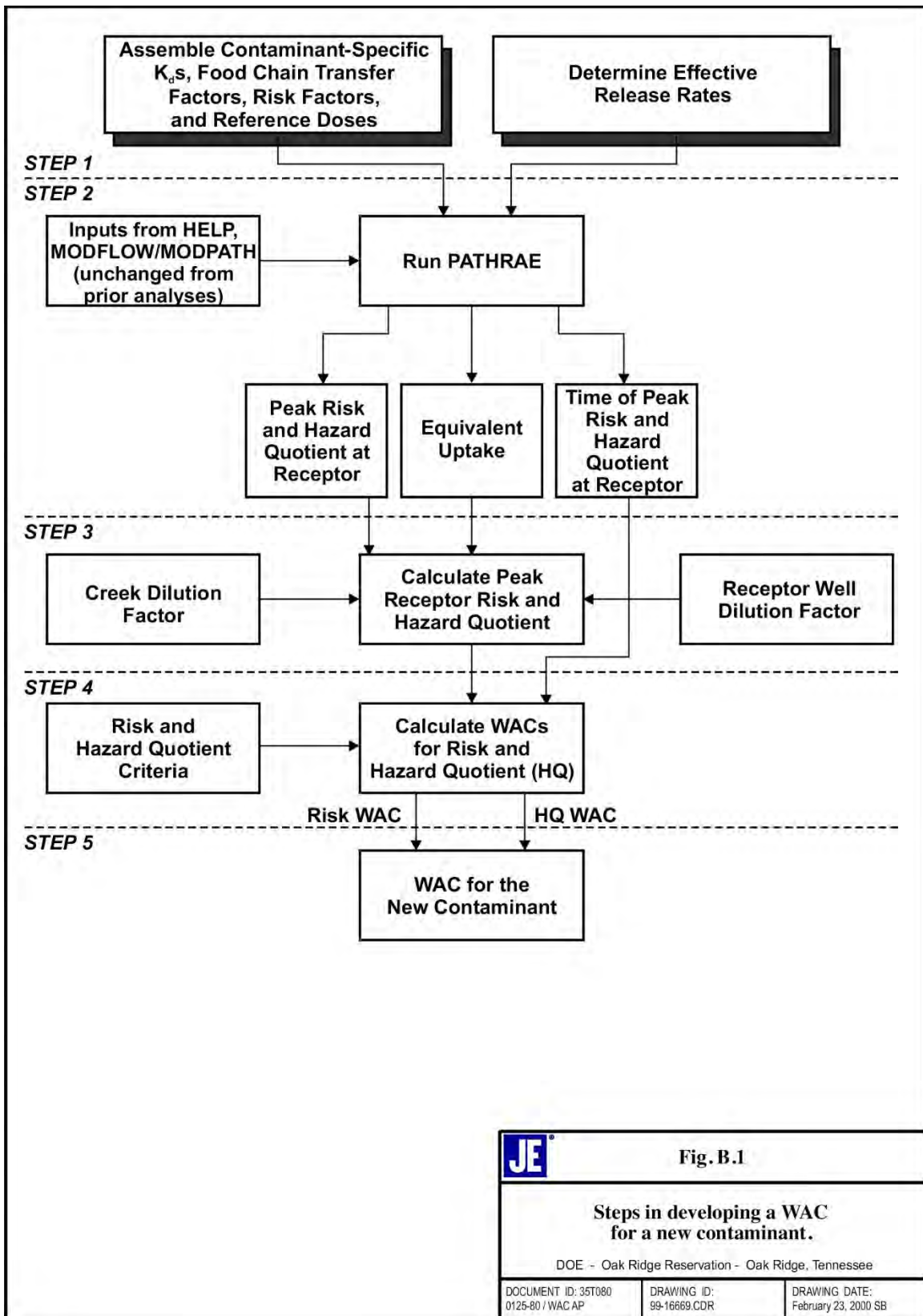


Fig. B.1. Steps in developing a WAC for a new contaminant (cont.).

B.2. REFERENCES

DOE/OR/01-2794&D2/R2, *Record of Decision for Comprehensive Environmental Response, Compensation, and Liability Act Oak Ridge Reservation Waste Disposal at the Environmental Management Disposal Facility, Oak Ridge, Tennessee*, 2022, U.S. Department of Energy, Oak Ridge Office of Environmental Management, Oak Ridge, TN, August.

UCOR-5094/R2. *Performance Assessment for the Environmental Management Disposal Facility at the Y-12 National Security Complex, Oak Ridge, Tennessee*, 2020, United Cleanup Oak Ridge LLC, Oak Ridge, TN, April.

APPENDIX C.
GENERAL GUIDANCE FOR DATA COLLECTION, DATA ANALYSIS,
AND DEVELOPMENT OF SAMPLING PLANS

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C.1. INTRODUCTION

One of the more fundamental aspects of waste acceptance is the ability to collect appropriate data, analyze it in a consistent and rigorous manner, and formulate plans to mitigate any data insufficiencies. This appendix outlines this process and refers to appropriate regulatory guidance for more specific details when needed.

A flow diagram of the overall data evaluation process is present in Fig. C.1. The first four steps relate to the collection of data and evaluation of the data to determine which WAC constituents are site related contaminants (SRCs). The next two steps relate to analysis of the data to produce the inputs required by the Waste Acceptance Criteria Forecasting Analysis Capability System (WACFACS), which is the principal analytical tool that will be used to calculate the sums-of-fractions (SOFs) for waste lots and the volume-weighted sums of fractions (VWSFs) for the Environmental Management Disposal Facility (EMDF). The final two steps relate to the identification of data gaps and their mitigation, either prior to remedial actions, during response actions, or both.

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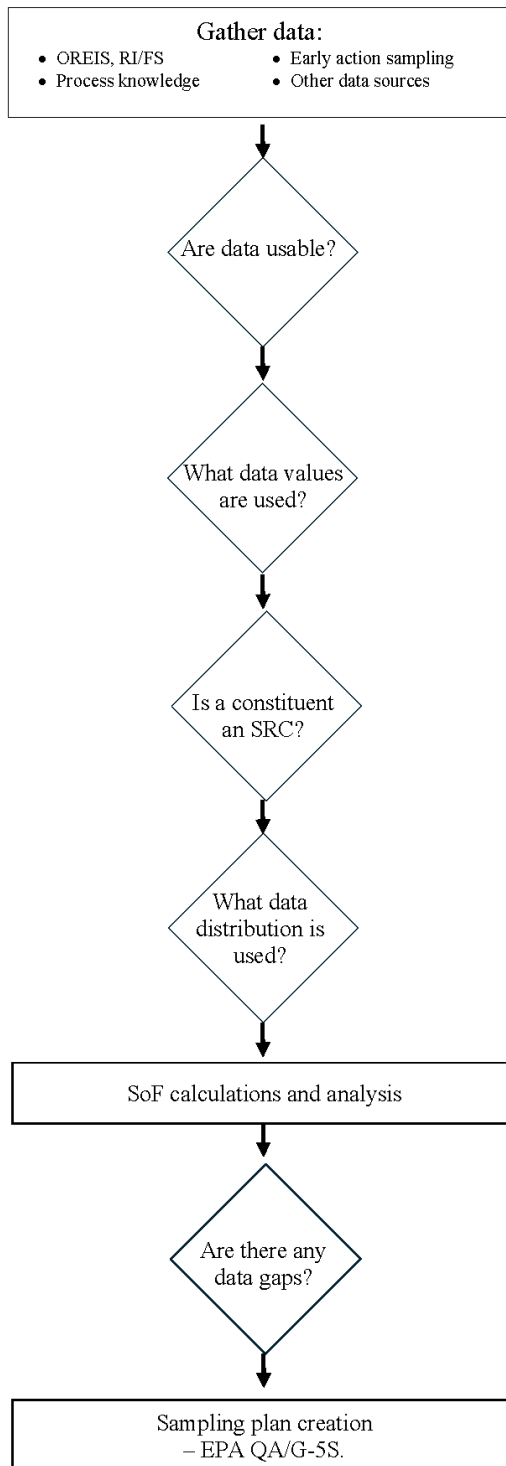
C.2. DETERMINATION OF SITE-RELATED CONTAMINANTS

An SRC is a chemical or radionuclide that has a WAC limit and is present in a waste lot in concentrations that are above background. SOFs are calculated for all SRCs with analytic WAC limits and, conversely, constituents that are not SRCs are excluded from SOF calculations. Other SRCs are those associated with Resource Conservation and Recovery Act of 1976 (RCRA) and Toxic Substance Control Act of 1976 (TSCA) land disposal restriction (LDR) compliance requirements. Still others are used and reported to assess contaminants needed for characterization and categorization of the waste lot.

This appendix focuses mainly upon the data requirements necessary to meet analytic WAC and other reporting requirements. Specific limits and trigger levels have been set for analytic WAC compliance and are presented in Appendix A. For conservatism purposes, it is generally acceptable to have large uncertainties in reported concentrations (e.g., purely high-biased data are often acceptable for most disposal criteria), but they are often not acceptable for analytic WAC compliance. Sampling goals for SRCs that do not have analytic WAC limits often focus on upper confidence limits (UCLs) without consideration of expected concentrations. This focus often leads to biased sampling approaches to maximize the efficiency of any further sample data collected. For EMDF compliance purposes, the goal is to derive representative average concentrations of the wastes disposed and the uncertainty of those average concentrations. These average concentrations and their uncertainties will be used to make determination of whether wastes are acceptable for disposal in the EMDF and whether additional analytical data are needed. However, as stated in Section 5.3.1.1, a combination of statistical (random) and judgmental sampling is usually implemented to characterize diverse waste streams under a single waste lot. This process provides a representative average concentration for a given SRC, while also bounding the maximum level of contamination.

To determine whether a waste constituent is an SRC, data for the constituent must be available and representative of the wastes to be disposed. The sources of these data can be analytical data from past Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) investigations, which are typically found in the Oak Ridge Environmental Information System (OREIS), or from other investigations such as sampling done to support early removal actions or remedial designs.

Once data are gathered, there are often factors that complicate the evaluation of this existing information relevant to determining WAC compliance. Refer to Fig. C.1, Overall data evaluation flowchart for the types of data that may be used to support waste characterization and how these data are evaluated prior to use.



Examples/Outputs

- From area of excavation?
- Biased or random samples?
- Data available for all constituents with a waste acceptance criteria WAC limit?
- Can land disposal restriction compliance be assessed?

- Rules for interpreting data flags
- Use of proxy values for initial determinations

- Does process knowledge indicate that the constituent is potentially present?
- Is the constituent concentration greater than background?

Note: this step can be bypassed if it is decided to carry a constituent forward as a site-related contaminant.

- Goodness-of-fit tests
- Normal, lognormal, or beta distribution?
- Parameters used by WACFACS

- Expected values and their uncertainties
- Propagated errors to determine SOF uncertainties
- Propagated SOF uncertainties to determine VWSF uncertainties
- SOF drivers and insignificant contributors

- Constituents missing data
- Constituents requiring data for background comparisons
- SOF uncertainty mitigation
- Determination of physical and administrative WAC compliance

- Data gap mitigation
- Pre-removal action and intra-removal action sampling
- Expected waste characteristics

OREIS = Oak Ridge Environmental Information System
 RI/FS = remedial investigation/ feasibility study
 SOF = sum of fraction

WACFACS = Waste Acceptance Criteria Forecasting Analysis Capability System
 WAT = Waste Acceptance Team
 VWSF = volume-weighted sum of fractions

Fig. C.1. Overall data evaluation flowchart.

C.2.1 DATA USABILITY

Ideally, purely unbiased analytical data within the actual area of excavation/demolition should be used to determine expected average concentrations of waste to be placed in the EMDF. However, given the varied sources of data and the need to strike a balance between data collection and analytical costs, other considerations may apply.

Definitive PK may be sufficient to justify the elimination of a waste constituent as an SRC without the need for analytical data. In cases where PK is less certain, a combination of PK and limited analytical data may be sufficient. In either case, the justification for such determinations should be stated explicitly in a sampling and analysis plan, a waste management plan, or another CERCLA document.

In other cases, biased data may exist that skew the statistical parameters in an overly conservative manner. When this occurs, the effects of the biased data must be evaluated. If the incorporation of biased data does not materially affect the calculations of SOF (i.e., the contaminant represents a small fraction of the analytic WAC even using the biased data), then the biased data can be accepted as representative of the wastes. However, if the incorporation of biased data significantly impacts the SOF calculations, additional data that is representative of the expected wastes to be generated may be required to address these potential data gaps. If possible, the degree of bias should be estimated to predict the actual average concentration for unbiased samples in order to determine whether the wastes are potentially acceptable for disposal in the EMDF. If the wastes appear to be likely candidates for disposal, then sampling plans for these wastes should include the collection of unbiased samples for the contaminants of interest. The goal for collecting these additional samples is the determination of representative average concentrations of waste contaminants contributing significantly to the SOFs.

C.2.2 INTERPRETATION OF DATA FLAGS

Contract laboratory data are often accompanied by laboratory data qualifiers and, if validated, validation qualifiers. Rules for interpreting data qualifiers are found in the U.S. Environmental Protection Agency's *Risk Assessment Guidance for Superfund* (EPA 1989; RAGS) Part A. Because RAGS was used in developing analytic WAC concentrations for the EMDF, it is appropriate to use this guidance for the evaluation of data used to demonstrate analytic WAC acceptance. These same rules are also appropriate for evaluating data for administrative and overall waste characterization.

For cases in which data have undergone validation, validation qualifiers will always take precedence over laboratory qualifiers. For unvalidated data, laboratory data qualifiers will be used to assign equivalent validation codes. In general, uncertain data are replaced with proxy values, which are then used in subsequent statistical analyses.

Figure C.2 outlines the logic for interpretation of data qualifiers. If more specific guidance is needed beyond that presented in Fig. C.2, RAGS and other EPA guidance for data interpretation [e.g., regional bulletins and EPA's *Guidance for Data Usability in Risk Assessment* (EPA 1992)] should be consulted.

C.2.3 DECISION RULES TO DETERMINE SRCS

The overall logic for screening constituents to determine whether they are SRCs is presented in Fig. C.3. The decision of whether a waste constituent is an SRC will depend largely on PK and comparisons to background concentrations or detection rates. In general, any constituent with a significant detection is to

be considered an SRC. Otherwise, the following guidelines can be used to determine whether a constituent can be screened out of SOF calculations.

The first step is to determine whether PK indicates the potential presence of a WAC constituent for the waste lot under consideration. If definitive PK exists that a constituent should not be present, then it may be screened out of the assessment on this basis alone; the CERCLA documentation for the project should identify these determinations. Any anecdotal evidence supporting this assertion should also be reported.

If definitive PK does not exist supporting the elimination of a constituent, but also does not exist indicating a constituent should be present, then the constituent can still be screened out based upon its detection rate. If all “detected” concentrations are “J” flagged data or equivalent, then a detection rate of less than 20% of the samples present can be used as sufficient evidence of the absence of the constituent. If some values are not flagged but are only nominally above their sample quality limit (SQL) (e.g., a reported concentration less than approximately two times the reported SQL), then a detection rate of less than 5% of the samples can be used to eliminate an SRC.

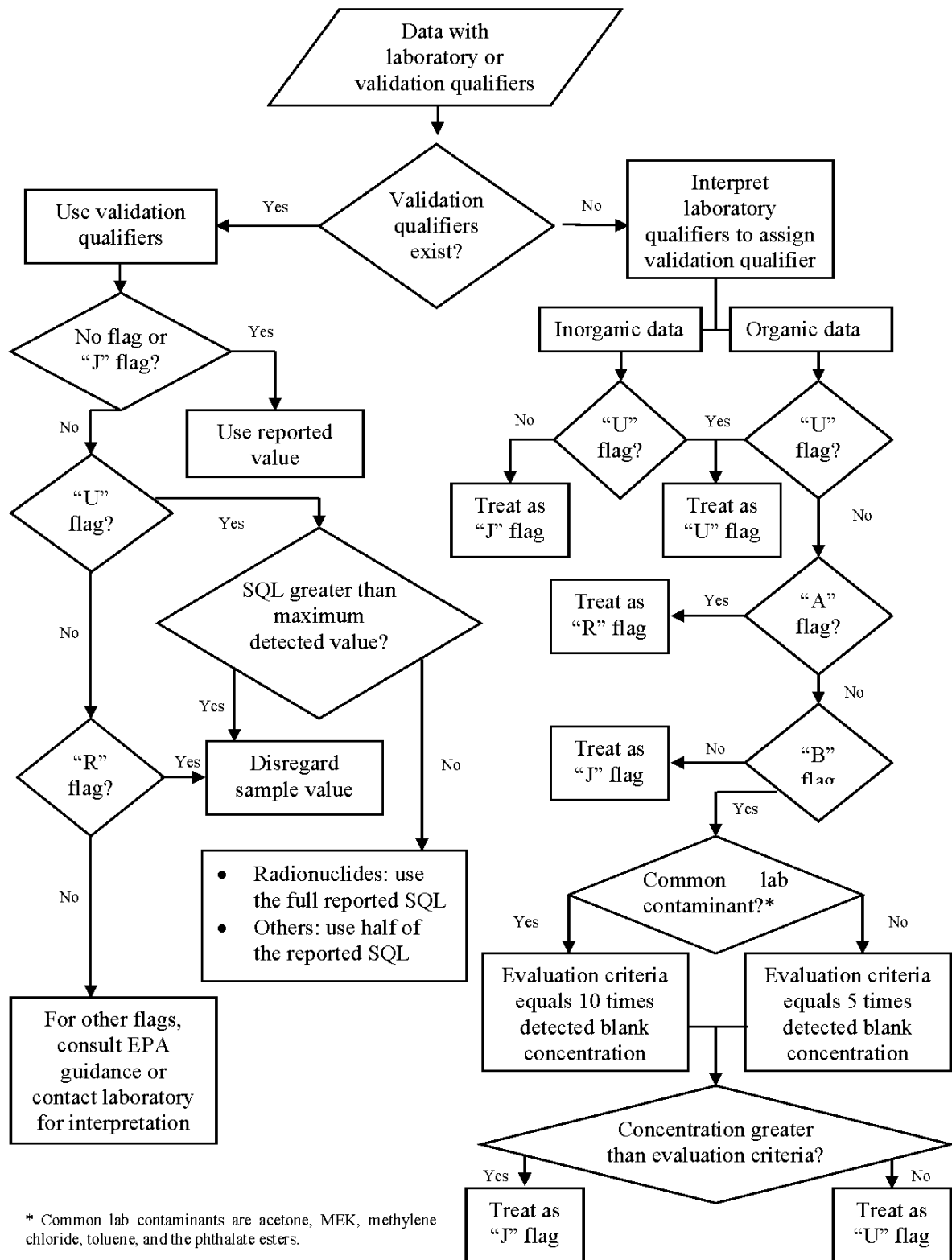


Fig. C.2. Interpretation of data qualifiers.

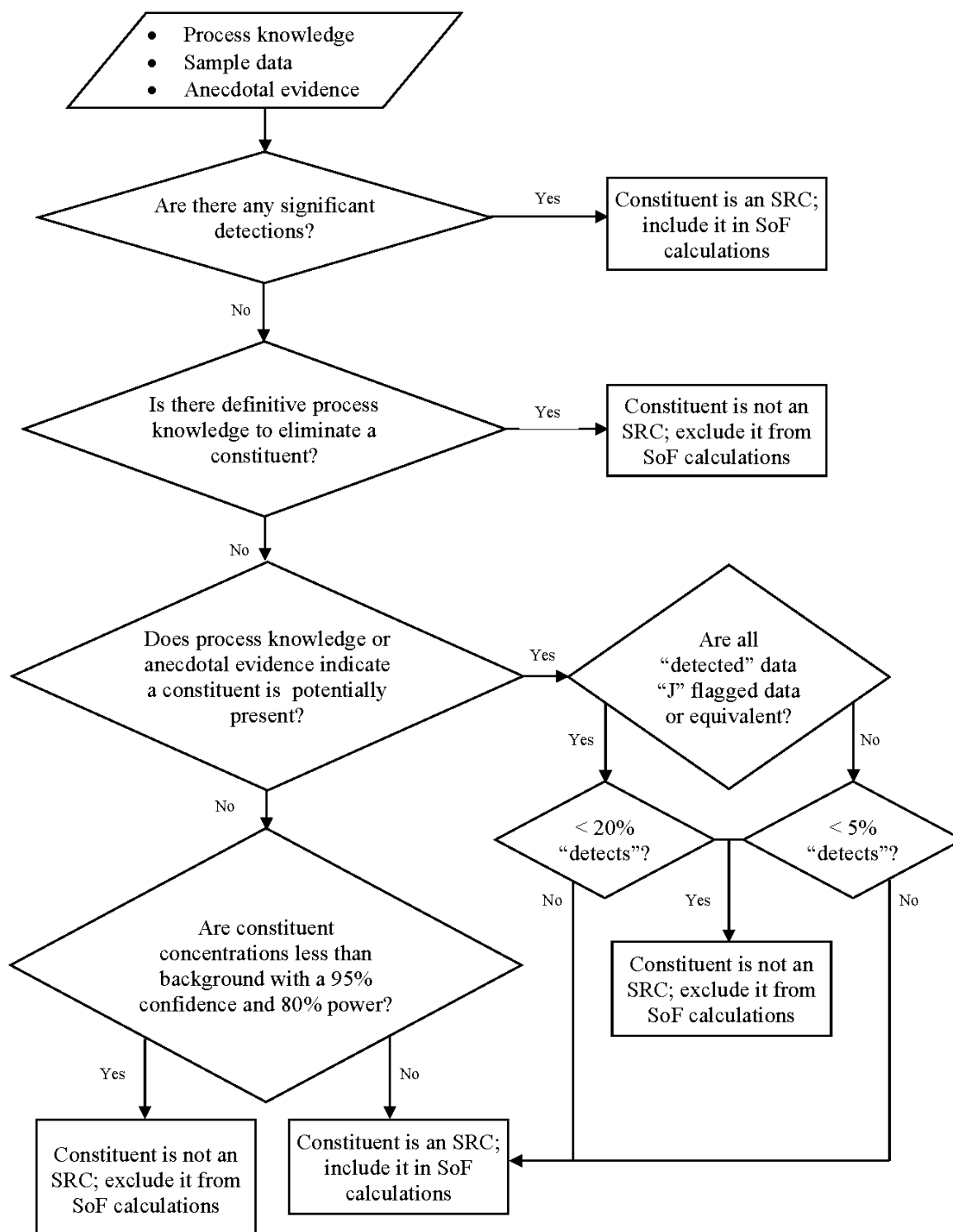


Fig. C.3. Determination of site-related contaminants.

Determinations of the absence of a constituent using detection rates must also consider whether a representative number of samples has been collected. For relatively homogenous wastes, representativeness is assumed when at least five samples are available to ascertain that a detection rate is less than 20%, or when 20 samples are available to ascertain that a detection rate is less than 5%. For relatively heterogeneous wastes, larger sample populations may be required. If biased samples representing expected maximum concentrations for a waste lot are available for these comparisons, or when sufficient PK exists to support the elimination of a constituent as an SRC, smaller sample populations can be used.

For constituents with background concentrations and one or more significantly detected concentrations (i.e., a sample result that is significantly greater than its SQL), sample concentrations can be compared with the expected range of background levels. If the concentrations fall within this range, it can be excluded from the list of SRCs. The specific comparison criteria to use for these comparisons involves a 5% false negative rate and a 20% false positive allowance (95% confidence and 80% power). The data used for this screening must be of sufficient quality to perform the analysis, i.e., the SQLs must be less than the background concentrations. As with other such determinations, the basis for this elimination must be included in the DQO and other CERCLA documentation for the project.

If a constituent is not screened out as an SRC, it must be carried forward in the subsequent calculations of analytic WAC SOFs and other reporting. A project may elect to carry a constituent forward as an SRC without explicitly screening it against detection rates or background concentrations, even if it is suspected that such efforts may result in its elimination as an SRC. This may be desirable for certain constituents with large WAC concentration limits such that, at background levels, they represent a SOF less than 0.01. In such cases, the effort to eliminate the constituent as an SRC may not be warranted against the minimal effect it would have on SOF calculations. This is consistent with the logic to ensure waste contaminants were not inappropriately screened out, but with a much larger tolerance being given to inappropriately saying a constituent was present when in fact it was not.

C.3. DATA ANALYSES TO DERIVE WASTE LOT SOFS

Figure C.4 diagrams the overall data distribution analysis process. Once the list of SRCs has been determined, the next step is to analyze the data to determine the representative average concentrations and their uncertainties. The distributions of the data populations must be determined and descriptive statistical parameters calculated for use in WACFACS. Once these parameters are known, WACFACS will be used to calculate the expected value and its uncertainty of the waste lot SOFs.

The determination of data distributions is accomplished by following EPA's *Guidance for Data Quality Assessment, Practical Methods for Data Analysis* (EPA QA/G-9). In general, three distributions have been chosen for use by WACFACS: normal, lognormal, and a three-point PERT beta distribution (hereafter referred to as a beta distribution). These distributions were chosen based upon EPA CERCLA risk assessment guidance, which prescribes the use of normal or lognormal distributions. The beta distribution was added as a third choice based upon its ability to mimic either a normal or lognormal distribution.

When five or fewer data points are available, the beta distribution is to be assumed, and the minimum, median (i.e., the 50th percentile), and maximum values are to be reported along with the number of data points. The use of these descriptive statistics will provide a beta distribution that is shaped roughly like either a normal or lognormal distribution.

When more than five data points exist, goodness-of-fit tests are to be performed to determine the best distribution to use. Specifically, the Shapiro-Wilk (S-W) Test is to be used to determine whether a normal

distribution provides a sufficient fit, with the computed W values compared to $W_{0.10}$ evaluation criteria. If the W value exceeds its associated $W_{0.10}$ evaluation criterion, a normal distribution is to be used and the average, standard deviation, and number of data points for the data set are to be reported.

Since the S-W Test is applicable for only up to 50 data points, other tests are required for larger data sets. If more than 50 data points are available, EPA QA/G-9 specifies the use of Filliben's statistic or the studentized range test. However, if critical values for these tests (for the specific sample size) are not available, then EPA QA/G-9 specifies either Geary's test or the Lilliefors Kolmogorov-Smirnoff test. Consult the guidance in EPA QA/G-9 for more details in these cases.

If a normal distribution is found to be inadequate, the data are then tested to determine if a lognormal distribution provides a sufficient fit. The S-W Test is to be used on the log-transformed data, with the new W values again compared to the $W_{0.10}$ evaluation criterion. If the S-W Test indicates a lognormal distribution is adequate, then the average and standard deviation of the log-transformed data are to be reported, as well as the number of data points.

If the goodness-of-fit tests indicate that neither a normal nor a lognormal distribution is adequate, a beta distribution is to be assumed. The values to be reported are the minimum, median, and maximum values and the number of data points.

Once the data distribution is known and the relevant descriptive statistics are reported, WACFACS will be used to calculate the expected SOF and its uncertainty. Though an expected average SOF value can be calculated using the predicted mean values of each contaminant, the process of correctly propagating each contaminant's uncertainty is a nontrivial exercise requiring the use of Monte Carlo simulations. Using the expected values and uncertainties of the SOFs, WACFACS can also determine the expected value and uncertainty in the VWSF calculations. See Appendix D for more details on the calculations that WACFACS performs.

Once the SOFs and their uncertainties are calculated, it is possible to determine which contaminants are significantly affecting the waste lot's SOFs and their uncertainties. In general, any contaminant with a concentration greater than 1% of an analytic WAC limit and which contributes greater than 1% of the final expected or UCL SOF can be considered a significant contributor to the SOF calculations. If an analysis of the output of the VWSF calculations from WACFACS indicates the uncertainty of a waste lot's SOF significantly contributes to the 90% UCL_{90} VWSF, the significant SOF contributors will be examined to determine whether additional samples are needed to mitigate the uncertainty in their average concentrations. The decision to obtain additional samples for this purpose will utilize a graded approach, under which the cost of obtaining the data are balanced against the desire to minimize the difference between the expected mean VWSF and its UCL_{90} . For other reporting purposes (e.g., waste classification or Table 1 limits), the average and the UCL_{95} concentrations may be used to calculate the associated SOF.

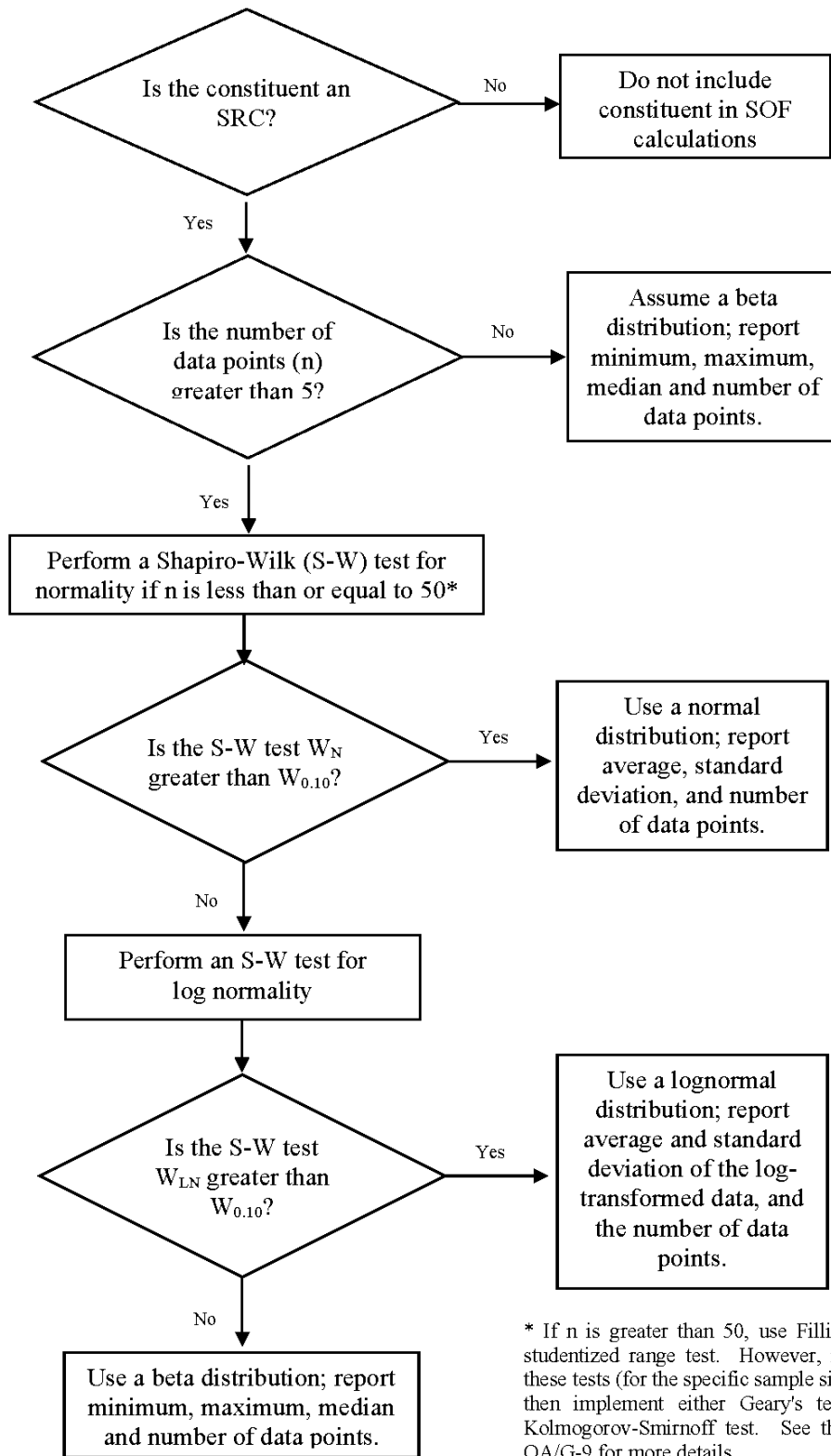


Fig. C.4. Data distribution analysis.

C.4. DETERMINATION AND MITIGATION OF DATA GAPS

In order to declare analytic WAC SOF calculations complete, the underlying data upon which it depends must be complete and sufficiently confident in its determinations of waste lot average concentrations to make accurate predictions of the VWSFs. Any additional data required to meet these goals is considered a data gap. Other data gaps may exist when there are insufficient data to assess administrative or analytic WAC compliance.

Confirmation of most administrative WAC is essentially as simple as confirming that wastes are from CERCLA actions and are not transuranic or high-level wastes by definition. Assurance that these criteria are met essentially takes the form of answering yes/no questions for a checklist of requirements. However, when determining RCRA and TSCA LDR compliance, relevant EPA sampling guidance should be consulted to determine any additional data needs.

Confirmation of Table A.2 in Appendix A concentration limits and other reporting will be assured when representative concentrations are available for all listed radionuclides, or definitive PK or anecdotal evidence indicates an expectation that their concentrations are less than 1% of the listed limits. One example of acceptable anecdotal evidence involves the use of gross alpha and gross beta measurements. When the total unaccounted activity of either gross alpha or gross beta concentrations (i.e., the gross measurement minus the sum of all radionuclide-specific alpha or beta concentrations including any daughter products expected to be in secular equilibrium) is less than 1% of the most restrictive WAC, no additional radionuclide-specific measurements are required to meet this WAC.

The following text discusses the identification of data gaps for analytic WAC compliance. The processes used for these determinations are somewhat more complex. Generally, EPA's *Guidance on Choosing a Sampling Design for Environmental Data Collection for Use in Developing a Quality Assurance Project Plan* (EPA QA/G-5S) will be used for developing sampling plans to address analytic WAC data gaps.

C.4.1 IDENTIFICATION OF ANALYTIC WAC DATA GAPS

Many of the previous data analysis steps already have obvious cases where data gaps exist, such as when there are no data available for an analytic WAC constituent with a concentration limit (i.e., there are no sample data, PK, or even anecdotal evidence to estimate concentrations or determine whether a WAC constituent is present or absent in a proposed waste lot).

However, even in cases where representative data of good quality exist, it is still possible to have situations in which additional data are needed. Figure C.5 provides a logic flow diagram for the decision process used to make these determinations.

One such case would be a waste constituent that is expected to be at or below background concentrations and that represents a meaningful percentage of a WAC at those concentrations. In such cases, additional data to ensure that a constituent is at or below background with the prescribed 90% confidence and 80% power will be needed.

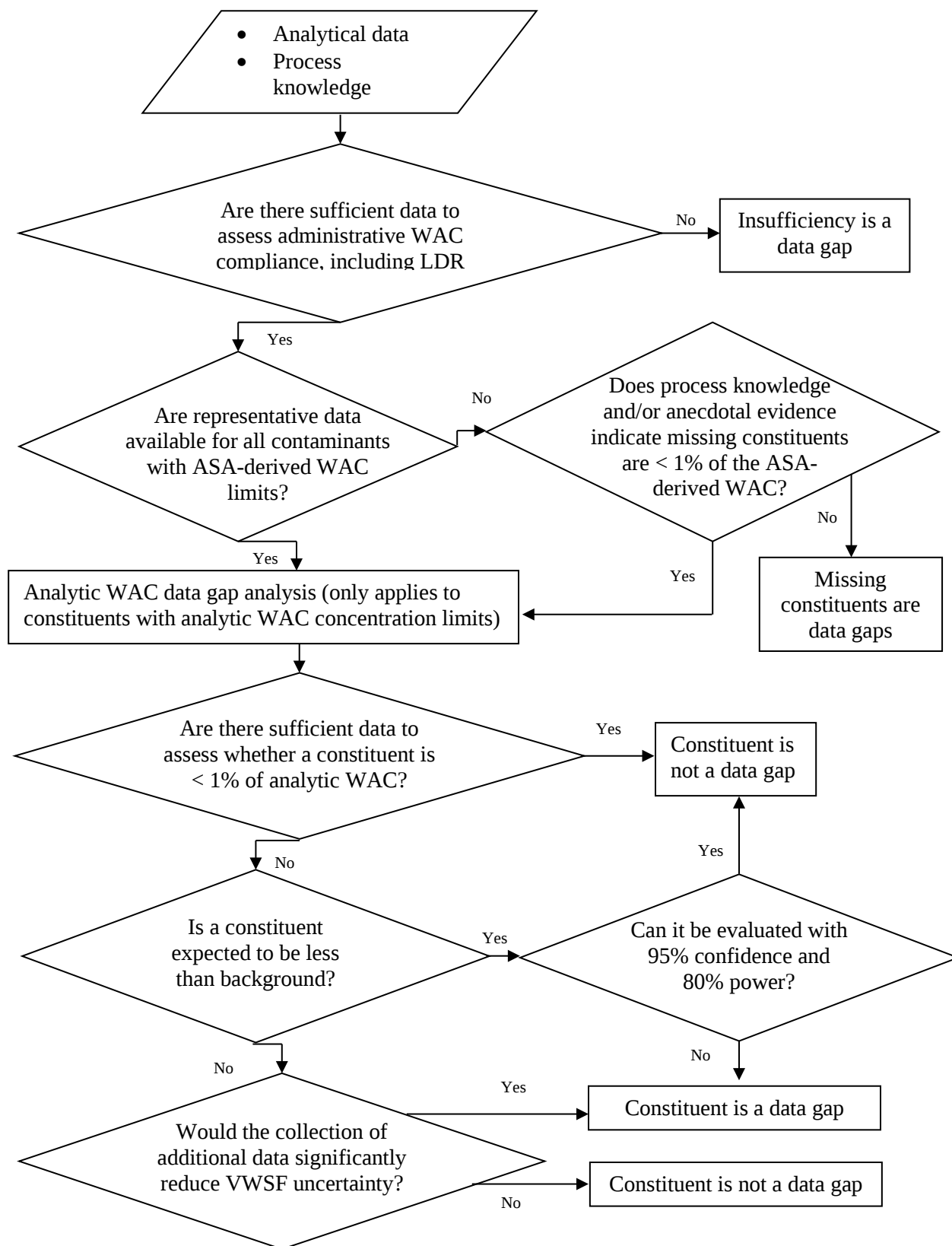


Fig. C.5. Data gap analysis.

Other cases can arise for waste contaminants that contribute significantly to SOF calculations or their uncertainties. One possibility frequently arises when SOFs are calculated using a significant number of biased data. In such cases, the collection of additional, unbiased data may reduce both the overall SOF and its uncertainty in a meaningful way. Also possible are cases in which the uncertainty of the average concentration for a waste contaminant is a driver for the overall SOF uncertainty. When the SOF uncertainty yields unacceptable effects on the VWSF uncertainty, additional samples for the waste contaminant may be warranted. The goal of these additional samples would be to refine the estimate of its average concentration in order to yield reductions in the overall SOF uncertainty and, thus, the VWSF uncertainties.

C.4.2 DEVELOPMENT OF SAMPLING AND ANALYSIS PLANS

The exact structure and timing for collecting additional samples is by necessity a project-specific determination. Also, different data collection goals often indicate a need for specific sampling strategies. Generic guidance for designing sampling plans to meet these various goals can be found in EPA QA/G-5S.

The ultimate use of any additional data being collected must be considered in the creation of sample designs. For instance, when sampling for analytic WAC compliance, it is important to remember that average concentrations will be used to calculate SOFs. As such, methods geared toward the determination of average concentrations and their uncertainties are appropriate. Therefore, composite sampling, while less desirable for many applications, may offer significant advantages towards meeting these goals. However, LDR compliance comparisons generally use comparisons of maximum concentrations to prescriptive regulatory limits, and limited numbers of biased samples often is an efficient way to fulfill these data needs. Biased samples may also be useful if the maximum concentration at a site is expected to be less than 1% of an analytic WAC, as the cost to refine estimates of averages in these cases is often disproportionate to the benefits gained in refining SOF estimates.

Sampling and analysis plans designed to mitigate all identified data gaps may be incorporated into the project's waste management plan or can be a stand-alone document. Example outlines for these plans are given in Figs. C.6 and C.7, respectively. The implementation of sampling plans can occur prior to the removal action, during the removal action, or both, depending upon the specific needs of the project. In cases where insufficient characterization exists prior to waste generation to support a determination that wastes can be disposed in the EMDF, some or all of the planned samples must be obtained prior to the CERCLA action.

In all cases, however, a waste management plan must specify how waste anomalies will be identified and characterized for separate determination of acceptability for disposal in the EMDF. Identification methods should maximize those already available in the field for all CERCLA activities. These include visual determinations and environment, safety, and health screening instruments, and often include methods being used for U.S. Department of Transportation compliance requirements.

PROJECT DESCRIPTION

PROJECT PARTICIPANTS AND RESPONSIBILITIES

U.S. Department of Energy (DOE), EPA, TDEC (FFA Parties)

DOE subcontractor(s)

EMDF subcontractor

WASTE CHARACTERIZATION

Waste characterization for disposal

Summary of existing data

Evaluation of data gaps for WAC acceptance

Waste characterization plan

- Sample locations
- Sampling method to obtain representative samples
- Analytical requirements (analytes and CAS numbers, analytical methods, reporting levels)
- QA/QC sample requirements
- Data verification and validation
- Data management

Waste profile for acceptance of waste for disposal

Verification of remedial action objectives

WASTE GENERATION

Types of wastes generated

Remedial action wastes

Soil dewatering fluids

Personal protective equipment (PPE)

Equipment decontamination waste

Sanitary wastes

Waste quantities

WASTE ACCEPTABLE FOR DISPOSAL AT EMDF

WASTE ANOMALIES IDENTIFIED DURING EXCAVATION

Identification of waste anomalies

Characterization of anomalies

Comparisons to existing waste lot characterization results and waste acceptance determination (either in the existing lot or as a separate waste lot)

WASTE HANDLING AND STAGING

Wastes for disposal at EMDF

Waste anomalies not suitable for disposal at EMDF

Dewatering fluids

PPE

Equipment decontamination wastes

Sanitary wastes

Waste containers and labeling requirements

Fig. C.6. Example generic waste management plan outline.

WASTE TREATMENT
Remedial action wastes
Equipment decontamination fluids
WASTE TRANSPORTATION
WASTE DISPOSAL
WASTE MINIMIZATION
REFERENCES
APPENDICES

Fig. C.6. Example generic waste management plan outline (cont.).

INTRODUCTION

SITE BACKGROUND AND PHYSICAL SETTING

DATA QUALITY OBJECTIVE PROCESS FOR (PROJECT NAME HERE)

- Summary of waste characterization sample planning meeting (see appendix for meeting minutes)
- Previous studies and existing data
- Areas of interest
- Evaluation of existing data
- Identification of data gaps for EMDF WAC acceptance

SAMPLING PLAN

- Number of samples
- Sampling locations and depths
- Sampling method
- Analytical requirements (analytical constituents and CAS number, analytical methods, detection limits)
- QA/QC sample requirements

FIELD ACTIVITIES

- Trenching, boring, etc.
- Sample selection and preparation (e.g., grinding)
- Sample management (e.g., staging, labeling, shipment, chain of custody, etc.)

DATA MANAGEMENT AND VALIDATION

WASTE MANAGEMENT DURING SAMPLING

- Types of waste generated
 - Personal protective equipment (PPE)
 - Equipment decontamination waste
 - Sanitary wastes
- Waste quantities
- Waste containers and labeling requirements
- Waste disposition

REFERENCES

APPENDIX –Waste characterization sample planning meeting minutes

Fig. C.7. Example generic sampling plan outline.

C.5. REFERENCES

EPA 1989, *Risk Assessment Guidance for Superfund*, 1989, U.S. Environmental Protection Agency, Washington, D.C., December.

———EPA 1992. *Guidance for Data Useability in Risk Assessment*. Publication No. 9285.7-09A and B, Washington, D.C., April.

EPA QA/G-5S, *Guidance on Choosing a Sampling Design for Environmental Data Collection for Use in Developing a Quality Assurance Project Plan*, 2002. U.S. Environmental Protection Agency, Washington, D.C. December.

———EPA QA/G-9, *Guidance for Data Quality Assessment, Practical Methods for Data Analysis*, 2000.

APPENDIX D.
WASTE PROFILE TEMPLATE

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D.1. WASTE PROFILE INTRODUCTION

D.1.1 GENERATOR PROJECT/FACILITY

[Insert here]

D.1.2 WASTE LOT NAME/WASTE LOT ID

[Insert Waste Lot name and ID here]

- ☐ New Profile
☐ Revised Profile

Profile Revision Number: _____ Profile Revision Date: _____

Profile revisions: *Describe and list **all** changes made to the profile.* _____

For revisions only, has any part of the waste generation, characterization, and/or certification process changed? ☐ Yes ☐ No

If yes, list all process changes in detail and provide applicable information that supports the changes to any processes. _____

D.1.3 ESTIMATED VOLUME (AS GENERATED)

[Insert volume number here in cubic yards] yd³

D.1.4 WASTE GENERATION

Waste generating process description: *Briefly describe the process that generated the waste stream identified in this profile. Attach process flow charts, maps, and other available information if helpful in explaining the waste generating process and waste stream characteristics in Attachment D.2, Process Knowledge Summary.*

[Insert content here]

D.1.5 WASTE COMPOSITION

List the waste composition (e.g., soil, concrete, construction debris) in the table below following *Process Plan for Determining As-Shipped Waste Volume for United Cleanup Oak Ridge LLC, Oak Ridge, Tennessee* (UCOR-4168).

Waste Composition Summary

Waste Type	Volume %	Volume yd ³	As-Shipped Density lb/yd ³	Mass lb
Asbestos - Friable	0.00%	0	405	0
Asbestos - Non Friable	0.00%	0	2295	0
Controlled Low-Strength Material (CLSM)	0.00%	0	3860	0
Concrete - Chunk	0.00%	0	1458	0
Concrete - Rubble	0.00%	0	2025	0
Concrete - Slab	0.00%	0	4050	0
Construction Debris	0.00%	0	1593	0
Granular Activated Carbon	0.00%	0	730	0
Metal - Heavy	0.00%	0	2187	0
Metal - Light (incl. scrap metal)	0.00%	0	1296	0
Metal - Non Ferrous	0.00%	0	3375	0
Metal - Steel (incl. cyclotron, transformer, etc.)	0.00%	0	12000	0
Misc Solids - Heavy	0.00%	0	2025	0
Misc Solids - Light	0.00%	0	621	0
Sediment/Sludge	0.00%	0	2025	0
Soil	0.00%	0	2511	0
Total	0	0		0

NOTE: Total should always equal 100.

Guide: To calculate total, enter data, right click grey box in bottom of table, and choose update field

D.2. ADMINISTRATIVE WAC COMPLIANCE

D.2.1 WASTE LOT CERCLA ACTION

Provide reference to relevant Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) document(s) and include approvals and cover pages in Attachment D.6.

[Insert here]

D.2.2 RADIONUCLIDE PROHIBITED WASTE TYPES

☐ Yes

☐ No

☐ Transuranic (TRU) Waste

☐ High-Level Radioactive Waste

☐ 11 e(2) Byproduct Waste

☐ Spent Nuclear Fuel

If checked yes, explain what steps will be made to segregate these prohibited waste categories from this waste lot.

☐ Waste **does not** contain total alpha-emitting TRU radionuclides with a half-life > 20 years and > 0.1 nCi/g, or TRU radionuclides have been eliminated using process knowledge (PK). *If checked, then leave table below blank.*

If total alpha-emitting TRU radionuclides with a half-life > 20 years are detected and > 0.1 nCi/g, then provide in the table below the maximum concentration.

TRU Waste Concentrations

Isotopes	Maximum nCi/g
Am-241	
Am-242m	
Am-243	
Bk-247	
Cf-249	
Cf-251	
Cm-243	
Cm-245	
Cm-246	
Cm-247	
Cm-248	
Cm-250	
Np-237	
Pu-238	
Pu-239	
Pu-240	
Pu-242	
Pu-244	
Total TRU	0.00

If eliminated by PK insert N/A. If eliminated by non-detects or screened out insert ND.

If waste exceeds 10 nCi/g further analyses and operational rigor is required in project plans to ensure no final waste package will exceed 100 nCi/g.

Enter data in each row. To calculate the Total TRU, right click in the box and choose update field.

- ☐ If the maximum TRU concentration is ≥ 10 nCi/g, then a container-by-container TRU and Greater Than Class C analysis shall be provided in Attachment D.5.

D.2.2.1 Approved Waste Categories

Check all that apply

- | | |
|--|--|
| ☐ LLW | ☐ TSCA/PCB Remediation Waste |
| ☐ Mixed Low-Level Waste | ☐ TSCA/PCB Bulk Product Waste |
| ☐ RCRA Waste | ☐ TSCA/PCB Article |
| ☐ RCRA/TSCA Waste | ☐ ACM Waste |

ACM = asbestos-containing material
 LLW = low-level waste
 PCB = polychlorinated biphenyl

RCRA = Resource Conservation and Recovery Act
 TSCA = Toxic Substances Control Act

D.2.3 PROHIBITION OF FREE LIQUIDS

Check all that apply by waste class.

LLW

- ☐ Confirmed < 1% by volume
☐ Visual inspection verification
☐ Waste is inherently dry
☐ Vent, purge, and drain
☐ Absorbent added
☐ Stabilized (e.g., sludge)
☐ Other _____

RCRA/TSCA LLW

- ☐ Confirmed with no free liquids
☐ Visual inspection verification
☐ Waste is inherently dry
☐ Paint Filter Test
☐ Absorbent added
☐ Stabilized (e.g., sludge)
☐ Other _____

D.2.4 RCRA HAZARDOUS WASTE DETERMINATION AND LAND DISPOSAL REGULATIONS

Listed Waste Determination

Note: Listed Hazardous Waste is prohibited waste.

- ☐ Based on documented PK, this waste stream **is not** a RCRA-listed hazardous waste, nor has it been mixed with or derived from a RCRA-listed hazardous waste. Complete Attachment D.4 for Listed Waste Determination with appropriate approvals.

D.2.4.1 Characteristic of Ignitability

- ☐ Based on PK, this waste stream does not meet the narrative regulatory description of ignitability as defined in 40 *Code of Federal Regulations (CFR)* 261.21. This waste is not a liquid, compressed gas, or Department of Transportation Class 5.1 Oxidizer, and is not capable, under standard temperature and pressure, of causing fire through friction, adsorption of moisture, or spontaneous combustion.

Other:

D.2.4.2 Characteristic of Corrosivity

☐ Based on PK, this waste stream does not meet the narrative regulatory description of corrosivity as defined in 40 *CFR* 261.22. This waste is not aqueous, or a liquid with a pH ≤ 2 or ≥ 12.5 , or that corrodes steel at a rate > 6.35 mm/year.

Other:

D.2.4.3 Characteristic of Reactivity

☐ Based on PK, this waste stream does not meet the narrative regulatory description of reactivity as defined in 40 *CFR* 261.23. This waste is not unstable nor will it readily undergo violent change without detonation. It will not react with water; form potentially explosive mixtures with water; or when mixed with water, it will not generate toxic gases, vapors, or fumes in sufficient quantity to present a danger to human health or the environment. It is not a cyanide- or sulfide-bearing waste that will generate toxic gases, vapors or fumes in sufficient quantity to present a danger to human health and environment when exposed to pH conditions between 2 and 12.5. It is not capable of detonation or explosive reaction if subjected to a strong initiating source or if heated under confinement. It is not capable of detonation or explosive decomposition or reaction under standard temperature and pressure; it is not a forbidden explosive as defined in 49 *CFR* 173.54; a Class A explosive as defined in 49 *CFR* 173.53; a Class B explosive as defined in 49 *CFR* 173.88; or Division 1.1, 1.2, 1.3, 1.4, 1.5, or 1.6 explosive as defined in 49 *CFR* 173.50.

Other:

D.2.4.4 Characteristic of Toxicity

Define the sampling source and frequency used for RCRA characterization including data compiled to complete the RCRA characteristic summary table below.

[Insert here]

Check one that applies

☐ Based on PK or historical data, this waste stream does not include any hazardous characteristic constituents and does not exhibit a toxicity characteristic as defined in 40 *CFR* 261.24.

☐ Based on PK or analytical data, this waste stream does include hazardous characteristic constituents as defined in 40 *CFR* 261.24; however, the waste stream concentrations are below regulatory levels and do not exhibit a toxicity characteristic. If RCRA characteristic constituents are present, complete the table below for this waste stream.

☐ Based on PK or analytical data, this waste stream **does** include hazardous characteristic constituents and **does** exhibit a toxicity characteristic as defined as defined in 40 *CFR* 261.24; however, **the waste stream has been treated to meet all applicable land disposal restrictions (LDRs)** of 40 *CFR* 268. If checked, describe the treatment performed and analytical data collected to support LDR determination, as required by regulations.

Note: Treatment plans shall be approved by FFA parties.

Other:

RCRA Characteristic Summary Table

EPA Hazardous Waste No. - contaminant	Total concentration ^{1, 2} ☐ Max ☐ UCL-90 (mg/kg)	Derived TCLP concentration ³ (mg/L)	TCLP concentration ^{1, 2} ☐ Max ☐ UCL-90 (mg/L)	Regulatory limit (mg/L)	Exceeds regulatory limit? Yes/No
D004 -Arsenic				5.0	
D005 -Barium				100.0	
D006 -Cadmium				1.0	
D007 -Chromium				5.0	
D008 -Lead				5.0	
D009 -Mercury				0.2	
D010 -Selenium				1.0	
D011 -Silver				5.0	
D012 -Endrin				0.02	
D013 -Lindane				0.4	
D014 -Methoxychlor				10.0	
D015 -Toxaphene				0.5	
D016 -2,4-D				10.0	
D017 -2,4,5-TP (Silvex)				1.0	
D018 -Benzene				0.5	
D019 -Carbon Tetrachloride				0.5	
D020 -Chlordane				0.03	
D021 -Chlorobenzene				100.0	
D022 -Chloroform				6.0	
D023 -o-Cresol				200.0 ⁴	
D024 -m-Cresol				200.0 ⁴	
D025 -p-Cresol				200.0 ⁴	
D026 -Cresol				200.0 ⁴	
D027 -1,4-Dichlorobenzene				7.5	
D028 -1,2-Dichloroethane				0.5	
D029 -1,1-Dichloroethylene				0.7	
D030 -2,4-Dinitrotoluene				0.13 ⁵	
D031 -Heptachlor (epoxide)				0.008	
D032 -Hexachlorobenzene				0.13 ⁵	
D033 -Hexachlorobutadiene				0.5	
D034 -Hexachloroethane				3.0	
D035 -MEK				200.0	
D036 -Nitrobenzene				2.0	
D037 -Pentachlorophenol				100.0	
D038 -Pyridine				5.0 ⁵	
D039 -Tetrachloroethylene				0.7	

RCRA Characteristic Summary Table

EPA Hazardous Waste No. - contaminant	Total concentration ^{1, 2}	Derived TCLP concentration ³ (mg/L)	TCLP concentration ^{1, 2}	Regulatory limit (mg/L)	Exceeds regulatory limit? Yes/No
	☐ Max ☐ UCL-90 (mg/kg)		☐ Max ☐ UCL-90 (mg/L)		
D040 -Trichloroethylene				0.5	
D041 -2,4,5- Trichlorophenol				400.0	
D042 -2,4,6- Trichlorophenol				2.0	
D043 -Vinyl Chloride				0.2	
Mass Balance (if applicable)					

RCRA = Resource Conservation and Recovery Act of 1976

TCLP = toxicity characteristic leaching procedure

UCL = upper confidence limit

Guidance:

Input "PK" if process knowledge is used to eliminate contaminant from waste stream consideration and ensure that Attachment D.2 supports this declaration. Verify that all concentrations used match the controlled data set for this waste lot.

Footnotes:

¹If non-detect, provide maximum detection limit in parentheses and ensure this concentration is below the regulatory limit. If the maximum detection limit is above the regulatory limit then provide an explanation as to how this contaminant can be eliminated or provide confirmatory TCLP results.

²If both UCL-90 and max values or used provide footnotes to signify which value was used.

³Total concentration divided by 20.

⁴If o-, m-, and p-Cresol concentrations cannot be differentiated, the total cresol (D026) concentration is used. The regulatory level of total cresol is 200 mg/L.

⁵Quantification limit is greater than the calculated regulatory level. The quantitation limit therefore becomes the regulatory level.

D.2.4.5 Universal Waste

Based on PK, this waste stream includes universal waste items such as batteries, lamps, pesticides, or mercury-containing equipment as defined in 40 *CFR* 273.

☐ Yes ☐ No

If yes, please explain how these waste types will be managed including identification, segregation, removal, or treatment performed to meet LDRs.

D.2.4.6 Materials of Construction, Mass Balance Calculations, and Upper confidence limit (UCL)-90 Calculations

Have materials of construction (MOC) or mass balance calculations been prepared for this waste lot?

☐ Yes ☐ No

If yes, please provide reference to the approved calculation package and attach to Attachment D.5.

D.2.5 TSCA PCB DISPOSAL REQUIREMENTS

Check all that apply.

SOURCE

- ☐ PK or historical data is used solely for TSCA PCB determination (if checked please include evidence in Attachment D.2)
- ☐ Analytical data from WL is used for TSCA determination

PCB REGULATED WASTE CATEGORIES

- ☐ PCB Remediation Waste
- ☐ PCB Bulk Product Waste
- ☐ PCB Article
- ☐ All oils and other free-flowing liquids have been drained from equipment/waste and absorbent has been added

Prohibited PCBs

- No disposal of PCB liquids.
- PCB waste not authorized for disposal in a RCRA Hazardous Waste Landfill

If PCB-regulated waste, briefly describe source and concentration.

If a portion of the waste stream will be managed separately (i.e., PCB Remediation Waste versus PCB Bulk Product Waste), please describe.

D.2.6 INFECTIOUS WASTE PROHIBITION

- ☐ Based on PK, infectious wastes are not present in this waste stream.
- ☐ If present, provide plans for how these wastes will remain segregated from this waste stream.

D.2.7 PYROPHORIC MATERIAL PROHIBITION

- ☐ Based on PK, pyrophoric wastes are not present in this waste stream.
- ☐ If present, provide plans for how these wastes will remain segregated from this waste stream.

D.2.8 EXCLUSION OF WASTES CAPABLE OF DETONATION OR EXPLOSIVE DECOMPOSITION

- ☐ Based on PK, wastes capable of detonation or explosive decomposition are not present in this waste stream.

- ☐ If present, provide plans for how these wastes will remain segregated from this waste stream.

D.2.9 TOXIC GASES, VAPORS, OR FUMES PROHIBITION

Check all that apply

- ☐ Based on PK or visual inspections, toxic gases, vapors, or fumes are not present in this waste stream.
- ☐ Vent, purge, drain, and other field activities have been performed to eliminate the presence of toxic gases, vapors, or fumes.
- ☐ If present, provide plans for how these wastes will remain segregated from this waste stream.

D.2.10 STRUCTURAL STABILITY DETERMINATION

- ☐ This waste stream has been processed at the point of generation and will be in a final waste form to achieve stability using normal EMDF Operations equipment (see Sect. 1.4).
- ☐ This waste stream has been or requires stabilization or special handling to achieve stability prior to final disposal. If so, please explain the process/plans. _____

D.2.11 VOID SPACE REQUIREMENTS

Check all that apply

- ☐ The waste stream will be disposed in bulk, and void spaces within the waste have been reduced to the extent practicable at the point of generation.
- ☐ Waste will be disposed in compliance with an approved physical waste acceptance criteria (PWAC) variance (provide reference to variance). _____
- ☐ Large items and pieces of equipment have been evaluated for void space using an appropriate void space package calculation and have been certified as meeting EMDF void space criteria. If checked, please provide reference to Void Space calculation packages that have been provided to EMDF Operations. _____

D.2.12 CONTAINER VOID SPACE REQUIREMENTS

Check all that apply

- ☐ No containerized waste; therefore, container void space requirements are not applicable to this waste lot.
- ☐ Bulk hard-sided containers that cannot be compacted with heavy equipment have been verified as being 90% full. If checked, please provide reference to Void Space calculation packages that have been provided to EMDF Operations. _____
- ☐ A PWAC variance to allow container void space to be mitigated at EMDF has been approved by EMDF Operations (provide reference to variance). _____

D.2.13 CRITICALITY SAFETY EVALUATION

☐ An EMDF Material Screen per *Nuclear Criticality Safety Determination EMDF Operations*, NCSD-YT-EMDF-0012 has been approved and included in Attachment D.

☐ A waste lot-specific Nuclear Criticality Safety Evaluation has been approved (provide reference)._____

D.2.14 TDEC CLASS C WASTE LIMITATION

☐ Based on PK or analytical data, the waste is absent of regulated long- and short-lived radioisotopes; therefore, the waste is Class A.

☐ Based on analytical data (detected radioisotopes) and the total sum of fractions (SOF) in the table below, the waste meets one of the following:

- ☐ Class A
☐ Class B
☐ Class C

Tennessee LLW Classification of Long-lived Radionuclides

Radionuclide	Concentration limits (pCi/g)	Expected value concentration (pCi/g)	Fraction
Carbon-14	4.7E+06		0.0000000000
Carbon-14 in activated metal	4.7E+07		0.0000000000
Nickel-59 in activated metal	1.3E+08		0.0000000000
Niobium-94 in activated metal	1.2E+05		0.0000000000
Technetium-99	1.8E+06		0.0000000000
Iodine-129	4.7E+04		0.0000000000
Alpha emitting transuranics ¹	1.0E+05		0.0000000000
Plutonium-241	3.5E+06		0.0000000000
Curium-242	2.0E+07		0.0000000000
		SOF	0.000

¹The Alpha-emitting transuranics with half-life greater than 5 years include the following with UCL-95 concentrations: _____

NA = not applicable or not present based on PK or non-detect

SOF = sum of fractions

UCL = upper confidence limit on the mean

Guide: Enter data in each row in the 3rd column. Then, for each row, go to last column, inside the grey box right click and choose update field.

Once each row is completed, go to the last column, bottom row, right click, and choose update field to update the long-lived total SOF.

Tennessee LLW Classification of Short-lived Radionuclides

Radionuclide	Class A concentration limits (pCi/g)	Expected value concentration (pCi/g)	Fraction
Total all nuclides $T_{1/2} < 5$ years ¹	4.1E+08		0.0000000000
Hydrogen-3	2.4E+07		0.0000000000
Cobalt-60	4.1E+08		0.0000000000
Nickel-63	2.1E+06		0.0000000000
Nickel-63 in activated metal	2.4E+07		0.0000000000
Strontium-90	2.4E+04		0.0000000000
Cesium-137	5.9E+05		0.0000000000
		SOF	0.0000000000

Radionuclide	Class B concentration limits (pCi/g)	Expected value concentration (pCi/g)	Fraction
Total all nuclides $T_{1/2} < 5$ years ¹	NA	NA	NA
Hydrogen-3	NA	NA	NA
Cobalt-60	NA	NA	NA
Nickel-63	4.1E+07		0.0000000000
Nickel-63 in activated metal	4.1E+08		0.0000000000
Strontium-90	8.8E+07		0.0000000000
Cesium-137	2.6E+07		0.0000000000
		SOF	0.0000000000

Radionuclide	Class C concentration limits (pCi/g)	Expected value concentration (pCi/g)	Fraction
Total all nuclides $T_{1/2} < 5$ years ¹	NA	NA	NA
Hydrogen-3	NA	NA	NA
Cobalt-60	NA	NA	NA
Nickel-63	4.1E+08		0.0000000000
Nickel-63 in activated metal	4.1E+09		0.0000000000
Strontium-90	4.1E+09		0.0000000000
Cesium-137	2.7E+09		0.0000000000
		SOF	0.0000000000

¹Isotopes with $T_{1/2} < 5$ years include the following with UCL-95 concentrations:

NA = not applicable or not present based on PK or non-detect.

LLW = low-level (radioactive) waste

UCL = upper confidence limit on the mean

Guide: Enter data in each row in the 3rd column. Then, for each row, go to last column, inside the grey box right click and choose update field. Once each row is completed, go to the last column, bottom row, right click, and choose update field to update the short-lived total sum of fractions. If waste does not exceed Class A, then leave other tables blank.

D.3. ANALYTIC WAC COMPLIANCE

Describe the sampling and analysis performed to characterize this waste stream. Characterization data used in the waste profile shall be consistent with the approved DQO and DQA. Attach DQO and DQA in Attachment D.6.

[Insert here]

☐ Summary statistics for all reportable SRCs are provided below.

WL XXX.X SRC summary statistics

SRC	Units	N	Detects	Min.	Med.	Max.	Mean	Std. Dev.	PDF	LN Mean	LN Std. Dev.	E(X)	UCL-95

E(X) = expected value

N = number of samples

LN = lognormal

PDF = probability distribution function

SRC = site-related contaminant

Std. Dev. = standard deviation

UCL = upper confidence limit

Insert text and table in (Word format) provided by EMDF WAT (example provided below):

The 3-year window is fiscal year (FY)_____ using Waste Acceptance Criteria Forecasting Analysis Capability System (WACFACS) _____

EMDF WAT WACFACS Configuration Control File: _____

WGF Volume = _____ CY (CIVV = _____ for _____ CY of Soil-Like Waste and CIVV = _____ for _____ CY of Debris-Like Waste). E = _____ CY and UCL-95 Total Volume = _____ CY.

Note:

CIVV = confidence in volume value

CY = cubic yards

E = Expected Total Volume

L = low

UCL = upper confidence limit

VH = very high

WGF = Waste Generation Forecast

TABLE 1 EMDF waste concentration limits

Average Concentration SOF = XXXX

CARCINOGENIC WAC SITE-RELATED CONTAMINANTS AND SOF

Expected Total Volume (E) (WL _____ Carcinogenic [CA] SOF) = _____

Upper confidence limit (UCL)-95 (WL _____ CA SOF) = _____

CA WAC 3-Year VWSF Compliance

E (WL _____ CA volume-weighted sum of fractions [VWSF]) = _____

E (EMDF CA VWSF) = _____

UCL-90 (EMDF CA VWSF) = _____

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Attachment 3 - Summary of SRC and Volume Information for Waste Lot

WL Number and Description

WACFACS Input Worksheet Rev 14-01 dated February 27, 2025

ID	EMWMF SRC FOR Waste Lot	Units	Analytical Data Available (Y, N, or X)	Process Knowledge Eliminates as SRC (Y or N)	Is this an SRC (Y, N)	Detects / Samples	N for Statistics	Rationale	WACFACS Function	Minimum Value	Median Value	Maximum Value	Expected SRC Concentration	UCL-95 (SRC Concentration)	Expected HI SOF Value	Expected Carcinogenic SOF Value	SRC SOF % of HI SOF	SRC SOF % of Carcinogenic SOF
1	Am-241	pCi/g																
2	C-14	pCi/g																
2A	Ca-41	pCi/g																
3	H-3	pCi/g																
4	I-129	pCi/g																
5	Np-237	pCi/g																
6	Pu-239	pCi/g																
7	Pu-240	pCi/g																
67	Pu-239/240	pCi/g																
8	Tc-99	pCi/g																
9	U-233	pCi/g																
10	U-234	pCi/g																
910	U-233/234	pCi/g																
11	U-235	pCi/g																
12	U-236	pCi/g																
13	U-238	pCi/g																

WACFACS CM: Q3 FY25	Rev 14-01 dated February 27, 2025	WGF Volume (CY)	CIVV	WACFACS Calculated	Expected	05	UC	Q3 FY25
WACFACS ID		SOIL		No Fill Required				Expected SOF
SUBPROJECT/WASTE LOT		DEBRIS		Fill Required				UCL-95 SOF
WBS		TOTAL		Total				Comment:

NOTES

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D.4 REFERENCES

List references below. Do not include DOE Orders or *CFRs*. Do include the titles of these when they are called out in the text.

UCOR-4168, *Process Plan for Determining As-Shipped Waste Volume for United Cleanup Oak Ridge LLC, Oak Ridge, Tennessee*, latest revision, United Cleanup Oak Ridge LLC, Oak Ridge, TN.

D.5 GENERATOR SIGNATURES

To the best of my knowledge, the information provided on this form and the attached documentation is a full, true, and accurate description of the waste stream. Willful and deliberate omissions have not been made. All known and suspected hazardous materials have been disclosed.

Waste Generator Contact Name: _____ Date: _____

Signature: _____

Technical Peer Review Contact Name: _____ Date: _____

Signature: _____

ATTACHMENT D.1 WASTE LOT ANOMALY DETECTION PLAN

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Attachment D.1: Waste Lot Anomaly Detection Plan

Guidance:

This attachment shall provide an overview of the Waste Anomaly Detection Plan (ADP) or waste generation strategy that shall be implemented to confirm anomalous waste are appropriately identified and removed from this waste lot. The rigor applied in the ADP shall be risk-based and use a graded approach that is commensurate with the hazards and risks to workers, the environment, and the public. Any suspect or identified anomalous waste shall be segregated, managed separately, and controlled to ensure proper disposal. In the event an anomalous item is detected in a shipment at EMDF, notify EMDF WAT immediately and follow corrective action instructions provided by EMDF Operations.

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Reference below the plans or procedures (e.g., project waste management plans or other project plans) that support waste anomaly or prohibited items detection, management, and disposition.

[Insert here]

Anomaly Detection Plans (ADPs) and the Waste Lot Anomaly Detection Checklists (ADCs) are written and implemented primarily for individuals who are responsible for certifying that wastes are consistent with the approved waste profile (e.g., Waste Packaging Specialists) and documented on Form-3411, *Waste Lot Anomaly Detection Checklist* that has been prepared for each waste lot profile. The ADC shall be completed by trained project personnel for each shipment that certifies all waste is in compliance with the approved waste profile(s).

Check all that apply.

- ☐ Prior to waste generation, all anomalous waste has been verified as removed.
- ☐ Anomalous waste items are expected to be present during waste generation and these waste items have been marked in the field and included in field instructions (e.g., work package) and listed on the attached ADC.
- ☐ Sorting and segregation of all waste prior to packaging.
- ☐ Prescribed radiological and chemical monitoring.
- ☐ Other field screening and detection systems. Describe. _____

Identify (by position) who is authorized to sign the certification statements for waste shipments.

[Insert here]

All waste certification personnel have read this waste lot profile and the EMDF Waste Acceptance Criteria Compliance Plan.

☐ **Yes** ☐ **No**

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Waste Lot Anomaly Detection Checklist

Waste Lot/Rev. No. and Title:	
Expected Waste Types:	
Physical Indicators of Potential Anomalies:	

Certification Statement (To be completed and sent with each waste shipment.)			
I certify that the wastes in this shipment conform to the descriptions found in the waste profile for Waste Lot No.: _____			
For question regarding the contents of this shipment, call: _____			
2. Waste Certifier Printed Name:	Signature:	Badge No.:	Date:
Note: The phone number and printed name for this form may be electronically inserted. However, the waste lot number , signature , and date shall be handwritten in ink.			
Truck No.:		Release Time:	
		Tarp & Gasket Checked:	☐ Yes ☐ No

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ATTACHMENT D.2 PROCESS KNOWLEDGE SUMMARY

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Attachment D.2 Process Knowledge Summary

Guidance:

Since the main text portion of the waste profile is intended to contain summary-level information, this attachment is used for detailed information of relevant PK and anecdotal evidence that is used to define the waste generating process, waste stream characteristics, support characterizing data, etc. This attachment should support the waste generation process description (Sect. 1.5), waste determinations (Chap. 2), and waste characterization data (Chap. 3).

If PK is used to designate proxy values for contaminants within the profile, the bases for doing so must be clearly discussed and defended; those values should then be used in Attachment D.5 for any calculations performed for those contaminants. The structure of this attachment is left up to the author in order to tailor the information to the needs of individual profiles. If reference documents have been used to provide relevant PK, these documents should be inserted in this attachment. However, it is recommended that only the relevant sections of these PK documents be included, along with the title page. Adding extraneous information that does not represent the waste lot should be avoided.

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**ATTACHMENT D.3 CONTROLLED DATA SET TRANSMITTAL TO
EMDF WASTE ACCEPTANCE TEAM**

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Attachment D.3 Controlled Data Set Transmittal to EMDF WAT

Guidance:

The purpose of Attachment D.3 is to provide a copy of the transmittal document of the CDS to the EMDF Waste Acceptance Team. Provide e-mail or other form of correspondence from the waste generating project to the EMDF WAT. The CDS is an electronic file. The waste generating project shall transmit the CDS in an unprotected Microsoft Excel format. The data set should be ordered by (1) first by analysis type (radionuclides, metals, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, herbicides, and PCBs), (2) then by analyte, and (3) sorted from the lowest value to the highest value to facilitate a timely review of the data set. All data in the CDS shall include any associated data validation qualifiers. The final CDS shall be dated and shall also be 100% consistent with the data in the profile.

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**ATTACHMENT D.4 ENVIRONMENTAL COMPLIANCE ASSESSMENT-
LISTED WASTE DETERMINATION**

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Attachment D.4: Environmental Compliance Assessment – Listed Waste Determination

Guidance:

The purpose of Attachment D.4 is to provide clear and succinct documentation that all aspects of the RCRA compliance have been reviewed by and approved by the waste generating project's Environmental Compliance Organization. Complete the Listed Waste Determination Checklist below or provide equivalent documentation as required by the waste generator's applicable programs and procedures as Listed Hazardous Wastes are prohibited from disposal.

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Listed Waste Determination

Provide process knowledge (PK) in support of waste determination of the waste stream (past/present activities that may affect the listed waste determination such as manifests, storage records, accident /spill reports, site investigation reports, and enforcement orders and permits):

See Attachment D.2 .

1. Has a review of historical data been conducted?

Yes ☐ No ☐

If yes, please explain how this information applies to this waste stream:

See Attachment D.2.

2. Is the waste stream, or any portion of the waste stream, from a non-specific source listed in 40 *CFR* 261.31?

Yes ☐ No ☐

3. Is the waste stream, or any portion of the waste stream, from a specific source listed in 40 *CFR* 261.32?

Yes ☐ No ☐

4. Is the waste stream, or any portion of the waste stream, an unused commercial chemical product (CCP) listed in 40 *CFR* 261.33(e)?

Yes ☐ No ☐

5. Is the waste stream, or any portion of the waste stream, an unused CCP listed in 40 *CFR* 261.33(f)?

Yes ☐ No ☐

6. If yes to questions 3, 4, 5, and/or 6: Is the waste stream, or a portion of the waste stream, an ignitable, corrosive, or reactive (ICR)-listed waste?

Yes ☐ No ☐ N/A ☐

If yes, is the waste stream, or any portion of the waste stream, still characteristic for the listed ICR waste?

Yes ☐ No ☐ N/A ☐

7. Is the waste stream, or any portion of the waste stream, a listed waste derived from the treatment, storage, or disposal of listed waste as defined in 40 *CFR* 261.3 (c), (d), and (g)?

Yes ☐ No ☐

8. Is the waste stream, or any portion of the waste stream, solid waste mixed with a listed hazardous waste as defined in 40 *CFR* 261.3(a), (b), and (g)?

Yes ☐ No ☐

9. Is/was the waste stream, or any portion of the waste stream, listed waste by way of the contained-in policy?

Yes ☐ No ☐

If yes, has a determination been documented that the waste stream no longer contains listed waste?

Yes ☐ No ☐ N/A ☐

10. Based on the above information, is the waste stream, or any portion of the waste stream, listed waste?

Yes ☐ No ☐

If yes, please explain how the listed waste will be segregated from the waste stream.

A good-faith-effort review of existing and available site and waste-specific information has been conducted by Environmental Compliance personnel to determine that no Resource Conservation and Recovery Act (RCRA)-listed waste is associated with the waste determination for this waste stream.

The responses to the above are based on a “good faith” due-diligence review of all known information and is accurate to the best of my knowledge.

Prepared By: _____
Name/Title Date

Reviewed By: _____
Name/Title Date

Approved By: _____
Name/Title Date

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ATTACHMENT D.5 CALCULATION/MEASUREMENT METHODS

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Attachment D.5. Calculation/Measurement Methods

Guidance:

Typical calculations include, but are not limited to, data transformations, materials of construction calculations; mass balance determinations; UCL-90 calculations for RCRA waste determinations, dpm/100cm² to pCi/g, etc. Calculations and spreadsheets that are generated to support waste management decisions shall be peer-reviewed for independent verification of the results. Calculations that are performed to support regulatory compliance shall be reviewed and approved by project environmental compliance staff, and if necessary, legal concurrence.

If the waste generating project uses Engineering Calculation Packages used to develop or transform the data for characterization purposes, the project shall insert approved copies of the Engineering Calculation Package(s).

If the waste generating project uses NDA for characterization purposes, the CERCLA Project shall insert the title pages and summary level results.

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ATTACHMENT D.6 DQO/DQA

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Attachment D.6: DQO/DQA

Guidance:

The purpose of Attachment D.6 is to present the final and approved DQO and DQA presentations supporting the waste lot. Provide any approval signatures if available.

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ATTACHMENT D.7 CERCLA DOCUMENTATION

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Attachment D.7: CERCLA Documentation

Guidance:

The purpose of Attachment D.7 is to present the cover pages and any relevant information from CERCLA documentation associated with the profile. Copies of the entire CERCLA documents are not required.

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**ATTACHMENT D.8 EMDF NUCLEAR CRITICALITY
COMPLIANCE DOCUMENTATION**

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Attachment D.8: EMDF Nuclear Criticality Compliance Documentation

Guidance:

The purpose of Attachment D.8 is to present the approved EMDF Material Screen Calculation Worksheet associated with the profile, or other approved evidence that the waste meets the nuclear criticality safety compliance requirements. An example is provided below and a new worksheet will be developed by EMDF Operations.

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EMDF Material Screen Calculation Worksheet

[Click here](#) for the EMDF Material Screen Calculation Worksheet

Title:		Revision No: ☐ 0 ☐ 1 ☐ 2 ☐ __	
Date:	Contact:	Charge #:	Phone No:
WASTE DESCRIPTION			
DESCRIPTION OF THE WASTE MATERIAL: (include origin of waste, mass of waste, form and composition of waste, quantity of fissionable nuclides, types of containers, FEM calculations, etc. If information is attached, list attachments here.)			
Use Calculation Worksheet answer for each applicable and corresponding question/criteria below			
General Questions			
A. Radiological summary data attached?		☐ YES	☐ NO
B. ²³⁵ U FEM Calculation Worksheet completed/signed by preparer and reviewer and attached?		☐ YES	☐ NO
Special Reflector Questions			
C. Are all quantities of beryllium and graphite together less than 1 wt. % of the mass of waste? (include data or process knowledge to support this conclusion.)		☐ YES	☐ NO
D. Are all quantities of the beryllium and/or graphite, dispersed within the waste with no concrete drums?*		☐ YES	☐ NO
Fissionable TRU Questions			
E. Is the total activity of fissionable transuranic (TRU) nuclides (i.e., ²⁴² Cm and ²⁴⁴ Pu less than 450 pCi/g waste?		☐ YES	☐ NO
F. Is the total activity of ²⁴¹ Pu less than 3,500 pCi/g; ²⁴² Cm less than 1,000 pCi/g?		☐ YES	☐ NO
G. Is there no ²³⁸ Pu in the waste?		☐ YES	☐ NO
<i>The answers to the questions above must all be YES before proceeding.</i> <i>NOTE: This form is not required if an approved NCSE/D addresses the waste shipment.</i>			
Enrichment Exemption Criteria			
1. Is the uranium enrichment in the shipment less than 0.90 wt% ²³⁵ U?		☐ YES	☐ NO
2. Is the less than 1% FEM contribution from ²³⁵ U, ²³³ U, and ²³⁴ U? **		☐ YES	☐ NO
3. Is there less than 0.1% FEM contribution from TRU?		☐ YES	☐ NO
If the answer to questions 1, 2 and 3 are all YES , then the shipment meets the requirements of Enrichment Exempt material and may be shipped to EMWMF with NCS concurrence noted below. Answers to questions 4 - 12 are not required.			
Mass/Volume Exemption Criteria			
4. Does each waste package*** contain less than 15 g ²³⁵ U FEM?		☐ YES	☐ NO
5. Is each CLOSED waste package**** operationally filled with <10% void space?		☐ YES	☐ NO
If the answer to questions 4 and 5 are both YES , then the material meets the requirements of Mass/Volume Exempt materials and may be shipped to EMWMF with NCS concurrence noted below. Answers to questions 1 - 3 and 6 - 12 are not required.			
Concentration/Mass Exemption Criteria			
6. Is the highest fissile material concentration less than 2 g ²³⁵ U FEM / kg-waste?		☐ YES	☐ NO
7. Does the waste primarily consist of soil; building debris; and/or steel?		☐ YES	☐ NO
8. Is the fissile material dispersed within the waste with NO concentrated deposits of fissile material?		☐ YES	☐ NO
9. Are both a & b satisfied? a. 55-gal drums, 85-gal drums- 110-gal drums and 2'x4'x6' boxes individually contain less than or equal to 300 g ²³⁵ U FEM or not present in WL? b. 4'x4'x6' boxes, Sealands and larger containers, e.g., dump trucks, side loaders and other larger conveyances individually contain less than or equal to 350 g ²³⁵ U FEM?		☐ YES	☐ NO
If the answers to questions 6, 7, 8 and 9 are all YES , then the shipment meets the requirements of Concentration/Mass Exempt material and may be shipped to EMWMF with NCS concurrence noted below. Answers to questions 1 - 5, and 10 - 12 are not required.			
Concentration Exemption Criteria			
10. Is the highest fissile material concentration no more than 1 g ²³⁵ U FEM / kg-waste?		☐ YES	☐ NO
11. Does the waste primarily consist of soil; building debris; and/or steel?		☐ YES	☐ NO
12. Is the fissile material dispersed within the waste with NO concentrated deposits of fissile material?		☐ YES	☐ NO

EMDF Material Screen Calculation Worksheet

[Click here](#) for the EMDF Material Screen Calculation Worksheet

Title:			Revision No: ☐ 0 ☐ 1 ☐ 2 ☐ __		
Date:	Contact:	Charge #:	Phone No:		
If the answers to questions 10, 11 and 12 are all YES , then the shipment meets the requirements of Concentration Exempt material and may be shipped to EMWMF with NCS concurrence noted below. Answers to questions 1 - 9 are not required.					
*Beryllium and graphite shall be distributed within waste and be physically no larger than that of metal fines (< ~ 3mm diameter). The requirement to limit graphite applies to quantities of reactor grade graphite and is not meant to be applied to hydrocarbons or other carbonaceous material that have carbon mixed with other materials. **Process Knowledge (PK) may be used to determine the answer. When U-233/-234 results are above the Minimum Detection Limit, justifiable PK could be used to state there is no U-233. In that case do not enter activity for U-233 ***A waste package is defined as a container together with its contents of waste in its final form for disposal, one or more of which may constitute a shipment. Examples are (1) a single box; (2) a single drum; (3) the entire contents of a single bulk shipment. For this form, a waste package may not be smaller than 30 gallons in volume. ****void space limitation not required for bulk shipments					
I certify all information on this form, including that on the Material Screen Calculation Worksheet, is accurate and correct to the best of my knowledge.					
Responsible Waste Management Lead:					
		Signature		Print	Date
Concurrence that the information on this form meets the specified NCS exemption criterion.					
Waste Generator Project NCS or RAD Engineer:					
		Signature		Print	Date
Concurrence that the Waste Lot specified on this form meets the EMWMF administrative WAC for NCS.					
EMWMF NCS Engineer:					
		Signature		Print	Date
Concurrence that the Waste Lot specified on this form is acceptable for receipt at the EMWMF.					
EMWMF Facility Manager:					
		Signature		Print	Date

Waste Lot	see profile				
Container Mass	Pounds	0.00	kg		
Beryllium	mg/kg	0.00	g	0.000	kg 0 lbs
Graphite	mg/kg	0.00	g	0.000	kg 0 lbs
Lead	mg/kg	0.00	g	0.000	kg 0 lbs
Aluminum	mg/kg	0.00	g	0.000	kg 0 lbs
Estimated Sand/Gravel	wt. %				
0	Grams				

Bulk (minus PP, G, Pb, Al)	-	g
Sand/Gravel	-	g
New Bulk	-	g

Special Reflector Question	Be wt. %	Grph wt. %	
C. Be and Graphite less than 1 wt. %?	#DIV/0!	#DIV/0!	#DIV/0!

Fissionable TRU Questions	
E. Is the total activity of fissionable transuranic (TRU) nuclides minus ²⁴² Cm and ²⁴¹ Pu less than 450 pCi/g waste?	Yes
F. Is the total activity of ²⁴¹ Pu less than 3500 nCi/g; ²⁴² Cm less than 20,000 nCi/g?	Yes
G. Is there no ²³⁸ Pu in the waste?	Yes

Enrichment Exemption Criteria	
1. Is the ²³⁵ U enrichment < 0.90 wt %?	100.00% wt% ²³⁵ U No
2. Is there less than 1% FEM contribution from ²³² U, ²³³ U, and ²³⁴ U?	No
3. Is there less than 0.1% FEM contribution from TRU?	No

Nuclide	<enter> Maximum Activity ¹ (pCi/g)	Specific Activity ² (Ci/g)	mass / container (g)	Curies (Ci)	Nuclide Mass (g)	²³⁵ U FEM Mass Factor	²³⁵ U FEM (g)
²³³ U		2.150E+01	0.000E+00	0.000E+00	0.000E+00	0.78	0.000E+00
²³³ U		9.680E-03	0.000E+00	0.000E+00	0.000E+00	1.4	0.000E+00
²³⁴ U		6.250E-03	0.000E+00	0.00E+00	0.000E+00	0.021	0.000E+00
²³⁵ U		2.160E-06	0.000E+00	0.00E+00	0.000E+00	1	0.00E+00
²³⁸ U (mean)		3.360E-07	0.000E+00	0.00E+00	0.000E+00	N/A	N/A
²³⁷ Np		7.050E-04	0.000E+00	0.00E+00	0.000E+00	0.033	0.00E+00
²³⁶ Pu		5.320E+02	0.000E+00	0.00E+00	0.000E+00	1.56	0.00E+00
²³⁹ Pu		1.710E+01	0.000E+00	0.00E+00	0.000E+00	0.21	0.00E+00
²⁴⁰ Pu		6.220E-02	0.000E+00	0.00E+00	0.000E+00	1.56	0.00E+00
²⁴¹ Pu		2.280E-01	0.000E+00	0.00E+00	0.000E+00	0.047	0.00E+00
²⁴¹ Pu		1.030E+02	0.000E+00	0.00E+00	0.000E+00	5	0.00E+00
²⁴² Pu		3.930E-03	0.000E+00	0.00E+00	0.000E+00	0.018	0.00E+00
²⁴¹ Am		3.430E+00	0.000E+00	0.00E+00	0.000E+00	0.044	0.00E+00
^{242m} Am		1.050E+01	0.000E+00	0.00E+00	0.000E+00	78	0.00E+00
²⁴³ Am		1.990E-01	0.000E+00	0.00E+00	0.000E+00	0.016	0.00E+00
²⁴² Cm		3.310E+03	0.000E+00	0.00E+00	0.000E+00	0.18	0.00E+00
²⁴³ Cm		5.160E+01	0.000E+00	0.00E+00	0.000E+00	8.8	0.00E+00
²⁴⁴ Cm		8.090E+01	0.000E+00	0.00E+00	0.000E+00	0.1	0.00E+00
²⁴⁵ Cm		1.720E-01	0.000E+00	0.00E+00	0.000E+00	32	0.00E+00
²⁴⁶ Cm		3.070E-01	0.000E+00	0.00E+00	0.000E+00	0.07	0.00E+00
²⁴⁷ Cm		9.280E-05	0.000E+00	0.00E+00	0.000E+00	2	0.00E+00
²⁴⁸ Cf		4.100E+00	0.000E+00	0.00E+00	0.000E+00	70	0.00E+00
²⁵¹ Cf		1.590E+00	0.000E+00	0.00E+00	0.000E+00	140	0.00E+00
Mass/Volume Exemption Criteria							0.00E+00 g Total ²³⁵ U FEM
4. Does each waste package contain < 15 g ²³⁵ U FEM?							Yes
Concentration/Mass Exemption Criteria							#DIV/0! g FEM/ kg-waste
6. Is the highest fissile material concentration < 2 g ²³⁵ U FEM per kilogram of waste?							#DIV/0!
Concentration Exemption Criteria							#DIV/0!
10. Is the highest fissile material concentration < 1 g ²³⁵ U FEM per kilogram of waste?							

¹Use the Mean Activity for U-238

²Specific Activities taken from FAT-CAT

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APPENDIX E.
EMDF WASTE ACCEPTANCE CRITERIA
TRACKING REPORTING ANALYSIS CAPABILITY SYSTEM
PENDING FINAL ANALYTICAL WAC

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WACFACS – TO BE FINALIZED AFTER ALL ANALYTICAL WAC HAVE BEEN VERIFIED AND COMPLETED.

Attachment 3 - Summary of SRC and Volume Information for Waste Lot

WACFACS Input Worksheet Rev 14-01 dated February 27, 2025

WL Number and Description																		
ID	EMWMF SRC FOR Waste Lot	Units	Analytical Data Available (Y, N, or X)	Process Knowledge Eliminates as SRC (Y or N)	Is this an SRC (Y, N)	Detects / Samples	N for Statistics	Rationale	WACFACS Function	Minimum Value	Median Value	Maximum Value	Expected SRC Concentration	UCL-95 SRC Concentration)	Expected HI SOF Value	Expected Carcinogenic SOF Value	SRC SOF % of HI SOF	SRC SOF % of Carcinogenic SOF
1	Am-241	pCi/g																
2	C-14	pCi/g																
2A	Ca-41	pCi/g																
3	H-3	pCi/g																
4	I-129	pCi/g																
5	Np-237	pCi/g																
6	Pu-239	pCi/g																
7	Pu-240	pCi/g																
67	Pu-239/240	pCi/g																
8	Tc-99	pCi/g																
9	U-233	pCi/g																
10	U-234	pCi/g																
910	U-233/234	pCi/g																
11	U-235	pCi/g																
12	U-236	pCi/g																
13	U-238	pCi/g																

WACFACS CM: Q3 FY25	Rev 14-01 dated February 27, 2025	WGF Volume (CY)	CIVV	WACFACS Calculated	Expected	LCL-05	UCL-95
WACFACS ID		SOIL		No Fill Required			
SUBPROJECT/WASTE LOT		BRIS		Fill is Required			
WBS		TOTAL		Total			
		START					
		FINISH					

Q3 FY25				
Expected SOF				
UCL-95 SOF				
Comment:				

NOTES

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APPENDIX F.DEFINITIONS

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DEFINITIONS

Administrative WAC: Requirements or standards of federal laws and promulgated state laws that are deemed applicable or relevant and appropriate to the hazardous substances, pollutants, or contaminants being addressed by a cleanup action being taken under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). They also include waste acceptance criteria (WAC) agreements among the parties to the *Federal Facility Agreement for the Oak Ridge Reservation* (DOE/OR-1014; FFA), specifically those addressing prohibited wastes.

Analytic WAC: Inventory limits and concentration limits presented in the Record of Decision that are derived from the work presented in the Performance Assessment performed under the U.S. Department of Energy (DOE) Directives (DOE Order 435.1, DOE Manual 435.1-1, and DOE Order 458.1).

CERCLA-derived remediation and removal waste: Waste from CERCLA activities that may include but is not limited to soil, water, contaminated personal protective equipment, filters, and other support equipment that cannot be decontaminated.

Certification: Statement from waste generator or designee that confirms the waste on the shipment matches the waste on the profile.

Data quality objectives: Qualitative and quantitative statements derived from a process that clarifies and establishes a study's objectives, defines the appropriate type of data, and specifies the tolerable levels of potential decision errors that are to be used to support decisions.

FFA Project Manager: The group of DOE, U.S. Environmental Protection Agency (EPA), and Tennessee Department of Environment and Conservation (TDEC) project managers responsible for adhering to the provisions of the FFA.

FFA Parties: The DOE, EPA, and TDEC personnel assigned to oversee individual CERCLA projects.

Free liquids: Liquids that can readily separate from the solid portion of a waste under ambient temperature and pressure (DOE O 435.1 Chg. 2), as demonstrated by "Method 9095B: Paint Filter Liquids Test" (EPA 2021).

Hazardous substance: Any material designated as such pursuant to CERCLA, including all Resource Conservation and Recovery Act of 1976 (RCRA) hazardous waste types, radionuclides, a variety of other chemical substances, and any material identified as a hazardous substance, such as petroleum, petroleum products, and all hazardous waste types.

Hazardous waste: Waste designated as hazardous by EPA regulations 40 *Code of Federal Regulations (CFR)* Part 261 (*Identification and Listing of Hazardous Waste*, Section 261.3, "Definition of Hazardous Waste") and regulated under RCRA.

High-level waste: Highly radioactive waste material. High-level waste results from the reprocessing of spent nuclear fuel, including the liquid waste produced directly during reprocessing. As per DOE O 435.1 Chg. 2, the term refers to any solid material derived from such liquid waste that contains fission products in sufficient concentrations, and to other highly radioactive material that is determined, consistent with existing law, to require permanent isolation (adapted from the Nuclear Waste Policy Act of 1982, as amended [42 USC § 10101 et seq.])

Infectious waste: Waste containing living organisms that could endanger human health or the health of domestic animals or wildlife by extending the range of biological pests, viruses, pathogenic microorganisms, or other agents capable of infesting, infecting, or extensively and permanently altering the normal populations of organisms.

Investigation-derived waste: Materials that are generated from CERCLA investigations, such as drill cuttings, purge water, development water, overburden, interstitial and underburden soils, and wastes (such as debris or sludge).

Low-level radioactive waste: Waste that cannot be defined as high-level radioactive waste, spent nuclear fuel, transuranic (TRU) waste, by-product material (as defined in Section 11e [2] of the Atomic Energy Act of 1954, as amended [42 USC § 2011, et seq.]), or naturally occurring radioactive material (DOE O 435.1 Chg. 2).

Mixed waste: Waste containing both radioactive components, as defined by the Atomic Energy Act of 1954 (as amended), and hazardous components, as defined by 40 *CFR* 262 (*Identification and Listing of Hazardous Waste*).

Radioactive waste: Solid, liquid, or contained gaseous material that contains radionuclides regulated under the Atomic Energy Act of 1954 (as amended), which is of negligible economic value considering costs of recovery.

Secondary waste: A generic category of waste that is generated from support activities (including operation and maintenance activities) related to retrieving, processing, and packaging the primary waste stream. Examples of secondary waste include waste associated with routine decontamination activities (excluding facility closure), personal protective equipment, administrative area and support services waste, used equipment and filters, and other similar waste types generated during operation and maintenance activities.

Soil waste: Soils excavated as part of a project that may be contaminated as a result of spill, leaks, or release or contaminated liquids from facility operations, or soils that exceed risk-based criteria.

Site-related contaminants: Waste constituents with WAC concentration limits that exist at concentrations above site background concentrations. Note that a constituent does not have to be a contaminant of concern at the remedial action site to be a site-related contaminant (SRC) for Environmental Management Disposal Facility (EMDF) WAC compliance purposes.

Solid waste: Includes soils, debris, contaminated equipment, investigation-derived waste, drill cuttings, personal protective equipment, unused and unaltered sample material, analytical residue and sample preservative residue, sample containers, miscellaneous solid waste (such as trash, labels, or rags), solid secondary waste, and construction waste.

Solidification: A technique that limits the solubility and mobility of hazardous waste constituents through physical means.

Spent nuclear fuel: Fuel that has been withdrawn from a nuclear reactor following irradiation and that has not yet been reprocessed to remove its constituent elements.

Stabilization: A technique that limits the solubility and mobility of hazardous waste constituents by causing the constituents to bond or chemically react with the stabilizing material.

Structural stability: A waste form that will generally maintain its physical dimensions and its form under the expected disposal conditions, such as weight of overburden and compaction equipment, the presence of moisture and microbial activity, and internal factors such as radiation effects and chemical changes. The waste form itself can provide structural stability by processing the waste to a stable form or by placing the waste in a disposal container or structure that provides stability after disposal.

Supplemental Analysis: An evaluation conducted in accordance with the Record of Decision to inform development of the WAC Compliance Plan by performing additional sensitivity/uncertainty analysis, possible revisions to and/or addition to total inventory (mass) limits, and informing the landfill design.

Sum of fractions: Sum of the ratios of the concentrations of SRCs in a waste to their corresponding WAC concentration values. A sum of fraction (SOF) calculation is also used for administrative WAC compliance based on TDEC waste classification regulations.

Toxic Substances Control Act waste: Waste managed strictly under the Toxic Substances Control Act of 1976 (TSCA) regulations (15 USC § 2601 et seq.). Presently, only polychlorinated biphenyls and asbestos are regulated by EPA as TSCA waste per 40 *CFR* 761 (*Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions*) and 40 *CFR* 763 (*Asbestos*).

Transuranic waste: Per DOE O 435.1 Chg. 2, radioactive waste containing more than 100 nanocuries (3700 becquerels) of alpha-emitting TRU isotopes per gram of waste, with half-lives greater than 20 years, except for (1) high-level radioactive waste; (2) waste that the Secretary of Energy has determined, with the concurrence of the administrator of EPA, does not need the degree of isolation required by the 40 *CFR* 191 (*Transportation of Natural and Other Gas by Pipeline; Annual, Incident, and Other Reporting*) disposal regulations; or (3) waste that the U. S. Nuclear Regulatory Commission has approved for disposal on a case-by-case basis in accordance with 10 *CFR* 61 (*Licensing Requirements for Land Disposal of Radioactive Waste*) (Source: Waste Isolation Pilot Plant Land Withdrawal Act of 1992, as amended [Public Law 102-579].)

Trigger levels. Facility average concentrations for total uranium and mercury that provide a basis for initiating evaluation of additional risk management activities in the event that actual or forecast average concentrations of the total EMDF waste disposed to date approach the trigger level.

Verification: The process to determine the waste stream profile representative of the physical waste from a generating waste area group that meets the physical, chemical, and radiological limits of the WAC.

Volume weighted sum of fractions (VWSF): Sum of all of the analytic WAC SOFs for each waste lot already placed and anticipated to be placed in the disposal cell, with each individual lot's SOF multiplied by the volume of the waste in that lot and then divided by the total volume of wastes for the period of interest. The total volume used to determine compliance for these calculations is the 3-year projected volume of waste plus the volume of material already in the EMDF. Other volumes of interest may be used for planning purposes.

Waste Acceptance Team: A team of prime contractor personnel tasked to evaluate waste lots independently to determine whether the wastes can be accepted for disposal in the EMDF as proposed by the CERCLA projects.

Waste lot: Primary unit of waste used to determine WAC compliance for disposal in the EMDF and to track waste as it moves through the waste management system. The waste lot can include all of the wastes generated by a CERCLA project or one of several subsets of those wastes. Other criteria to use for subdividing a waste stream into one or more waste lots could be material type, similarity of contaminants,

or any other logical grouping that enhances the ability of the CERCLA project to characterize and manage its wastes.

Waste package: A container together with its contents of waste in its final form for disposal, one or more of which may constitute a shipment. Examples of waste packages are a single box, a single drum, or the entire contents of a single bulk shipment.

Waste stream: A waste or group of waste types generated from the same process or facility with similar physical, chemical, or radiological properties and with the same disposition pathway

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