Attachment II-1-12-4

Thermal Desorption

Volatile Metals Pre-Demonstration Plan

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Volatile Metals Pre-Demonstration Plan

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Section 1 - Introduction

This Volatile Metals Pre-Demonstration Plan (PDP) provides requirements to conduct Waste Family Demonstration Testing within the thermal desorption (TD) unit for volatile metal contaminants within feed wastes to the TD unit. This testing shall be designated Volatile Metals Waste Family Demonstration Testing to distinguish from the Volatile and Semi-Volatile Organic Waste Family Demonstration Testing described in Attachment II-1-12-2, *Pre-Demonstration Plan for Volatile and Semi-volatile Organic Compounds*, and the CMBST-coded waste Waste Family Demonstration Testing described in Attachment II-1-12-3, *CMBST-Coded Waste Pre-Demonstration Plan*, of this Permit. The Volatile Metals Waste Family Demonstration Testing shall determine the viability of the TD unit at the Energy*Solutions* Clive, Utah Mixed Waste Facility (the Permittee) for processing waste containing volatile metal contaminants, particularly the separation of mercury from the waste feed material. Furthermore, Volatile Metals Waste Family Demonstration Testing is designed to demonstrate that air emissions from the process will be minimized and shall be protective of human health and the environment. Operational Parameters used for Volatile Metals Waste Family Demonstration Testing, have been established based on the TD unit design and past experience. Final Operational Parameters shall be established based on the data obtained in the Volatile Metals Waste Family Demonstration Testing along with previous TD testing.

Attachment II-1-12-2 contains descriptions of a preliminary system test and Waste Family Demonstration Testing for volatile and semi-volatile organic compounds. This Attachment contains descriptions of the Volatile Metals Waste Family Demonstration Testing and consists of a test of the air pollution control (APC) equipment and operability of the system. Attachment II-1-12-2 provides a majority of the preparatory work for the Volatile Metals Waste Family Demonstration Testing described in this Attachment and will be referenced consistently throughout this Attachment.

As required in Condition 2.b. of Attachment II-1-12-1, *Thermal Desorption Shakedown Operations and Waste Family Demonstration Testing*, this Attachment has been created to supplement the Demonstration Testing plan described in Attachment II-1-12-2, *Pre-Demonstration Plan for Volatile and Semi-volatile Organic Compounds*.

For consistency, Sections within this Attachment correspond with Sections within Attachment II-1-12-2.

This Volatile Metals PDP includes:

- a review of results from previous demonstration tests (Section 9);
- a description of the feed material used during the Volatile Metals Waste Family Demonstration Testing (Section 7);
- Data Quality Objectives (DQOs) (Section 5);

- analytical verification testing to achieve the DQOs (Section 7);
- a Sampling and Analysis Plan (Section 7);
- quality assurance/quality control (QA/QC) measures for operational testing and analytical data (Section 7);
- expected secondary waste streams and by-products and a discussion of their final disposition (Section 7);
- an outline of the testing (Section 7); and
- personnel (positions) necessary to complete the testing (Section 9).

The TD unit has not been changed from the descriptions in Attachment II-1-12-2; therefore, the detailed description of the system and all equipment from Attachment II-1-12-2 remain valid.

This Attachment provides a basis for the Volatile Metals Waste Family Demonstration Testing. Additional details will be provided in the schedule submitted in accordance with Condition 5.b. of Attachment II-1-12-1.

1.1 *Definitions*

The definitions of terms used within this Attachment are found in Attachment II-1-12, *Thermal Desorption Separation Plan*.

1.2 Acronyms

The following acronyms are used within this Attachment:

APC	=	air pollution control
AWFCO	=	Automatic Waste Feed Cut-Off system
BDT	=	Biannual Demonstration Testing (conducted in 2006)
CE	=	condenser efficiency
CMBST	=	CMBST Demonstration Testing (conducted in 2008)
DQO	=	Data Quality Objective
LDR	=	Land Disposal Restrictions
MACT	=	Maximum Achievable Control Technology
ODT	=	Operational Demonstration Testing (conducted in 2008)

PDP	=	Pre-Demonstration Plan
POHC	=	principal organic hazardous constituent
QA/QC	=	Quality Assurance/Quality Control
RCRA	=	Resource Conservation and Recovery Act
RE	=	removal efficiency
RVM	=	Representative Volatile Metal or metallic compound
SVOC	=	semi-volatile organic compound
TCLP	=	Toxicity Characteristic Leaching Procedure
TD	=	thermal desorption
TE	=	treatment efficiency
US EPA	=	United States Environmental Protection Agency
WFDT	=	Designation of the 2004 Waste Family Demonstration Testing

Section 2 – Demonstration Objectives

Volatile Metals Waste Family Demonstration Testing is designed to determine the TD unit APC system capabilities when processing metals within the Volatile Metals Waste Family. The TD unit is designed to treat wastes with volatile constituents below their Land Disposal Restriction (LDR) standards. TD processing is not designed to treat regulated metal contaminants below their LDR standards. Regulated metals include antimony, arsenic, barium, beryllium, cadmium, chromium, lead, mercury, nickel, selenium, silver, thallium, vanadium, and zinc. Volatility is based upon the vapor pressure and, conversely, the boiling point of the contaminant. The United States Environmental Protection Agency (US EPA) MACT standard in 40 CFR 63, Subpart EEE, describes three categories of volatile metals. Mercury is the only high volatility metal; cadmium and lead are in the semivolatile metal category; and arsenic, beryllium, and chromium are the constituents of the low volatile metal category. The other eight metals are considered non-volatile. The TD unit is not subject to the MACT standards; however, they provide a useful reference framework for terminology and performance test criteria.

The TD units operating temperature is significantly lower than the operating temperature of MACT regulated hazardous waste combustors. The MACT semivolatile metals and low volatile metals have negligibly low vapor pressure at the operating temperature of the TD unit and are generally represented as particulate matter. Mercury is the only volatile metal that should be completely volatilized during TD processing; all other metals will be retained to a greater extent in the solid processed material. The primary objective of Volatile Metals Waste Family Demonstration Testing is to demonstrate that the TD unit can separate mercury from waste feed material while maintaining compliant emissions of all volatile metals, including mercury.

If the total mercury concentration within the feed material is less than the regulatory threshold of 260 mg/kg, other options exist for treatment; however, by definition (40 CFR 268.40), waste contaminated with mercury greater than 260 mg/kg must be treated using the RMERC technology. RMERC is defined in 40 CFR 268.42 Table 1 as "[R]etorting or roasting in a thermal processing unit capable of volatilizing mercury and subsequently condensing the volatilized mercury for recovery." By definition, the TD unit performs the RMERC technology. Therefore, the first objective of TD is to reduce the mercury concentration within the processed material below 260 mg/kg, making the waste amenable to additional treatment. Secondarily, the thermal desorption system may reduce the mercury concentration of the processed material below Land Disposal Restriction (LDR) standards (0.20 mg/L TCLP).

During Volatile Metals Waste Family Demonstration Testing, data shall be collected to determine System and Operating Parameters for the TD unit while processing waste containing volatile metals. Sampling and analysis shall be performed to verify regulatory compliance.

The TD unit is not subject to the MACT standards; however, they provide a suitable reference for the performance of the TD unit. The MACT standards for an existing incinerator are as follows:

- emissions of mercury ≤ 130 μg/dscm;
- total emissions of cadmium and lead ≤ 240 μg/dscm; and
- total emissions of arsenic and beryllium and chromium ≤ 97 μg/dscm

The existing incinerator MACT standards have been chosen as a reference because the TD unit is an existing unit and because of the low vent gas volumetric flow rate of the TD unit, which is generally less than 15 cfm. The vent gas concentrations from Volatile Metals Waste Family Demonstration Testing shall be compared to the MACT standards in order to ascertain the performance of the TD unit.

2.1 Risk Assessments

A detailed preliminary risk assessment has been completed for thermal desorption operations in a document dated July 14, 2003 (see Condition II.T.5.d. of this Permit). Additional risk assessments were performed using the data from previous Waste Family Demonstration Testing of the TD unit; a description of these additional risk assessments is provided in Section 9.3 of this Attachment.

In order to verify the assumptions of the preliminary risk assessment, a risk assessment shall be performed using the actual vent gas emissions detected during Volatile Metals Waste Family Demonstration Testing. This Volatile Metals Post-Waste Family Demonstration Testing risk assessment shall consider both direct and indirect exposure pathways for metals found in the vent gas.

2.2 Demonstration Plan Objectives

The objectives of this plan and the associated Volatile Metals Waste Family Demonstration Testing are:

- Determine if feed material containing volatile metals are amenable to TD processing and that the processed material either meets the LDR standard for mercury or has a total mercury concentration below the regulatory threshold of 260 mg/kg.

- Identify and justify representative volatile metallic compounds (RVMs) to represent the volatile metals waste family.

- Demonstrate, for each RVM, that RE of at least 99.99% is attained.

- Demonstrate that the MACT standards for an existing incinerator are met for metal emissions.

- Perform a second risk assessment using the results of Volatile Metals Waste Family Demonstration Testing to verify the assumptions of the preliminary risk assessment.

- Evaluate the secondary waste streams generated during TD processing to determine treatment and disposal options.

- Demonstrate that the TD unit, as designed, complies with all applicable conditions of the Permittee's state-issued Part B Permit.

Section 3 – Physical Description of Technology

Since no equipment or process changes have been made to the TD unit, the technology description has not changed from the description provided in Section 3 of Attachment II-1-12-2.

Section 4 – Technical Approach

The Volatile Metals Waste Family Demonstration Testing objectives shall be accomplished by monitoring System Parameters during operation and by acquiring analytical data over the course of the Volatile Metals Waste Family Demonstration Testing.

Attachment II-1-12-2 describes three separate testing phases for the demonstration of the VOC and SVOC waste families. These testing phases have been completed in previous Waste Family Demonstration Testing events. This plan describes an additional Waste Family Demonstration Testing phase for the Volatile Metals Waste Family: the Volatile Metals APC Waste Family Demonstration Testing phase. As described below, the preliminary testing and operational testing phases shall not be required during Volatile Metals Waste Family Demonstration Testing.

The preliminary testing phase of the TD unit consisted of functional testing, system testing, and shakedown operations. Functional and system testing was completed prior to the Waste Family Demonstration Testing for the VOC and SVOC Waste Families. These test phases are described in Section 4.1 of Attachment II-1-12-2 with details provided in Appendix B of that Attachment. In summary, these tests were performed during construction of the TD unit prior to mobilization to the Permittee's facility and again at the Permittee's facility after it was re-assembled. Shakedown operations were conducted for the VOC and SVOC Waste Families to determine appropriate operating conditions for the Waste Family Demonstration Testing. Mercury has similar separation characteristics to the SVOC compounds.

Moreover, the ability of the TD unit to process metals other than mercury was examined in the WFDT, the BDT, and the ODT events. Therefore, shakedown operations shall not be necessary for the Volatile Metals Waste Family and the operating conditions confirmed during previous Waste Family Demonstration Testing shall be used during Volatile Metals Waste Family Demonstration Testing.

The purpose of the operational testing phase was to determine the capabilities of the TD unit to process different waste matrices. Operational testing was completed on several waste matrices during previous Waste Family Demonstration Testing events (WFDT in 2004 and ODT in 2008). With the exception of mercury, the other regulated metals have been processed and analyzed within these other Demonstration Testing events. Since operational testing has effectively been completed for most regulated metals and the separation characteristics of mercury are similar to the previously evaluated SVOC contaminants, additional operational testing is not required during Volatile Metals Waste Family Demonstration Testing.

This attachment details the Volatile Metals APC Waste Family Demonstration Testing phase. The APC testing phase is the only phase of testing required for this Demonstration Testing. For convenience, future references to Volatile Metals Waste Family Demonstration Testing within this plan will imply the APC testing phase.

4.1 Volatile Metals Waste Family Demonstration Testing

The Volatile Metals Waste Family Demonstration Testing is designed to determine the TD unit APC system capabilities. This will be accomplished by processing mixed waste feed material spiked with applicable RVMs. The results of this test shall be used to set the Operational Parameters for the Volatile Metals Waste Family. All subsequent processing of feed material contaminated with volatile metals shall be limited to the Operational Parameters developed during Volatile Metals Waste Family Demonstration Testing.

Volatile Metals Waste Family Demonstration Testing shall consist of three process runs using mixed waste feed material spiked with applicable RVMs. These process runs shall be used to determine the emissions and RE of volatile metals and applicable RVMs through the TD unit. The effect of moisture content within the waste has been previously examined within the APC Waste Family Demonstration Test for VOCs and SVOCs described in Section 4.2 of Attachment II-1-12-2. Therefore, the Volatile Metals Waste Family Demonstration Test shall only be required on a wet or dry mixed waste feed material, not both.

In addition to the data objectives of Volatile Metals Waste Family Demonstration Testing, other Operational and System Parameters shall be monitored according to the frequencies outlined in Table 7-1 of Attachment II-1-12-2. These data objectives shall be accomplished by collecting samples from the processed material, condensate, and vent gas.

Section 5 – Data Quality Objectives

Data Quality Objectives (DQOs) have been established for the Volatile Metals Waste Family Demonstration Testing to ensure that Thermal Desorption is a viable option for treating feed material containing volatile metals. These DQOs have been established using guidance provided by the US EPA, "Guidance for the Data Quality Objectives Process", EPA QA/G-4 dated September 1994 (EPA/600/R-96/055).

The DQO process consists of seven steps: (1) state the problem, (2) identify the decision, (3) identify inputs to the decision, (4) define the study boundaries, (5) develop the decision rule, (6) specify limits on decision errors, and (7) optimize the design for obtaining data. More detailed descriptions of each step are described in Section 5 of Attachment II-1-12-2.

5.1 State the Problem

Problem statement: To collect data that demonstrates Thermal Desorption as a viable option for treating feed materials containing mercury and other volatile metals.

Planning Team: The planning team includes: from TD*X, the Thermal Engineer and the Operations Manager; and from the Permittee, the Environmental Engineer, the Quality Assurance Manager, the Lab Manager, and the Director of Mixed Waste Operations. The Permittee's Environmental Engineer is the primary decision maker for this project.

5.2 Identify the Decision

Determine whether all spiked RVM REs are greater than 99.99% and support continued operation of the TD unit. Additionally, determine whether the emission limits for metals are below the MACT standards for an existing incinerator and the processed material mercury concentration is either LDR-compliant or less than 260 mg/kg.

5.3 Identify the Inputs to the Decision

In order to estimate RVM REs, it shall be necessary to evaluate the concentration of each RVM fed into the dryer and emitted to the atmosphere. To perform risk-based calculations and regulatory assessments, the concentration of RVMs and other volatile metals emitted to the atmosphere shall be required. The variables needed are the feed material and RVM weights (masses), the feed material RVM concentrations, and the vent gas RVM and other volatile metals concentrations, quantified using EPA Methods 6010 or 7471. Additionally, the processed material shall be analyzed for both leachable and total mercury.

5.4 Define the Boundaries of the Study

Since the TD unit is a batch process, the boundaries are defined by the amount of feed material introduced into the system and the concentration of volatile metals within the feed material. The constraint is the laboratory detection limits and potential interferences associated with the processed material and the vent gas.

Potential errors may occur during data collection through weight (mass) measurements, the sampling process, and laboratory analyses. Errors within sampling data shall be controlled through QA/QC sampling, including duplicates, equipment blanks, and field blanks. These techniques are discussed in Section 7.4.1 of this Attachment. Data validation of laboratory analyses shall be conducted in accordance with Section 7.4 of Attachment II-1-12-2. Quality assurance measured are briefly described in Section 7.6 of this Attachment.

Section 7.4 of this Attachment describes the sampling of the feed and processed material for the Volatile Metals Waste Family Demonstration Testing. All RVM spikes shall be certified by the manufacturer or analyzed by the Permittee to determine the concentration within the spike material. Emissions testing shall be performed by contractors who are experienced and certified in the sampling and analytical methods. The boundary of emission sampling shall be contingent upon the method utilized.

5.5 Develop a Decision Rule

If the maximum vent gas mass of any RVM exceeds 0.0001 times the mass fed into the TD unit and the exceedance is not approved by the Executive Secretary, then the Volatile Metals Waste Family Demonstration Testing fails.

If any of the MACT standards described in Section 2 of this Attachment are not met in the vent gas, then the Volatile Metals Waste Family Demonstration Testing fails.

The Volatile Metals Waste Family Demonstration Testing fails if the processed material mercury concentration, after all treatment and re-treatment has been completed, remains above the LDR Toxicity Characteristic Leaching Procedure (TCLP) standard or above a total concentration of 260 mg/kg.

If the second risk assessment required by Section 2.1 of this Attachment indicates that the standards for the protection of human health and the environment are not met, then the Volatile Metals Waste Family Demonstration Testing fails.

5.6 Specify Tolerable Limits on Decision Errors

The possibility of a decision error exists because the parameter of interest is estimated using data that have been subjected to sampling design error and measurement error. The first baseline condition (null hypothesis) for the Volatile Metals Waste Family

Demonstration Testing is defined by an RE of greater than 99.99% for each RVM. A false positive decision error would assert that the Volatile Metals Waste Family Demonstration Testing was a failure when it actually produced safe emissions. The consequences of a false positive decision error are that processing could not be conducted through the TD unit and additional money and time would be put into fixing the problem that did not exist. These consequences of this false positive decision error do not adversely affect public health or the environment and therefore have a high tolerance. The consequences of a false negative decision error would be that TD processing would be conducted under a hazardous emission scenario. This negative decision error has a much lower tolerance level than the false positive decision error and shall be controlled through the quality assurance of the emission sampling methods. A 'Gray Region' exists where the 99.99% RE may not be met but the MACT standard is met, thereby demonstrating that the emissions do not adversely affect human health or the environment.

The second baseline condition is defined by the concentration of mercury (TCLP or total) in the processed material. A false positive decision error occurs when the TD unit successfully treats the waste to mercury LDR treatment standards, but the analysis of the processed material samples demonstrates otherwise. The consequences of a false positive decision error are that additional processing through the TD unit would be required, although not necessary. This is tolerable since the only adverse affect is time and cost. A false negative decision error occurs when testing determines that the mercury LDR concentration was met when in actuality it was not met. The consequence of a false negative decision error would be that processed material that was not LDR-compliant would be disposed in the Permittee's Mixed Waste Landfill Cell. The magnitude of a false negative decision error would be minimal and the results tolerable since the processed material shall be placed in an engineered triple-lined hazardous waste landfill cell with continual leachate and groundwater monitoring. A 'Gray Region' exists where the analytical data detects a concentration of mercury very close to the LDR concentration or near 260 mg/kg.

The burden of proof is placed on rejecting the baseline conditions, which are true, until overwhelming evidence is presented to indicate that the baseline conditions are not true.

5.7 Optimize the Design for Obtaining Data

Section 7.4 of this Attachment outlines the sampling technique the Permittee shall use. Other sampling techniques that may be used include: discrete sampling and analysis of feed and processed material streams (without compositing), mass spectroscopy analyses of data, and additional Quality Assurance / Quality Control (QA/QC) samples. Additional data collection and analysis techniques may be utilized, if required, due to the potential for false negative or false positive decision errors, as explained in the previous section. Any reduction or replacement to the sampling or analysis plans, as described in this Attachment, shall be submitted to the Executive Secretary. The Permittee shall detail and justify any reduction or

replacement sampling within the Volatile Metals Post-Waste Family Demonstration Testing Report. The Permittee may conduct additional sampling as long as the minimum sampling requirements, as detailed in this Attachment, are completed.

5.8 Other Decision Errors

Other potential decision errors are discussed in Section 5.8 of Attachment II-1-12-2. The Volatile Metals Waste Family Demonstration Testing described in this plan is specific to volatile metal contaminants only; therefore, these other decision errors are not directly applicable to this plan.

Section 6- Description of Waste Families

This section describes the volatile metals waste family for the specified Volatile Metals Waste Family Demonstration Testing. A discussion of waste families, in general, is provided in Section 6.1 of Attachment II-1-12-2. Specifics on exact testing protocols and procedures are provided in Section 7 of this Attachment.

6.1 Volatile Metals Waste Family

The Volatile Metals Waste Family, as used for this demonstration, is considered to be those metals and their associated metal compounds with relatively high vapor pressures and low boiling points that may potentially be present in the vent gas of the TD unit. The MACT regulations have been used as a reference, which identifies three categories of volatile metals: high volatility metals, semivolatile metals, and low volatile metals. The Volatile Metals Waste Family consists of the metals described by the MACT regulations within these three subcategories.

Mercury is the only contaminant within the high volatility metals subcategory. Cadmium and lead are the two metals listed within the semivolatile metals subcategory. Arsenic, beryllium, and chromium are the metals in the low volatile metals subcategory. These six metals comprise the Volatile Metals Waste Family.

6.2 Representative Volatile Metals (RVMs)

RVMs are the metals equivalent of principal organic hazardous constituents (POHCs) which are described in Section 6.1.3 of Attachment II-1-12-2. Rather than testing each individual volatile metal contaminant, specific metals or metallic compounds shall be chosen to represent each of the three categories within the Volatile Metals Waste Family during Volatile Metals Waste Family Demonstration Testing.

High Volatility Metals

In accordance with the MACT regulations, mercury is the only high volatility metal contaminant; therefore, elemental mercury shall be the RVM for the high volatility metals subcategory of the Volatile Metals Waste Family. Mercury is the most volatile metal and thereby provides a boundary condition for the Volatile Metals Waste Family Demonstration Testing.

Semivolatile Metals

Cadmium and lead are the two constituents of the semivolatile metals subcategory. Lead is a primary component of much of the waste received at the Permittee's

facility; further, lead is anticipated to be the highest concentration volatile metal within waste received for TD processing. In order to present a worst-case situation and to challenge the TD unit, a more volatile form of lead shall be chosen as the RVM for this subcategory. Based upon availability as well as separation characteristics, lead acetate shall be the RVM for the semivolatile metals subcategory of the Volatile Metals Waste Family.

Low Volatile Metals

Arsenic, beryllium, and chromium are the three constituents of the low volatile metals subcategory. Of these metals, arsenic has the lowest boiling point and is the most volatile. Arsenic has been present in waste received at the Permittee's facility and is anticipated to be present in wastes for TD processing. A more volatile form of arsenic shall be the RVM for the low volatile metals subcategory. Based upon availability as well as separation characteristics, arsenic trioxide shall be the RVM for the low volatile metals subcategory of the Volatile Metals Waste Family.

The primary chemical characteristic for separation within the TD unit is the boiling point of the compound. Although this is not the only property associated with the separation process, it is an indicator of the degree of separation that may be obtained during TD processing. Table 6-1 details the approximate boiling points of the elements within the RVMs as well as the RVM organo-metallic compounds that shall be used during the Volatile Metals Waste Family Demonstration Testing.

Table 6-1. Boiling Points of RVMs

Metal or RVM	Boiling Point	
	˚C	˚F
Arsenic	614	1,137
Lead	1,620	2,948
Mercury	356.9	674.4
Arsenic Trioxide	465	869
Lead Acetate	Decomposes at ~ 100 ˚C (212 ˚F)	

Section 7 – Waste Family Demonstration Testing Operations

Since the preliminary testing phase has already been completed and since no new waste matrices are being introduced for an operational phase, Volatile Metals Waste Family Demonstration Testing shall consist of only the APC demonstration phase. This section will define feeding and spiking specifications, process monitoring, and sampling and analysis that shall be conducted during the Volatile Metals Waste Family Demonstration Testing.

The Volatile Metals Waste Family Demonstration Testing shall be completed using mixed waste feed material, spiked with each of the RVMs (elemental mercury, lead acetate, and arsenic trioxide) described in Section 6.2 of this Attachment. The exact waste used for the Volatile Metals Waste Family Demonstration Testing will be described in the testing plan which shall be submitted at least seven days prior to the commencement of Volatile Metals Waste Family Demonstration Testing in accordance with Condition 5.b. of Attachment II-1-12-1.

The Volatile Metals Waste Family Demonstration Testing shall consist of three process runs of a similar matrix from a single generator. Additional process runs may be completed, as desired by the Permittee. Each process cycle will take approximately four to eight hours, potentially longer.

All process runs of the Volatile Metals Waste Family Demonstration Testing shall include sampling and analysis of input and output streams for total metals. The mixed waste shall be sampled prior to spiking with the RVMs to provide data for RE calculations. Sampling of the processed material, condensate, and vent gas shall be performed during each of the process cycles. Organic analysis of the processed material shall be completed to assure LDR compliance, but is not a parameter of this testing event. Radiological parameters shall also be analyzed during the testing process.

The treated emissions (vent gases) shall be sampled for metals and continuously analyzed for oxygen, carbon dioxide, and carbon monoxide. These tests do not have a minimum requirement on the sample volume; sampling will occur throughout each process cycle. It is anticipated that approximately 11 to 40 cubic feet of feed material will be required for each process cycle.

During each process cycle, the TD unit shall be operated continuously, without shutdown. If shutdown occurs, the Permittee shall immediately notify the onsite regulators and evaluate options on the applicability of the test. The Permittee shall document the shutdown in the Volatile Metals Post-Waste Family Demonstration Testing Report.

7.1 Pre-Processing Operations

Prior to operation of the TD unit, the waste feed material shall be prepared to the processing specifications in Sections 3 and 6 of Attachment II-1-12, *Thermal Desorption Treatment Plan*.

7.1.1 RVM Spiking

To adequately challenge the TD unit, the concentration of the feed material shall be spiked with the RVMs to a high concentration, which shall be determined in a complete testing schedule submitted seven days prior to the test.

Spiking of the waste feed material with RVMs within the Volatile Metals Waste Family Demonstration Testing shall be performed by one of the following methods:

(1) charging the RVM spike material directly into the feed hopper, using containers, at the same time that the hopper is charged with solid feed material; or

(2) Combining the RVM spike material with clean absorbent or solvent in a separate container and feeding this container with the other feed containers.

The Permittee shall accurately measure the mass of the spiking material introduced into the TD unit for RE calculations.

If necessary, an analysis of the RVMs shall be performed to assure additional contaminants are not introduced into the TD unit.

7.2 Process Monitoring

7.2.1 System Parameters

During the Volatile Metals Waste Family Demonstration Testing, System Parameters shall be monitored as explained in Section 7.2.1 of Attachment II-1-12-2. All of the System Parameters discussed in Attachment II-1-12-2 shall be monitored during the Volatile Metals Waste Family Demonstration Testing. Through this testing, Operational Parameters shall be established for the Volatile Metals Waste Family.

7.2.2 Automatic Waste Feed Cut-Off (AWFCO) System

The AWFCO system shall remain unchanged as specified in Section 7.2.2 of Attachment II-1-12-2 with one exception. Due to the higher temperatures necessary to volatilize volatile metals within a waste matrix, the temperature of material within the dryer set point shall be activated when T_p > 1,300 ˚F rather than 1,200 ˚F. Upon reaching this activation temperature, the Permittee shall have 30 minutes to lower the T_p below 1,300 ˚F. If the Permittee cannot lower the T_p below 1,300 ˚F within 30 minutes, the process cycle shall be aborted. If the T_p reaches 1,400 ˚F, the process cycle shall also be aborted and the burners shut off.

7.2.3 Monitoring Instruments

The Volatile Metals Waste Family Demonstration Testing does not contain any monitoring instrumentation different from the instruments discussed in Attachment II-1-12-2. Therefore, the instrumentation discussion in Section 7.2.3 of Attachment II-1-12-2 remains valid for the Volatile Metals Waste Family Demonstration Testing.

7.3 Volatile Metals Waste Family Demonstration Testing

The Volatile Metals Waste Family Demonstration Testing shall be completed using a mixed waste spiked with RVMs.

The demonstration processing shall consist of three process cycles in order to validate the data. Additional process runs may be completed, as desired by the Permittee. The mixed waste feed material shall be sampled prior to spiking and analyzed to provide data for RE calculations. Other samples may be collected from the clean sand and absorbent used during processing of the waste. Sampling of the processed material, condensate, and vent gas shall be performed during the Volatile Metals Waste Family Demonstration Testing process runs.

Condensate generated from the Volatile Metals Waste Family Demonstration Testing shall be collected separately for each process cycle. A qualitative examination of the amount of settled volatile metals (in particular, mercury) shall be made after the condensate has sat for at least one day after the process cycle was completed. If possible, the settled volatile metals will be collected and measured.

7.4 Sampling and Analysis

Two types of sampling and analysis methodologies shall be used during the Volatile Metals Waste Family Demonstration Testing. The first methodology is used to characterize the processed materials to verify compliance with LDR standards or to assure that the total mercury RVM concentration has been reduced below the regulatory threshold of 260 mg/kg, thereby allowing optional treatment of the residual. The second methodology shall be used to characterize the feed material and emissions to calculate REs.

Solid and liquid sampling associated with the Volatile Metals Waste Family Demonstration Testing shall be limited to metals analyses. Metals analyses shall be performed using SW-846 method 6010 for most regulated metals and SW-846 method 7471 for mercury. These methods shall be used to analyze all solid and liquid samples collected during Volatile Metals Waste Family Demonstration Testing. Other analyses associated with the TD unit are optional for this testing. These other analyses are described in Attachment II-1-12-2. The processed material shall not be approved for

disposal in the Permittee's Mixed Waste Landfill Cell until all parameters are verified LDR-compliant. Vent gas samples shall be collected for metals along with continuous oxygen, carbon monoxide, and carbon dioxide measurements.

Sampling locations on the TD unit are designed to capture the process streams of bulk solids, process liquids, and vent gases. Approved US EPA sampling methods and apparatus shall be used for all sample collection. The system is equipped with sampling access ports for collection of liquid and vent gas streams. The bulk solids shall be sampled as described in Section 7.4 of Attachment II-1-12-2. The vent gas shall be sampled in accordance with the Emission Test Protocol in Appendix C of Attachment II-1-12-2. Table 7-1 provides an overview of the sample locations and sampling methods and frequencies for the Volatile Metals Waste Family Demonstration Testing samples. All samples shall be analyzed for metals. The collection of additional samples may be necessary for the Permittee to verify LDR compliance or appropriate totals concentration reductions.

Table 7-1. Volatile Metals Waste Family Demonstration Testing Sampling

Location	Collection Method and Frequency
VM-FEED-1 VM-FEED-2 VM-FEED-3	Composite grab from waste material fed into the dryer.
VM-PROC-1 VM-PROC-2 VM-PROC-3	Composite grab from processed material as it is discharged from the TD unit, or three grabs per process cycle of processed material.
VM-ORG-1 VM-ORG-2 VM-ORG-3	Grab sample from condensate transfer tank recirculation line; once at the end of each process cycle.
VM-VENT-1 VM-VENT-2 VM-VENT-3	EPA Method 29 throughout for metals; CEM for O_2, CO_2, and CO.

The Permittee shall submit all analytical data in accordance with the US EPA's CLP, Level IV reporting requirements. Sampling methods shall be performed in accordance with US EPA SW-846 for solid grab samples and direct liquid samples. All sample technicians shall have knowledge, training, and experience in the sampling methods. Sample technicians shall wear clean nitrile rubber disposable gloves when handling the sample equipment and containers. The sampling equipment shall be decontaminated prior to each use by washing with a non-phosphate laboratory detergent, followed by rinsing with clean tap water, and final rinsing with reagent grade distilled water. This preparatory work shall be documented in the Operating Record.

All sample collection preparatory work shall be performed in accordance with the appropriate sampling method. Pre-labeled sampling containers of appropriate size shall be supplied to the sample technicians by the Permittee's lab manager, or designee. The

Permittee shall maintain chain of custody records for all samples generated during Volatile Metals Waste Family Demonstration Testing. A record of all samples collected shall be recorded in the TD operations logbook.

All sample designations have an extra '-VM' within them to distinguish these samples as volatile metal samples. Sample collection shall be performed at each location using the methodology described in Section 7.4.1 of Attachment II-1-12-2. Sample collection shall be performed at each location using the following methodology:

FEED Samples: Feed samples of the waste material shall be collected while the waste is being loaded into the feed hopper. In the feeding process, drums of feed material are tipped one at a time into the feed hopper. The drums are lifted by a hoist that is mounted to the TD unit. An operator stands on a gallery platform located at the feed hopper to collect the feed samples. The sampler shall collect two aliquots from each waste drum fed into the TD unit by grabbing a quantity from the top of each drum before it is fed, and a similar quantity from the bottom of each drum (top of material in the hopper) after the drum is loaded into the hopper and before the spike RVMs are added. The grab samples shall be collected either using a stainless steel scoop or spoon, or disposable equipment. Sample compositing will be performed in a stainless steel collection bowl. The composite sample shall be analyzed for total metals, including mercury.

PROC Samples: The processed material shall be sampled and analyzed to verify compliance with LDR standards. Samples shall be collected either directly from the processed material cooling vessel or from the processed material container after the processed material has cooled to a reasonably safe temperature. Samples shall be collected either using a stainless steel scoop or spoon, or disposable equipment. Compositing of the samples shall be performed in a stainless steel collection bowl. If the containers are sampled, at least three random sample aliquots shall be collected and composited into a single sample from each container in a process cycle. The samples shall be analyzed for total metals, including mercury and TCLP metals. Other analyses outside the scope of the Volatile Metals Waste Family Demonstration Testing may be completed to ensure LDR compliance of the processed material.

ORG Samples: Condensate (ORG) samples shall be collected from each process cycle within the Volatile Metals Waste Family Demonstration Testing. In addition, visible metals within the condensate, if present, shall be estimated and, if possible, separated and weighed directly. The condensate is a two-phase liquid consisting of an aqueous phase and an oily organic phase. Separate samples shall be collected from each phase within the condensate. The condensate samples shall be collected directly from the discharge line as the condensate is being off-loaded into a liquid container. The aqueous sample shall be collected as the off-loading process begins. During the off-loading process, the physical nature of the condensate shall be observed (e.g., color, consistency and viscosity) to determine the point at which organic material is being discharged. At this point, the

condensate will be redirected into a clean five-gallon bucket from which the oily organic phase grab samples shall be collected. The condensate samples shall be analyzed for total metals, including mercury. The procedure described above may be changed based upon the conditions and amount of the condensate generated during Volatile Metals Waste Family Demonstration Testing. The exact method used to collect the condensate samples shall be discussed and justified in the Volatile Metals Post-Waste Family Demonstration Testing Report.

The ORG samples shall be collected to measure the amount of volatile metals within the stream, not for an analysis of potential chemical decomposition as stated in Attachment II-1-12-2.

VENT Samples: Vent samples shall be collected by contractors (Emissions Test Contractors) who are experienced in the US EPA methods utilized for this purpose. These samples shall be collected through access ports within specially designed manifolds located after the primary and secondary carbon adsorption beds. The emission gas flow, at this point, consists of non-condensable gases that have been cooled to less than 50 ˚F and filtered to remove particulates and organic compounds. The flow rate of the emission gas typically ranges from 5 to 25 scfm and is at or near ambient pressure. Generally, variations in flow rate are expected during the process cycle but will be limited for a majority of the test.

Radiological samples shall be collected by the Permittee's health physics personnel who have been specifically trained in the collection of vent gas samples from the TD unit. These samples shall be collected through access ports within a separate manifold located after the non-radiological vent samples manifold system.

The vent gas sampling manifolds are constructed of four-inch pipe, on or slightly above grade level, in the vent hose after the primary and secondary carbon adsorption beds. US EPA Method 29 shall be used to collect VENT samples for metals analysis; inherent in this sampling protocol, the procedures of US EPA Method 5 shall be used and the vent gas stream shall be characterized for gas velocity, moisture content, molecular weight, oxygen, and carbon dioxide using US EPA methods 1 through 3.

The low flow rate of the vent gas through a small (four-inch) line creates unique situations for the Emissions Test personnel. An emission test protocol specific to the Permittee's TD vent gas sampling has been developed and is included in Appendix C of Attachment II-1-12-2. This Emission Test Protocol provides details of the vent gas sampling, including all necessary modifications to the US EPA methods.

Prior to the CMBST Waste Family Demonstration Testing, the Permittee shall submit a complete testing schedule to the Executive Secretary as required by Condition 5.b. of Attachment II-1-12-1.

7.4.1 QC Samples

The quality of the sampling events shall be assessed during Volatile Metals Waste Family Demonstration Testing through duplicate samples, equipment blanks, and field blanks. Equipment blanks shall be collected from rinsate from the sampling equipment after decontamination from a prior sampling event. Duplicate samples, equipment blanks, and field blanks shall be named with an appropriate suffix relative to the sampling location that they assess: -DUP for duplicate, -EB for equipment blank, and -FB for field blank. For example, FEED-VM-1-EB would be the equipment blank sample collected from the first feed material sample for the Volatile Metals Waste Family Demonstration Testing.

Duplicates samples, field blanks, and equipment blanks shall be collected during the Volatile Metals Waste Family Demonstration Testing. The Permittee may optionally use disposable sampling equipment. In this case, rinsate shall not be collected and equipment blanks shall not be necessary.

At a minimum, during Volatile Metals Waste Family Demonstration Testing, a duplicate sample shall be required for one of the FEED and one of PROC samples.

All duplicate samples shall be collected randomly. Duplicate solid samples shall be collected from the composite sampling bowl. Duplicate liquid samples, if taken, shall be collected from the same sample access port immediately after filling the initial sample.

Additionally, at least one equipment blank, if required, and one field blank shall be collected during the Volatile Metals Waste Family Demonstration Testing. All blank sample collection times and dates, as well as results, shall be documented in the Volatile Metals Post-Waste Family Demonstration Testing Report.

Quality control for the vent gas sampling events are specified in the US EPA Methods utilized. These methods and measures are described in Appendix C of Attachment II-1-12-2. Personnel familiar with these methods (Emissions Test personnel) shall perform this sampling.

7.5 Secondary Waste Streams

The TD unit may generate secondary waste streams that include spent filters and spent carbon adsorption media. However, the limited waste required for the Volatile Metals Waste Family Demonstration Testing should not generate enough material to load the filters or the carbon adsorption media to capacity. If generated, containers of secondary waste shall be labeled and managed in accordance with the requirements of this Permit. Any wastes created shall be documented in the Volatile Metals Post-Waste Family Demonstration Testing Report.

7.6 Quality Assurance

All data collected during the Volatile Metals Waste Family Demonstration Testing shall be generated following the quality assurance requirements designated for the US EPA methods utilized. The Permittee shall maintain on-site, a Quality Assurance Manual based on US EPA methodology.

7.7 Data Validation

Validation of the analytical data shall be performed as described in Section 7.7 of Attachment II-1-12-2.

Section 8 – Reporting

A Volatile Metals Post-Waste Family Demonstration Testing Report shall be submitted to the Executive Secretary within 90 calendar days of completion of the testing unless an extension is granted in writing by the Executive Secretary. At a minimum, the Volatile Metals Post-Waste Family Demonstration Testing Report shall include the following data:

- System Parameter electronic data logged from the PLC data management system for the parameters described in Table 7-1 of Attachment II-1-12-2;

- all alarm logs recorded by the computer from the PLC data management system during the Volatile Metals Waste Family Demonstration Testing;

- manual data logged by the operators for feed rates, sampling frequencies, flow rates, differential pressures, and other data described in this Attachment and Attachment II-1-12-2;

- inspection forms completed in preparation of, and during, the Volatile Metals Waste Family Demonstration Testing; and

- analytical laboratory reports, including laboratory quality control data, for all of the samples listed in Table 7-1 of this Attachment.

The Permittee shall submit all raw data in the Volatile Metals Post-Waste Family Demonstration Testing Report. Accepted laboratory surrogate recoveries shall be within the US EPA Standard Method's required limits and all recoveries shall be reported by the laboratories. All required calculations shall be documented and checked.

Additionally, System Parameters for each process cycle shall be tabulated and the results explained in the Volatile Metals Post-Waste Family Demonstration Testing Report. Operating Parameters shall be tabulated for each process cycle including dryer temperature (high and low), solids temperature (high and low), system pressure (high and low), and processing times (feed time, cycle time, hold time).

Risk assessment calculations showing REs and the fate of RVMs and other volatile metals shall be performed and detailed within the Volatile Metals Post-Waste Family Demonstration Testing Report.

Section 9 - Personnel, Training, Previous Experience and Radiation Monitoring

9.1 Personnel

Key personnel for the Volatile Metals Waste Family Demonstration Testing will be provided in the schedule required by Condition 5.b. in Attachment II-1-12-1. The positions required to be identified include:

- The TD contractor's Thermal Engineer
- The TD contractor's Operations Manager
- The Permittee's Director of Mixed Waste Operations
- The Permittee's TD Project Manager
- The Permittee's Environmental Engineer
- The Permittee's Quality Assurance Manager
- The Permittee's Director of Health Physics
- The Permittee's Safety & Health Manager
- The Permittee's Laboratory Manager

Operations personnel for the Volatile Metals Waste Family Demonstration Testing shall work under the direct supervision of the TD contractor's Thermal Engineer, the TD contractor's Operations Manager, or the Permittee's Director of Mixed Waste Operations. Health physics support shall be supervised by the Permittee's Director of Health Physics.

Volatile Metals Waste Family Demonstration Testing shall be performed within the Permittee's Mixed Waste facility and is thereby governed by Attachment II-6, *Contingency Plan*. This attachment contains a list of emergency coordinators for the site that are on call 24-hours per day.

Operations of the TD unit shall be conducted by personnel certified in accordance with the training requirements of Attachment II-4, *Personnel Training Plan*, during Volatile Metals Waste Family Demonstration Testing. At least two qualified TD operators shall be present at all times during operation of the TD unit. Site personnel, under the direction of the Permittee's Director of Mixed Waste Operations, shall manage the waste prior to processing within the TD unit.

The Permittee shall only accept and use valid analytical results from a Utah Department of Health certified laboratory (Utah Certified Laboratory) or from a non-Utah certified laboratory with approval from the Executive Secretary.

Vent gas sampling shall be conducted by Emissions Test Contractor personnel who shall be qualified in source emission testing. The Emissions Test Contractor shall have the necessary staff, expertise, and equipment to perform this function.

9.2 Training

Training for operators of the TD unit shall be conducted in accordance with Attachment II-4, *Personnel Training Plan*, and shall be documented in the Operating Record.

9.3 Previous Experience

The previous experience of the TD contractor principals prior to partnering with the Permittee is documented within Section 9.3 and Appendix A of Attachment II-1-12-2.

Pilot-scale studies were conducted at the Permittee's facility in November, 2002, using a one-gallon per process cycle, bench-scale version of the TD unit. Two separate batches were treated with a waste stream that had relatively high levels of radioactive contamination. The condensed material was examined from both of these batches and a gamma spectroscopy analysis was completed. The results were undetectable for radioactivity within the separated condensate. An analysis of the processed material was not conducted at that time.

The full-scale TD unit at the Permittee's facility has been operational since March, 2003 and has been through several demonstration tests including Waste Family Demonstration Testing for the VOC and SVOC Waste Families in August/September, 2004 (WFDT); Bi-annual Demonstration Testing in October, 2006 (BDT); Operational Demonstration Testing for paper, plastic, and metal debris in April, 2008 (ODT); and Waste Family Demonstration Testing for CMBST-coded wastes in April/May, 2008 (CMBST). A substantial amount of data has been collected during these tests which demonstrated the high treatment efficiency of the system. The WFDT, BDT, and CMBST have demonstrated the applicability of the TD unit for processing a variety of organic feed materials. A review of volatile metals parameters from the WFDT, BDT, and ODT tests is provided in Appendix A of this Attachment.

The VOC/SVOC WFDT in 2004 consisted of three Operational Demonstration Tests and four APC Demonstration Tests. The Operational Demonstration Tests consisted of dry and wet waste feed material as well as liquid waste feed material. The APC Demonstration Tests were performed in duplicate for both wet and dry waste feed material. The APC Demonstration Test feed material was spiked with specific POHCs (carbon tetrachloride, trichloroethylene, 1,2-dichloroethene, and 1,2-dichlorobenzene, and m-cresol) at concentrations from 5,000 to 30,000 mg/kg. The testing demonstrated that all processed material was LDR compliant, all POHC REs were greater than 99.99%, visual opacity was 0%, carbon monoxide emissions were below nine parts per million after dispersion, the cancer risk to adults was less than 1×10^{-6}, the hazard index to children was less than one, and the total mass balance had recoveries greater than 75%.

Lead and chromium had high concentrations in the feed and the vent gas met the MACT requirements.

The BDT in 2006 consisted of four APC Demonstration Tests. The BDT was performed in duplicate for both wet and dry waste feed material. The feed material was spiked with specific POHCs (carbon tetrachloride, trichloroethylene, 1,2-dichloroethene, and 1,2-dichlorobenzene, and p-cresol) at concentrations ranging from 4,000 to 31,000 mg/kg. The testing demonstrated that all processed material was LDR compliant, all POHC REs were greater than 99.99%, visual opacity was 0%, carbon monoxide emissions were below nine parts per million after dispersion, the cancer risk to adults was less than 1 x 10^{-6}, the hazard index to children was less than one, and the total mass balance had recoveries greater than 75%. Metals contamination was relatively low in the feed; the MACT requirements were met for all metals in the vent gas.

These tests concluded that the TD unit does not emit non-compliant levels of particulate matter, metals, carbon monoxide, VOCs, SVOCs, dioxins/furans, or radionuclides and that the processed material was LDR compliant throughout.

The ODT test in April, 2008 had very high concentrations of lead in the feed. All MACT requirements were met during this test.

Since March, 2003, the full-scale TD unit at the Permittee's facility has logged over 2800 operational hours and processed over 280 batches. Through all of this processing, only one instance has been noted where the processed material was not LDR compliant and required re-treatment. Verification of the re-treatment processing from that batch demonstrated LDR compliance and the processed material was disposed in the Permittee's Mixed Waste Landfill Cell.

Additionally, in September 2005 the Permittee performed treatability studies of mercury contaminated wastes through the TD unit. Approximately 20,000 lbs of waste were processed in 12 process cycles. The mercury content in the feed material waste ranged from 0.131 mg/L in aqueous liquid (prior to solidification) to 1,310 mg/kg (2.90 mg/L TCLP) in sludge. The processed material from each process cycle was analyzed with a maximum leachable concentration of 0.0107 mg/L TCLP detected; eight of the runs had non-detectable amounts of leachable mercury. Vent gas monitoring was not performed during these studies.

9.4 Radiation Monitoring

All waste feed material treated during Volatile Metals Waste Family Demonstration Testing shall be mixed waste with radiological contamination.

Radiological vent gas samples shall be collected on standard particulate filters, charcoal (carbon) filters, silica gel columns, and within marinelli jars (grab samples). In order to evaluate radiological emissions throughout the process cycle, the filters shall be changed out, and the marinelli jar grab samples taken, at specific points within the process cycle.

The sampling plan for radiological samples is further detailed in the Emissions Test Protocol of Appendix C in Attachment II-1-12-2. Additional details shall be provided in the schedule required by Condition 5.b. in Attachment II-1-12-1.

The particulate filters shall be analyzed for gross alpha, gross beta, on-site gamma spectroscopy, and other radiochemical analysis if needed to identify radiological contributors. The charcoal filters shall be screened for gross beta to evaluate the presence of I-129 and will also be analyzed on-site by gamma spectroscopy and off-site for other radiochemical analyses (e.g., alpha spectroscopy and liquid scintillation counting) if necessary. The silica gel columns shall be analyzed for radiochemical parameters. The marinelli jars shall be analyzed on-site by gamma spectroscopy and sent off-site if detections are observed.

Section 10 - Acceptance Criteria

10.1 Acceptance Criteria

The Volatile Metals Waste Family Demonstration Testing may be considered successful or unsuccessful based upon the data collected. There are three possible outcomes of the Volatile Metals Waste Family Demonstration Testing as follows:

- The results of the Volatile Metals Waste Family Demonstration Testing demonstrate that the TD unit was successful in meeting the test objectives;
- The results of the Volatile Metals Waste Family Demonstration Testing demonstrate that the TD unit was unsuccessful in meeting the test objectives;
- The results of the Volatile Metals Waste Family Demonstration Testing indicate that the TD unit was unsuccessful in meeting the test objectives; however, the Permittee can demonstrate that the testing was actually successful or that minor corrections can be made to the TD unit that will provide successful results.

The Volatile Metals Waste Family Demonstration Testing shall be determined to be successful if the following acceptance criteria are met:

- The mercury concentration within the processed material meets LDR standards or has been reduced below 260 mg/kg after all processing has been completed.
- RVM REs are greater than 99.99%.
- The volatile metal emissions are below the MACT standards for an existing incinerator.
- The cancer risk, based upon exhaust concentrations, is less than 1×10^{-6} for an adult residing at the point of maximum concentration.
- The hazard index, based upon exhaust concentrations, is less than one for a child residing at the point of maximum concentration for the duration of the test.

The Volatile Metals Waste Family Demonstration Testing shall be considered unsuccessful if one or more of the following results occur:

- The mercury concentration within the processed material does not meet LDR standards or is greater than 260 mg/kg. However, if this criterion is not met, the waste may be reprocessed (without associated vent gas monitoring) and re-analyzed as necessary;

- RVM REs are less than 99.99%;
- The volatile metal emissions exceed the MACT standards for an existing incinerator.
- The cancer risk is greater than 1 x 10^{-6} for an adult residing at the point of maximum concentration;
- The hazard index, based on exhaust concentrations, is greater than one for a child residing at the point of maximum concentration;

The Permittee shall submit the results of the Volatile Metals Waste Family Demonstration Testing in a Volatile Metals Post-Waste Family Demonstration Testing Report as required by Section 8 of this Attachment. The Permittee may propose in this report that unsuccessful results were incorrect, or that minor system adjustments may need to be made to provide successful results. Requests for any additional testing shall be submitted to the Executive Secretary with the Volatile Metals Post-Waste Family Demonstration Testing Report.

10.2 Efficiency Calculations

REs shall be calculated using the RVM and known contaminant data. These RE calculations shall be performed using data collected during the Volatile Metals Waste Family Demonstration Testing. The masses required for these RE calculations shall be estimated using the chemical specific analytical data and the measured flow rates for each of the system streams (with the exception of the mass of the RVM fed into the dryer which will be measured directly).

A RE shall be calculated to determine the efficiency of the air pollution control system using the following formula:

$$RE = \frac{mass_{feed} - mass_{vent\ gas}}{mass_{feed}} \times 100$$

where**,**

$mass_{feed}$ = the mass of the RVM (weight in lbs) or known contaminant fed into the dryer, and

$mass_{vent\ gas}$ = the mass of the RVM (weight in lbs) or known contaminant found in the vent gas.

The $mass_{feed}$ shall be calculated by multiplying the total feed flow rate by the RVM concentration in the feed material. The $mass_{vent\ gas}$ is calculated by multiplying the vent gas flow rate by the RVM concentration in the vent gas.