

Attachment II-1-12-2

**Thermal Desorption**

**Pre-Demonstration Plan for Volatile and Semi-volatile  
Organic Compounds**

December 5, 2003

# Pre-Demonstration Plan

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## Section 1 - Introduction

This Pre-Demonstration Plan (PDP) provides requirements to conduct Waste Family Demonstration Testing for wastes containing volatile and semi-volatile organic compounds. This testing shall determine the viability of a Thermal Desorption (TD) unit at Envirocare of Utah, Inc. (the Permittee). Furthermore, Waste Family Demonstration Testing is designed to demonstrate that air emissions from the process will be minimized and will be protective of human health and the environment. Operational Parameters and Automatic Waste Feed Cut Off (AWFCO) settings, used for Waste Family Demonstration Testing, have been established based on the TD unit design and past experience. Final Operational Parameters and AWFCO settings shall be established based on the results of the Waste Family Demonstration Testing.

This PDP contains descriptions of two tests: 1) a preliminary system test which includes Functional Testing, Systems Demonstration Test and Shakedown Operations, as defined in Attachment II-1-12-1, *Thermal Desorption Shakedown Operations and Waste Family Demonstration Testing*; and 2) Waste Family Demonstration Testing consisting of a test of the air pollution control (APC) equipment and a test of the operability of the system when subject to various waste matrices.

This Pre-Demonstration Plan includes:

- a detailed description of the system and all equipment (Section 3);
- a review of results from previous demonstration tests, either at the Permittee's facility, or elsewhere (Section 9);
- a description of the feed material used during the Waste Family Demonstration Testing (Section 7);
- initial process operating parameters, including justifications for each (Section 7);
- Data Quality Objectives (DQOs) (Section 5);
- analytical verification testing to achieve the DQOs (Section 7);
- 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
- names of operators and contact personnel, including emergency coordinators (Section 9).

## 1.1 Definitions

The definitions used within this Attachment are found in Attachment II-1-12, *Thermal Desorption Separation Plan*, and Attachment II-1-12-1, *Thermal Desorption Shakedown Operations and Waste Family Demonstration Testing*.

## 1.2 Acronyms

The following acronyms are used within this Attachment:

APC	=	air pollution control
ASTM	=	American Society of Testing Materials
AWFCO	=	Automatic Waste Feed Cut-Off system
CAT	=	Construction Acceptance Testing
CE	=	condenser efficiency
cfm	=	cubic feet per day
cfh	=	cubic feet per hour
CFR	=	Code of Federal Regulations
CO	=	carbon monoxide
DQO	=	Data Quality Objective
DRC	=	Utah Division of Radiation Control
ETV	=	Emission Threshold Value
°F	=	degrees Fahrenheit
gph	=	gallons per hour
HCl	=	hydrochloric acid
HEPA	=	High Efficiency Particulate Absorption (filter)
inches W.C.	=	inches of water column
LDR	=	Land Disposal Restrictions
LEL	=	Lower Explosive Limit
LOC	=	limiting oxidant content
mm Hg	=	millimeters of Mercury (pressure)
MWSB	=	Mixed Waste Storage Building
NAAQS	=	National Ambient Air Quality Standards
NFPA	=	National Fire Protection Association
PAH	=	polycyclic aromatic hydrocarbon
PCB	=	polychlorinated biphenyl
PCDD	=	polychlorinated dibenzo-para dioxins

PCDF	=	polychlorinated dibenzofurans
PDP	=	Pre-Demonstration Plan
PLC	=	programmable logic controller
PM	=	particulate matter
POHC	=	principal organic hazardous constituent
PPE	=	personal protective equipment
psid	=	pounds per square inch differential
QA/QC	=	Quality Assurance/Quality Control
RCRA	=	Resource Conservation and Recovery Act
RE	=	removal efficiency
RTD	=	Resistance Temperature Device
scfm	=	standard cubic feet per minute
SITE	=	Superfund Innovative Technology Evaluation
SSO	=	Site Safety Officer
STL	=	Severn Trent Laboratories
SVOC	=	semi-volatile organic compound
TCLP	=	Toxicity Characteristic Leaching Procedure
TD	=	thermal desorption
TDS	=	total dissolved solids
TE	=	treatment efficiency
TOX	=	total organic halides
T <sub>p</sub>	=	processing temperature
tph	=	tons per hour
TS	=	treatment standards
TSCA	=	Toxic Substances Control Act
TSDF	=	Treatment, Storage, and Disposal Facility
TSS	=	total suspended solids
UMTRA	=	Uranium Mill Tailings Remedial Action
US DOE	=	United States Department of Energy
US EPA	=	United States Environmental Protection Agency
VOC	=	volatile organic compound
VOST	=	volatile organic sampling train
VTD	=	vacuum thermal desorption

## **Section 2 – Demonstration Objectives**

The TD unit is designed to treat wastes with volatile and semi-volatile organic constituents to below LDR standards. Data shall be collected to determine System and Operating Parameters for the TD unit. Sampling and analysis shall be performed to verify regulatory compliance.

### ***2.1 Risk Assessments***

A preliminary risk assessment (dated November 15, 2002) has been performed for the TD unit in accordance with Condition II.T.5 of this Permit. A second risk assessment will be performed using the results of Waste Family Demonstration Testing to verify the assumptions of the preliminary risk assessment. The second risk assessment shall consider both direct and indirect exposure pathways for volatile, semi-volatiles organic compounds and PCBs.

### ***2.2 Demonstration Plan Objectives***

The objectives of this PDP and the associated Waste Family Demonstration Testing are:

- Determine if wastes containing volatile and semi-volatile organic compounds are amenable to TD processing and that the processed material meets LDR standards for those compounds.
- Identify and justify which principal organic hazardous constituents (POHCs) will represent each waste family being demonstrated.
- Demonstrate, for each POHC, that removal efficiencies (RE) of at least 99.99% are attained.
- Demonstrate that the waste constituents are accounted for through material balances.
- Demonstrate that the TD unit is capable of batch operation.
- Perform a second risk assessment using the results of 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.

- Demonstrate that all conditions concerning radiation safety, including emissions of radioactive materials are in compliance with the Permittee's Radioactive Materials License.
- Demonstrate that regulatory acceptance criteria are met for air quality. This includes a visual opacity (40 CFR 60, Appendix A, Method 9) limit of 0% for both exhaust points and a carbon monoxide limit within the process vent stream that is less than the National Ambient Air Quality Standard (NAAQS) of 9 ppm (volume) over an 8-hour period, after dispersion modeling has been performed.

## Section 3 – Physical Description of Technology

### 3.1 *Equipment Description*

The TD unit is a vacuum dryer system designed and constructed by TD\*X Associates, LLC (Past experience of this vendor is provided in Section 9 of this Attachment). The TD unit is designed to separate volatile and semi-volatile contaminants from waste matrices leaving the resulting processed material LDR compliant. If necessary, contaminants not amenable to TD processing will be treated using additional permitted processes (e.g., stabilization, macroencapsulation).

The TD unit consists of four subsystems constructed primarily of stainless steel alloys: a thermal separation system (dryer), a processed material discharge system, an off-gas treatment train, and a condensate tank system. Some individual parts of the TD unit are constructed from other materials (e.g. vacuum pump, HEPA filters, carbon absorption media). Figure 1 is a schematic block diagram of the TD unit that shows the interaction of these four subsystems.

The components of the TD unit are installed on three equipment skids: the dryer skid, gas skid (containing the off-gas treatment train), and the condensate-processing skid. Dimensional drawings of these skids and the layout within the Permittee's Mixed Waste Storage Building (MWSB) are displayed in Figures 2 – 5.

Figure 2 shows, in plan view, the general layout of the TD unit. The TD unit consists of three skids, the discharge system and a fan cooler. The dryer skid is located near the center of the building. The off-gas and condensate skids are located near the north wall inside the building. A fan cooler is located outside the north wall of the building. Figure 2 also shows a plan view of the discharge system. The discharge system is shown more clearly in Figure 3. All systems are connected using hard piping or flexible hose.

Figure 3 is a dimensional drawing of the dryer skid, including the processed material discharge system. The dryer skid is a three level system. A dryer platform is located approximately six feet from the floor. A feed platform is located above the dryer, approximately 15 feet from the floor. A steel framework with a hoist system is located approximately 25 feet from the floor. The side view shows the conveyor of the discharge system. This conveyor is used to transfer the processed material from the dryer discharge point to the processed material container (typically a B-25 container).

The dryer is a cylindrical tank with an external diameter of approximately six feet and a length of approximately ten feet (Figure 3 provides a scaled drawing of the dryer skid). The dryer has a processing capacity of approximately 29 cubic feet of feed material per process cycle and up to 470 cubic feet per day. The dryer is totally enclosed and is indirectly heated by a separate propane fired furnace. The indirect furnace contains safety features and is designed to the inert oven standards as required by the National Fire Protection Association (NFPA) (Standard 86 – 1999 version). The waste is heated by conduction at the internal surface of the dryer walls. The open flame from the furnace does not come in contact with the waste or the volatilized materials

Feed material is introduced into the dryer through a feed hopper. Two waste streams are generated from the dryer, the processed material and the off-gas.

The processed material is collected in the discharge system after the process cycle is completed. A small amount of water is added to the processed material to aid in cooling the material and to provide dust control since the processed material is dry when discharged from the dryer.

Off-gas is generated within the dryer and is purged from the dryer with a nitrogen carrier gas. The nitrogen provides a relatively inert atmosphere (oxygen content less than 7%), which prevents combustion of the volatile or semi-volatile constituents. The nitrogen purge gas carries the volatilized constituents from the dryer to the off-gas treatment train, which consists of condensers in series, a vacuum pump, and a filtration system (pre-filter, HEPA filter, and carbon adsorption beds). The condensers cool the gas stream to remove (condense) a majority of the volatile and semi-volatile compounds. Condensate traps, located in the liquid discharge line from the condensers, collect the condensate and pass it to the condensate transfer tank. The gas stream then passes through the filtration system to remove the remaining volatile and semi-volatile compounds. The residual gas is vented to the atmosphere through a stack that discharges approximately 35 feet above ground level. The gas leaves the APC system at a rate of approximately 30 cubic feet per minute and is boosted (with outside air) through a blower to approximately 1,000 cubic feet per minute in order to provide good dispersion of the resulting emission. The system is also arranged so that the carrier gas may be recycled back to the dryer.

The condensate skid, as depicted in Figure 5, contains three 650-gallon condensate/wastewater collection tanks and associated piping. The base of this skid is designed as a drip pan to provide containment in case of leaks from the collection tanks.

The off-gas skid is depicted in Figure 4. This skid contains condensers and filters for the off-gas treatment train. Similar to the dryer skid, this skid has two platforms above ground level on which the gas treatment equipment resides.

The entire system is powered through a control panel and power distribution center. The system requires a 460-volt, three-phase power source, a nitrogen supply, and a propane supply. Control and monitoring of the system are achieved through a computer interface that provides the operators with continuous information about the TD unit operations.

There are other features of the TD unit that were not included in Figures 2 – 5. The Permittee has submitted detailed drawings of these features as Confidential Business Information (CBI). The Executive Secretary has made the determination that these detailed drawings meet the criteria of CBI.

## Section 4 – Technical Approach

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

Waste Family Demonstration Testing shall be conducted in three separate phases. The three testing phases are:

- Preliminary System Testing;
- APC Waste Family Demonstration Testing; and
- Operational Waste Family Demonstration Testing.

The Preliminary System Testing Phase shall be completed prior to the two Waste Family Demonstration Testing phases.

### **4.1 Preliminary System Testing Phase**

Preliminary System Testing consists of the Functional Testing, Systems Demonstration Test and Shakedown Operations as described in Attachment II-1-12-1, *Thermal Desorption Shakedown Operations and Waste Family Demonstration Testing*.

Functional Testing of the TD unit was conducted in February 2003, in South Carolina during construction of the system and repeated in March 2003, at the Permittee's facility. The results of the Functional Testing are summarized in the Construction Acceptance Testing (CAT) Report provided in Appendix B of this Attachment.

Shakedown Operations began at the Permittee's facility on March 5, 2003 using a treatability study and shall continue in accordance with the time limitation described in Condition 4.b. of Attachment II-1-12-1, *Thermal Desorption Shakedown Operations and Waste Family Demonstration Testing*. During Shakedown Operations, maximum feed rates for various matrices will be developed. Information from the Shakedown Operations and contractor knowledge will be used to establish the feed rate for the APC Waste Family Demonstration Testing.

A Pre-Test was performed on March 13, 2003 using a PCB POHC. Stack monitoring indicated a RE of greater than six nines (99.9999%) was achieved for the PCB POHC. The results of the Shakedown Operations performed in March 2003, are summarized in the System Operability Test Results Interim Report also included in Appendix B of this Attachment.

Prior to APC and Operational Waste Family Demonstration Testing, a check of the functionality of the AWFCO system and a positive pressure check to assure that the seal

ratings are accurate for the maximum operating pressures of the system will be performed.

A positive pressure test shall be used to test and examine the function of the seals within the equipment. During this test, a positive pressure of 1120 mmHg absolute will be applied inside the TD unit. The Permittee shall determine if there are leaks using visual, audible, or analytical indications. The visual observations shall be accomplished by the use of a bubble test using soapy water. Alternatively, the Permittee may spike the material within the dryer with VOCs and employ an organic detection meter. The positive pressure test shall be documented and the results shall be included in the Post-Waste Family Demonstration Testing Report. Any release from the TD unit while under positive pressure shall be considered a failure of that seal or joint. Failed seals or joint shall be replaced, or repaired and retested prior to Waste Family Demonstration Testing.

The AWFCO system shall be tested by setting each “trip” condition through the computer. The AWFCO “trip” conditions are identified in Table 7-2 of this Attachment. Waste Family Demonstration Testing shall not commence until the AWFCO functional test is successful for all “trip” conditions. Results from these tests shall be reported in the Post-Waste Family Demonstration Testing Report.

#### **4.2 *APC Waste Family Demonstration Testing Phase***

The APC Waste Family Demonstration Testing is designed to determine the APC system capabilities, by processing a large amount of volatile and semi-volatile material (POHCs) within a waste matrix over a short time period. The results of this test will be used to set the Operational Parameters for each waste family represented within the test. All subsequent processing of volatile and semi-volatile waste families shall be limited to the Operational Parameters developed during the APC Waste Family Demonstration Testing.

The APC Waste Family Demonstration Testing shall consist of four process runs using mixed waste that is spiked with the POHCs. Two process runs shall be performed; one using wet waste, and the other using dry waste. Two additional process runs shall be performed to validate the results of the first two runs. These process runs will be used to determine emissions and removal efficiencies of the TD unit.

In addition to the data objectives of the APC Waste Family Demonstration Testing, other Operational and System Parameters shall be monitored according to the frequencies outlined in Table 7-1 and Table 7-3 of this Attachment. These data objectives shall be accomplished by collecting samples from the feed, processed material, condensate and vent gas.

#### **4.3 *Operational Waste Family Demonstration Testing Phase***

The Operational Waste Family Demonstration Testing is designed to determine processing capabilities within the TD unit by processing varied waste matrices. Waste matrices that are not tested during the initial Operational Waste Family Demonstration Testing will require Executive Secretary notification and approval prior to processing. The Operational Waste Family Demonstration Testing is proposed to be conducted over a

single day; however, additional testing days may be conducted if other data are necessary to establish operational conditions, or to demonstrate additional waste matrices. The results from Operational Waste Family Demonstration Testing shall establish a processing rate that demonstrates successful treatment of the processed material.

In addition to the data objectives of the Operational Waste Family Demonstration Testing, other Operational and System Parameters shall be monitored according to the frequencies outlined in Table 7-1 and Table 7-3 of this Attachment.

Mixed waste shall be processed during the Operational Waste Family Demonstration Testing. It shall not be necessary to spike the feed material with POHCs, because LDR compliance shall be verified after each process cycle.

## Section 5 – Data Quality Objectives

Data Quality Objectives (DQOs) have been established for the Waste Family Demonstration Testing to ensure that Thermal Desorption is a viable option for treating mixed wastes containing volatile and semi-volatile organic compounds. These DQOs have been established using guidance provided by the Environmental Protection Agency, “Guidance for the Data Quality Objectives Process”, EPA QA/G-4 dated September 1994 (EPA/600/R-96/055). The DQOs presented below shall be addressed for each waste family.

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

### 5.1 *State the Problem*

**Problem statement:** To collect data that demonstrate Thermal Desorption as a viable option for treating mixed wastes containing volatile and semi-volatile organic compounds.

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

### 5.2 *Identify the Decision*

This step of the DQO process is to identify the principal study question and to define alternative actions that could result from resolution of the principal study question. These two procedures are combined into a decision statement that expresses a choice among alternative actions. Each of the Waste Family Demonstration Testing phases are designed to answer a separate principal study question; therefore, each phase has a separate decision statement. The decision statements for each of the Waste Family Demonstration Testing phases are detailed below.

#### 5.2.1 *APC Waste Family Demonstration Testing Phase*

Determine whether all spiked POHC REs and known contaminants are greater than 99.99% and support continued operation of the TD unit.

#### 5.2.2 *Operational Waste Family Demonstration Testing Phase*

Determine whether the processed material is LDR compliant for volatile and semi-volatile organic contaminants and is a viable treatment option under the demonstrated Operational Parameters.

### **5.3 *Identify the Inputs to the Decision***

This step identifies the informational inputs to resolve the decision statement and lists the environmental variables that will be measured.

#### **5.3.1 *APC Waste Family Demonstration Testing Phase***

In order to estimate POHC and known contaminant REs, it will be necessary to evaluate the concentration of each POHC and known contaminant fed into the dryer and emitted to the atmosphere. To perform risk-based calculations, the concentration of POHCs emitted to the atmosphere shall be required. The variables needed are the POHC concentrations and known contaminants that are quantified using EPA Methods 8260 and 8270.

#### **5.3.2 *Operational Waste Family Demonstration Testing Phase***

Analysis of the processed material will produce data used to determine if the processed material is in compliance with LDR standards. If LDR standards are not met a comparison of the constituents in the feed material to those in the processed material will provide information concerning the degree of success. The waste families described within this Attachment are quantified using EPA Methods 8260 and 8270.

### **5.4 *Define the Boundaries of the Study***

This step defines spatial and temporal boundaries of the problem and also describes any practical constraints that may interfere with the study. Since the TD unit is a batch process, the boundaries are defined by the amount of feed material introduced into the system. The constraint is the laboratory detection limits and potential interferences associated with the feed and processed material.

Potential errors may occur by data collection through both the sampling process and laboratory analyses. Errors within sampling data will be controlled through QA/QC sampling, including duplicates, equipment blanks, and field blanks. These techniques are discussed in Section 7.3.3 of this Attachment. Data validation of laboratory analyses will be conducted in accordance with Section 7.3 of this Attachment.

#### **5.4.1 *APC Waste Family Demonstration Testing Phase***

Section 7.3.1 of this Attachment describes the sampling of the feed and processed material for the APC Waste Family Demonstration Testing. Only Certified chemicals (POHCs) shall be used so that further sampling of these compounds shall not be necessary. 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; a 240-minute sampling time is required.

#### *5.4.2 Operational Waste Family Demonstration Testing Phase*

Section 7.3.2 of this Attachment describes the sampling of the feed and processed material for the Operational Waste Family Demonstration Testing. Grab samples shall be collected from each container of feed material during the feeding process. The grab samples will be combined into composite samples for analysis. This sampling technique is designed to provide representative samples of the feed material for each process cycle. Grab samples shall be collected from each container of processed material after the process cycle (one container per process cycle).

### **5.5 *Develop a Decision Rule***

This step develops a statement of alternatives that would be necessary if an action level is not met.

#### *5.5.1 APC Waste Family Demonstration Testing Phase*

If the maximum off-gas mass of each POHC and known contaminant exceeds 0.0001 times the mass fed into the TD unit, then the Waste Family Demonstration Testing fails.

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 Waste Family Demonstration Testing fails.

#### *5.5.2 Operational Waste Family Demonstration Testing Phase*

If the concentration of individual contaminants within the processed material is greater than LDR standards, then that waste family shall be required to be retested.

### **5.6 *Specify Limits on Decision Errors***

This step of the DQO process involves specifying the limits on decision errors based on the consequences of making an incorrect decision. Examination of the consequences related to “false positive” and “false negative” decision errors is considered. A “false positive” decision error occurs when the baseline condition is rejected when it is true. A “false negative” decision error occurs when the baseline condition is not rejected when it is false. Additionally, if applicable, a gray area is defined in close proximity to the baseline condition where the consequences of decision errors are minor.

#### *5.6.1 APC Waste Family Demonstration Testing Phase*

The baseline condition for the APC Waste Family Demonstration Testing is defined by an RE of greater than 99.99% for each POHC and known contaminant. A “false positive” decision error would assert that the 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. A “false negative” decision error would assert that the Waste Family Demonstration Testing was successful, when it actually produced unsafe emissions. The consequences of a “false negative” decision error would be that TD processing would be conducted under a hazardous emission scenario.

#### *5.6.2 Operational Waste Family Demonstration Testing Phase*

The baseline condition for the Operational Waste Family Demonstration Testing is defined by the concentration of all volatile and semi-volatile contaminants within the processed material meeting LDR standards. A “false positive” decision error would assert that LDR standards were exceeded when, in fact, they were actually met. The consequences of a “false positive” decision error are that additional processing would need to be conducted on constituents that already met LDR standards. A “false negative” decision error would assert that LDR standards were met when, in fact, they were actually exceeded. The consequences of a “false negative” decision error are the disposal of waste within the Mixed Waste Landfill Cell, that didn’t meet LDR standards.

### **5.7 *Optimize the Design for Obtaining Data***

This step defines data collection design in order to generate acceptable DQO data. Section 7 of this Attachment outlines the sampling technique the Permittee expects to use. Other sampling techniques that may be used, include discreet sampling and analysis of feed and processed material streams (without compositing), verification sampling of POHC compounds, mass spectroscopy analyses of data, and additional 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 Post-Waste Family Demonstration Testing Report. The Permittee may conduct additional sampling if the minimum sampling, as detailed in this Attachment, is performed.

### **5.8 *Other Decision Errors***

Three additional decision errors can occur during Waste Family Demonstration Testing. These decision errors include the calculated total mass balance, the calculated dispersed CO concentration, and the visual exhaust determination.

The baseline condition for the dispersed CO concentration is defined by an emission of greater than nine ppm by volume. A “false positive” decision error would assert that CO concentration standards were exceeded when, in fact, they were actually met. The consequences of a “false positive” decision error are that Waste Family Demonstration Test fails. A “false negative” decision error would assert that CO concentration standards were met when, in fact, they were actually exceeded. The consequences of a “false negative” decision error are the emissions of CO concentrations above the regulated limits.

The baseline condition for the visual exhaust is defined by an opacity of zero. A “false positive” decision error would assert opacity was exceeded when, in fact, it was actually met. The consequences of a “false positive” decision error are a violation of the Air Quality Approval Order had occurred when, in fact, it hadn’t. A “false negative” decision error would assert that the opacity was met when, in fact, it was actually exceeded. The consequences of a “false negative” decision error are violations of the Air Quality Approval Order going undetected.

The baseline condition for the mass balance recovery is defined by a range above 75%. A “false positive” decision error would assert that the mass balance recovery requirement was exceeded when, in fact, it was actually met. The consequences of a “false positive” decision error result in an unnecessary engineering analysis to determine the cause of the low recovery. A “false negative” decision error would assert that the mass balance recovery requirement was met when, in fact, it was actually exceeded. The consequences of a “false negative” decision error are allowing the unit to operate when the acceptance criteria has not been met.

## Section 6- Description of Waste Families

This section describes the waste families utilized for the TD unit Waste Family Demonstration Testing. Specifics on exact testing protocols and procedures are provided in Section 7 of this Attachment

### 6.1 Waste Families

Waste families are chemical groups that have similar separation characteristics. The volatility of each target contaminant is the most important factor in TD separation. For this Waste Family Demonstration Testing, the Permittee has identified two general waste families that encompass the majority of the waste material that will be processed through the TD unit. The two identified waste families are volatile organics and semi-volatile organics. These two families are described in more detail below. If additional waste families are identified in the future (e.g., volatile metals such as mercury), the Permittee will perform additional Waste Family Demonstration Testing for each of those waste families.

Operation of the TD unit is unaffected by the presence of toxic metals; however, toxic metals may be present within the waste used for Waste Family Demonstration Testing. Stabilization of the waste may be required to meet the LDR standards when metals are present. For waste streams that are a combination of waste families, proper Operational Parameters and verification sampling shall be required for all waste families present.

Polychlorinated biphenyls (PCBs) have been identified as an additional waste family. PCBs are a subset of semi-volatile organic compounds; however, due to regulatory requirements, they are permitted separately by the USEPA. The Permittee shall submit all information regarding Waste Family Demonstration Testing for the PCB waste family to the Executive Secretary.

#### 6.1.1 Volatile Organic Compounds (VOCs)

The VOC waste family, as used for this demonstration, is considered to be the entire list of compounds that are detected using the most current US EPA SW-846 Method 8260. A copy of this list is included in Appendix C of this Attachment. VOCs are defined as organic chemicals that have a high vapor pressure, and therefore, easily form vapors at ambient temperature and pressure. These compounds typically have lower boiling points (< 360 °F) and will be vaporized earlier in the process cycle. Due to their volatility, it is expected that VOCs will not be condensed as readily as other compounds and will therefore place more of a load on the carbon adsorption beds. This aspect will be examined during the Waste Family Demonstration Testing.

#### 6.1.2 Semi-Volatile Organic Compounds (SVOCs)

The SVOC waste family is comprised of the list of compounds presented in the most current US EPA SW-846 Method 8270. A copy of this list is included in

Appendix D of this Attachment. SVOCs generally have higher boiling points (360 – 750 °F) and lower vapor pressures than VOCs. These contaminants should be condensed more readily than VOCs, and the residual material should be easily adsorbed within the carbon adsorption beds. However, these compounds will be more difficult to separate from the waste matrix than VOCs. As stated above, PCBs are a subset of the SVOC family; however, due to regulatory requirements, PCBs are permitted by the USEPA as a separate waste family.

### 6.1.3 *Principal Organic Hazardous Constituents (POHCs)*

Rather than test each specific VOC or SVOC constituent associated with each waste family, specific compounds shall be chosen to represent the entire waste family for purposes of Waste Family Demonstration Testing. These waste family representative compounds have similar separation characteristics and are known as POHCs. Mixed waste will be spiked with applicable POHCs for the APC Waste Family Demonstration Testing. APC Waste Family Demonstration Testing results for POHCs shall be applicable to all compounds within the specific waste family that the POHC represents.

The following criteria shall be used to select POHCs for specific waste families:

- Each POHC shall be chosen to represent the chemicals within each waste family with respect to their physical properties (e.g., boiling point, vapor pressure, molecular weight, etc.).
- Each POHC shall be chosen based on the degree of difficulty of removal from the waste matrix and the off-gas.
- Each chosen POHC shall be a common constituent in waste streams that may be processed through the TD unit in the future.
- Each POHC shall be readily available and of laboratory grade quality.
- Each POHC can be managed in a manner that is protective of facility personnel.
- Each POHC shall be chosen so that interference with sampling and monitoring does not occur during Waste Family Demonstration Testing.

Based upon these criteria, the Permittee has determined that trichloroethene and carbon tetrachloride are representative POHCs for the VOC waste family. Further, 1,2-dichloroethene and 1,2-dichlorobenzene have also been chosen as POHCs in order to encompass the volatile nature of all compounds within the VOC waste family

The Permittee has selected trichloroethene, carbon tetrachloride, 1,2-dichloroethene, and 1,2-dichlorobenzene as POHCs for VOCs. Trichloroethene

and carbon tetrachloride are common constituents in waste generated by the US Department of Energy and meet the selection criteria for POHCs. 1,2-dichloroethene is representative of higher vapor pressure compounds within the VOC waste family and will challenge the APC system since it is only weakly adsorbed by activated carbon. 1,2-dichlorobenzene, is representative of the lower vapor pressure compounds within the VOC waste family and will challenge the separation capabilities of the TD unit. The testing of these four POHCs should provide significant confidence in the ability of the TD unit to process and contain all compounds associated with the VOC waste family.

The Permittee has selected m-cresol and 1,2-dichlorobenzene as POHCs for the SVOC waste family. Few waste streams are contaminated with high concentrations of SVOCs. Therefore, the choice of POHCs is based more upon availability, interferences, and risk.

The m-cresol, POHC has a vapor pressure in the middle range for the SVOC waste family; however, most compounds with lower vapor pressures are solids at room temperature and would provide significant interferences with air sampling and condensate removal. Furthermore, many of the lower vapor pressure polycyclic aromatic hydrocarbons (PAHs) within this waste family are highly toxic.

PCBs have a vapor pressure slightly lower than m-cresol and will also be demonstrated within the TD unit. A PCB spike may be included in the Waste Family Demonstration Testing if a source of PCBs can be found.

1,2-dichlorobenzene is a transition compound that is listed in both the VOC and SVOC tables. 1,2-dichlorobenzene represents the high vapor pressure end of the SVOC waste family as well as the low vapor pressure end of the VOC waste family.

## Section 7 – Waste Family Demonstration Testing Operations

Waste Family Demonstration Testing will consist of three separate demonstration phases. The three phases are Preliminary System Testing, APC Waste Family Demonstration Testing, and Operational Waste Family Demonstration Testing. The Preliminary System Testing shall be completed before initiation of the APC or Operational Waste Family Demonstration.

This section describes the Waste Family Demonstration Testing plan for the APC and Operational Waste Family Demonstration Testing. The tests described in this section will be conducted after Preliminary System Testing has been successfully completed. This section will define feeding and spiking specifications, process monitoring, and sampling and analysis that will be conducted during the testing process.

For APC Waste Family Demonstration Testing, four process runs shall include sampling and analysis of input and output streams for the concentration of spiked POHCs (VOC and SVOC). The treated emissions (off-gases) shall be tested for hydrogen chloride, carbon monoxide, metals, particulate matter, and dioxins and furans. Further, a visual determination of emission opacity will be conducted during all process runs. During each process run, the unit shall be operated continuously, without shutdown. The emissions testing procedures require a sample time of at least 240 minutes (four hours); therefore, multiple process cycles will be associated with each process run. It is anticipated that approximately 90 to 240 cubic feet of feed material will be required for each process run.

For Operational Waste Family Demonstration Testing, feed and processed material samples shall be collected and analyzed for each process cycle. Further, condensate samples shall be collected after each process cycle in accordance with Table 7-3 of this Attachment. Grab samples in accordance with Table 7-4 of this Attachment shall be collected during Operational Waste Family Demonstration Testing. Operational Waste Family Demonstration Testing will occur over one to three days. It is anticipated that approximately 300 to 400 cubic feet of waste feed material will be required each day of Operational Waste Family Demonstration Testing.

### 7.1 *Pre-Processing Operations*

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

#### 7.1.1 *POHC Spiking*

Spiking of the waste feed material within APC Waste Family Demonstration Testing shall be performed by one of the following methods:

- (1) pumping the POHC into the dryer feed hopper using a metering pump; or
- (2) charging the spike material directly into the feed hopper, using containers, at the same time that the hopper is charged with solid feed material.

It will be necessary to accurately measure the mass of the spiking material introduced into the TD unit for RE calculations.

A scale shall be used to measure the mass of the liquid feed.

## 7.2 *Process Monitoring*

### 7.2.1 *System Parameters*

During both APC and Operational Waste Family Demonstration Testing System Parameters and locations are monitored and summarized in Table 7-1 and explained below. System Parameters monitor the TD unit operation.

Operational Parameters are a subset of the System Parameters. Operational Parameters shall be the limiting operational settings for the TD unit. Operational Parameters are set points developed and established in Waste Family Demonstration Testing to verify a successful process cycle. One of the Operational Parameters to be monitored for treatment of the feed material is the dryer solids temperature. When the required dryer solids temperature is achieved, the processed material shall be sampled and analyzed to verify that treatment is successful. Other Operational Parameters monitored for treatment of the feed material include, the dryer internal pressure, the oxygen concentration, and the temperature of the carrier gas leaving the condenser.

Monitoring equipment is described in Section 7.2.3.

Data from System and Operational Parameters shall be recorded either manually on official TD processing logs or continually measured by a computer interface programmable logic controller (PLC) data management system. The processing logs shall be official Permittee forms that are dated and signed by all operators present. The data collected through the PLC data management system shall be updated to a hard drive every minute and a new file shall be automatically created at midnight for each process run. The data management system shall automatically update the daily files into a weekly summary. The weekly summary shall be backed up at the first of each month by the Thermal Engineer or TD Operations Manager. A single controlled CD shall be created for all data obtained during Waste Family Demonstration Testing. All of the data shall become part of the operating record and shall be controlled in accordance with the Permittee's Quality Assurance procedures.

**Table 7-1. Monitored System Parameters**

<b>Parameter</b>	<b>Units</b>	<b>Monitoring Device</b>	<b>Frequency</b>	<b>Location</b>
Feed Rate	cubic feet per process cycle	Feed Log or Pump Counter	Process Cycle	Feed Hopper or Pump
Feed Rate	pounds per	Feed Scale	Process	Feed Preparation

	process cycle		Cycle	Area
Daily Feed Rate	cfm	Feed Log or Pump Counter	Daily	Feed Hopper or Pump
Daily Feed Rate	tpd	Feed Scale	Daily	Feed Preparation Area
Time of Process Cycle	minutes	Clock	Process Cycle	TD unit
Final Temperature Hold Time	minutes	Clock	Process Cycle	TD unit
Dryer Internal Temperature	°F	Thermocouple	Continuous	Dryer
Dryer Solids Temperature, T <sub>p</sub>	°F	Thermocouple	Continuous	Dryer
Dryer Off-Gas Temperature	°F	Thermocouple	Continuous	Dryer
Dryer Internal Pressure	mmHg	Pressure Indicator	Continuous	Dryer
Condenser Inlet Off-Gas Temperature	°F	Thermocouple	Continuous	Off-Gas Treatment Train
Condenser Outlet Off-Gas Temperature	°F	Thermocouple	Continuous	Condenser
Oxygen Concentration	%, by volume	Oxygen Analyzer	Continuous	Process vent
Process Vent Flow	scfm	Flow meter	Hourly	Outlet of Carbon Beds
Nitrogen flow	scfm	Flow meter	Hourly	Nitrogen feed line
Pre-Filter Differential Pressure	psid	Pressure indicator	Daily	Process vent
HEPA Filter Differential Pressure	inches W.C.	Pressure indicator	Daily	Process vent

**Feed Rate:** Two feed rates shall be used to characterize the feed process. The mass feed rate (both on a per cycle and per day basis) is a necessary parameter for REs and mass balance calculations. The mass feed rate shall be measured in pounds per process cycle and converted into tons per day (tpd) based upon the time of the process cycle. A scale shall be used to determine the weight of the feed material. A measurement will be taken both before and after the contents are fed into the feed hopper. The difference between these two measurements is the weight of feed material processed within the TD unit.

The volumetric feed rates are less critical than the mass feed rates and are estimated by the operator based upon the size and fullness of the feed container. This parameter shall be measured to assure that the volume of material fed into the dryer does not exceed the capacity of the dryer. The daily volumetric feed rate provides an indication of the total volume of material processed within a single day. A dryer feed log shall be kept by TD operators. The time, container

full weight, container tare weight, and approximate volume of material shall be recorded on this log.

**Time of Process Cycle:** This parameter is measured as the elapsed time between the initiation of depositing feed material into the dryer through completion of discharge from the dryer (when the discharge valve is closed). The operator shall record the following clock times on a process log: beginning of feed; end of feed; when the dryer solids reach the pre-determined processing temperature; when the discharge valve is opened and discharge begins; and the end of discharge (when the discharge valve is closed). The time of process cycle shall be calculated from these clock times and shall be recorded on the process log.

**Final Temperature Hold Time:** This parameter is established as part of the waste stream recipe. The final temperature hold time shall be achieved to ensure that the processed material meets LDR standards for volatile and semi-volatile contaminants. Using the Time of Process Cycle, the final temperature hold time is the time between the dryer solids reaching the pre-determined processing temperature and the beginning of discharge (opening of the discharge valve). This calculated value shall be recorded on the process log.

**Dryer Internal Temperature:** This parameter measures the internal skin temperature of the dryer, in degrees Fahrenheit (°F). This temperature may be adjusted by the operator to achieve the required dryer solids temperature. This measurement shall be recorded from four locations equally spaced along the length of the dryer near the top and shall be continually monitored and recorded by the PLC data management system.

**Dryer Solids Temperature:** This shall be one of the Operational Parameters that determines treatment completion. This parameter is measured using a 10-minute rolling average to assure that all solids within the dryer have reached this temperature. After this temperature is reached for the prescribed hold time, the discharge process may begin and the dryer will be cooled for the next process cycle. Dryer solids shall not exceed the temperature identified in the recipe. Two probes will provide the dryer solids temperature; one located on the end of the dryer approximately 12-inches up the side of the dryer and a second located within the discharge section of the dryer. Both of these probes protrude approximately three inches into the solid material. Due to the uniformity and movement of the solid material, these measurements are designed to provide a good indication of the temperature of material within the dryer. The Dryer Solids Temperature shall be the average temperature of the two probes. Readings from both thermocouples are continually monitored and recorded by the PLC data management system.

**Dryer Off-Gas Temperature:** This parameter is a measurement of the off-gas temperature within the dryer. The Dryer Off-Gas Temperature is approximately the same as the condenser inlet temperature. This parameter shall be considered as a performance measure of the TD unit. This temperature is read where the off-gases leave the dryer but before the off-gas treatment train. This temperature

reading is continually monitored and recorded by the PLC data management system.

**Dryer Internal Pressure:** This parameter is measured in millimeters of mercury (mmHg) and is collected in the dryer vessel through an access port. This parameter is continually monitored and recorded by the PLC data management system. As described in Section 7.2.2 of this Attachment, the TD unit seals are rated up to approximately 1520 mmHg. A pressure relief device within the TD unit will open when the dryer internal pressure reaches a range from 1277 mmHg to 1484 mmHg.

**Condenser Outlet Off-Gas Temperature:** This temperature reading shall be monitored to evaluate RE compliance. The measurement for the off-gas treatment train is taken at the condenser outlet. This Operational Parameter shall be established during APC Waste Family Demonstration Testing. This measurement shall be continually monitored and recorded by the PLC data management system.

**Oxygen Concentration:** The Oxygen Concentration is an Operating Parameter that shall be measured to assure that the oxygen concentration is below combustion levels in the dryer. The oxygen content of the off-gas should be maintained at more than three percentage units below the limiting oxidant content (LOC) for the compounds that are being processed. The LOC is the minimum amount of oxygen at which combustion of the material could occur. A review of the tables provided in Standard 86 of the National Fire Protection Association (NFPA) has been performed. The Permittee has concluded that the typical LOC values for the volatile and semi-volatile organic constituents expected in the waste to be in the range of 10 – 12% oxygen at temperatures above 500 °F. Therefore, during normal operations the oxygen concentration shall be limited to a maximum value of 7%. If oxygen concentrations exceed 7%, the AWFCO system shall be initiated.

The oxygen concentration shall be measured in the process vent line at the end of the off-gas treatment train. Since the oxygen concentration is measured after the vacuum pump (at ambient pressure), the measured value will need to be adjusted to the vacuum conditions within the dryer. Section 7.2.3 provides an explanation of this correction.

The oxygen concentration within the system shall be continually monitored and recorded by the PLC data management system.

**Process Vent Flow:** This parameter shall be measured using a flow meter. The flow meter is located within the off-gas vent piping. This location provides an accurate and representative flow value. The flow rate is measured in standard cubic feet per minute (scfm). This parameter will be used to determine the mass flow rate of the contaminants within the off-gas stream. This parameter will be documented hourly on the TD operating log.

**Nitrogen Flow:** This parameter shall be measured using a rotameter in the

nitrogen feed line. The nitrogen supply flow rate shall be monitored and adjusted by the operator based on the oxygen concentration in the dryer. The nitrogen flow rate will be adjusted as necessary to maintain the concentration of oxygen below 7%. This parameter will be documented hourly on the TD operating log.

**Pre-Filter and HEPA Filter Differential Pressures:** These parameters shall be measured using access ports on either side of the filters. This parameter shall be used to determine when a filter has become plugged. The pre-filter is measured using a differential pressure gauge that reads in pounds per square inch differential (psid). The pre-filter shall be replaced when a continual rise in the measured differential pressure is noted.

The HEPA filter differential pressure (inches W.C.) shall be read from two gauges surrounding the filter. The HEPA filter differential pressure shall be replaced upon exceeding two inches W.C. If the HEPA filter differential pressure reaches five inches W.C., the process cycle shall be aborted. Both the pre-filter and HEPA filter differential pressure measurements shall be recorded daily on the TD operating log.

7.2.2 *Automatic Waste Feed Cut-Off (AWFCO) System*

The TD unit is equipped with an AWFCO system that shall be active any time that feed material is being fed into the dryer. The AWFCO Parameters are listed in Table 7-2. These set points prohibit the feed hopper cover from opening if they are exceeded. The AWFCO system includes seals around both the internal valve and the external cover of the hopper to ensure that feed material is not released from the hopper when the AWFCO system is operational. A demonstration of the AWFCO system shall be conducted during Preliminary Systems Testing prior to Waste Family Demonstration Testing of the TD unit.

Activation of the AWFCO shall immediately shut off the feed to the dryer if any of the parameters in Table 7-2 is exceeded excepting the off-gas temperature of the carrier gas leaving the condenser during Shakedown Operations, as noted.

**Table 7-2. AWFCO Parameters and Activation**

AWFCO Parameter	AWFCO Activation
Temperature of Material in Dryer	$T_p > 1,200 \text{ }^\circ\text{F}$

Dryer Internal Pressure	Pressure >1120 mmHg absolute
Oxygen Concentration	% Oxygen in dryer > 7%
Temperature of Carrier Gas leaving the Condenser	Temperature of gas > 50 °F

**Temperature of Material in Dryer:** A high value for the dryer solids temperature ( $T_p$ ) could promote breakdown of volatile and semi-volatile constituents within the waste rather than separation. At 1200 °F, the AWFCO shall be activated. The Permittee shall have 30 minutes to lower the  $T_p$  below 1200 °F. If the Permittee cannot lower the  $T_p$  below 1200 °F within 30 minutes, the process cycle shall be aborted. If the  $T_p$  reaches 1300 °F, the process cycle shall also be aborted and the burners shut off.

**Dryer Internal Pressure:** A high internal pressure value could cause a positive pressure release of contaminated material from the TD unit. When the internal pressure reaches 860 mmHg, the Permittee shall increase vent flow in the TD unit to reduce the internal pressure of the dryer. The AWFCO shall be activated when the internal pressure of the TD unit exceeds 1120 mmHg. Once the TD unit internal pressure has reached 1120 mmHg, the Permittee shall have 60 seconds to reduce the internal pressure below 1120 mmHg. If 60 seconds have elapsed and the pressure has not been reduced below 1120 mmHg, the Permittee shall turn off the burners and abort the process cycle. Pressure seals within the TD unit are rated at up to approximately 1520 mmHg. If the internal pressure exceeds 1520 mmHg, the Permittee shall conduct an evaluation of all TD unit seals to determine seal integrity.

**Oxygen Concentration:** High oxygen concentrations could cause chemical breakdown of volatile and semi-volatile constituents and could therefore cause combustion within the dryer. During the feed process, oxygen concentrations may

be allowed to spike beyond 10% for a time not exceeding 15 minutes as long as the autoignition temperature of the waste constituents within the dryer is not exceeded.

Typical LOC values for the organic constituents range between 10 – 12% oxygen at temperatures greater than 500 °F. If the oxygen concentration exceeds 5%, nitrogen flow shall be automatically increased to maintain the reduced oxygen atmosphere. Upon reaching an oxygen concentration of 7%, the AWFCO system shall be activated. If the oxygen concentration exceeds 9% and the temperature of the material within the dryer is greater than 500 °F, the Permittee shall turn the burners down. If the oxygen content is not brought below 9% or the temperature of the material within the dryer is not reduced below 500 °F within 30 minutes, the Permittee shall shut off the burners and abort the process cycle. If the oxygen concentration exceeds 10% and the temperature of the material within the dryer is greater than 500 °F (except during the feed process), the Permittee shall immediately turn off the burners and abort the process cycle. The Permittee shall continue to monitor the TD unit using all efforts to reduce the oxygen concentration below 10% or to reduce the temperature of the material within the dryer below 500 °F as quickly as possible. After the system has cooled down, the root problem shall be identified and a corrective action report shall be submitted to the Executive Secretary. Further operation of the unit shall not continue without authorization from the Executive Secretary.

**Temperature of Carrier Gas leaving the Condenser:** This temperature measurement shall be monitored to ensure proper operation of the condenser system and to ensure that volatile and semi-volatile contaminants are not being emitted to the atmosphere. The anticipated operating range of the carrier gas leaving the condenser is between 32 – 50 °F. Upon reaching 50 °F during Shakedown Operation, the AWFCO system shall activate to prevent volatile or semi-volatile organics from being added to the dryer. During WFDT, the temperature of the carrier gas leaving the condenser can be varied to develop and establish Operational Parameters for future operation of the VTD unit, including temperatures above 50 °F.

### 7.2.3 *Monitoring Instruments*

Various instruments and procedures shall be used to monitor System Parameters during Waste Family Demonstration Testing. These include electronic instruments with continuous indication and data logging, local direct reading analog instruments, and administrative monitoring procedures. The Permittee shall maintain a file of manufacturer manuals (including recommended calibration frequencies and methods) for all monitoring instruments.

**Feed Material Mass Measurement:** A scale shall be used to measure the mass of feed material for use in the feed rate calculations. The scale shall have accuracy greater than 99%. Calibration of the scale shall be based on manufacturer's specifications and shall be performed in accordance with the Permittee's Quality Assurance Plan. This calibration shall be performed annually

by an approved calibration vendor. Documentation of the calibration shall be placed in the Operating Record. During operations, the empty scale shall be reset using the scale's "Auto Zero" functions.

**Temperature Measurements:** Soil and dryer skin temperature measurements shall be monitored using thermocouples. Carrier gas temperatures shall be monitored with either thermocouples or RTDs. Prior to installation, functional checks have been completed and are documented in the operations logbook for the TD unit.

**System Internal Pressure Measurement:** Pressure shall be measured using an electronic pressure transmitter. The pressure reading shall be recorded electronically. The electronic pressure transmitter shall be calibrated at least once per year or according to manufacturer's specifications. Instrument "zero" checks and "re-zeroing" shall be performed during scheduled maintenance every four to six weeks of operation. A single zero check shall be necessary prior to the Waste Family Demonstration Testing.

**Oxygen Concentration Measurement:** The oxygen analyzer extracts a continuous flow of gas from the vent line, analyzes it for oxygen content, and returns the gas to the vent line. Due to pressure differences between the vacuum pump's inlet and outlet, the oxygen content shall be corrected as follows:

$$[O_2]_{\text{Dryer}} = [O_2]_{\text{Vent}} \times \frac{\text{Dryer Pressure, mmHg}}{\text{Vent Pressure, mmHg}}$$

where  $[O_2]_{\text{dryer or vent}}$  is the oxygen concentration (%) at that location.

The oxygen analyzer is calibrated at least once per day according to the manufacturer's specification using reference gases of known and certified oxygen content. This calibration shall be a two-point calibration, with a zero gas and a span gas, chosen according to the operating range of the instrument.

**Process Vent Flow Rate Measurement:** Vent flow shall be measured using an in-line rotameter. This instrument is located after the vent filters and in front of the dispersion fan.

### **7.3 Waste Family Demonstration Testing**

Six potential mixed waste streams have been identified to be used during the Waste Family Demonstration Testing. Waste characterization of these six waste streams is provided in Appendix G of this Attachment. One or more of these waste streams shall be used to perform the Waste Family Demonstration Testing described in this Attachment.

#### **7.3.1 APC Waste Family Demonstration Testing Phase**

The APC Waste Family Demonstration Testing shall be completed using a mixed waste feed material that is spiked with each of the POHCs. The Permittee shall

receive Executive Secretary approval for the waste selected for spiking, prior to APC Waste Family Demonstration Testing. The mixed waste shall be spiked on the magnitude of 10,000 ppm for each POHC. The following four process runs shall be conducted:

- Wet waste with a moisture content of approximately 20 – 30 % and a duplicate run.
- Dry waste (moisture content less than the wet waste) and a duplicate run.

The duplicate process runs shall be performed to ensure a statistically significant amount of valid data.

A process cycle will take approximately one to six hours. In order to achieve RE objective of the APC Waste Family Demonstration Testing, each process cycle shall be performed in as short a time period as possible.

The mixed waste feed material shall be sampled and analyzed prior to spiking to provide data for mass balance calculations. Sampling of the processed material, condensate, and off-gas shall be performed during these process runs. Sampling intervals of at least 240 minutes shall be used to collect the required data for each process run.

### 7.3.2 *Operational Waste Family Demonstration Testing Phase*

The objective of the Operational Waste Family Demonstration Testing is to demonstrate that the processed material from each waste matrix meets LDR standards. Several different waste matrices shall be processed during this Operational Waste Family Demonstration Testing. The Permittee expects the following waste matrices will be processed during the Operational Waste Family Demonstration Testing:

- soil
- liquid
- organic sludge
- clay-like material
- debris (plastic, metal, or both)

In addition, other waste matrices may be processed, if available, during the Operational Waste Family Demonstration Testing. All waste characterization information shall be compiled and provided in the Post-Waste Family Demonstration Testing Report.

Grab samples shall be collected for RE calculations during the Operational Waste Family Demonstration Testing.

## 7.4 *Sampling and Analysis*

Two types of sampling and analysis procedures shall be used during both the APC and Operational Waste Family Demonstration Testing. The first procedure is used to characterize the processed materials to verify compliance with LDR standards. The second procedure is used to characterize the feed material and emissions to calculate REs. These data will also be used to verify material balances over the TD unit.

Sampling locations on the TD unit are designed to capture the process streams of bulk solids, process liquids, and vent off-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 off-gas streams. The bulk solids shall be sampled as described below. Tables 7-3 and 7-4 provide an overview of the sample locations, methods, and frequencies for all Waste Family Demonstration Testing samples; Table 7-3 is specific to the APC Waste Family Demonstration Testing, and Table 7-4 describes testing for Operational Waste Family Demonstration Testing. The collection of additional samples may be necessary for the Permittee to verify LDR compliance.

Codified sampling and analytical methods will be used, primarily from SW-846, US EPA Standard Methods, and ASTM (American Society of Testing Materials). The reference analytical methods for each parameter are provided in Tables 7-3 and 7-4. The Permittee shall submit all data in accordance with the 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. Sample containers for organic compounds shall be filled to zero headspace. Pre-labeled sampling containers of appropriate size and preservative (if necessary) shall be supplied to the sample technicians by the Permittee's lab manager. The Permittee shall maintain chain of custody records for all samples generated during Waste Family Demonstration Testing. A record of all samples collected shall be recorded in the TD operations logbook.

As required by Condition 5.b. of Attachment II-1-12-1, *Thermal Desorption Shakedown Operations and Waste Family Demonstration Testing*, the Permittee shall submit a complete testing schedule to the Executive Secretary at least seven days prior to commencement of Waste Family Demonstration Testing.

### 7.4.1 *APC Waste Family Demonstration Testing Phase*

Sampling requirements for APC Waste Family Demonstration Testing are provided in Table 7-3. An explanation of each sample mentioned in Table 7-3 is provided below.

The sampling protocol in Table 7-3 is specific to the waste families that are being tested within this Waste Family Demonstration Testing.

**Table 7-3. APC Waste Family Demonstration Testing Sampling**

Location ID	Collection Method and Frequency	Parameter	Methods
FEED-1 FEED-2 FEED-3 FEED-4	Composite grab from waste material fed into the dryer	VOC	8260
		SVOC	8270
		pH TS	9045 160.3
		TPH Metals	418.1 6010/7471
		Radioactive isotope Analysis**	Various lab methods
PROC-1 PROC-2 PROC-3 PROC-4	Composited from grab samples as processed material is discharged from the TD unit, or three grabs per process cycle of processed material	VOC	8260
		SVOC	8270
		pH TS	9045 160.3
		TPH Metals	418.1 6010/7471
		Radioactive isotope Analysis**	Various lab methods
ORG-1 ORG-2 ORG-3 ORG-4	Grab sample from condensate transfer tank recirculation line; once at end of each process cycle	VOC	8260
		SVOC	8270
		pH	150.1
		Fuels* TPH Metals	- 418.1 6010/7471
		Radioactive isotope Analysis**	Various lab methods
VENT-1 VENT-2 VENT-3 VENT-4	Method 0010; 240 minutes Method 23; 240 minutes Method 18; 240 minutes Method 26A; 240 minutes	SVOC	8270
		PCDD/PCDF	8290
		VOC	8260
		HCl	26A
	Continuous gas monitoring or grab samples; to be submitted to DRC	Radioactive emission gas analysis***	Continuous or grab samples

	Method 5; 240 minutes	PM – radioactive isotope analysis ***	Various lab methods
	Method 5; 240 minutes	PM	5
	Method 10; continuous	CO	10
	Method 29; 240 minutes	Metals	6010/7471
	Method 9	Visible emissions	9
FURNACE-1 FURNACE-2 FURNACE-3 FURNACE-4	Method 9	Visible emissions	9

All applicable analytical methods that report chromatograph results shall include a report of all TICs and an analysis of TICs at 85% probability match of the spectral standard library.

- \* Fuels = Fuels recycling parameters: Heating value (BTU content), Method ASTM D-240; total chlorine; total sulfur.
- \*\* = Shall meet radioactive concentration limits in the Permittee's Radioactive Materials License.
- \*\*\* = Shall not exceed effluent concentration limits for specific materials in UAC R313-15-302

**FEED-1, 2, 3 and 4:** Mixed waste shall be utilized for the APC Waste Family Demonstration Testing. Feed samples shall be collected while the material 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. A hoist that is mounted to the TD unit lifts the drums. An operator stands on a gallery platform located at the feed hopper to collect this sample. The sampler will collect aliquots by grabbing a quantity of feed material from the top, middle, and bottom of each drum as the material falls into the hopper. The grab samples shall be collected using a stainless steel scoop or spoon and placed in a stainless steel collection bowl for compositing. The composite sample shall be divided and analyzed for VOCs, SVOCs, radiological compounds, pH, total petroleum hydrocarbon, and metals (total and TCLP).

For liquid feed materials that are pumped directly into the dryer, three grab samples shall be collected and composited from each liquid waste container prior to the initiation of pumping operations. The composite sample shall be divided and analyzed for VOCs, SVOCs, total solids, radiological compounds, pH, total petroleum hydrocarbon, and metals (total and TCLP).

**PROC-1, 2, 3, and 4:** Processed material shall be sampled and analyzed to verify compliance with LDR standards. Samples shall be collected from the discharge conveyor or from the processed material container. Samples shall be collected using a stainless steel scoop or spoon and composited within a stainless steel collection bowl. At least three samples shall be taken and composited from the processed material. Samples shall be collected from the discharge chute of the

conveyor by placing the scoop or spoon directly into the flow through a sampling port designed into the system. Samples shall be collected near the beginning, middle, and end of discharge into the processed material container. All samples from individual process cycles shall be composited into a single sample. Alternatively, grab samples may be collected from three random locations within the processed material container, after all of the processed material has been discharged into the container. Only one composited sample shall be needed for each of the APC Waste Family Demonstration Testing process cycles.

The composite sample shall be divided and analyzed for VOCs, SVOCs, total solids, radiological compounds, pH, total petroleum hydrocarbon, and metals (total and TCLP).

**ORG-1, 2, 3, and 4:** Condensate shall be collected and analyzed to determine whether chemical decomposition has occurred. Condensate samples shall be collected from each process cycle within the APC Waste Family Demonstration Testing. The condensate transfer tank contains a recirculation line. In order to obtain representative samples from the condensate transfer tank, the condensate shall be recirculated for at least five minutes prior to collecting the sample. The condensate samples shall be collected from a sampling access port located within the recirculation line. The sample shall be collected by opening the valve in the sample access port, purging the sample line into a container, and then collecting samples directly into prepared sample containers. After the samples have been collected, the purged material will be returned to the condensate tank or an appropriate container. The composite sample shall be divided and analyzed for VOCs, SVOCs, radiological compounds, pH, total petroleum hydrocarbon, total solids, fuels recycling parameters, and metals (total and TCLP). If the process cycle generates more condensate than the capacity of the transfer tank, samples shall be collected and composited before condensate is discharged from the transfer tank.

**VENT-1, 2, 3, and 4:** Vent samples shall be collected and analyzed to determine REs. These samples shall be collected through an access port located after the 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, volatile and semi-volatile compounds. The flow rate of the emission gas ranges from 10 to 75 scfm and is at ambient pressure. Generally, variations in flow rate are expected during the process cycle but will be limited during a majority of the test. In order to test the condenser's ability to remove contaminants, the maximum emission gas flow shall be attained at some time during the sampling event, especially during the water vaporization phase.

The emission gas access port is a two-inch pipe, on grade level, in the vent hose between the carbon adsorption beds. A tee shall be inserted in the access port so that gas samples can be withdrawn according to 40 CFR 60 Appendix A methodology. This tee shall have an integral static mixer at its inlet.

As identified in Table 7-3, seven separate samples shall be collected for each process cycle. The results of these analyses shall be used for RE calculations, to determine whether dioxins or furans were formed, to determine whether chemical breakdown occurred, HCl content determination, particulate matter determination (radioactive and non-radioactive), metals determination, and carbon monoxide determination. In support of these analyses, EPA methods 1 through 4 shall be performed to characterize the emission gas velocity, moisture content, molecular weight, and carbon dioxide concentration.

In addition to the above samples, the Permittee shall employ EPA Method 9 to assess the opacity of the process vent stream leaving the stack, and this observation shall be performed by someone who is certified in opacity measurement.

**FURNACE-1, 2, 3, and 4:** These observations are visual determinations for opacity of emissions from the furnace exhaust stack. The Permittee shall employ EPA Method 9 to assess the opacity of the furnace exhaust leaving the stack, and this observation shall be performed by someone who is certified in opacity measurement.

*7.4.2 Operational Waste Family Demonstration Testing Phase*

Sampling requirements for Operational Waste Family Demonstration Testing are provided in Table 7-4. An explanation of each sample mentioned in Table 7-4 is provided below.

The sampling protocol in Table 7-4 is specific to the waste families that are being tested within this Waste Family Demonstration Testing.

**Table 7-4. Operational Waste Family Demonstration Testing Sampling**

Location ID	Collection Method and Frequency	Parameter	Methods
FEED-#	Composite grab from feed material	VOC	8260
		SVOC	8270
		Radioactive isotope analysis **	Various lab methods
		pH	9045
		TS	160.3
PROC-#	Composite of three grabs per container of processed material	Metals	6010/7471
		TPH	418.1
		VOC	8260
		SVOC	8270
		Radioactive isotope analysis **	Various lab methods

		pH TS TPH Metals	9045 160.3 418.1 6010/7471
ORG-#	Grab sample from condensate transfer tank recirculation line; once per process cycle	VOC	8260
		SVOC	8270
		TPH	418.1
		Radioactive isotope analysis **	Various lab methods
		pH Fuels* Metals	150.1 - 6010/7471
VENT-# FURNACE-#	Grab sample from between carbon adsorption beds Method 9	Grab Sample***	Various lab methods
		Visible emissions	9

All applicable analytical methods that report chromatograph results shall include a report of all TICs and an analysis of TICs at 85% probability match of the spectral standard library.

- \* Fuels = Fuels recycling parameters: Heating value (BTU content), Method ASTM D-240; total chlorine; total sulfur.
- \*\* = Shall meet radioactive concentration limits in the Permittee's Radioactive Materials License
- \*\*\* = Shall not exceed effluent concentration limits for specific materials in accordance with UAC R313-15-302.

**FEED-#:** For feed materials, samples shall be collected as described for FEED-1, 2, 3 and 4 in Section 7.4.1 of this Attachment.

**PROC-#:** For processed material, samples shall be collected as described for PROC-1, 2, 3, and 4 in Section 7.4.1 of this Attachment. Processed material shall be sampled and analyzed separately for each process cycle of the Operational Waste Family Demonstration Testing.

**ORG-#:** For condensate, samples shall be collected as described for ORG-1, 2, 3, and -4 in Section 7.4.1 of this Attachment. Condensate shall be sampled and analyzed separately for each process cycle of the Operational Waste Family Demonstration Testing.

**VENT-#:** One emission gas sample shall be collected. This sample shall be collected from the access port located between the carbon adsorption beds. This sample shall be collected using a filter or a grab sampling method. The Permittee shall employ EPA Method 9 to assess the opacity of the process vent stream leaving the stack, and this observation shall be performed by someone who is certified in opacity measurement.

**FURNACE-#:** One emission gas sample shall be collected. This sample is a visual determination for opacity of emissions from the furnace exhaust stack. The Permittee shall employ EPA Method 9 to assess the opacity of the furnace exhaust leaving the stack, and this observation shall be performed by someone who is certified in opacity measurement.

#### 7.4.3 *Duplicate Samples and Field Blanks*

The quality of the sampling events shall be assessed through duplicate samples and field blanks. These quality samples include duplicates, field blanks, and equipment blanks (collected from rinsate from the sampling equipment after decontamination from a prior sampling event). Duplicates, 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-1-EB would be the equipment blank sample collected from the first feed material sample for the Operational Waste Family Demonstration Testing.

Duplicates and field blanks shall be collected for VOC and SVOC analyses conducted during Waste Family Demonstration Testing. Metals analyses shall also be examined for any Operational Waste Family Demonstration Testing PROC samples that are duplicated.

At a minimum, during Waste Family Demonstration Testing, a duplicate will be required for the following:

- one of the PROC samples from the APC Waste Family Demonstration Testing;
- one of the ORG samples from the APC Waste Family Demonstration Testing;
- one of the FEED samples from the Operational Waste Family Demonstration Testing; and
- one of the PROC samples from the Operational Waste Family Demonstration Testing.

At least nine duplicate samples shall be taken during Waste Family Demonstration Testing; two from each for the first three bullets above (VOC and SVOC) and three for the last bullet (VOC, SVOC, and metals). These duplicate samples will be chosen randomly from the suite of samples collected during Waste Family Demonstration Testing.

Duplicate solid samples shall be collected from the composite sampling bowl. Duplicate liquid samples shall be collected from the same sample access port immediately after filling the initial sample.

Additionally, at least two equipment blanks and two field blanks shall be collected during each of the two demonstration phases. All blank sample

collection times and dates, as well as results, shall be documented in the Post-Waste Family Demonstration Testing Report.

#### **7.5 *Secondary Waste Streams***

The TD unit will generate secondary waste streams that include spent filters and spent carbon adsorption media. However, the limited waste required for 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.

#### **7.6 *Quality Assurance***

All data collected during Waste Family Demonstration Testing shall be generated following EPA's SW-846 quality assurance requirements. The Permittee shall maintain on-site, a Quality Assurance Manual that conforms to SW-846.

## Section 8 – Reporting

A Post-Waste Family Demonstration Testing Report shall be submitted to the Executive Secretary within 120 days of Waste Family Demonstration Testing completion. At a minimum, the 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;
- all alarm logs recorded by the computer from the PLC data management system during the 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;
- inspection forms completed in preparation of, and during, the Waste Family Demonstration Testing; and
- analytical laboratory reports, including laboratory quality control data, for all of the samples listed in Tables 7-3 and 7-4.

The Permittee shall submit all raw data in the Post-Waste Family Demonstration Testing Report. Accepted surrogate recoveries shall fall within the SW-846 method 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 (and process run) shall be tabulated and the results explained in the Post-Waste Family Demonstration Testing Report. Operating Parameters shall be tabulated for each process cycle including dryer temperature (high and low), the solids temperature (high and low), the system pressure (high and low), and the processing times (feed time, cycle time, hold time, etc.).

Calculations showing REs and the fate of POHCs and other hazardous components shall be performed and detailed within the Post-Waste Family Demonstration Testing Report.

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

### 9.1 Personnel

Key personnel for this Waste Family Demonstration Testing include:

- TD\*X Thermal Engineer, Carl R. Palmer, P.E.
- TD\*X Operations Manager, Gregg Meyers
- The Permittee's Mixed Waste Operations Manager, Jesse Garcia
- The Permittee's Director of Technology Solutions, Paul Larsen
- The Permittee's Environmental Engineer, Timothy L. Orton, P.E.
- The Permittee's Quality Assurance Manager, Robert R. Reifsnnyder
- The Permittee's Site Radiation Safety Officer, Dan Jordan
- The Permittee's Site Safety Officer, Zeke Wilmot
- The Permittee's Lab Manager, Kurt Fogleman

Operations personnel for Waste Family Demonstration Testing shall work under the direct supervision of Gregg Meyers, Carl Palmer, or Jesse Garcia. Health physics support shall be supervised by Joe Heckman.

Waste Family Demonstration Testing will 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 will be conducted by TD\*X personnel, certified in accordance with the training requirements of Attachment II-4, *Personnel Training Plan*, during Waste Family Demonstration Testing. At least two qualified TD operators shall be present at all times during operation of the TD unit. Site personnel shall manage the waste prior to processing within the TD unit.

#### 9.1.1 Sampling and Analytical Support

All of the laboratories listed below shall be accredited through the National Environmental Laboratory Accreditation Conference (NELAC).

- The analytical laboratory for the analysis of soils, waters, and oil shall be Mountain States Analytical, Inc., located in Salt Lake City, Utah. This lab shall complete most of the process monitoring samples from Waste Family Demonstration Testing. Mountain States Analytical, Inc. is a Utah certified laboratory.

- The emissions test contractor shall be URS Corp (formerly Radian International) located in Sacramento, California. This contractor will perform required process vent sampling during Waste Family Demonstration Testing. URS Corp is certified in source emission testing and has the necessary staff, expertise, and equipment to perform this function, and has done so on numerous similar tests for hazardous waste treatment units.
- The emissions test lab shall be Severn Trent Laboratories (STL) located in Sacramento, California. This lab shall analyze most of the process vent samples supplied by the emissions test contractor.
- A second emissions test lab, Air Toxics Ltd, located in Folsom, California shall analyze the volatile organic sample train (VOST) samples generated by the emissions test contractor.
- Alta Analytical Perspectives, out of Wilmington, North Carolina shall perform dioxin and furan analyses on the processed material and process vent samples.

Other accredited laboratories and test contractors may be used. Acceptable laboratory accreditation is described in Section II.4.a. of Attachment II-1, *Waste Analysis Plan*. Any changes in testing laboratories, procedures, or sampling contractors shall be submitted to the Executive Secretary for approval.

## 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 principals of TD\*X originally developed this technology for Chemical Waste Management in the early 1990's. Chemical Waste Management (RUST Environmental at the time) moved in another direction and the TD\*X principals were allowed to branch off and form their own company to refine the technology. Past experience of TD\*X using TD technology similar to the system designed for the Permittee includes the following:

- uranium and plutonium organic waste at two US DOE facilities,
- mixed fission products for a power plant,
- radium from US DOE/UMTRA, and
- mixed fission products from a US DOE production reactor.

The TD\*X system is a second-generation improvement to the X\*TRAX system that was employed in US EPA tests in the early 1990's. Appendix A contains reported data from laboratory, pilot, and full-scale processing using the X\*TRAX unit.

A US EPA Superfund Innovative Technology Evaluation (SITE) demonstration was conducted in May, 1992. The SITE report summary (provided in Appendix A) confirms that the system was successful in removing PCBs from feed soil. The PCB concentrations in the treated soils were less than 1 ppm with an average concentration of 0.25 ppm. There were no polychlorinated dibenzo-p-dioxins (PCDD) or polychlorinated dibenzofurans (PCDF) formed in the system. Organic air emissions were negligible, 0.4 g/day. Concentrations of tetrachloroethene, total recoverable petroleum hydrocarbons, and oil / grease were all reduced to below detectable levels in the treated soils. Metal concentrations and soil physical properties were not altered by the system.

A report detailing all X\*TRAX testing was presented at the “Remediation of Contaminated Sites Regulations and State of the Art Technologies” conference in May, 1993. A copy of this report is also provided in Appendix A. This report contains five years of laboratory, pilot, and full-scale testing of the X\*TRAX system. The report shows that the unit was very successful in treating PCBs, VOCs, and SVOCs and formed no PCDDs or PCDFs.

In a 1996 pilot test for Rocky Flats, plutonium contaminated granular absorbent media and PPE were processed. The Pu-239 level of the feed was approximately 70 nCi/g with F001, 2, 4, and 5 waste codes. No plutonium was found in the condensate or vent system.

Pilot-scale studies were also completed 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 this time.

#### **9.4 *Radiation Monitoring***

All waste feed material treated during the Waste Family Demonstration Testing shall be mixed waste.

Grab samples (frequency defined in Tables 7-3 and 7-4) shall be collected from the effluent of the stack and analyzed for radiological parameters. Samples will be analyzed by gross alpha and beta counting, and by gamma spectroscopy. Additional analysis may be performed including beta scintillation or alpha spectroscopy if gross beta and gross alpha analysis indicate elevated concentrations that cannot be identified by the radionuclides in the waste or by gamma spectroscopy analysis. The appropriate sampling media shall be chosen to ensure that radionuclides in particulates and gases can be adequately measured.

During Operational Waste Family Demonstration Testing, grab samples of the off-gases shall be taken and analyzed in accordance with Section 7.4.2 of this Attachment.

## Section 10 - Acceptance Criteria

### 10.1 *Acceptance Criteria*

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

- The results of the Waste Family Demonstration Testing demonstrate that the TD unit was successful in meeting the test objectives;
- The results of the Waste Family Demonstration Testing demonstrate that the TD unit was unsuccessful in meeting the test objectives;
- The results of the 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 Waste Family Demonstration Testing shall be determined to be successful if the following acceptance criteria are met:

- The processed material meets LDR standards for volatile and semi-volatile contaminants.
- All POHC REs are greater than 99.99%.
- All known waste contaminants, other than POHCs, have REs greater than 99.99%, or are approved by the Executive Secretary based on a review of explanations, demonstrations, and/or research provided by the Permittee.
- Visual opacity monitoring is 0% for both exhaust points.
- Carbon monoxide, after dispersion modeling, is below 9 ppm (volume) averaged over an 8-hour period.
- The cancer risk, based upon exhaust concentrations, is less than  $1 \times 10^{-6}$  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 average overall total mass balance has a recovery greater than 75% of the feed.

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

- The processed material does not meet LDR standards for volatile and semi-volatile contaminants;
- POHC REs are less than 99.99%;
- Visual exhaust is observed;
- Known waste contaminants within the waste matrix, other than POHCs, have REs less than 99.99% or that have not been approved by the Executive Secretary;
- Calculated dispersed carbon monoxide emissions are greater than 9 ppm (volume) averaged over an 8-hour period;
- The cancer risk is greater than  $1 \times 10^{-6}$  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;
- Compounds identified in the condensate or exhaust gas stream differ from those identified in the waste matrix;
- Conditions in the Permittee's Radioactive Materials License are not met;
- The off-gas exceeds the effluent concentration limits for specific materials in accordance with UAC R313-15-302; or
- The average overall total mass balance has a recovery less than 75% of the feed.

The Permittee shall submit the results of the Waste Family Demonstration Testing in the 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 Post-Waste Family Demonstration Testing Report.

## **10.2 Efficiency Calculations**

Three process efficiencies shall be calculated using the POHC and known contaminant data. These efficiency calculations shall be performed using data collected during the Waste Family Demonstration Testing. The masses required for these efficiency 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 POHC fed into the dryer which will be measured directly).

### 10.2.1 Removal Efficiency Calculation Criteria

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

$$RE = \frac{\text{mass}_{\text{feed}} - \text{mass}_{\text{off-gas}}}{\text{mass}_{\text{feed}}} \times 100$$

where,

$\text{mass}_{\text{feed}}$  = the mass of the POHC fed into the dryer,

$\text{mass}_{\text{off-gas}}$  = the mass of the POHC found in the off-gas,

The  $\text{mass}_{\text{feed}}$  shall be calculated by multiplying the total feed by the POHC concentration. The  $\text{mass}_{\text{off-gas}}$  is calculated by multiplying the vent gas flow rate by the POHC concentration.

### 10.2.2 Treatment Efficiency Calculation Criteria

Treatment efficiency (TE) shall be calculated to determine the efficiency of treatment between the feed and the processed material using the following formula:

$$TE = \frac{\text{mass}_{\text{feed}} - \text{mass}_{\text{processed}}}{\text{mass}_{\text{feed}}} \times 100$$

where,

$\text{mass}_{\text{feed}}$  = the mass of the POHC fed into the dryer, and

$\text{mass}_{\text{processed}}$  = the mass of the POHC in the processed material.

The  $\text{mass}_{\text{feed}}$  shall be calculated by multiplying the total feed by the POHC concentration. The  $\text{mass}_{\text{processed}}$  is calculated by multiplying the processed material total by the POHC concentration.

### 10.2.3 Condenser Efficiency Calculation Criteria

Condenser efficiency (CE) shall be calculated to determine the recovery efficiency of the condenser system using the following formula:

$$CE = \frac{\text{mass}_{\text{condensate}}}{\text{mass}_{\text{feed}}} \times 100$$

where,

$\text{mass}_{\text{feed}}$  = the mass of the POHC fed into the dryer, and

$\text{mass}_{\text{condensate}}$  = the mass of the POHC in the condensate.

The  $\text{mass}_{\text{feed}}$  shall be calculated by multiplying the total feed by the POHC concentration. The  $\text{mass}_{\text{condensate}}$  is calculated by multiplying the condensate total by the POHC concentration.

### **10.3 Material Mass Balance Calculation**

Historically, in TD\*X's pilot testing operations on a similar scale to this TD unit, overall mass balance recovery calculations based upon operational data have provided a recovery of total mass greater than 75%, and often in the range of 90 to 110%. If the measured recovery of the total mass is less than 75%, an engineering evaluation shall be made to determine the reason for this low result. An explanation and the results of this engineering analysis shall be provided in the Post-Waste Family Demonstration Testing Report.

The Permittee shall use data collected during Waste Family Demonstration Testing to calculate the material mass balance for the TD unit using the following formula:

$$\text{Total mass}_{\text{feed}} = \text{Total mass}_{\text{processedmaterial}} + \text{Total mass}_{\text{condensate}} + \text{Total mass}_{\text{off-gas}}$$

where,

$\text{Total mass}_{\text{feed}}$  = the total mass of all material introduced into the dryer,

$\text{Total mass}_{\text{processedmaterial}}$  = the total mass of the processed material,

$\text{Total mass}_{\text{condensate}}$  = the total mass of the condensate, and

$\text{Total mass}_{\text{off-gas}}$  = the total mass of the off-gas.