Trial Burn Plan for the Drake Chemical Superfund Site's Mobile Hazardous Waste Incinerator

Volume I
Trial Burn Plan

For OHM Remediation Services Corp.

MRI Project No. 3620-09-21

Revised
September 20, 1996
 APPROVALS

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PREFACE

This trial burn plan and associated quality assurance plan were prepared by the Applied Engineering Department of Midwest Research Institute (MRI) for OHM. This trial burn plan is for the hazardous waste incinerator to be located at the Drake Chemical Superfund Site, Lock Haven, Pennsylvania.

Approved for:

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September 18, 1996
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SECTION 1

INTRODUCTION

The primary objective of this testing program is to determine the ability of the incinerator to be installed by OHM at the Drake Superfund Site (Drake) to meet the performance standards and facility design criteria of the Drake specifications, while thermally treating contaminated soil containing selected Principal Organic Hazardous Constituents (POHCs). This trial burn demonstration is intended, at a minimum, to satisfy the permit requirements for the incinerator operated as part of the cleanup effort specified in the Record of Decision (ROD).

Three test runs will be conducted under the same operating conditions during this trial burn. The operating conditions will represent maximum input of soil taken from the contaminated areas and fed to the incinerator operating at minimum combustion temperature and maximum combustion gas flow rate.

Results of the test burn will be evaluated to determine the status of the incinerator’s operation with respect to the performance standards of 40 CFR 264.343, and Title 25 Pennsylvania Code Section 264.343, as follows:

- Stack gas will be continuously monitored for CO, O₂, CO₂, THC, and NOₓ.
• Particulate emissions shall not exceed 0.01 gr/dscf, corrected to 7 percent oxygen (O₂) equivalent.

• Hydrochloric acid (HCl) emissions shall not exceed 4 lb per hour, or shall be reduced by 99 percent on an hourly average, in accordance with 40 CFR 264.343.

• Carbon monoxide (CO) emissions shall not exceed 100 ppmv as an hourly running average corrected to 7% O₂ equivalent.

• Dioxin and furan emissions, expressed as total dioxin/furans, shall not exceed 30 ng/per cubic meter, corrected to 7 percent O₂, equivalent.

• NOx emissions, expressed as NO₂, shall not exceed 300 ppmv, on a daily average (corrected to 7 percent O₂, equivalent).

• Metals emissions shall be in compliance with Title 25 of the Pennsylvania Code, Section 127.1, and 40 CFR 266.106.

The trial burn will also demonstrate the facility's ability to meet the ash quality criteria of 55 ppb β-naphthylamine and establish ash treatment quality criteria for other volatile and semivolatile compounds.

The solid waste feed will be spiked with two POHCs (naphthalene and 1,4-dichlorobenzene) during the tests. In addition, the solid waste feed will be spiked with the five metals for which Tier-III based permit limits are needed (As, Be, Cd, Cr, and Pb). Waste feed may contain up to 0.25% Cl in some instances, equivalent to a Cl input rate of 300 lb/hr. The trial burn will thus supply feed rate

a Correction to 7% O₂ equivalent will be based on CO₂, as explained in Appendix B.
information and demonstrated performance data to support issuance of the operating conditions for remediation of the Drake site.

Details for the trial burn are presented in subsequent sections of this trial burn plan. Section 2 provides a description of the facility. Section 3 describes the trial burn conditions including the incinerator operating conditions, waste feed characteristics, and recommended POHCs for the trial burn. The sampling, monitoring, and analysis protocols are presented in Section 4. Sections 5 and 6 present summaries of the sampling and analysis procedures, respectively. Section 7 describes the information to be presented in the Trial Burn Report. The QAP for the trial burn is included as Volume II.
OHM will use a transportable rotary kiln incinerator to treat site waste at the Drake Chemical Site. OHM's proprietary design, the PY*ROX™ 8212 Transportable Incinerator Facility (IF) is a scaled-up version of the PY*ROX™ 8200 IF which has been previously permitted and used on three superfund cleanup sites at Prentiss, Mississippi; the Bog Creek Farm Superfund Site in Howell Township, New Jersey; and Old Midland Products Site in Ola, Arkansas.

The incineration system includes a rotary kiln incinerator, particularly well suited for processing the waste at the Drake Chemical Site due to its inherent ability for processing a wide variety of waste feed compositions and its ability to handle oversize feed material with minimal feed preparation. The rotary kiln operation allows feed of a wide range of soil types and consistencies.

The incineration system also includes a Secondary Combustion Chamber (SCC) and Air Pollution Control (APC) System utilizing proven technologies to ensure destruction of organics and compliance with regulatory agency emission requirements. Finally the IF also includes the utility systems required to support safe and efficient operation of the incineration system.

The information presented in this document describes the design planned for the Drake Chemical Site Remedial Activities. The following sections provide a description of the IF design.
2.1 APPLICABLE AND/OR RELEVANT AND APPROPRIATE REGULATIONS

Because this effort is being executed under CERCLA protocol, no federal (U.S. EPA) or state permits will be required. However, the substantive requirements of these permits must be complied with. Therefore, OHM has designed the IF in accordance with background data contained in the specifications, documentation, design, and procedural requirements contained in applicable federal and state statutes and regulations and the project specifications. This design will meet the following performance requirements:

- Allowable HCl emissions will be limited to 4 lb/hr or 1% of the HCl in the stack gas prior to pollution control (40 CFR 264.343(b) and PA Title 25 264.343(2)).

- Allowable particulate emissions will be limited to 0.01 gr/dscf corrected to 7% O₂ based on CO₂ in stack gas, as explained in Appendix B.

- The IF will be capable of achieving a destruction and removal efficiency (DRE) of 99.99% of the POHCs (40 CFR 264.343(a) and PA Title 25 264.343(1)). (This will be demonstrated using naphthalene and 1,4-dichlorobenzene.)

- Metals emissions shall be in compliance with 40 CFR 266.106.

- Dioxin and furan emissions shall not exceed 30 ng/dscm corrected to 7% O₂ using the CO₂ formula provided in Appendix B.

- Carbon monoxide emissions shall not exceed 100 ppmv as an hourly rolling average corrected to 7% O₂.

- Daily average NOₓ emissions shall not exceed 300 ppmv corrected to 7% O₂ using the CO₂ formula provided in Appendix B.

- The incinerator will be continuously monitored for CO, CO₂, O₂, THC, and NOₓ as required by the contract specifications.

- The incinerator will maintain a combustion efficiency of 99.9% or greater, as an 8-hr average, calculated as follows:
2.2 CHARACTERISTICS FOR PROCESS DESIGN

In determining the process design characteristics for the Drake Chemical Site Project, OHM has evaluated the type of waste (i.e., BTU value, moisture content, etc.) and physical characteristics of the soil to be incinerated. Based on composite analysis of available soil data, the IF is capable of treating up to 60 ton/hr.

An overall process flow diagram and accompanying heat and material balance data table which quantifies process flows and conditions are provided in Appendix C. This flow data represents a design case of expected maximum expected values which will be demonstrated during the trial burn.

2.2.1 SCC Effective Volume and Flue Gas Flow Calculations

The Secondary Combustion Chamber (SCC) is depicted in Figure 2-2. The effective volume for flue gas treatment within the SCC is calculated based on the internal diameter (11 ft) and the total height from the upper burner centerline to the outlet centerline elevation (73.5 ft):

SCC Effective Volume:

\[(11 \text{ ft})^2 \times \pi/4 \times 73.5 \text{ ft} = 6,981 \text{ ft}^3\]

The SCC exit flue gas flow which corresponds to a 2-sec residence time is calculated as follows:
This SCC exit flow of 209,400 ACFM is quenched to a stack gas volume of 103,100 ACFM which corresponds to a velocity of 61 ft/sec in the 6-ft diameter stack. As shown in the Heat and Material Balance in Appendix C the stack gas flow rate will be approximately 53 ft/sec, resulting in an SCC residence time above 2 seconds.

2.2.2 NO\textsubscript{x} Generation Estimate

The maximum annual quantity of NO\textsubscript{x} generated by the PY*ROX 8212 incineration system is estimated to be no greater than 98 ton/yr as NO\textsubscript{2}. This estimate is based on NO\textsubscript{x} concentrations produced by the PY*ROX 8200 incinerator during the Bog Creek Superfund site Trial Burn. PY*ROX 8212 NO\textsubscript{x} generation is expected to be somewhat lower than that from the PY*ROX 8200 incinerator due to the low NO\textsubscript{x} burners used in the SCC.

Two North American Model 4798 "Magna-Flame" burners will be utilized in the secondary combustion chamber. These burners are inherently low NO\textsubscript{x} producers. A high degree of swirl is imparted to the burner combustion air which entrains and recirculates kiln gases into the flame's primary reaction zone. This dilution effect lowers flame zone temperatures and lowers the burner's NO\textsubscript{x} formation. Test data indicate that NO\textsubscript{x} production rates of approximately 0.1 lb/MM Btu can be expected from these burners. NO\textsubscript{x} production rates from standard burners are typically 0.2 lb/MM Btu.

A summary of the "worst-case" PY*ROX 8212 NO\textsubscript{x} generation calculation, based on the PY*ROX 8200 is as follows:
1. Stack gas NO\textsubscript{x} concentration from Bog Creek Trial Burn:

<table>
<thead>
<tr>
<th>Run No.</th>
<th>NO\textsubscript{x} conc., ppm\textsubscript{v} dry, uncorrected</th>
<th>NO\textsubscript{x} conc., ppm\textsubscript{v} dry, corrected to 7% O\textsubscript{2}</th>
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<tr>
<td>I-CEM-1</td>
<td>125</td>
<td>138</td>
</tr>
<tr>
<td>I-CEM-2</td>
<td>120</td>
<td>132.5</td>
</tr>
<tr>
<td>I-CEM-3</td>
<td>115</td>
<td>128.6</td>
</tr>
<tr>
<td>Average</td>
<td>120</td>
<td>133</td>
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\textsuperscript{a} Dry CO\textsubscript{2} correction factor used, based on JAPCA article entitled "Deviation of Oxygen Correction Factors for Oxygen-Enriched Incinerators," Journal of Air & Waste Management Association, November 1989.

2. PY*ROX 8212 dry stack gas flow rate, based on the trial burn testing target of 60-ton/hr soil treatment rate is 29250 dry scfm.

3. NO\textsubscript{x} concentration in the PY*ROX 8212 stack gas, based on 133 ppm average PY*ROX 8200 corrected concentration, and 9.8% CO\textsubscript{2} (dry volume basis) in the PY*ROX 8212 stack gas, is 153 ppm\textsubscript{v} dry (uncorrected). The "uncorrected" concentration used for the PY*ROX 8212 NO\textsubscript{x} generation calculations (153 ppm\textsubscript{v}) is higher than the uncorrected concentration measured for the PY*ROX 8200 (120 ppm\textsubscript{v}) because the PY*ROX 8212 is expected to operate at a higher carbon dioxide concentration. In other words, the flue gas constituents will be less diluted in the PY*ROX 8212 stack than in the 8200 stack.

4. NO\textsubscript{x} generation during PY*ROX 8212 operation at 60 ton/hr soil treatment rate, with 93% capacity utilization is:
(29250 scfm) x (60 min/hr) x (0.000153 mole frac. NO\textsubscript{x}) x (1lb/mole/385.3 scf) x (46 lb NO\textsubscript{2}/lb-mole) x (.93) = 29.9 lb NO\textsubscript{2}/hr.

5. The PY\textsuperscript{ROX} 8212 incineration is expected to process soil 75% of the total available hours. Maximum annual NO\textsubscript{x} production is therefore.

29.9 lb/hr x 8,760 hr/yr x 0.75 x 1 ton/2,000 lb = 98 ton/yr as NO\textsubscript{2}

2.3 INCINERATION SYSTEM DESCRIPTION

This subsection provides a detailed description of the incineration system. The incineration system consists of the following components:

- Waste feed systems
- Rotary kiln incinerator
- Ash discharge systems
- Cyclone and secondary combustion chamber (SCC)
- Air pollution control (APC) system
- Utilities

The incineration system components are described below. Also included in the discussions of each component are the process control strategies employed for this system. The process control strategies are designed to operate the facility safely and efficiently. Detailed process flow diagrams which show the interconnection of system components are provided in Appendix D.

2.3.1 Waste Feed System

A belt conveyor system feeds bulk solids from the material handling system to the kiln feed hopper located above the screw feed system. The
system consists of a feed hopper, apron conveyor, and weigh belt conveyor. The apron conveyor is powered by a variable speed drive, which is used to control the feed rate of solid waste to the incinerator. The weigh belt conveyor is fitted with a weigh bridge, which is used to measure the feed rate of solid waste to the incinerator. To control potential fugitive emissions, the belt conveyor system is enclosed once it exits the feed preparation building. Inside the feed preparation building fugitive emissions are controlled by the air handling units on the building.

From the kiln feed hopper, waste is conveyed into the kiln with a dual rotor screw feeder. The screw feeder is water jacketed, and equipped with a variable speed drive. The screw feeder is powered by a 50-hp motor. The screws are fabricated of carbon steel or stainless steel.

2.3.2 Rotary Kiln Incinerator

The rotary kiln is the heart of the incineration system. Kiln rotation ensures uniform heating of wastes while providing a high throughput capacity. Wastes enter the kiln through the front end faceplate. The waste feed systems and oxygen fuel burners are located in the kiln faceplate. The kiln burners operate on oxygen and fuel. The burners themselves typically operate between 80% and 110% of the stoichiometric oxygen to fuel ratio. There is also air introduced into the kiln by inleakage and by an air blower which results in operating at approximately stoichiometric to 25% excess oxygen. The air introduced to the kiln is shown as stream 29 of the heat and material balance contained in Appendix C. The amount of this air that is expected to be due to air inleakage is approximately 1500 SCFM.
Solids progressing through the kiln by gravity pass through three phases: drying/volatilization, ignition, and burnout. Burnout can be described as the removal of organics from the inert portion of the incinerator feed.

Three factors can affect burnout including solids retention time (typically 30 minutes), oxygen/solid contact, and the kiln operating temperature. The rate of travel, or solid retention time, is determined by the slope and geometry of the kiln, rotational speed, and material conveying characteristics.

Oxygen/solids contact in a kiln is a function of oxygen concentration and inside peripheral velocity of the kiln. The peripheral velocity is calculated as the inside circumference times revolutions per minute (rpm). As this velocity is increased, the solids are carried higher up the kiln wall allowing more intimate mixing with the oxygen in the combustion gases.

Kiln operating parameters control the exit gas temperatures between 1000° and 1400°F while maintaining desired gas velocities. Although vigorous gas/solids contact is desirable at the front end of the kiln, the gas turbulence at the kiln outlet is sufficiently low to minimize entrainment of fine solids (particulate carryover) out of the kiln. Ash exiting the kiln discharges into the ash discharge system.

Rotary Kiln System

The rotary kiln shell has an inside diameter of 11 ft and a length of 60 ft. It is shown schematically in Figure 2-1. The shell is fabricated from ¾-in-thick plate with heavier plate sections under the two tires.
Figure 2-1. Schematic of rotary kiln.

ROTARY KILN

12' x 60'

3/4" Carbon Steel

Steel Chain Sprocket Drive

11' DIA

Refractory
• **Supporting Trunnion Mechanisms**—There are two sets of supporting trunnion mechanisms, each consisting of two rollers with shafts and bearings on a structural steel base. One set of trunnions also includes a thrust roller mechanism to control the longitudinal movement of the cylinder. The thrust roller mechanism consists of two rollers and bearings. The rollers are cast steel with the same material characteristics as the kiln tires.

• **Kiln Drive**—The kiln drive system is powered by a 150-hp motor and variable-speed gear reducer connected to a girt gear. The kiln variable speed drive allows for the adjustment of the kiln rotating speed from 0.5 to 3 rpm. An emergency drive consisting of a 10-hp, 480-V electric motor is connected to the main gear reducer by an overrunning clutch coupling. The emergency drive rotates the kiln at 0.1 rpm during periods of main kiln drive failure or power outages. This enables continuation of the kiln rotation, providing burnout of wastes remaining in the kiln and preventing warping of the kiln shell.

• **Kiln End Seals**—The kiln seals are flexible stainless-steel type composed of overlapping, adjustable, stainless-steel spring plates. The sealing edges of each plate, which rest on the kiln shell, are fitted with a sintered-metal wear shoe similar to a brake shoe. The powdered metal formulation for the seal shoes includes graphite granules which make the shoes self-lubricating.

• **Kiln Discharge Chamber**—The discharge chamber connects the kiln to the hot gas cyclone and SCC. This chamber is sized to reduce the gas velocity and dropout large particulates carried in the kiln exit gas stream. Kiln bottom ash collected in the bottom of the discharge chamber and ash collected in the cyclone and SCC are combined and removed by the ash discharge system.

• **Kiln Refractory**—The kiln is lined with a 5½-in-thick, high-fired, super-duty firebrick backed with a ½-in-thick insulating board. Therefore the inside diameter of the kiln (including refractory) is 11 ft. The kiln faceplate and discharge chamber are lined with 6 in of refractory.

• **Kiln Faceplate**—All kiln feeds enter through the kiln faceplate. The faceplate contains openings for oxygen-fuel burners, feed screw sludge lance, and water lance. [Note: Neither the sludge lance nor water lance are being used at the Drake site.]
• Kiln Burner—Two oxygen-fuel burners installed in the kiln faceplate are designed to burn natural gas or propane. These burners are each rated at a nominal 30 million Btu/hr. The two kiln burners operate on pure oxygen.

The incinerator system operates in an oxygen-enriched combustion environment. The use of oxygen or oxygen-enriched air in place of air for incineration improves the overall performance and efficiency of rotary kiln incinerators by enabling throughput increases, better DRE and better mobility. As oxygen replaces part or all of the air for incineration, the nitrogen portion is reduced in both the oxidant and the flue gas. Therefore the volumes of the oxidant and flue gas are reduced per unit of waste processed. In addition, the concentration of oxygen in the fuel/oxidant mixture is increased.

Natural gas is fired in the kiln burner as required to maintain temperature in the kiln discharge. Natural gas is fed to each burner on flow control which is cascaded to temperature. A burner management system is installed to control burner light-off, operation and shutdown. The system is designed to control the air purge cycle prior to burner light-off; to control the lighting of the burner; and to monitor the flame, combustion oxygen supply pressure, and fuel supply pressure. The burner management system is interlocked to immediately close the fuel double-lock valves when unsafe conditions occur.

2.3.3 Ash Discharge System

The incineration system is provided with a series of conveyors designed to segregate incinerator ash into two main categories; bottom ash and fly ash. Bottom ash consists of kiln bottom ash, cyclone ash, and SCC ash and slag. Fly ash consists of evaporative cooler ash and baghouse ash. Bottom ash is conveyed to the bottom ash storage area, and fly ash is conveyed to the fly ash
area. To control fugitive emissions, conveyors utilized in the incineration system before the ash has been wetted are enclosed. After the ash has been wetted it is transferred on belt conveyors. The ash system is constructed of carbon steel.

In each ash storage area, each day's production of ash is separated for testing to verify that it meets disposal requirements. The following summary describes the primary ash conveying devices and methods of ash stream handling at each incinerator collection point:

**Primary Ash Conveyor Devices**

- **Kiln Dry Ash Drag Conveyor**—The kiln dry bottom ash drag conveyor collects all incineration system bottom ash and transfers it to the ash storage area. Incineration system ash enters the conveyor from two points; kiln bottom ash from the kiln discharge chamber and combined cyclone/SCC ash from the bottom ash transfer screw conveyor. Due to the amount of heat contained in the bottom ash, it is necessary to cool the ash. Scrubber blowdown and process water is sprayed into the conveyor to provide this cooling.

- At the top of the inclined portion of the kiln dry ash drag conveyor the ash stream falls through a double flap valve into a wet ash drag. The wet ash drag uses scrubber blowdown and process water to further cool and wet the ash for fugitive emission control. This wet ash drag discharges the wetted ash onto a belt conveyor which transfers the ash into the ash storage area.

- **Bottom Ash Transfer Screw Conveyor**—The bottom ash transfer screw conveyor provides collection for the Cyclone and SCC ash streams. Ash is transferred by this conveyor to the kiln dry ash conveyor.

- **Fly Ash Transfer Screw Conveyor System**—The fly ash transfer screw conveyor system provides collection for the Evaporative Cooler and Baghouse Fly Ash. Ash is transferred by enclosed screw conveyors to the fly ash wetting pugmill. The wetting pugmill cools and wets the ash prior to discharge into the fly ash storage area.
Bottom Ash Collection Points

- Kiln Bottom Ash—Kiln bottom ash which is by far the major portion of solid residue collected by the incinerator, is removed from the bottom of the kiln discharge chamber by the kiln dry ash conveyor. The bottom ash falls from the discharge chamber directly onto the kiln dry ash conveyor.

- Cyclone Bottom Ash—Ash collected in the cyclone bottom discharges through a dump valve and is conveyed by a screw conveyor to the bottom ash transfer screw conveyor.

- SCC Slag and Bottom Ash—Slag and ash fall from the SCC into a water cooled screw conveyor. This conveyor feeds cooled ash via a transfer screw to the bottom ash transfer screw conveyor.

- The transfer conveyor collects the cyclone and SCC ash and discharges them into the kiln dry ash conveyor.

Fly Ash Collection Points

- Evaporative Cooler Fly Ash—Ash collected in the evaporative cooler falls into a screw conveyor. The screw conveyor feeds ash into the fly ash collection screw conveyor.

- Baghouse Fly Ash—Ash collected in the six baghouse compartments is collected in the trough hopper sections of the compartments. Three screw conveyors, each one servicing two baghouse compartments, remove fly ash from the trough hoppers. The three conveyors feed the fly ash collection conveyor, which transfers ash to the fly ash transfer screw conveyor system.

- The fly ash is then transferred through a series of enclosed screw conveyors to the wetting pugmill.

- The wetting pugmill transfers the ash into the fly ash storage area. While the ash is in the pugmill it is cooled and wetted using process water.
2.3.4 Cyclone and Secondary Combustion Chamber (SCC)

Hot flue gases from the kiln are discharged through a hot gas cyclone into the SCC. The hot gas cyclone is a refractory-lined vessel that removes a portion of the particulate carry-over from the flue gases prior to their introduction into the SCC. The SCC is a vertical cylindrical chamber with a burner located at the base of the unit. The SCC will operate at a minimum temperature of 1650°F (determined by the trial burn) to achieve 99.99% DRE for other POHCs, with a minimum gas retention time of two seconds in the SCC.

The refractory-lined cyclone, SCC, and interconnecting ducts all have large cross-sectional areas to provide for a relatively low gas velocity. The large cross-sectional area of the ducts minimize the pressure drop between the discharge chambers and the SCC.

Cyclone

The hot gas cyclone is a vertical cylindrical vessel with a conical base and tangential gas inlet. The chamber is fabricated from $\frac{3}{8}$-in plate with 6 in of gunned high temperature refractory lining. Ash collected in the cyclone discharges through a dump valve in the bottom of the cyclone.

Secondary Combustion Chamber (SCC)

The SCC is a vertical, refractory-lined vessel, fabricated from $\frac{1}{2}$-in plate and lined with 9 in of high temperature refractory. It is shown schematically in Figure 2-2. The required turbulence within the SCC is provided with the SCC burners firing perpendicularly into the flow of the kiln flue gases. An oxygen
Figure 2-2. Schematic diagram of Secondary Combustion Chamber.
lance is provided in the SCC to improve combustion efficiency. Gases exit the SCC from the top and go to the APC system.

Slag and ash collected from the SCC are removed by the ash discharge system. The following paragraphs provide detail on components of the SCC.

- **Thermal Relief Vent (TRV)**—A refractory-lined emergency thermal relief vent (TRV) is installed at the top of the SCC for releasing hot combustion gases. A damper, held in the closed position by a pneumatic cylinder, opens in the event of power failure or certain process interlocks. Conditions under which the TRV may be opened are described in the subsection "Incineration System Operation".

- **Refractory**—The SCC walls and roof are lined with 9 in of refractory. In addition to ash cleanout doors, manways also provide additional access into the chambers for inspection and maintenance.

- **SCC Burners**—Two North American Model 4796 "Magna Flame" burners, rated at 55 million Btu per hour each, provide heat to the SCC. Natural gas is fired in the SCC burner, as required to maintain the exiting flue gas temperature. Natural gas is fed to each burner on flow control cascaded to temperature. These burners have low NO\textsubscript{x} production, due to a high degree of swirl imparted to the burner combustion air which entrains and recirculates combustion gases into the flame’s primary reaction zone. This re-entrainment of combustion gases results in a lower flame zone temperatures which lowers the burner’s NO\textsubscript{x} formation. Test data indicate that NO\textsubscript{x} production rates of approximately 0.1 lb/MM Btu can be expected from these burners, while standard industrial burners are typically in the range of 0.2 lb/MM Btu.

A burner management system is installed to control burner light-off, operation and shutdown. The system controls the air purge cycle prior to burner light-off; to control the lighting of the burner and monitors the flame, combustion air supply pressure, and fuel supply pressure. The burner management system is interlocked to immediately close the fuel double-block valves when unsafe conditions occur.

The SCC is also equipped with an oxygen lance to improve combustion efficiency when needed. This lance is expected to be used when carbon monoxide levels in the stack are increasing or when the oxygen levels in the SCC are dropping, in order to improve combustion in the SCC and minimize formation of CO.
2.3.5 Air Pollution Control (APC) System

The APC system conditions the combustion gases for particulate and acid gas control. The gases pass through the evaporative cooler, baghouse, ID fan, venturi quencher, acid gas scrubber, and finally the stack. The following is a description of the major APC system components.

Evaporative Cooler

Upon exiting the SCC, the gases enter the evaporative cooler where the temperature is lowered to approximately 400°F with air-atomized water spray nozzles. The gas enters the top of the chamber where it is sprayed with enough water to achieve the specified chamber exit temperature. The evaporative cooler is constructed of carbon steel with gunned high-temperature refractory in the upper section.

The outlet temperature must be controlled to ensure the proper operating temperature of the baghouse. This is accomplished by an outlet temperature controller, which controls the amount of water sprayed into the evaporative cooler.

Two pumps are dedicated to supply water from the process water supply. One of these pumps is on-line, the other is redundant. The circulation system consists of a redundant pumping system and the necessary piping, valves, spray nozzles, and controls.
Baghouse Assemblies

The cooled combustion gases flow into six parallel baghouse modules. The baghouse is designed with a 3 to 1 air-to-cloth ratio. The baghouse gas discharge exits into the ID fan which is followed by the venturi quencher and wet scrubber. The baghouse is constructed of carbon steel. Each baghouse module will consist of approximately 5,607 square feet of filter area. The bags will be 16-oz fiberglass felt fabric. The bags will be cleaned using on-line pulse jet cleaning.

The primary differential pressure instrument will measure the pressure drop across the entire baghouse. This instrument will be the control point to initiate cleaning and the interlock control. OHM will put magnahelic type pressure gauges on the individual baghouse compartments for troubleshooting purposes. The overall baghouse pressure drop will be used to initiate the cleaning sequence. Each of the six modules contains 17 rows of bags. Two rows of bags will be cleaned in one module, followed by two rows of bags in another module, provided the overall pressure drop is still above the cleaning setpoint, until all six modules have had two rows of bags cleaned. This sequence will then repeat itself, cleaning two additional rows of bags in each module. Cleaning will continue until the overall baghouse pressure drop has fallen below the setpoint. When cleaning is subsequently reinitiated by high pressure drop, the sequence restarts.

The baghouse maintenance inspections include establishing a low pressure drop interlock across the baghouse, inspecting the scrubber water for unusually fast buildup of suspended solids and internal inspection of the baghouse when the system is in a "cold shutdown" mode. If gases were bypassing the filter bags the pressure drop across the unit would drop which would activate the low pressure drop interlock. If normal operating pressure
drops (above interlock) could not be reestablished and the instrument operation is confirmed then inspection of the baghouse would be used to determine the probable cause of the low pressure drop. An unusually fast buildup of suspended solids in the scrubber water could indicate that particulate loading on the scrubber has increased. This would be confirmed by increasing the blowdown rate of the scrubber until the suspended solids loading has decreased, then reducing the blowdown rate back to the normal rate and checking to see if the suspended solids are building up in the scrubber faster than normal. If this is the case then inspection of the baghouse would be used to determine the probable cause of the suspended solids buildup. On-going inspection of the baghouse will be performed when the TDF is in a "cold shutdown mode." A gross buildup of material around individual bags indicates that either a bag failure has occurred or the bag is not seated properly.

Induced Draft (ID) Fan

The ID fan draws combustion gases through the system and discharges them through the wet scrubbing system to the stack. The fan is of centrifugal design, sized to develop a vacuum of approximately 25 in water column (inWC) at its suction. The fan is powered by a 600-hp variable speed motor. The fan maintains a negative pressure in the kiln with increasing negative pressure throughout the remainder of the system up to the fan.

A negative pressure is maintained in the incineration system to eliminate the escape of fugitive emissions into the atmosphere. A pressure controller modulates the ID fan speed to maintain a slightly negative pressure at the kiln hood. Since the kiln hood is at the front end of the incinerator system, the combustion and gas cleaning processes upstream of the ID fan are under increasingly negative pressure.
The wet scrubbing system consists of:

- A venturi quencher
- A packed bed absorber
- A Chevron mist eliminator

The entire wet scrubbing system is enclosed, with all gases being discharged to the stack. Fugitive emissions are controlled by the totally enclosed design. The scrubber is constructed of fiberglass-reinforced plastic (FRP) with an alloy venturi elbow.

The ID fan discharges flue gases into the venturi quencher. Water sprays in the venturi cool the incoming gases from approximately 350°F to 185°F. Water is recirculated from the base of the scrubber system to the quench nozzles. Process water is used to make-up losses, and is controlled to achieve a constant level in the scrubber sumps. Water is sprayed through three nozzles into the venturi quencher. There is a set water flow rate to the venturi which consists of three to four times the flow required for saturation of the gas and cooling to 185°F. Emergency cooling water is available to protect the scrubber from high temperature excursions in the event of scrubber pump failure. A portion of the water is diverted to blowdown, to control suspended and dissolved solids in the scrubber water.

A mildly caustic scrubber-water solution neutralizes dissolved acid gases in the system. The pH of the circulating water in the acid gas scrubber system is monitored and kept within a pH range of 6 to 9 by the addition of NaOH solution. The flow of the caustic solution makeup is controlled by a pH monitor installed in
the scrubber recirculation line. Flow of caustic is controlled to maintain the desired pH.

The cooled flue gases enter two vertical packed bed absorbers situated in parallel where they come in contact with the scrubber solution. The packed bed provides sufficient contact between the incinerator gases and the scrubber solution to permit efficient absorption and removal of the acid gas contaminants.

The recycle liquid is distributed across the top of the packing using a spray header and flows down counter current to the upward gas flow. The scrubbing liquid drains into the scrubber sump section. Additional make-up water is added to the scrubber sump to balance water lost through evaporation and blow down. The cleaned gas passes through a high efficiency multi-pass Chevron mist eliminator for removal of entrained water droplets. The cleaned gas exiting each scrubber is combined in a common stack.

Stack

The stack is of fiberglass-reinforced plastic (FRP) construction and 150 ft high with a design flue gas exit velocity of 35 to 55 ft/sec. The stack is complete with sample platforms, hand rails kickplates, and caged, staged, ladders. Sample ports and platforms are located to allow for isokinetic sampling of the stack.

2.3.6 Continuous Emission Monitors

To monitor the performance of the incinerator, the stack is fitted with a set of CEMs (continuous emission monitors). Stack gas analysis in the CEM is
accomplished using an extractive-type instrument. Stack gas monitoring equipment analyzes the following constituents of the stack gas on a continuous basis, using the indicated methods of measurement:

- Oxygen—Zirconium Oxide
- Carbon dioxide—nondispersive infrared
- Carbon monoxide—nondispersive infrared
- Total hydrocarbons—flame ionization detector (FID)
- Nitrous Oxides (NO\textsubscript{x})—Chemiluminescence

The oxygen content of the SCC exit gas is also continuously monitored, using a zirconium oxide cell. Backups for all continuous emission monitors are provided on-site (but not on-line).

Stack gas velocity is an indication of the gas residence time in the SCC, which is critical to the complete thermal destruction of waste materials; therefore, stack gas velocity is continuously monitored.

2.3.7 Utilities

OHM will provide temporary distribution of site utilities including primary and emergency electrical power distribution systems to the operations control center, and the motor control center. A brief description of the utility systems are described below.
Electrical

**Primary Electrical Service.** High voltage power will be brought into the site at 13 kV, three-phase. Transformers will supply power at 480/277 V to the incinerator MCC.

**Emergency Electrical Power Generator.** A diesel-powered emergency generator supplies power when needed. The generator can provide power to the Motor Control Center (MCC) #1 emergency bus. This emergency power generator is capable of supplying power to the following critical systems: ID Fan, Kiln emergency drive, UPS, one cooling water pump, one evaporative cooler pump, one scrubber pump and one air compressor. When a power failure occurs all incinerator equipment will shutdown and the TRV will open. The operator will start up the emergency generator, transfer the power source to the emergency generator and then proceed to restart the following equipment: Kiln emergency drive, one cooling water pump, one evaporative cooler pump, one scrubber pump, one air compressor and the ID Fan. After the above equipment has been started and stabilized the TRV will be closed. When the primary power source is restored the equipment will be shutdown and the TRV will be opened to allow restarting the system on primary power.

**Uninterruptable Power Supply (UPS) Electrical System.** The UPS system is a 3-kVA, 120-V, one-phase, constant-voltage supply for instrumentation and control systems. The UPS consists of a rectifier/battery charger, batteries, invertor, static transfer switch, and bypass transformer. The UPS provides continuity of electric power to the operations control center for a period of 15 min and is backed up by the emergency generator.
Compressed Air System

A compressed air system provides up to 2,100 scfm of air at 120 psig (approximately 200°F) required for the operation of the incineration system. The incineration system requires purge air for the instruments mounted in the kiln transition chamber, SCC, and APC system, as well as atomizing air to the evaporative cooler water sprays.

The system consists of three electric-driven air compressors and one air-drying unit. Two compressors are usually adequate to provide the required air. The third compressor is piped in parallel with the others to provide redundancy.

A small amount of air, bled from the main air header for instrument use, is cooled, filtered, and dried in a twin-tower, heatless, regenerative dryer, and stored in an air receiver.

Process Water System

There are two independent water systems. One is the water to the evaporative cooler, and the other is general plant process water. Each system has its own pumps and piping.

Process and quench water are supplied from two 15,000-gal tanks on the facility. The process water system pumps provide water to the scrubber and ash conveyor system, as well as the various pieces of water cooled equipment. The quench water system pumps provide water to the evaporative cooler. Water to the tank is made up by city water and water treatment plant discharge water.
Liquid Oxygen Storage and Supply

The oxygen storage and supply system consists of liquid oxygen storage tanks, oxygen vaporizers and distribution piping. Liquid oxygen is trucked to the site and off-loaded into liquid oxygen storage tanks. These storage tanks along with the truck access road are located in a clean area of the site.

Auxiliary Fuel System

The auxiliary fuel is supplied from a locally available natural gas supply pipeline.

2.4 INCINERATION SYSTEM OPERATION

The scope and complexity of the Drake Chemical Site project requires the careful selection of an integrated project team for the various phases of the project. The team which OHM has assembled for this project has been selected based upon experience and qualifications.

OHM has assembled a comprehensive corporate project organization to provide for effective implementation of the management tasks associated with the Drake Chemical Site project. The team has been developed to manage both the on-site tasks at the site as well as the engineering, support, and development activities which will take place off-site.
2.4.1 Start-Up/Shutdown/Maintenance Procedures

Start-Up

The following normal start-up procedures ensure that the incineration system achieves a steady-state, permitted operational condition before waste is introduced to the system. The major tasks involved in a normal start-up are summarized as follows:

- Verify that instrumentation and control systems are operational
- Start water and caustic circulating pumps to APC system
- Start compressed air system
- Start the ID fan, verify that draft control is automatic, and that the TRV is closed
- Start kiln burner on virgin fuel and set the burner on low fire
- Start kiln rotation
- Start SCC burner and combustion air fan, and set burner on low fire
- Bring combustion chambers to operating temperatures
- Start ash system
- Verify normal operation of APC system
- When combustion temperatures are in the normal operating range, verify that all permissives are clear for waste feed
- Start solids feed, verify that temperature stabilizes in normal range, and readjust the waste feed as necessary
Waste Feed Shutoff Procedures

If the incinerator operating conditions deviate from acceptable ranges, the automatic interlock system interrupts waste feeds. This situation is called to the operator's attention by audible alarms and an alarm message on the control room CRT(s).

The operator’s actions following such an event are as follows:

• Continue operation of the SCC burners to maintain temperatures.
• Continue operation of kiln burner to maintain temperatures.
• Locate and correct cause of problem.
• Return system to permissible operating conditions. Verify that all interlocks for waste feed have cleared.
• Restart waste feed per standard hot start-up instructions.

Emergency Shutdown Procedures

An emergency shutdown is a major incinerator upset and is to be avoided whenever possible in favor of a waste feed cutoff or a controlled shutdown. An emergency shutdown immediately stops all waste and fuel feeds and the combustion air and ID fans. The kiln drive and the ash conveyor continues to operate if power is available and the TRV opens and the hot gas in the SCC vents to the atmosphere by natural draft.
Normal Shutdown Procedures

Normal shutdown procedures are followed for any scheduled activity which requires that the incinerator be off line and accessible to maintenance personnel or for entry into equipment items. Normal shutdown includes the following major activities:

- Shut off all waste feed streams.
- Reduce system temperatures.
- Shut off fuel to the burners.

Detailed steps required in the shutdown sequence are as follows:

- Shut down bulk solids feed.
- Wait 30 min for combustion of solids in kiln.
- Increase kiln rotational speed to discharge remaining solids, while reducing kiln and SCC temperatures.
- Shut down burners.
- Stop kiln rotation, ash conveyors, and evaporative cooler water feeds.
- Stop ID fan.
- Verify that air blowers have stopped and that TRV has opened.

Incineration emissions are maintained within compliance during a normal shutdown sequence. The temperature of the SCC is maintained within the compliance range for 30 minutes after waste feed is stopped, to allow combustion of solids in the kiln. The scrubber system remains on line until the final shutdown steps have been completed.
2.4.2 Process Monitoring Procedure (Including CEMs)

The following sections provide information the process monitoring locations, instrument ranges and recording statuses.

Instrumentation and Controls

The overall incinerator monitoring and control functions are centralized in the control building. The overall architecture of the incinerator control system is designed to permit direct network communication among components.

Control system hardware utilized includes Distributed Control System (DCS) and microcomputers. The DCS is comprised of a rack mounted remote transmission unit (RTU), vax minicomputer and two, control-room mounted independent engineering workstations. Each workstation provides a graphical interface to the process and displays alarm messages simultaneously on both units. Alarms are also logged on one of the two system printers, the other printer being utilized for hourly and shift reports. Incinerator operational records are maintained as follows:

- **Alarm Printer**—Records process alarms and interlocks when they occur.
- **Data Logger**—Records instantaneous value every 15 min of items in Table 2-1.
- **Magnetic Tape**—Records instantaneous values of items in Table 2-1 at 1-min intervals. These data can be retrieved by either of the incinerator's work stations.
- **CEM DAHS**—The CEM is equipped with a stand-alone Data Acquisition and Handling System (DAHS) which provides periodic stack emissions reports.
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Data Logger</th>
<th>Magnetic Tape</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste Feed Rate</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Kiln Pressure</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Kiln Temperature</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>SCC Temperature</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Evaporative Cooler Discharge Temp</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Baghouse Differential Pressure</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Scrubber Flow Rate</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Scrubber pH</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Stack Gas CO</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Stack Gas THC</td>
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<td>X</td>
</tr>
<tr>
<td>Stack Velocity</td>
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</tr>
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<td>X</td>
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<tr>
<td>Stack Gas NOₓ</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>
Historical incinerator operating data will be archived in the form of hard copy print outs and electronic files (magnetic tape). The DCS records all monitored parameters required by contract. Parameters are collected and processed on a 1- to 2-sec scan interval for control purposes and archived on a 1 minutes interval for historical record purposes. The DCS is capable of trending any combination of monitored parameters.

Reports will contain information required by contract regarding process reporting such as, CEM data, kiln temperature, SCC outlet temperature, scrubber data, feed rate, stack flow rate, etc.

In addition to the DCS reporting, data and alarms are also recorded in printout form by an independent Data logger in conjunction with the DCS. Key process variables are recorded at 15-min intervals on the Data Logger.

The control room is positioned to give the operator a view of major portions of the incinerator even though direct observation is not a prerequisite. A closed circuit television system is installed to permit the operator to visually monitor other critical aspects of the incinerator system operation. The system consists of one monitor located in the control room. The camera location permits monitoring of the solids feed operation.

An Uninterruptable Power Supply (UPS) system consists of a rectifier/battery charger, batteries, inverter, synchronizing equipment and protective devices. The 120-V, single-phase, 60-Hz power supply output provides emergency power for the instrumentation systems.
Parameters Continuously Monitored

Pressure, flow, and temperature are monitored on certain streams, in support of process control. These streams are shown schematically on Figure 2-3 and are listed in Table 2-2. A subset of these parameters is defined as critical control parameters. Instrument details, including calibration procedures and frequencies are presented in Table 2-3. The critical control parameters have been reviewed, with respect to continuous demonstration of compliance with the performance standards. This review was conducted considering guidance presented in "Guidance on Setting Permit Conditions and Reporting Trial Burn Results, Volume II of the Hazardous Waste Incineration Guidance Series," EPA 625/6-89-019, January 1989. This review resulted in the selection of several critical control parameters to be criteria control parameters. The criteria control parameters and the suggested values associated with them are presented in Section 3.
Figure 2.3. Schematic of process monitoring.
<table>
<thead>
<tr>
<th>Stream</th>
<th>Parameter monitored</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid Waste Feed</td>
<td>Flow rate</td>
</tr>
<tr>
<td>Natural Gas to Kiln</td>
<td>Flow rate</td>
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<tr>
<td>Oxygen to Kiln</td>
<td>Flow rate</td>
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<tr>
<td>Gas in Kiln Hood</td>
<td>Pressure</td>
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<tr>
<td>Gas in Kiln Exit</td>
<td>Temperature</td>
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<tr>
<td>Across Cyclone</td>
<td>Differential Pressure</td>
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<tr>
<td>Natural Gas to SCC</td>
<td>Flow rate</td>
</tr>
<tr>
<td>Oxygen to SCC</td>
<td>Flow rate</td>
</tr>
<tr>
<td>Combustion Air to SCC</td>
<td>Flow rate</td>
</tr>
<tr>
<td>Combustion Gas Leaving SCC</td>
<td>Temperature, O₂</td>
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<tr>
<td>Water to Evaporative Cooler Nozzles</td>
<td>Flow rate</td>
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<tr>
<td>Combustion Gas to Baghouse</td>
<td>Temperature</td>
</tr>
<tr>
<td>Across Baghouse</td>
<td>Differential Pressure</td>
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<tr>
<td>Combustion Gas Leaving Baghouse</td>
<td>Temperature</td>
</tr>
<tr>
<td>Combustion Gas to Scrubber</td>
<td>Temperature</td>
</tr>
<tr>
<td>Water to Scrubber Packing</td>
<td>Flow rate, pH</td>
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<tr>
<td>Scrubber Water Blowdown</td>
<td>Flow rate</td>
</tr>
<tr>
<td>Stack Gas</td>
<td>Flow rate, Temperature, CO, O₂, CO₂, THC, NOₓ</td>
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<tr>
<td>Kiln Rotation</td>
<td>rpm</td>
</tr>
<tr>
<td>Parameter</td>
<td>Instrument manufacturer</td>
</tr>
<tr>
<td>-------------------------</td>
<td>----------------------------</td>
</tr>
<tr>
<td>Solid Waste Feed Rate</td>
<td>Milltronics or equivalent</td>
</tr>
<tr>
<td>Kiln Fuel Rate</td>
<td>YEWFLO or equivalent</td>
</tr>
<tr>
<td>Oxygen to Kiln</td>
<td>YEWFLO or equivalent</td>
</tr>
<tr>
<td>Kiln Temperature</td>
<td>Honeywell</td>
</tr>
<tr>
<td>Kiln Hood Pressure</td>
<td>Rosemount (or equivalent)</td>
</tr>
<tr>
<td>Kiln Rotation</td>
<td>Electro-sensors or equivalent</td>
</tr>
<tr>
<td>Parameter</td>
<td>Instrument manufacturer</td>
</tr>
<tr>
<td>---------------------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>Cyclone Differential Pressure</td>
<td>Rosemount or equivalent</td>
</tr>
<tr>
<td>Fuel Rate to SCC</td>
<td>YEW FLOW or equivalent</td>
</tr>
<tr>
<td>Oxygen to SCC</td>
<td>YEWFLOW or equivalent</td>
</tr>
<tr>
<td>Combustion Air to SCC</td>
<td>FCI or equivalent</td>
</tr>
<tr>
<td>O₂ Leaving SCC</td>
<td>Thermox or equivalent</td>
</tr>
<tr>
<td>SCC Exit Temperature</td>
<td>Honeywell</td>
</tr>
<tr>
<td>Parameter</td>
<td>Instrument manufacturer</td>
</tr>
<tr>
<td>------------------------------------------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>Water to Evap. Cooler Nozzles</td>
<td>Brooks or equivalent</td>
</tr>
<tr>
<td>Evaporative Cooler Exit Temperature</td>
<td>Honeywell</td>
</tr>
<tr>
<td>Baghouse Exit Temperature</td>
<td>Honeywell</td>
</tr>
<tr>
<td>Baghouse delta P</td>
<td>Rosemount or equivalent</td>
</tr>
<tr>
<td>Scrubber Inlet Temperature</td>
<td>Honeywell</td>
</tr>
<tr>
<td>Differential Pressure Across Scrubber Packing</td>
<td>Rosemount or equivalent</td>
</tr>
<tr>
<td>Flow Rate to Scrubber Packing</td>
<td>Foxboro or equivalent</td>
</tr>
</tbody>
</table>
Table 2-3 (Continued)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Instrument manufacturer</th>
<th>Model No. and instrument type</th>
<th>Instrument range</th>
<th>Instrument accuracy</th>
<th>Calibration procedures</th>
<th>Calibration frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scrubber Water pH</td>
<td>Rosemount or equivalent</td>
<td>399 pH-05-11 (pH meter)</td>
<td>4-10</td>
<td>1% of span</td>
<td>pH probe span is verified with buffer solution and instrument span adjusted with span pot.</td>
<td>Bi-weekly</td>
</tr>
<tr>
<td>Stack Velocity</td>
<td>Hydri or equivalent</td>
<td>5106/VLP (turbine flowmeter)</td>
<td>0-100 FPS</td>
<td>1% span</td>
<td>Apply 0 Hz to the FDC 1100 and adjust zero potentiometer to 4 mA. Apply 100% Hz and adjust span potentiometer to 20 mA. Repeat steps until error is corrected.</td>
<td>Monthly</td>
</tr>
<tr>
<td>Stack Temperature</td>
<td>Honeywell</td>
<td>Type K (Thermocouple)</td>
<td>0-300°F</td>
<td>1% span</td>
<td>Adjust zero with voltage source calibrator representing 4 mA or 10 mA. Adjust upscale using voltage source to 20 mA or 50 mA using coarse and fine span adjustments.</td>
<td>Annually</td>
</tr>
<tr>
<td>Stack O₂</td>
<td>Rosemount or equivalent</td>
<td>Model OXA-1000 or equivalent (zirconium oxide)</td>
<td>0%-25%</td>
<td>1% span</td>
<td>Set and verify zero with oxygen free gas standard. Set instrument span with known gas standard. Set span to equal gas standard concentration.</td>
<td>Daily</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Verify instrument linearity with a midrange gas standard. During calibration, the process interlock will be bypassed.</td>
<td>Weekly</td>
</tr>
<tr>
<td>Stack CO</td>
<td>Rosemount or equivalent</td>
<td>880A or equivalent (NDIR)</td>
<td>0-500 ppm</td>
<td>1% of span</td>
<td>Set and verify zero with CO free gas standard. Set instrument span with known gas standard. Set span to equal gas standard concentration. Verify instrument linearity with a midrange gas standard. During calibration, the last recorded measurement of stack gas will be sent to the DCS. [for the purpose of calculating rolling hourly average]</td>
<td>Daily</td>
</tr>
</tbody>
</table>
Table 2-3 (Continued)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Instrument manufacturer</th>
<th>Model No. and instrument type</th>
<th>Instrument range</th>
<th>Instrument accuracy</th>
<th>Calibration procedures</th>
<th>Calibration frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stack CO₂</td>
<td>Rosemount or equivalent</td>
<td>880A or equivalent (NDIR)</td>
<td>0%-20%</td>
<td>1% of span</td>
<td>Set and verify zero with CO₂ free gas standard. Set instrument span with known gas standard. Set span to equal gas standard concentration.</td>
<td>Daily</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Verify instrument linearity with a midrange gas standard. During calibration, the last recorded measurement of stack gas will be sent to the DCS (for the purpose of calculating rolling average).</td>
<td>Weekly</td>
</tr>
<tr>
<td>Stack NOₓ</td>
<td>Rosemount or equivalent</td>
<td>951A (chemiluminescent)</td>
<td>0-1000 ppm</td>
<td>1% of span</td>
<td>Set and verify zero with NOₓ free gas standard. Set instrument span with known gas standard. Set span to equal gas standard concentration.</td>
<td>Daily</td>
</tr>
<tr>
<td></td>
<td>Thermo Environmental</td>
<td>10A/R (chemiluminescent)</td>
<td></td>
<td></td>
<td>Verify instrument linearity with a midrange gas standard. During calibration, the last recorded measurement of stack gas will be sent to the DCS (for the purpose of calculating rolling average).</td>
<td>Weekly</td>
</tr>
<tr>
<td>Stack THC</td>
<td>Rosemount or equivalent</td>
<td>402 or equivalent (FID)</td>
<td>0-250 ppm</td>
<td>1% of span</td>
<td>Set and verify zero with hydrocarbon free gas standard. Set instrument span with known propane standard. Set span to equal gas standard concentration.</td>
<td>Daily</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Verify instrument linearity with a midrange gas standard. During calibration, the last recorded measurement of stack gas will be sent to the DCS (for the purpose of calculating rolling average).</td>
<td>Weekly</td>
</tr>
</tbody>
</table>
2.4.3 Process Interlocks

The incinerator system is operated with an automatic interlock and shutdown system used to ensure an orderly transition to a safe condition in an effective manner during a process upset or mechanical equipment malfunction. These occurrences could cause major equipment damage or unsafe operating conditions if the incinerator were not shutdown. There are a variety of shutdown levels, depending on the nature and cause of the upset. These are discussed in detail below, and a schematic of the interlock system is provided in Appendix E.

Waste Shutdown (I-1)

The following conditions initiate the automatic shutdown of all waste to kiln but virgin fuel stays on. Cutoff results from the following:

- Kiln firing hood pressure > -0.1 inWC for 10 sec or > 0 inWC instantaneously
- SCC discharge temperature < 1800°F (to be determined by trial burn)
- CO in stack gas > 100 ppm, for 1-hr rolling average; or > 500 ppm, instantaneously; or loss of signal
- Stack gas flow > 55 fps (value to be determined from results of trial burn)
- Failure of both SCC burners
- Scrubber water flow to packing < 450 gpm
- Scrubber pH < 6.0 for 1 hr
- Differential pressure across the baghouse < 1.0 inWC
- NOx > 300 ppm, daily average; or loss of signal
• Kiln discharge gas temperature < 1000°F instantaneous and hourly rolling average at < 1200°F (to be determined by trial burn).

• Failure of both kiln burners

• Kiln dry ash conveyor stopped

• Kiln rotation < 0.4 rpm

• TRV not closed

• Solids feed rate hourly average > 60 tons/hr (to be determined from trial burn)

• I-2, I-3 or I-4 interlock.

Emergency Shutdown and TRV Open (I-2)

There are four process events which will automatically initiate an emergency system shutdown and open the thermal relief vent (TRV):

• ID fan failure

• Evaporative Cooler discharge gas temperature > 500°F

• Electrical power failure

• High scrubber inlet temperature > 250°F

All Waste and Fuel Shutdown (I-3)

The following conditions will initiate the automatic shutdown of all waste and fuel to the IF. Cutoff results from the following:

• SCC discharge gas temperature > 2600°F

• I-2 interlock
Kiln Waste and Fuel Shutdowns (I-4)

The following conditions initiate the automatic shutdown of all kiln waste and fuel. Cutoff results from the following:

- Kiln discharge gas temperature > 2200°F
- 1-2 or 1-3 interlock.

2.4.4 Emission Monitoring Procedures

Stack gas analysis and emission monitoring is accomplished using an extractive type systems. The following stack gas concentrations are monitored on a continuous basis:

- Oxygen
- Carbon dioxide
- Carbon monoxide
- Total hydrocarbons
- Nitrous oxides

Stack gas velocity is an indication of the gas residence time in the SCC, which is critical to the complete thermal destruction of waste materials; therefore, stack gas velocity is continuously monitored.
2.4.5 Emergency Response

The rotary kiln incinerator design is well established and represents one of the most dependable and safe means of treating hazardous waste. Special safety features are inherent in the system, such as complete burning of waste under negative pressure conditions at all times. With negative pressure control, there is essentially no chance for wastes to escape to the atmosphere from the kiln.

Dust emissions from ash are controlled by the use of water sprays or enclosed material handling conveyors.

Mechanical

The following paragraphs present discussions of the emergency response systems in place for specific mechanical portions of the incinerator system.

- Kiln Emergency Drive—The rotary kiln is provided with an auxiliary motor drive that will be used to drive the kiln if the main drive fails. This enables continuation of the kiln rotation, providing burnout of wastes remaining in the kiln and preventing warping of the kiln shell.

- UPS System—A UPS system allows a safe and orderly plant shutdown during emergency power outages. The UPS supplies low voltage power supply for operation of instrumentation and the control system.

- Emergency Generator Set—A diesel-driven generator system is provided for emergency backup power to critical incinerator electrical loads. During a power failure-induced Emergency Shutdown, the following components will be restarted after the generator is on line:
  - Control system
  - Continuous emissions monitoring system
  - All temperature monitoring instrumentation
  - All pressure monitoring instrumentation
• Kiln emergency drive motor
• Bottom ash conveyor system
• Cooling water supply system
• Process water supply system
• System induced draft fan
• SCC TRV Stack—The TRV stack at the top end of the SCC is a relief for hot combustion gases during an emergency shutdown of the incineration system.

Instrumentation

The instrumentation and control systems for this facility are designed with safety and reliability in mind. Consequently, appropriate alarms and automatic system shutdowns are incorporated into the design of the IF. Process interlocks are designed to ensure an effective orderly transition to a safe condition during a process upset or mechanical equipment malfunction.

Wherever practical, an alarm is activated prior to a shutdown to alert the operator to impending shutdown conditions. In many cases, this early warning may provide enough time to allow operator initiated corrective action prior to the actual shutdown, thereby avoiding the shutdown.

Specific Upset Conditions

There are several specific emergency conditions which can be planned for, if not anticipated. These are discussed below.

• Failure of Auxiliary Fuel Supply—If the auxiliary fuel supply were interrupted for any reason, both the kiln and SCC burners would shut down. In response to this, the waste feed would be shut off.
• Failure of Oxygen Supply—Failure of the oxygen supply to the kiln burner will shut down the kiln burners, which will result in a waste feed shutdown.

• Combustion Temperatures Too High—The interlock system shuts off feed to the incinerator if the combustion temperature in either the kiln or the SCC is above proper limits.

• Combustion Temperatures Too Low—The interlocking system automatically stops waste feed until the appropriate temperature levels have been reestablished, using auxiliary fuels.

• Sudden Loss of Integrity of Refractory Lining—The sudden loss of the integrity of refractory linings would be apparent in one of three ways:
  - A hot spot becoming visibly evident.
  - A periodic shell temperature scan detecting a major departure from previous scans.
  - Pieces of refractory being found in the ash conveyor discharge or obstructing the flow of ash.

Since the response must be commensurate with the magnitude of the problem, such a response can be either:

  - To continue operation for a period of time at a feed rate, firing rate, and temperature which reduces the impact of the problem to tolerable levels in the short term and still results in compliant operations.
  - To execute a rapid, orderly, manual shutdown to effect the necessary repairs.

• ID Fan Failure—The ID fan can fail because of:
  - Loss of electrical power.
  - Mechanical failure of rotating parts.

If either of these should occur, the interlocking system would immediately shut the incinerator down and open the TRV.

• Increase in Temperature After Evaporative Cooler—The interlock system shuts down all feeds to the incinerator and the ID fan if the Evaporative Cooler exit temperature exceeds its maximum.
• Failure of Ash Handling System—A failure of the ash system will cause the feed of solid waste to the kiln to be shut off while corrective measures are initiated.

• Kiln Cannot Rotate at Adequate Speed—A complete halt in kiln rotation will trigger a shutdown of kiln waste and fuel feeds.
SECTION 3
TRIAL BURN CONDITIONS

3.1 NUMBER OF TEST RUNS

A miniburn will be conducted prior to the full trial burn. The miniburn will consist of two test runs conducted at one condition, and the trial burn will consist of three test runs conducted at that same condition. A fourth trial burn test run may be conducted if OHM deems it appropriate. The optional fourth test run is used to provide an extra set of samples to ensure that completeness objectives are met. If four sets of samples are analyzed then all four sample results will be reported. OHM would anticipate that if all four sets of samples are valid (i.e., QA/QC is met) then all four runs would be used to develop the permit conditions. If one of the runs was not valid then OHM would propose that the permit conditions development would not include the invalid run.

A "Risk Burn" will be conducted prior to the Trial Burn to provide stack emissions information with no spiking being conducted. The details of this Risk Burn are provided in Appendix G.

Periodic metals and particulate test will be conducted during the operational phase of the TDF at the Drake site. These test are described in Appendix F.
3.2 TRIAL BURN TEST CONDITION AND PROPOSED PERMIT OPERATING PARAMETERS

The trial burn test will be conducted to demonstrate the performance of the incinerator facility (IF) when operating at minimum temperature and maximum throughput. The test will define a set of operating parameters that will ensure compliance with the performance specifications and facility design criteria. The exit temperatures from the kiln and secondary combustion chamber will be demonstrated at the lowest levels desired for normal operation, while the combustion gas flow rate will be demonstrated at the highest level desired. This will result in demonstration of POHC DRE under the operating conditions of minimum combustion temperature and maximum combustion gas velocity (minimum gas residence time).

Demonstration of the performance of the IF will be conducted during three independent runs. During each run, process parameters will be measured and samples will be collected and analyzed by MRI to develop independent assessment of all performance standards.

Certain operating parameters are identified as targets for the trial burn. These parameters are proposed operating limits for the final operating conditions issued after acceptance of the trial burn report. Table 3-1a lists these criteria parameters, their target value in the trial burn, and the proposed permitting approach. Table 3-1b provides the same information for metals feed rates.

An analysis of the potential metals emissions from the incineration process at the site has been performed. This analysis used the Tier I, Tier II, Tier III, and Adjusted Tier I approaches identified in 40 CFR 266.106, along with site-specific air dispersion modeling, the expected waste feed rate, and the concentration of metals in the feed provided in Attachment VII of the specifications. This analysis
Table 3-1a. PROPOSED CRITERIA OPERATING PARAMETERS

<table>
<thead>
<tr>
<th>Process Parameter</th>
<th>Value</th>
<th>Permitting Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CLASS A OPERATING PARAMETERS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum Solid Waste Feed Rate&lt;sup&gt;a&lt;/sup&gt;</td>
<td>120,000 lb/hr</td>
<td>Average of the Mean Waste feed rate of the trial burn test runs. Set as an hourly rolling average.</td>
</tr>
<tr>
<td>Maximum Kiln Pressure</td>
<td>-0.1 in WC</td>
<td>Based on Guidance&lt;sup&gt;b&lt;/sup&gt;. Waste shutoff if pressure exceeds -0.1 in WC for 10 seconds or 0.0 in WC instantaneously.</td>
</tr>
<tr>
<td>Minimum Hourly Average Kiln Temperature&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1200°F</td>
<td>Average of the Mean Temperature of the trial burn test runs. Set as an hourly rolling average.</td>
</tr>
<tr>
<td>Minimum Instantaneous Kiln Temperature</td>
<td>1000°F</td>
<td>Minimum instantaneous kiln temperature interlock will be demonstrated during the trial burn by having the interlock in place at 1000°F.</td>
</tr>
<tr>
<td>Minimum SCC Temperature&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1800°F</td>
<td>Average of the Mean Temperature of the trial burn test runs.</td>
</tr>
<tr>
<td>Minimum Differential Pressure Across the Baghouse</td>
<td>1 in WC</td>
<td>Set as a 5-min timer. Baghouse minimum differential pressure will be demonstrated during the trial burn by having the interlock in place at the set point of 1 in WC.</td>
</tr>
<tr>
<td>Minimum Flow Rate of Scrubber Water for each scrubber</td>
<td>450 gpm</td>
<td>Minimum Scrubber water flow rate is based on the design liquid to gas ratio. Minimum Scrubber water flow will be demonstrated during the trial burn by having the interlock in place.</td>
</tr>
<tr>
<td>Minimum pH of Scrubber Water&lt;sup&gt;a&lt;/sup&gt;</td>
<td>6.0</td>
<td>pH minimum interlock to be set as 1-hr timer at the average of the Mean pH during the trial burn test runs. Based on Guidance Document.&lt;sup&gt;c,d&lt;/sup&gt; Set as hourly rolling average.</td>
</tr>
<tr>
<td>Maximum Hourly Average Carbon Monoxide in the Stack Gas&lt;sup&gt;d&lt;/sup&gt;</td>
<td>100 ppm&lt;sub&gt;v&lt;/sub&gt;</td>
<td>Based on Guidance Document.&lt;sup&gt;c,d&lt;/sup&gt;</td>
</tr>
<tr>
<td>Maximum Instantaneous Carbon Monoxide in the Stack</td>
<td>500 ppm</td>
<td>Based on Guidance Document.&lt;sup&gt;c,d&lt;/sup&gt;</td>
</tr>
<tr>
<td>Maximum Stack Velocity&lt;sup&gt;a&lt;/sup&gt;</td>
<td>55 fps</td>
<td>Average of the Mean Velocity of the trial burn test runs. Set as hourly rolling average.</td>
</tr>
<tr>
<td>Nitrogen Oxide&lt;sup&gt;d&lt;/sup&gt; (NO&lt;sub&gt;x&lt;/sub&gt;)</td>
<td>300 ppm&lt;sub&gt;v&lt;/sub&gt;</td>
<td>Based on specification requirement of 300 ppm, maximum daily average</td>
</tr>
<tr>
<td><strong>CLASS B OPERATING PARAMETERS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum Chlorine Feed Rate</td>
<td>300 lb/hr</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Maximum Total Dissolved Solids of Scrubber Water by Solution Density Metals</td>
<td>1.09 sp. grav. at 85°F</td>
<td>Maximum of the Mean Density during TB test runs.</td>
</tr>
<tr>
<td><strong>CLASS C OPERATING PARAMETERS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Burner Settings</td>
<td>Not applicable</td>
<td>According to manufacturer's specifications.</td>
</tr>
<tr>
<td>Maximum Quench Tower Discharge Temperature</td>
<td>500°F</td>
<td>Required to protect the APC train.</td>
</tr>
</tbody>
</table>

<sup>a</sup> See Table 3-5a for interlock setpoints during the trial burn testing phase and trial burn system optimization period.

<sup>b</sup> Guidance on Setting Permit Conditions and Reporting Trial Burn Results.

<sup>c</sup> Guidance on Carbon Monoxide Controls for Hazardous Waste Incinerators.

<sup>d</sup> CO and NO<sub>x</sub> will be corrected based on CO<sub>2</sub> in stack gas, as explained in Appendix B.
<table>
<thead>
<tr>
<th>Metal</th>
<th>Value</th>
<th>Permitting approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noncarcinogenic metals</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barium</td>
<td>Not applicable</td>
<td>The maximum identified concentration results in less than the 40 CFR 266.106 Tier 1 feed rate when adjusted for site specific modeling. Based on this, no stack or ongoing feed testing will be performed.</td>
</tr>
<tr>
<td>Silver</td>
<td>Not applicable</td>
<td>The maximum identified concentration results in less than the 40 CFR 266.106 Tier 1 feed rate when adjusted for site specific modeling. Based on this, no stack or ongoing feed testing will be performed.</td>
</tr>
<tr>
<td>Mercury</td>
<td>Not applicable</td>
<td>The maximum identified concentration results in less than the 40 CFR 266.106 Tier 1 feed rate when adjusted for site specific modeling. Based on this, no stack or ongoing feed testing will be performed.</td>
</tr>
<tr>
<td>Lead</td>
<td>90 lb/hr</td>
<td>Tier III. Feed rate to be established at the average of the Mean Lead feed rate of the TB test runs. Compliance will be demonstrated by analyzing a weekly composite sample for Pb content.</td>
</tr>
<tr>
<td>Antimony</td>
<td>Not applicable</td>
<td>Antimony was not identified as a metal of concern in either the ROD or Specifications. Based on this, no stack or ongoing feed testing will be performed.</td>
</tr>
<tr>
<td>Thallium</td>
<td>Not applicable</td>
<td>Thallium was not identified as a metal of concern in either the ROD or Specifications. Based on this, no stack or ongoing feed testing will be performed.</td>
</tr>
<tr>
<td>Carcinogenic metals</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arsenic</td>
<td>14.3 lb/hr</td>
<td>Tier III. Feed rate to be established at the average of the Mean Arsenic feed rate of the TB test runs. Compliance will be demonstrated by analyzing a weekly composite sample for arsenic content.</td>
</tr>
<tr>
<td>Chromium</td>
<td>9.4 lb/hr</td>
<td>Tier III. Feed rate to be established at the average of the Mean Chromium feed rate of the TB test runs. Compliance will be demonstrated by analyzing a weekly composite sample for chromium content.</td>
</tr>
<tr>
<td>Cadmium</td>
<td>2.1 lb/hr</td>
<td>Tier III. Feed rate to be established at the average of the Mean Cadmium feed rate of the TB test runs. Compliance will be demonstrated by analyzing a weekly composite sample for cadmium content.</td>
</tr>
<tr>
<td>Beryllium</td>
<td>0.4 lb/hr</td>
<td>Tier III. Feed rate to be established at the average of the Mean Beryllium feed rate of the TB test runs. Compliance will be demonstrated by analyzing a weekly composite sample for beryllium content.</td>
</tr>
</tbody>
</table>
demonstrated that stack testing for lead, arsenic, chromium, cadmium, and beryllium are required.

The site specific dispersion modeling resulted in a maximum ground level concentration of 1.6 μg/m³ for an emission rate of 1 g/sec (see Appendix A). The dispersion model result and the Reference Air Concentrations (RACs) were used to develop adjusted Tier I feed rates for barium, mercury, and silver. Table 3-2 shows, using the maximum waste concentration, that the potential feed rates for barium, mercury, and silver are well below the adjusted Tier I limit. Therefore, stack testing for barium, mercury, and silver is not required.

Antimony and thallium have not been identified as metals of concern at the Drake Chemical Superfund Site. Therefore, as indicated in Table 3-1b, permit limits for these two metals should not be applicable.

For Pb and for the four carcinogenic metals (As, Be, Cd, Cr), the average and maximum concentrations found in the waste were used to calculate the average and maximum metal feed rates, as shown in Table 3-3. The trial burn target feed rate was selected at 1.5 times the feed rate at the maximum concentration. Table 3-3 develops the metal spiking rate for the trial burn assuming the average concentration of metals being present in the waste used for the trial burn. A manganese compound may be spiked into the feed during the Trial Burn to allow calculation of a removal efficiency. Any manganese spiking which is included in the Trial Burn will be described in the Trial Burn Report.

The trial burn metal feed rates shown in Table 3-3 were used to estimate the metal emission rates using removal efficiency data for the PYROX system measured at Bog Creek (except for Be, which was from the Guidance Document). Those calculated emissions, shown in Table 3-4, were then used to calculate the potential maximum ground level concentration using the dilution
Table 3-2. ADJUSTED TIER I FEED RATES FOR Ba, Hg, AND Ag

<table>
<thead>
<tr>
<th>Concentration in waste</th>
<th>Metals feed rate</th>
<th>RAC</th>
<th>Adjusted Tier I feed rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Maximum (ppm)</td>
<td>Average (ppm)</td>
<td>Maximum (lb/hr)</td>
</tr>
<tr>
<td>Barium</td>
<td>284</td>
<td>105</td>
<td>34.08</td>
</tr>
<tr>
<td>Mercury</td>
<td>0.5</td>
<td>0.3</td>
<td>0.06</td>
</tr>
<tr>
<td>Silver</td>
<td>12.2</td>
<td>3.5</td>
<td>1.464</td>
</tr>
</tbody>
</table>

a Metal feed rate based on Total Waste Feed Rate of 120,000 lb/hr.
b Adjusted Tier I feed rate based on RAC values for each metal and a Valley Model dispersion coefficient of 1.6 (μg/m³)/(g/sec emission rate).

Table 3-3. METAL FEED RATES FOR As, Be, Cd, Cr, AND Pb

<table>
<thead>
<tr>
<th>Metal</th>
<th>Concentration in feed</th>
<th>Expected feed rate</th>
<th>Trial burn feed rate</th>
<th>Metal spiking rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average (ppm)</td>
<td>Maximum (ppm)</td>
<td>Average (lb/hr)</td>
<td>Maximum (lb/hr)</td>
</tr>
<tr>
<td>As</td>
<td>18.6</td>
<td>79.6</td>
<td>2.23</td>
<td>9.55</td>
</tr>
<tr>
<td>Be</td>
<td>1.1</td>
<td>2.3</td>
<td>0.13</td>
<td>0.28</td>
</tr>
<tr>
<td>Cd</td>
<td>1.4</td>
<td>11.8</td>
<td>0.17</td>
<td>1.42</td>
</tr>
<tr>
<td>Cr</td>
<td>26.8</td>
<td>52.0</td>
<td>3.22</td>
<td>6.24</td>
</tr>
<tr>
<td>Pb</td>
<td>127</td>
<td>485</td>
<td>15.24</td>
<td>58.2</td>
</tr>
</tbody>
</table>

a Metal feed rate based on waste feed rate of 120,000 lb/hr.
b Trial burn feed rate is 1.5 times the maximum metals feed rate.
c Metal spike rate is the trial burn feed rate minus average expected metals feed rate.
Table 3-4. COMPARISON OF PREDICTED GROUND LEVEL CONCENTRATION WITH ADJUSTED RSDs

<table>
<thead>
<tr>
<th>Metal</th>
<th>Trial burn feed rate (lb/hr)</th>
<th>Removal efficiency (%)</th>
<th>Emission rate (lb/hr)</th>
<th>Emission rate (g/sec)</th>
<th>Predicted maximum ground level conc.</th>
<th>Adjusted RSD (µg/m³)</th>
<th>Ratio of predicted conc. to adjusted RSD</th>
</tr>
</thead>
<tbody>
<tr>
<td>As</td>
<td>14.3</td>
<td>99.93</td>
<td>0.0100</td>
<td>0.00126</td>
<td>0.0020</td>
<td>0.0805</td>
<td>0.0250</td>
</tr>
<tr>
<td>Be</td>
<td>0.4</td>
<td>99.75</td>
<td>0.0010</td>
<td>0.000126</td>
<td>0.00020</td>
<td>0.1435</td>
<td>0.0014</td>
</tr>
<tr>
<td>Cd</td>
<td>2.1</td>
<td>99.4</td>
<td>0.0126</td>
<td>0.00159</td>
<td>0.0025</td>
<td>0.1925</td>
<td>0.0132</td>
</tr>
<tr>
<td>Cr</td>
<td>9.4</td>
<td>99.94</td>
<td>0.0056</td>
<td>0.000706</td>
<td>0.0011</td>
<td>0.0291</td>
<td>0.0388</td>
</tr>
<tr>
<td>Pb</td>
<td>89.6</td>
<td>99.99</td>
<td>0.0090</td>
<td>0.00114</td>
<td>0.00182</td>
<td>RAC</td>
<td>0.09</td>
</tr>
</tbody>
</table>

Aggregate 0.0785

a Maximum ground level concentration calculated from emission rate and dilution factor of 1.6 µg/m³ per g/sec from site specific dispersion modeling.

b Risk Specific Dose (per EPA Technical Implementation Document for BIF Regulations) adjusted by ratio of 2- to 70-year potential exposure.
factor obtained from the site-specific dispersion modeling. Table 3-4 provides a comparison of the predicted concentration with the adjusted risk specific dose (RSD). Adjustment was made in the RSD to reflect the fact that RSDs are based on a lifetime cumulative (70-year) exposure whereas the facility will be in operation for less than 2 years. It is clear from Table 3-4 that the predicted maximum ground level concentrations are well below the RSDs for each metal, and the aggregate risk is well below 1.0 for the four carcinogenic metals.

Table 3-4 also shows that the predicted maximum ground level concentration of Pb will be well below the RAC for Pb (the RAC for Pb was not adjusted because the RAC is not based on a cumulative lifetime exposure).

The information and calculations discussed above demonstrate that operation of the incinerator system under the specified conditions will not represent any significant hazard to human health or the environment.

3.3 TRIAL BURN OPERATION

This section proposes operating conditions for the incinerator facility during the period of time of the trial burn system optimization and Trial Burn Testing. The trial burn period consists of two phases:

Phase 1—Trial Burn System Optimization Period
Phase 2—Trial Burn Testing Period

Under PA. Title 25 Chapter 264.344 regulations for hazardous waste incinerators, up to 720 hr of operating time (with the potential for an extension of up to 720 hr) are allowed for treatment of hazardous waste, for the purpose of establishing the operational readiness of the incinerator system prior to initiation
of trial burn testing. This period of time will be used to verify the performance of the IF under various operating conditions prior to performance of the trial burn.

After the mechanical, electrical, and thermal performance of the facility is confirmed, the IF will be operated at or near the target conditions for the trial burn test. The purpose of this testing is to establish the operational readiness for the incinerator facility and to ensure the success of the trial burn. The operating conditions for the trial burn system optimization period and trial burn testing period are shown in Tables 3-5a and 3-5b.

The operating conditions proposed for the trial burn system optimization period are more liberal than that for the trial burn testing period, to allow for process variations around the trial burn testing targets.

As part of the trial burn system optimization activities, OHM will conduct a two-run miniburn so that confidence in the proposed trial burn testing operating conditions can be established. Testing for the following performance standards will be performed: POHC DRE, particulate matter, metals emissions, PCDD/PCDF emissions, and HCl emissions. Following the miniburn, Performance Specification Tests will be carried out on the facilities' continuous emission monitors.
### Table 3-5a. PROPOSED PERMIT OPERATING CONDITIONS FOR TRIAL BURN AND TRIAL BURN SYSTEM OPTIMIZATION PERIOD

<table>
<thead>
<tr>
<th>Process Parameter</th>
<th>Trial Burn System Optimization Maximum Operating Conditions(^a)</th>
<th>Trial Burn Testing Interlock Setpoints</th>
<th>Trial Burn Target</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CLASS A OPERATING PARAMETERS(^b)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum Solid Waste Feed Rate (lb/hr)</td>
<td>124,000</td>
<td>128,000</td>
<td>120,000</td>
</tr>
<tr>
<td>Maximum Kiln Pressure (in WC)</td>
<td>-0.1</td>
<td>-0.1</td>
<td>-0.1</td>
</tr>
<tr>
<td>Minimum Instantaneous Kiln Temperature (°F)</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
</tr>
<tr>
<td>Minimum Hourly Average Kiln Temperature (°F)</td>
<td>1100</td>
<td>1100</td>
<td>1200</td>
</tr>
<tr>
<td>Minimum SCC Temperature (°F)</td>
<td>1600</td>
<td>1700</td>
<td>1600</td>
</tr>
<tr>
<td>Minimum Differential Pressure Across the Baghouse</td>
<td>1 in. wc</td>
<td>1 in. wc</td>
<td>1 in. wc</td>
</tr>
<tr>
<td>Minimum Flow Rate of Scrubber Water to the Packing (gpm)</td>
<td>450</td>
<td>450</td>
<td>450</td>
</tr>
<tr>
<td>Minimum pH of Scrubber Water</td>
<td>6.0</td>
<td>5.5</td>
<td>6.0</td>
</tr>
<tr>
<td>Maximum Instantaneous Carbon Monoxide in the Stack Gas (ppmv)(^c)</td>
<td>500</td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td>Maximum Hourly Average Carbon Monoxide in the Stack Gas (ppmv)(^d)</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Maximum Stack Velocity (fps)</td>
<td>61</td>
<td>61</td>
<td>55</td>
</tr>
<tr>
<td>NOx (ppmv)(^d)</td>
<td>300</td>
<td>300</td>
<td>300</td>
</tr>
</tbody>
</table>

**CLASS B OPERATING PARAMETERS**

<table>
<thead>
<tr>
<th>Process Parameter</th>
<th>Trial Burn System Optimization Maximum Operating Conditions(^b)</th>
<th>Trial Burn Testing Interlock Setpoints</th>
<th>Trial Burn Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Chlorine Feed Rate (lb/hr)</td>
<td>330</td>
<td>N/A(c)</td>
<td>300</td>
</tr>
<tr>
<td>Maximum Total Dissolved Solids of Scrubber Water (spec. grav.)</td>
<td>1.09</td>
<td>N/A(c)</td>
<td>1.09</td>
</tr>
<tr>
<td>Metals</td>
<td>See Table 3-5b</td>
<td>N/A(c)</td>
<td>See Table 3-5b</td>
</tr>
</tbody>
</table>

**CLASS C OPERATING PARAMETERS**

<table>
<thead>
<tr>
<th>Process Parameter</th>
<th>Trial Burn System Optimization Maximum Operating Conditions(^b)</th>
<th>Trial Burn Testing Interlock Setpoints</th>
<th>Trial Burn Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burner Settings</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Maximum Quench Tower Discharge Temperature (°F)</td>
<td>500</td>
<td>500</td>
<td>500</td>
</tr>
</tbody>
</table>

\(^a\) Details on timing, delays, and averages are as presented in Table 3-1a.
\(^b\) Interlocks will be set at the Class A Operating Condition Points during the system optimization period.
\(^c\) Interlocks are not required for Class B and C Operating Parameters.
\(^d\) CO and NO\(_x\) concentration will be corrected based on CO\(_2\) in the stack gas, as explained in Appendix B.
Table 3-5b. PROPOSED PERMIT OPERATING CONDITIONS FOR TRIAL BURN OPERATION METALS FEED LIMITS

<table>
<thead>
<tr>
<th>Process parameter</th>
<th>Trial burn system optimization period</th>
<th>Trial burn target</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Noncarcinogenic metals (lb/hr)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barium</td>
<td>Not applicable</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Silver</td>
<td>Not applicable</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Mercury</td>
<td>Not applicable</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Lead</td>
<td>100</td>
<td>90</td>
</tr>
<tr>
<td>Antimony</td>
<td>Not applicable</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Thallium</td>
<td>Not applicable</td>
<td>Not applicable</td>
</tr>
<tr>
<td><strong>Carcinogenic metals (lb/hr)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arsenic</td>
<td>16</td>
<td>14.3</td>
</tr>
<tr>
<td>Chromium</td>
<td>10.4</td>
<td>9.4</td>
</tr>
<tr>
<td>Cadmium</td>
<td>2.4</td>
<td>2.1</td>
</tr>
<tr>
<td>Beryllium</td>
<td>0.5</td>
<td>0.4</td>
</tr>
</tbody>
</table>

* Compliance demonstration approach is presented in Table 3-1b.
3.4 WASTE FEED CHARACTERISTICS

During the miniburn and trial burn, contaminated material from the site will be used as the waste feed. The material to be used will be from the incinerator and water line areas, which will have been excavated during the construction phase of the project. A goal of the trial burn will be to treat waste having the following difficult-to-treat characteristics:

- Higher heating value ≤ 250 BTU/lb
- Ash content ≥ 80%
- Chlorine content ≤ 0.25%

Contaminated soil fed to the incinerator during the miniburn and trial burn will be spiked with the five metals and two POHCs.

Metals spiking rates were discussed previously in Section 3.2. Additional information on the metals spiking is provided in Table 3-6. It is intended that a mixture of the metal compounds will be prepared in small bags or "pillows" which will be placed on waste feed conveyor every 2 min to provide the necessary spiking rate of the metals.

<table>
<thead>
<tr>
<th>Metal</th>
<th>Metal spiking rate (lb/hr)</th>
<th>Example metal compound</th>
<th>Compound spiking rate (lb/hr)</th>
<th>Weight of compound in each pillowa (lb)</th>
<th>Weight of compound in each pillowb (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arsenic (As)</td>
<td>12.1</td>
<td>As₂O₃</td>
<td>16.0</td>
<td>0.53</td>
<td>240</td>
</tr>
<tr>
<td>Beryllium (Be)</td>
<td>0.3</td>
<td>BeSO₄ • 4H₂O</td>
<td>5.9</td>
<td>0.20</td>
<td>91</td>
</tr>
<tr>
<td>Cadmium (Cd)</td>
<td>1.9</td>
<td>Cd(NO₃)₂ • 4H₂O</td>
<td>5.2</td>
<td>0.17</td>
<td>77</td>
</tr>
<tr>
<td>Chromium (Cr)</td>
<td>6.2</td>
<td>Cr₂O₃</td>
<td>9.1</td>
<td>0.30</td>
<td>136</td>
</tr>
<tr>
<td>Lead (Pb)</td>
<td>74.4</td>
<td>PbO</td>
<td>80.1</td>
<td>2.67</td>
<td>1,210</td>
</tr>
</tbody>
</table>

a Metal compounds shown are only intended as example of compounds to be spiked. Actual compounds may be different depending on cost and availability, etc. If different compounds are used, the spiking rate of the compound will be adjusted as necessary to provide the metal spiking rates given in the second column of the table.

b Weight of compound in each pillow, to be fed every 2 min.
Two POHCs will also be spiked into the waste during the miniburn and trial burn in order to determine DRE for the incinerator system. A spiking rate of 85 lb/hr will be used for each POHC. In order to achieve this, bags containing 2.83 lb of each POHC will be placed on the conveyor every 2 min. This spiking rate was calculated based on the practical quantitation limits (PQL) for the two POHCs in the stack gas (i.e., 6 µg per sample train or a stack gas concentration of 2 µg/m³), the stack gas flow rate of 825 dscm/min, and a gas sample volume of 3.0 dscm. A feed rate of 85 lb/hr should produce stack gas concentrations that are 10 times the PQL, at 99.99% DRE, enabling demonstration of DREs up to 99.999%. Selection criteria for the two POHCs is discussed in the next section.

As mentioned previously, the Cl content of the waste may be as high as 0.25%.

<table>
<thead>
<tr>
<th>Waste Feed</th>
<th>Total Pounds per Hour</th>
<th>% Chlorine</th>
<th>Chlorine Pounds per Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,4-Dichlorobenzene</td>
<td>85</td>
<td>47.9%</td>
<td>41</td>
</tr>
<tr>
<td>Naphthalene</td>
<td>85</td>
<td>0.0%</td>
<td>0</td>
</tr>
</tbody>
</table>

### 3.5 SELECTION OF PROPOSED PRINCIPAL ORGANIC HAZARDOUS CONSTITUENTS (POHCs)

The POHCs for this project are identified in the project specifications as naphthalene and 1,4-dichlorobenzene. A review of the POHC selection criteria confirms these POHCs are appropriate.
The following items were considered in this review of the POHC selection:

1. The selected POHC should be as "difficult to destroy" as the materials which will be treated at the site.

2. High relative abundance in the waste material.

3. Physical state of the waste and POHC should be compatible.

4. Stability of the POHC should allow for sampling and analysis.

5. The compounds selected should be sufficiently available to allow an adequate quantity for the trial burn demonstration.

Naphthalene and 1,4-dichlorobenzene are both ranked as Class I (hardest to incinerate) on EPA's Thermal Stability Index. Therefore, demonstration of the incinerator's ability to achieve 99.99% Destruction and Removal Efficiency (DRE) on naphthalene and 1,4-dichlorobenzene will demonstrate the incinerator's ability to meet the DRE requirements for any of the compounds at the site.

Naphthalene and 1,4-dichlorobenzene have both been identified as being present in the waste. Therefore, they are appropriate for representing the waste at the site.

The physical states of both compounds are compatible with the waste feed methods being used in the incinerator at the site.
Naphthalene and 1,4-dichlorobenzene can be sampled and analyzed by approved and demonstrated techniques. Both compounds are considered semivolatile and can be sampled using Modified Method 5 procedures. The analysis method for these compounds is well demonstrated.

Both materials are available in sufficient quantities to allow their use in performing the trial burn.
SECTION 4

SAMPLING AND MONITORING PLAN

The performance of the incinerator will be determined by sampling and subsequent analysis of the waste feed, incinerator ash, and stack gas. Sampling and monitoring locations are identified in Section 4.1. The overall sampling and analysis protocol is described in Section 4.2. The process parameters to be monitored during the trial burn by the facility's process instrumentation are presented in Section 4.3. Specific sampling and analysis procedures are presented in Sections 5 and 6, respectively.

4.1 SAMPLE AND MONITORING LOCATIONS

Figure 4-1 indicates schematically the four major sampling points for the miniburn and the trial burn. The stack sampling ports will be located in accordance with EPA Method 1, as shown in Figures 4-2a and 4-2b.

4.2 SAMPLING AND ANALYSIS PROTOCOL

Samples to be collected during each test run will be of two types (solid or stack gas). Prior to the trial burn, a two-run miniburn will be conducted to demonstrate the system's ability to achieve 99.99% DRE for POHCs, as well as determining HCl, particulate, and metal emissions. For actual trial burn, three separate test runs will be conducted at one incinerator operating condition.
Figure 4-1. Schematic diagram of PYROX incinerator system.

S1, S2, S3 & S4 are sampling points for the trial burn.
A1 and A2 are on upper cross sectional plane (5 ft above platform grating)
B1 and B2 are on middle cross sectional plane (4 ft above platform grating)
C is on lower cross sectional plane (3 ft above platform grating)

Figure 4-2a. Top view of stack sampling ports locations.
Figure 4-2b. Levels for sampling ports to accommodate Method 5 trains and CEMS simultaneously.
A fourth trial burn test run may be performed if OHM deems it appropriate. The sampling time for each test run will be approximately 3 hr (180 min). Actual incinerator operation at the test conditions will be longer (4 to 6 hr) in order to line out the incinerator at steady-state conditions prior to initiating sampling. Actual trial burn soils and the POHC and metals will be burned at the specified test conditions for at least 30 min prior to the start of sampling.

A summary of the frequency, number, type, size (or quantity), and source (or collection point) of all samples to be collected during each test run of the miniburn and the trial burn are presented in Tables 4-1 and 4-2, respectively. The test sample matrixes presented in the tables also list the sampling and analytical method(s) to be used for each sample and is organized by sample type and analytical parameters.

A summary of the sample collection procedures is presented in Section 5.0 of this trial burn plan. A summary of the sample preparation and analytical methods are included in Section 6.0.

4.3 PROCESS MONITORING PROTOCOL

In addition to samples taken during each test as indicated in Tables 4-1 and 4-2, process data measured by OHM's process monitors will be recorded throughout the test. The parameters to be monitored were listed in Table 2-1. That process data will also be manually recorded on a log sheet at 15-min intervals during the test. Permanent magnetic records and/or data logging records will be available for the parameters listed in Table 2-1. All instruments used to monitor the parameters listed in Table 2-1 will undergo normal maintenance and calibration procedures prior to the tests.
Table 4-1. SUMMARY OF SAMPLING AND ANALYSIS PARAMETERS AND METHODS FOR THE MINIBURN

<table>
<thead>
<tr>
<th>Sample</th>
<th>Sampling frequency for each run</th>
<th>Sample method/size</th>
<th>Analytical parameters</th>
<th>Preparation method(^a)</th>
<th>Analytical method(^a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid Waste Feed</td>
<td>One grab sample every 15 min composited and split into 3 samples</td>
<td>Scoop (S007)/ ~ 50 g per grab</td>
<td>SV-POHCs(^a)</td>
<td>Solvent Extraction (SW-846 3540)</td>
<td>GC/MS (SW846-8270)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Chloride (total)</td>
<td>NA</td>
<td>ASTM E-442-74 or ASTM D-808-87/D-4327-91</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Metals(^b)</td>
<td>Acid digestion (SW-846 3050A or 3051)</td>
<td>ICP or AA (SW-846 6010A or 7000 series as needed to meet detection limits)</td>
</tr>
<tr>
<td>Bottom Ash</td>
<td>One grab sample every 30 min composited and split into 2 samples</td>
<td>Scoop (S007)/ ~ 50 g per grab</td>
<td>SV-POHC, SVOCs(^d)</td>
<td>Solvent Extraction (SW-846 3540)</td>
<td>GC/MS (SW846-8270) and GC/ECD (SW846-8151)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>VOCs(^d)</td>
<td>Dispersion/Purge and Trap (SW846-8260)</td>
<td>GC/MS (SW846-8260)</td>
</tr>
<tr>
<td>Fly Ash</td>
<td>One grab sample every 30 min composited and split into 2 samples</td>
<td>Scoop (S007)/ ~ 50 g per grab</td>
<td>SV-POHC, SVOCs(^d)</td>
<td>Solvent Extraction (SW-846 3540)</td>
<td>GC/MS (SW846-8270) and GC/ECD (SW846-8151)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>VOCs(^d)</td>
<td>Dispersion/Purge and Trap (SW846-8260)</td>
<td>GC/MS (SW846-8260)</td>
</tr>
</tbody>
</table>

(Continued on next page)
<table>
<thead>
<tr>
<th>Sample</th>
<th>Sampling frequency for each run</th>
<th>Sample method/size</th>
<th>Analytical parameters</th>
<th>Preparation methoda</th>
<th>Analytical methoda</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stack gas</td>
<td>3-hr composite per run</td>
<td>Method 00501/ - 100 ft³</td>
<td>Particulate</td>
<td>Desiccation</td>
<td>Gravimetric (EPA Method 5)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>HCl/Cl₂</td>
<td></td>
<td>NA</td>
<td>Ion Chromatography (SW-846 9057)</td>
</tr>
<tr>
<td>Draft EPA</td>
<td>Method 29/ - 100 ft³³</td>
<td>Metalsb</td>
<td>Acid digestion (EPA Draft Method 29)</td>
<td>ICP or AA (SW-846 6010A or 7000 series as needed to meet detection limits)</td>
<td></td>
</tr>
<tr>
<td>Method SW-846 0010/ - 100 ft³³ (split extracts for analysis of PCDD/PCDF and SV-POHCs)</td>
<td>PCDD/PCDF³</td>
<td>Soxhlet extraction (SW-846 3500 series)</td>
<td>HRGC/HRMS (EPA Method 23)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>SV-POHCs³</td>
<td>Soxhlet extraction (SW-846 3500 series)</td>
<td>GCMS (SW-846 8270)</td>
<td></td>
</tr>
</tbody>
</table>


b Metals to be included in the analysis are As, Be, Cd, Cr, and Pb.

c Semivolatile principal organic hazardous constituents, naphthalene, and 1,4-dichlorobenzene.

d Drake SVOC contaminants = 1,2-dichlorobenzene, 1,4-dichlorobenzene, 1,2,4-trichlorobenzene, naphthalene, benzo[a]fluoranthene, benzo[a]anthracene, benzo[g,h,i]perylene, benzo[ghi]perylene, benzo[a]pyrene, pentachlorophenol, phenanthrene, phenol, benzoic acid, β-naphthylamine, and FENAC.

Drake VOC contaminants = tetrachloroethylene, total xylenes, chlorobenzene, ethylbenzene, toluene, benzene, 1,2-dichloroethylene, tetrachloroethylene.

* Exact volume of gas sampled will be dependent on isokinetic sampling rate.

f In conjunction with sampling trains; moisture, temperature, velocity, O₂ and CO₂ will also be determined using EPA Methods 2 through 4.

g Polychlorinated dibenzodioxins and polychlorinated dibenzofurans.
### Table 4-2. SUMMARY OF SAMPLING AND ANALYSIS PARAMETERS AND METHODS FOR TRIAL BURN

<table>
<thead>
<tr>
<th>Sample</th>
<th>Sampling frequency for each run</th>
<th>Sample method/size</th>
<th>Analytical parameters</th>
<th>Preparation method</th>
<th>Analytical method</th>
</tr>
</thead>
</table>
| Solid Waste Feed             | One grab sample every 15 min composed and split into 3 samples for each run | Scoop (S007)/ 
  ~ 50 g per grab | Total Solids/Moisture Content | NA                 | ASTM D-3173        |
|                              | (See note)                      |                    | Ash Content           | NA                 | ASTM D-3174        |
|                              |                                 |                    | BTU                  | NA                 | ASTM D-2015        |
|                              |                                 |                    | Chloride (total)     | NA                 | ASTM E-442 or ASTM D-808/D4327 |
|                              |                                 |                    | Metals<sup>b</sup>   | Acid digestion (SW-846-3050A or 3051) | ICP or AA (SW-846 6010A or 7000 series as needed to meet detection limits) |
|                              |                                 |                    | SV-POHC<sup>s</sup> | Solvent Extraction (SW-846 3540) | GC/MS (SW-846 8270) |
| Motal Spike and POHC Spike Material | One grab sample during trial burn | Grab from spike bag, selected at random | NA                  | NA                 | Archive           |
| Bottom Ash                   | Two separate grab samples every 30 min, composited into two separate samples. Each composite sample split into 4 samples for analyses | Scoop (S007)/ 
  ~ 100 g per grab | SV-POHC<sup>s</sup>, 
  SVOCs<sup>d</sup> | Solvent Extraction (SW-846 3540) | GC/MS (SW-846 8270) and GC/ECD (SW846-8151) |
|                              | (See note)                      |                    | TOC                  | NA                 | SW-846 9060        |
|                              |                                 |                    | VOCs<sup>d</sup>     | Dispersion/Purge and Trap (SW-846 8260) | GC/MS (SW-846 8260) |
|                              |                                 |                    | TCLP Metals<sup>b</sup> | TCLP (EPA Method 1311) 
  Acid digestion per SW-846 3010A/3020A | ICP or AA (SW-846 6010A or 7000 series as needed to meet detection limits). 
  CVAA for Hg (SW-846 7470A). |
| Fly Ash                      | Two separate grab samples every 30 min, composited into two separate samples. Each composite sample split into 4 samples for analyses | Scoop (S007)/ 
  ~ 100 g per grab | SV-POHC<sup>c</sup>, 
  SVOCs<sup>d</sup> | Solvent Extraction (SW-846 3540) | GC/MS (SW-846 8270) and GC/ECD (SW846-8151) |
|                              | (See note)                      |                    | TOC                  | NA                 | SW-846 9060        |
|                              |                                 |                    | VOCs<sup>d</sup>     | Dispersion/Purge and Trap (SW-846 8260) | GC/MS (SW-846 8260) |
|                              |                                 |                    | TCLP Metals<sup>b</sup> | TCLP (EPA Method 1311) 
  Acid digestion per SW-846 3010A/3020A | ICP or AA (SW-846 6010A or 7000 series as needed to meet detection limits). 
  CVAA for Hg (SW-846 7470A). |

(continued on next page)
Table 4-2 (Continued)

<table>
<thead>
<tr>
<th>Sample</th>
<th>Sampling frequency for each run</th>
<th>Sample method/size</th>
<th>Analytical parameters</th>
<th>Preparation method$^a$</th>
<th>Analytical method$^a$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stack Gas</td>
<td>3-hr composite per run</td>
<td>Draft Method 29$^f$</td>
<td>Metals$^b$</td>
<td>Acid digestion (EPA Draft Method 29)</td>
<td>ICP or AA (SW-846 6010A or 7000 series as needed to meet detection limits)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Method 0050$^f$ $^g$</td>
<td>Particulate</td>
<td>Desiccation</td>
<td>Gravimetric (EPA Method 5)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>HCI/Cl$_2$</td>
<td></td>
<td>NA</td>
<td>Ion Chromatography (SW-846 9057)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Method 0010/ $^h$ $^i$</td>
<td>SV-POHC$^c$ and PICs$^9$</td>
<td>Soxhlet extraction (SW-846 3500 series)</td>
<td>GCMS (SW-846 8270)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>PCDDs and PCDFs$^h$</td>
<td>Soxhlet extraction (SW-846 3500 series)</td>
<td>HRGC/HRMS (EPA Method 23)</td>
</tr>
</tbody>
</table>


$^b$ Metals to be included in the analysis are As, Be, Cd, Cr, and Pb. TCLP metals are Ag, As, Ba, Cd, Cr, Hg, Pb, and Se.

$^c$ Semivolatile principal organic hazardous constituents = naphthalene and 1,4-dichlorobenzene.

$^d$ Drake SVOC contaminants = 1,2-dichlorobenzene, 1,4-dichlorobenzene, 1,2,4-trichlorobenzene, naphthalene, benzo[\textit{b}]fluoranthene, benzo[\textit{a}]anthracene, benzo[\textit{a}]fluoranthene, fluoranthene, pyrene, chrysene, benzo[\textit{a}]pyrene, pentachlorophenol, phenanthrene, phenol, benzoic acid, β-naphthylamine, and FENAC.

$^e$ Drake VOC contaminants = tetrahydroxylene, total xylenes, chlorobenzene, ethylbenzene, toluene, benzene, 1,2-dichloroethylene, trichloroethylene.

$^f$ Exact volume of gas sampled will be dependent on isokinetic sampling rate.

$^g$ In conjunction with sampling trains; moisture, temperature, velocity, O$_2$ and CO$_2$ will also be determined using EPA Methods 2 through 4.

$^h$ The 10 largest peaks (excluding POHCs) using full scan GCMS will be tentatively identified and semiquantified.

$^i$ Polychlorinated dibenzoxyxins and polychlorinated dibenzofurans.

Note: One extra set of samples of waste feed, bottom ash, and fly ash will be taken in one run. This extra set will be given to OHM, for transfer to USACOE's QA laboratory.
4.4 EXPECTED STACK GAS CONCENTRATIONS AND DETECTION LIMITS

It is important to estimate the expected stack gas concentrations based on the mass input rate of the metals, POHCs, and chlorine going into the incinerator in the waste feed. Those estimated stack concentrations, and the associated amount of analyte in the samples, must be greater than the analytical method detection limits in order to demonstrate compliance with regulatory limits (e.g., DRE).

Table 4-3 gives a comparison of the ICAP quantitation limits for the EPA metals method for the five metals of interest (As, Be, Cd, Cr, and Pb) with the expected stack gas concentrations. At the planned level of metal spiking and anticipated removal efficiency for each metal, the stack concentrations can be quantified by ICAP for all five metals. GFAAS analysis will be required only if the ICAP analysis cannot achieve the detection limits given in the method.

<table>
<thead>
<tr>
<th></th>
<th>Expected emissions rate(\text{a}) (g/sec)</th>
<th>Expected emission conc.(\text{b}) ((\mu)g/dscm)</th>
<th>ICAP detection limit(\text{c}) ((\mu)g/m(^3))</th>
<th>ICAP practical quantitation limit(\text{d}) ((\mu)g/m(^3))</th>
</tr>
</thead>
<tbody>
<tr>
<td>As</td>
<td>0.00126</td>
<td>91.6</td>
<td>19.1</td>
<td>57.3</td>
</tr>
<tr>
<td>Be</td>
<td>0.000126</td>
<td>9.2</td>
<td>0.11</td>
<td>0.33</td>
</tr>
<tr>
<td>Cd</td>
<td>0.00159</td>
<td>116</td>
<td>1.5</td>
<td>4.5</td>
</tr>
<tr>
<td>Cr</td>
<td>0.000706</td>
<td>51.3</td>
<td>2.5</td>
<td>7.5</td>
</tr>
<tr>
<td>Pb</td>
<td>0.00114</td>
<td>82.9</td>
<td>15.1</td>
<td>45.3</td>
</tr>
</tbody>
</table>

\(\text{a}\) Expected emission rate from Table 3-4.  
\(\text{b}\) Expected emission concentration calculated from emission rate (g/sec) and stack flow rate of 825 dscm/min.  
\(\text{c}\) ICAP detection limits from EPA draft Method 29 (Determination of Metal Emissions from Stationary Sources).  
\(\text{d}\) The practical quantitation limit was estimated to be 3 times the ICAP method detection limit referenced in footnote \(\text{c}\).
Table 4-4 gives a summary of the POHC feed rates during the trial burn and summarizes the mass of each POHC collected at a conservative DRE estimate of 99.99%. Based on the assumptions made and the estimated MM5-SV sample volume, 234 µg of each POHC (naphthalene and dichlorobenzene), will be collected in each MM5-SV sample at a DRE of 99.99%. This amount is well above the 6-µg PQL (or 2 µg/dscm) for the GC/MS analysis of a concentrated extract of a MM5-SV sample. Thus a DRE of well above 99.99% can actually be confirmed for both POHCs.

Total Cl input to the incinerator will be ≤ 300 lb/hr (2,300 g/min) as contributed by the solid waste feed. Assuming the required removal efficiency of 99% and a stack flow rate of about 825 dscm/min, the resulting Cl concentration in the stack gas would be 0.028 g/dscm. The MM5-PH train used for sampling should collect about 3.0 dscm (about 100 ft³) of gas and yield about 3,500 mL of liquid sample (i.e., condensate). On this basis, the concentration of Cl⁻ in the condensate will be 0.024 g/L or 24 mg/L. The detection limit for the ion chromatography analysis of Cl⁻ is 0.4 mg/L. Thus, the required removal efficiency for HCl can be confirmed, or HCl emissions of < 4 lb/hr can be confirmed.

Another goal of the trial burn is to demonstrate that dioxin/furan emissions do not exceed 30 ng/dscm. Based on an approximate gas sample volume of 3 dscm, the PQL for total dioxin/furans is 2 ng/dscm, which is well below the level of 30 ng/dscm.
<table>
<thead>
<tr>
<th>POHC</th>
<th>Average POHC input rates (lb/hr)&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Average POHC stack gas concentration at 99.99% DRE&lt;sup&gt;b&lt;/sup&gt; (µg/dscm)</th>
<th>Sample volume&lt;sup&gt;c&lt;/sup&gt; (dscm)</th>
<th>Total POHC collected (µg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Naphthalene</td>
<td>85</td>
<td>78</td>
<td>3.0</td>
<td>234</td>
</tr>
<tr>
<td>1,4-Dichlorobenzene</td>
<td>85</td>
<td>78</td>
<td>3.0</td>
<td>234</td>
</tr>
</tbody>
</table>

<sup>a</sup> POHC input rates were obtained from Section 3.4

<sup>b</sup> Calculated at standard gas conditions; an average stack flow rate of 825 dscm/min was estimated.

<sup>c</sup> Estimated volume for MM5-SV train sampling 1 dscm per hour for 3 hr.
4.5 ASH ANALYSES AND QUANTITATION LIMITS

Analysis of the ash for organics will be performed during the trial burn to demonstrate that the ash quality requirement of 55 ppb β-naphthylamine is met. The ash analysis will also include those volatiles, semivolatiles, and herbicides which are identified in the Record of Decision (ROD) as being present in the site soils or sediments. The ash disposal criteria for the project will be established based on the results of the trial burn ash analysis.

The ash quality criteria shall be established based on the highest concentration of a specific analyte found during any one of the trial burn test runs, provided the sample meets the 55 µg/kg β-naphthylamine requirement. Any compound that tests at less than the PQL during all test runs shall have the ash quality criteria established at the PQL.

Table 4-5 provides the list of target analytes in the ash samples and the practical quantitation limits (PQL) for each analyte.
<table>
<thead>
<tr>
<th>Compound</th>
<th>Analysis Method</th>
<th>PQL (µg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Volatile Compounds</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Benzene</td>
<td>SW 846/Method 8260</td>
<td>5</td>
</tr>
<tr>
<td>Toluene</td>
<td>SW 846/Method 8260</td>
<td>5</td>
</tr>
<tr>
<td>Chlorobenzene</td>
<td>SW 846/Method 8260</td>
<td>5</td>
</tr>
<tr>
<td>Ethylbenzene</td>
<td>SW 846/Method 8260</td>
<td>5</td>
</tr>
<tr>
<td>Total xylenes</td>
<td>SW 846/Method 8260</td>
<td>5</td>
</tr>
<tr>
<td>Tetrachloroethene</td>
<td>SW 846/Method 8260</td>
<td>5</td>
</tr>
<tr>
<td>1,2-Dichloroethylene</td>
<td>SW 846/Method 8260</td>
<td>5</td>
</tr>
<tr>
<td>Trichloroethylene</td>
<td>SW 846/Method 8260</td>
<td>5</td>
</tr>
<tr>
<td><strong>Chlorinated Herbicides</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FENAC-(2,4,6-Trichlorophenyl acetic acid)</td>
<td>SW 846/Method 8151</td>
<td>1,000</td>
</tr>
<tr>
<td><strong>Semivolatile Compounds</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phenol</td>
<td>SW 846/Method 8270</td>
<td>660</td>
</tr>
<tr>
<td>1,4-Dichlorobenzene</td>
<td>SW 846/Method 8270</td>
<td>660</td>
</tr>
<tr>
<td>1,2-Dichlorobenzene</td>
<td>SW 846/Method 8270</td>
<td>660</td>
</tr>
<tr>
<td>Benzoic Acid</td>
<td>SW 846/Method 8270</td>
<td>3,300</td>
</tr>
<tr>
<td>1,2,4-Trichlorobenzene</td>
<td>SW 846/Method 8270</td>
<td>660</td>
</tr>
<tr>
<td>Naphthalene</td>
<td>SW 846/Method 8270</td>
<td>660</td>
</tr>
<tr>
<td>Pentachlorophenol</td>
<td>SW 846/Method 8270</td>
<td>3,300</td>
</tr>
<tr>
<td>Phenanthrene</td>
<td>SW 846/Method 8270</td>
<td>660</td>
</tr>
<tr>
<td>Fluoranthene</td>
<td>SW 846/Method 8270</td>
<td>660</td>
</tr>
<tr>
<td>Pyrene</td>
<td>SW 846/Method 8270</td>
<td>660</td>
</tr>
<tr>
<td>Benz[a]anthracene</td>
<td>SW 846/Method 8270</td>
<td>660</td>
</tr>
<tr>
<td>Chrysene</td>
<td>SW 846/Method 8270</td>
<td>660</td>
</tr>
<tr>
<td>Benzo[b]fluoranthene</td>
<td>SW 846/Method 8270</td>
<td>660</td>
</tr>
<tr>
<td>Benzo[k]fluoranthene</td>
<td>SW 846/Method 8270</td>
<td>660</td>
</tr>
<tr>
<td>Benzo[a]pyrene</td>
<td>SW 846/Method 8270</td>
<td>660</td>
</tr>
<tr>
<td>β-Naphthylamine</td>
<td>SW 846/Method 8270</td>
<td>55</td>
</tr>
<tr>
<td></td>
<td>(HRGC/MS with selective ion monitoring)</td>
<td></td>
</tr>
</tbody>
</table>
SECTION 5

SAMPLING PROCEDURES

This section summarizes the sampling procedures to be used during the miniburn and trial burn. Preparation of the sampling equipment and sampling procedures are addressed. Equipment calibration is briefly addressed; the Project Quality Assurance Plan more specifically addresses equipment calibration. Sample handling (transport and storage) and sample analysis procedures are addressed in Section 6.

All sample bottles required for recovery of samples from the Method 5-type trains and feed and ash samples will be purchased as precleaned glass bottles. These bottles will be purchased precleaned for trace metals and organics with accompanying certificates of analysis and QC lot numbers.

Performance Specification Tests will be carried out on the facilities' continuous emission monitors after the miniburn as described in Section 5.4.

5.1 STACK EMISSIONS TESTING

The stack gas samples to be collected will require the use of three separate sampling systems, as follows:
1. MM5-SV sampling train for semivolatile POHCs and PICs and for PCDDs and PCDFs
2. MM5-PH sampling train for particulate matter/HCl/Cl₂
3. MM5-MM sampling train for multiple metals

Integrated gas bag samples for Orsat analysis (oxygen and carbon dioxide) will be collected in conjunction with the MM5-PH, MM5-MM, and MM5-SV sampling trains. Prior to the tests, a cyclonic flow check will be conducted. If cyclonic or nonparallel flow conditions exist, modifications will need to be made to remedy this situation before stack testing begins.

5.1.1 MM5-SV Sampling Train for Semivolatile POHCs and PICs and for PCDDs/PCDFs

5.1.1.1 Sampling Train Description

The semivolatile POHCs, PICs, and PCDDs/PCDFs present in the stack gas will be collected using an MM5-SV sampling train as shown in Figures 5-1a and 5-1b. The MM5-SV procedure consists of isokinetically sampling stack gas with the MM5-SV apparatus per EPA Method 0010 (minimum volume will depend on the exact sampling rate but is expected to be near 3 m³ of dry stack gas corrected to standard conditions). The MM5-SV sampling procedures will be consistent with EPA Method 0010 in SW-846, with addition of toluene rinsing for determining PCDD/PCDF per EPA Method 23.

The MM5-SV sampling train is based upon the apparatus design normally employed for sampling conducted under USEPA Method 5 but is modified to include a special coiled condenser and sorbent module assembly for collection of semivolatile organic compounds as shown in Figures 5-1a and 5-1b. This
1. Condenser with Ice Water Jacket
2. XAD Resin Cartridge with Ice Water Jacket, 65 g of XAD-2
3. Modified Greenberg-Smith
4. Modified Greenberg-Smith, 100 mL of Double Distilled in Glass H₂O
5. Greenberg-Smith, 100 mL of Double Distilled in Glass H₂O
6. Modified Greenberg-Smith, Empty
7. Modified Greenberg-Smith, 200 g SiO₂

* This train design is a modification of the design shown in Method 0010, in that the condenser is not positioned directly above the XAD cartridge.

Figure 5-1a. Schematic of the MM5-SV sampling train.
* This train design is a modification of the design shown in Method 0010, in that the condenser is not positioned directly above the XAD cartridge.

Figure 5-1b. MM5 condenser and XAD resin cartridge.
represents a modification of the sampling train configuration given in EPA Method 0010. That is, in Method 0010 the condenser is mounted directly above the XAD cartridge. In the modified design shown in Figures 5-1a and 5-1b, the condenser is beside the XAD cartridge with an interconnecting tube in which condensate is carried up and over into the XAD cartridge by the gas flow. This design considerably reduces the height of the train thus reducing the potential for breakage of all the glassware in the train.

The MM5-SV train components consist of a quartz nozzle, a heat-traced borosilicate glass probe housed in a stainless steel sheath, an optional cyclone, a high efficiency quartz fiber filter on a Teflon-coated wire support mounted in a glass holder, a water-cooled glass coil condenser and a water-cooled glass tube filled with about 65 g XAD-2 resin-type sorbent (Figure 5-1b), five glass impingers, and a flow control module containing a leakless vacuum pump, a dry gas meter, an orifice meter and appropriate valves, gauges, and associated hardware to permit control and monitoring of the gas sampling rate. The five impingers are of the Greenburg-Smith design modified as follows:

- The first impinger is a modified Greenburg-Smith impinger. The impinger is modified by removal of the nozzle/plate assembly, and the stem length is extended to within 1/2 in from the bottom of the impinger bottle. Instead of the normal 500-mL impinger, a 2-L impinger will be used to collect the large amount of condensate expected.
- The second impinger is the modified Greenburg-Smith design with the normal 500-mL impinger capacity.
- The third impinger is the standard Greenburg-Smith tip design.
- The fourth and fifth impingers are the modified Greenburg-Smith design.

The impingers will be charged as follows:

- Impinger one—empty
- Impingers two and three—100 mL of distilled-in-glass water
• Impinger four—empty
• Impinger five—approximately 200 g of blue indicating type silica gel

Because of the low particulate emissions expected for this trial burn, a cyclone may not be used. The filter holder assembly is housed in a temperature controlled oven maintained at 120 ± 14°C.

5.1.1.2 MM5-SV Train Preparation

Calibration—The MM5-SV equipment will be calibrated, checked for proper operation, and cleaned for use prior to arrival on-site.

As a minimum, the following equipment will be calibrated:

1. Dry gas meter/orifice meter
2. Stack temperature thermocouple
3. Filter and filter oven thermocouples
4. Thermocouples for gas meter, XAD inlet, and impinger outlet temperatures
5. Probe nozzles
6. Pitot tube (by dimensional standards) as described by EPA methods
7. Barometer

Copies of all calibration data will be placed in the project calibration data file and will be submitted with the final report. The calibration procedures used by MRI are from the Quality Assurance Handbook for Air Pollution Measurement Systems: Volume III—Stationary Source Specific Methods, U.S. EPA 600/4-77-027b where applicable and from the latest procedures.
**Cleaning glassware**—All surfaces in the MM5-SV sampling trains that will come into contact with the sample gas stream will be thoroughly cleaned in MRI's laboratory prior to use as follows:

1. Scrub and soak in hot "Alconox" soapy water
2. Hot water rinse
3. Distilled water rinse
4. Acetone rinse
5. Methylene chloride rinse
6. Hexane rinse
7. Bake in 100°C oven until dry
8. Cap ends with hexane rinsed aluminum foil (dull side in)
9. Store in closed containers

All MM5-SV sampling train component connections will be leak-free glass-to-glass joints sealed with Teflon ferrules compressed with nylon bushings. The MM5-SV sorbet traps are one-piece assemblies, charged with approximately 65 g of XAD resin.

**Filters**—Quartz fiber filters will be used. Identification numbers will not be stamped on these filters.

**Resin cleanup**—The resin to be used in the MM5 train will be rinsed and extracted to remove any contaminants which may interfere with the analysis.

The XAD-2 resin for the MM5-SV is purchased from Supelco or Altech, precleaned. The precleaned XAD-2 resin is placed into a soxhlet extraction column and extracted with methylene chloride for 16 to 22 hr at MRI. After rinsing and extraction, the resin will be dried in a fluidized bed using purified nitrogen. If not to be used within 2 weeks, the cleaned resin will be stored under...
methanol. The resin will be dried with clean nitrogen just prior to use (within 2 weeks).

**XAD-2 resin traps**—The resin traps will be packed at MRI’s laboratory. The traps will be packed within 2 weeks of sampling. Once packed, the traps will be sealed with glass plugs and Teflon ferrules.

### 5.1.1.3 Sample Collection

Except as noted below, sample collection, including leak checking prior to sample collection, will be conducted in accordance with the procedures described in SW-846 Method 0010. The samples will be collected isokinetically over a complete traverse of the stack as required by 40 CFR 60 Appendix A, Methods 1 through 5. Approximately 100 dscf will be collected at a sampling rate of approximately 0.6 ft³/min (3-hr sample period).

**Blank train**—A blank MM5-SV sampling train will be fully assembled in the field, heated, and then recovered using the same procedures as those used for the actual MM5-SV sampling train. The blank train samples will be analyzed along with the other test samples.

### 5.1.1.4 Sample Recovery

At the end of each run, after the final leak check, the sampling train will be taken to the field laboratory to recover the sample components. The sample recovery will be as follows:

- Container 1—Filter. Use Teflon-coated or stainless steel forceps to recover the filter; place the filter in the labeled glass sample bottle.
• Container 2—XAD-2 resin. Any condensed moisture collected in the bottom of the condenser will be poured through the XAD resin. The XAD-2 resin cartridge will then be sealed with the glass plugs originally used to ship the module to the field and weighed for moisture determination. The XAD-2 resin cartridge will be covered with aluminum foil for shipment.

• Container 3—Rinses. Rinse and brush the probe nozzle, probe liner, and all glassware up to and including the front-half of the filter holder with methanol/methylene chloride three times. Rinse all glassware from and including the back-half of the filter holder to the XAD resin cartridge including the condenser with methanol/methylene chloride three times, and toluene three times.

• Container 4—Toluene rinses. Repeat all the above rinses with toluene (3 times).

• Container 5—Condensate. After weighing, collect impinger condensates.

• Weigh the silica gel in the fifth impinger.

5.1.2 MM5-PH Sampling Train for Particulate/HCl/Cl₂

5.1.2.1 Sampling Train Description

The MM5-PH train to be used for particulate/HCl/Cl₂ is a standard EPA Method 5 train, except that it includes dilute H₂SO₄ in the first three impingers (for HCl) and dilute NaOH solution in the fifth and sixth impingers (for Cl₂ as Cl⁻) per EPA Method 0050 (see Figure 5-2).

The types of impingers are described and will be charged as shown in Figure 5-2.
Figure 5-2. Schematic of the MM5 PH sampling train for particulates, HCl, and Cl₂.
5.1.2.2 MM5-PH Train Preparation

**Calibration**—Components of the MM5-PH train will be calibrated the same as previously described for the MM5-SV train.

**Filters**—Weighed quartz filters will be used but identification numbers will not be stamped on these filters. The filters will be placed in glass petri dishes which will be marked with identification numbers.

5.1.2.3 Sample Collection

Sample collection will follow EPA Method 5 procedures, the same as for the MM5-SV train, but will not involve a blank train.

5.1.2.4 Sample Recovery

At the end of each test run and after the final test check, the sample train will be taken to the field laboratory to recover the sample components, as follows:

- **Container 1**—Filter. Use nonmetallic forceps to recover the filter. Place the filter in the original labeled glass petri dish.

- **Container 2**—Front-Half Rinse. Rinse and brush the probe nozzle, probe liner, and all glassware up to and including the front-half of the filter holder with acetone; repeat three times or more until visually clean.

- **Container 3**—Condensate and H$_2$SO$_4$ solutions. After weighing impingers one through three, collect the impinger contents. After rinsing the impingers with water, measure the total combined volume of rinses and condensate, mix thoroughly, and then remove a 25-mL aliquot for chloride analysis (Container 3A).
- Container 4—NaOH. After weighing impingers four through six, combine the contents. Rinse impingers with water, measure the total volume, and mix thoroughly. Remove one 25-mL aliquot for chloride analysis (Container 4A).

- Weigh the silica gel in the seventh impinger.

5.1.3 MM5-MM Sampling Train for Metals

5.1.3.1 Sampling Train Description

The MM5-MM train used for metals emissions is similar to a standard EPA Method 5 train, except that it includes special solutions in the impingers to collect volatile metals (see Figure 5-3). The sampling train and procedure will be as specified in draft EPA Method 29, "Determination of Metals Emissions in Gases from Stationary Sources," except that no potassium permanganate will be used in the impingers since Hg is not included in the list of target metal analysis.

5.1.3.2 MM5-MM Train Preparation

**Calibration**—Components of the MM5-MM sampling train will be calibrated the same as previously described for the MM5-SV sampling train.

**Filters**—Weighed quartz fiber filters will be used. Identification numbers will not be stamped on these filters.

**Cleaning Glassware**—All glass parts of the train will be cleaned in MRI's laboratory prior to use as follows:
Figure 5-3. Schematic of the MM5-MM sampling train.
1. Rinse with tap water.
2. Wash with soapy (Acationox or equivalent) water.
3. Rinse three times with tap water.
4. Rinse three times with distilled water.
5. Soak in 10% HNO₃ for 4 hr.
6. Rinse three times with distilled water.
7. Rinse three times with ASTM Type I water.
8. Air dry.
9. Cover all openings with Parafilm or Teflon tape.

5.1.3.3 Sample Collection

Sample collection, including leak checking prior to sample collection, will be conducted in accordance with the procedures described in EPA Draft Method 29. The samples will be collected isokinetically over a complete traverse of the stack as required by 40 CFR 60 Appendix A, Methods 1 through 5. A sample volume of near 100 ft³ will be collected at a sampling rate of approximately 0.6 ft³/min (3-hr sample period).

5.1.3.4 Sample Recovery

At the end of each test run, after the final leak check, the sample train will be taken to the field laboratory to recover the sample, as follows:

- Container 1—Filter. Use nonmetallic tweezers to recover the filter. Place the filter in the labeled glass sample bottle.
- Container 2—Front-Half Rinse with Nitric Acid. Rinse and brush the probe nozzle, probe, and all glassware up to and including the front half of the filter holder with 0.1 N HNO₃; repeat three times using a total of 150 mL.
• Container 3—Impingers One Through Four. After weighing impingers one through four combine the impinger contents into Container 3. Rinse each twice with 0.1 N HNO₃ twice using a total of 100 mL and add to Container 3. Measure the final volume.

• Weigh the fifth and sixth impingers and dispose of their contents properly.

5.1.4 Oxygen and Carbon Dioxide Sampling

Integrated multipoint stack gas samples will be taken during each test run and subsequently analyzed for percentage oxygen (O₂) and carbon dioxide (CO₂) according to EPA Reference Method 3B (40 CFR 60). The samples will be taken from connections at the exhaust of each of the Method 5-type sampling train consoles. This will provide samples from which particulate and moisture have already been removed and will automatically provide multipoint integrated samples. Figure 5-4 is a schematic of the sampling system.

The integrated samples will be taken over the entire 3-hr sampling period, simultaneously with the MM5-PH, MM5-SV, and MM5-MM sampling.

The sampling system leak checks required in Method 3B will be conducted. These include:

1. Leak checks of bags prior to use.
2. Sampling system leak checks before and after each sampling period.
3. Orsat analyzer leak checks before and after each analysis.

Each bag sample collected will be taken to the field laboratory and will be analyzed within 4 hr using an Orsat analyzer. Ambient air will be analyzed prior to the test samples as a check on the accuracy of the Orsat system and operation.
Figure 5-4. Method 3 sampling system for oxygen and carbon dioxide (using a Method 5 train as primary sampling device).
5.2 BULK SOLIDS FEED SAMPLING

A grab sample of the bulk solids feed will be collected every 15 min during each run and composited for each run. A minimum of 50 g will be collected for each grab sample, thus the total composite sample will be at least 500 g. This composite will be split into three separate composite samples. One sample will be analyzed for total solids/moisture content, ash, HHV, and total chloride analysis. The second composite sample will be for metals analysis and the third composite sample will be for SV-POHC analysis. The bulk solids feed samples will be collected from the solids feed conveyor in the feed preparation building.

During one run, a sample will be collected at random from the metal and POHC spike materials. These samples will be archived and will not be analyzed unless required to verify composition of spike materials.

5.3 ASH SAMPLING

Two different ash streams will be sampled during each run; bottom ash (from kiln, cyclone, and SCC) and fly ash (from evaporative cooler and baghouse). Two separate grab samples of each ash stream will be collected every 30 min during each run to produce two separate composite samples of each stream. The ash samples will be collected from the two conveyors prior to entering the ash storage areas. A minimum of 100 g will be collected for each grab sample, so each total composite sample will be at least 500 g. From each of the two composite samples, four separate samples will be taken for the following analyses:

- Semivolatile POHCs and semivolatile organic compounds identified in Table 4-5
• Volatile organic compounds identified in Table 4-5
• Total Organic Carbon (TOC)
• TCLP metals (Ag, As, Ba, Cd, Cr, Hg, Pb, and Se)

5.4 PERFORMANCE SPECIFICATION TESTS ON CEMs

Following the miniburn, Performance Specification Tests will be carried out by MRI and OHM on the facility continuous emission monitor listed below:

CO
CO₂
O₂
NOₓ
THC

The test will be done as specified in 40 CFR 60, Appendix B, Specifications 2, 3, and 4, and 40 CFR 266, Appendix 9, Section 2.2. MRI will assist OHM in conducting the required system checkout, calibration error check, and the system response time check. These activities and results will be documented by MRI. Thereafter, MRI will conduct the relative accuracy determinations on all CEMs and report the results to OHM. After MRI completes the RA tests, OHM will carryout and document the 7-day calibration drift test on all CEMs.
SECTION 6

SAMPLE HANDLING AND ANALYSIS

The following sections briefly describe the procedures to be employed during the analysis of the samples collected during this project. These procedures cover the analysis of VOCs, SVOCs, SV-POHCs, and metals in various sample media, along with emission samples for particulate matter, hydrogen chloride, and PCDDs/PCDFs. These analysis procedures may be revised to accommodate any further information received regarding the exact composition of the waste feed materials. Any such revisions will be thoroughly documented in the final report and approval of the revision will be requested from the USACE prior to revising the methods.

6.1 SAMPLE HANDLING AND PREPARATION

All samples that are to be analyzed for VOCs, SVOCs, SV-POHCs, PCDDs/PCDFs, or metals will be stored with ice in insulated containers in the field and during transport. Solid feed samples, ash samples, and stack samples will be stored and shipped in separate containers.

Samples will be handled upon receipt in the laboratory as specified in the following sections.
6.1.1 MM5-SV Samples

Upon receipt in the laboratory, the MM5-SV samples will be removed from the insulated containers and will be placed in cold storage (< 4°C). The MM5-SV samples will be in the following fractions:

1. Filter
2. XAD-2 resin trap
3. Methanol/methylene chloride rinsate
4. Toluene rinsate
5. Condensate (impinger contents)

Figure 6-1 presents a diagram of the analytical scheme to which MM5-SV sampling train samples are subjected. The particulate filter and XAD-2 resin will be combined for extraction. The MeOH/MeCl₂ rinsate and condensate will be extracted with methylene chloride. All of the sample extracts and toluene rinsate will be combined to generate a laboratory composite. Only the combined particulate filter/XAD-2 resin will be spiked with surrogate compounds.

The SV-POHC surrogates used will be d₆-naphthalene and d₄-1,4-dichlorobenzene. The PCDD/PCDF surrogates are ¹³C-labeled tetra- through octa-CDDs and ¹³C-labeled tetra- through hepta-CDFs, as specified in EPA Method 23. Solvent extraction methods for MM5 sampling trains are consistent with SW-846 Method 0010 with the exception of the sampling train condensates, which are extracted according to Method 3510 (or 3520, if emulsions are present). The extraction solvent of choice is MeCl₂, since POHCs, PICs, and PCDD/Fs are to be analyzed. Also, all extracts are combined for analysis rather than separately analyzing the extract from each component as specified in EPA Method 0010 because of the cumulative result of increasing the detection limit. It is for this reason that only the filter/XAD will be spiked with the two surrogates to
Figure 6-1. POHC, PIC, and PCDD/PCDF analysis scheme for MM5-SV train components.
determine their recovery efficiency, since most if not all of the analytes are expected to be captured in the filter/XAD.

MM5-SV sampling train extract composites will be split, with one-third of the extracts being analyzed for the SV-POHCs and SV-PICs, one-third analyzed for PCDD/PCDFs, and one-third archived.

Composited extract analysis for the SV-POHCs and PICs will be conducted by SW-846 Method 8270. Although these samples generally do not need to undergo column cleanup, if GC/MS analysis indicates that there are significant interferences present in the sample extract, the extracts will be subjected to a silica gel column cleanup (consistent with SW-846 Method 3630). Composited extracts for analysis of PCDD/PCDFs will be subjected to the cleanup scheme described in EPA Method 23 and analyzed by HRGC/HRMS (high resolution gas chromatography/high resolution mass spectrometry), also per EPA Method 23, with a few minor modifications as listed in Table 6-1.

6.1.2 Metals Emission Samples (MM5-MM)

The probe/front-half nitric acid wash and filter fractions for the MM5-MM sample trains from all tests will be submitted for metal analysis along with the impinger samples. Field reagent blanks will be submitted, combined, and analyzed in the same manner as the train samples. These samples will be analyzed for As, Be, Cd, Cr, and Pb.

Figure 6-2 presents a schematic of the analytical scheme for the metals samples from the MM5-MM train.
Table 6-1. MODIFICATIONS TO EPA METHOD 23, PCDD/F PREPARATION AND ANALYSIS

1. Section 3.20-21: 4.1.1.2; 5.1.5

   Exception: Surrogates and IQS will be added in the amount of 4000 total pg.
   Except for $^{37}$Cl-TCDD (1600 pg) and $^{13}$C-OCDD (8000 pg).

   Justification: This allows for the final extract concentration to match the calibration
   concentrations used by MRI as noted below.

2. Section 5.2.2

   Exception: Acidic alumina will be used instead of basic alumina.

   Justification: Acidic alumina has been demonstrated to be more reliable in recovery
   of target analytes and labeled compounds. It has performed well for
   the off-site sample analysis.

3. Section 5.2.3

   Exception: Carbopak C will be used instead of AX-21 carbon.

   Rinsing and elution scheme is as follows:

   Rinse:
   - 5 mL toluene
   - 2 mL methylene chloride:methanol:benzene (75:20:5)
   - 1 mL cyclohexane:methylene chloride (1:1)
   - 5 mL hexane

   Elution:
   - Two 2-mL portions of hexane
   - 2 mL cyclohexane:methylene chloride (1:1)
   - 2 mL methylene chloride:methanol:benzene (75:20:5)

   Justification: Carbopak C is more efficient in the removal of diphenyl ether
   interferences.

   Reduction in the use of benzene (a known carcinogen).

   More effective scheme for use with Carbopak C.

4. Section 6.1 and Table 2

   Exception: Calibration curve will cover the range of 2-500 pg/μL for tetras.
   Calibration curve will cover the range of 10-2500 pg/μL for penta-
   heptas.

   Calibration curve will cover the range of 20-5000 pg/μL for octas.
   Labeled analogs will be at 100 pg/μL except for $^{37}$Cl-TCDD (range of
   2-500 pg/μL) and $^{13}$C-OCDD (200 pg/μL).

   Justification: This calibration range allows MRI to achieve lower detection limits
   than those listed in Method 23.
Figure 6-2. Analysis scheme for MM5-MM train components.
6.1.3 Particulate Matter/HCl Emission Samples

The MM5-PH probe/front-half wash and filter fractions from the MM5-PH particulate sample trains will be analyzed gravimetrically for particulates per EPA Method 5.

The two samples from the train used for chloride analysis are 25-mL aliquots of the 0.1 N H₂SO₄ impinger contents and 0.1 N NaOH impinger contents. No additional special handling of these sample fractions is required prior to Cl⁻ analysis.

6.1.4 Feed Samples

The feed samples to be analyzed for the two SV-POHCs, and five metals will be placed in cold storage upon receipt in the laboratory. The samples for semi-volatile analysis have a recommended 14-day holding time from collection to extraction, and a recommended 40-day holding time from extraction to analysis.

The samples will be prepared for semi-volatile POHC analysis by extracting an aliquot of the feed using Soxhlet extraction. The sample will be extracted using methylene chloride (DCM) for 16 to 22 hr. The sample extract will be passed through a short column of anhydrous sodium sulfate, prerinsed with extracting solvent (methylene chloride) into a 500-mL Kuderna-Danish (K-D) flask fitted with a 10- or 25-mL calibrated receiving tube containing boiling chips. The extract will be evaporated to 5 to 10 mL in the 500-mL K-D apparatus fitted with a three-ball Snyder column. The evaporation will be carried out using a steam bath, over a period of 30 to 60 min. The K-D apparatus will be allowed to cool, and the column and flask rinsed with the solvent. Extract will be further
concentrated to 1 mL final volume. Following these preparation steps, the samples will be submitted for GC/MS analysis as described in Section 6.2.1.1.

The samples to be analyzed for metals will be digested according to Method 3051 in SW-846 and analyzed for the metals of interest by ICAP (Method 6010) or by GFAA (SW-846 Method 7000 series).

No additional special handling is required for the samples to be analyzed for total chlorine, ash, HHV, and total solids/moisture content.

6.1.5 Ash Samples

The bottom ash and fly ash samples that are to be analyzed for SV-POHCS, SVOCs, VOCs, and TCLP metals will be placed in cold storage upon receipt in the laboratory. The samples for semivolatile analysis have a recommended 14-day holding time from collection to extraction, and a recommended 40-day holding time from extraction to analysis.

The samples will be prepared for SV-POHC and SVOC analysis by extracting an aliquot of the ash using Soxhlet extraction. Prior to extraction, the aliquot will be spiked with Method 8270 surrogates and Method 8151 surrogates. The sample will then be extracted using methylene chloride (DCM) for 16 to 22 hr. The extract will be split (9:1); 90% being used for analysis of SV-POHCS and SVOCs per Method 8270, with 10% being analyzed for FENAC per Method 8151. The larger (90%) portion of the extract will be passed through a short column of anhydrous sodium sulfate, prerinsed with extracting solvent (DCM) into a 500-mL Kuderna-Danish (K-D) flask fitted with a 10- or 25-mL calibrated receiving tube containing boiling chips. The extract will be evaporated to 5 to 10 mL in the 500-mL K-D apparatus fitted with a three-ball Snyder
column. The evaporation will be carried out using a steam bath, over a period of 30 to 60 min. The K-D apparatus will be allowed to cool, and the column and flask rinsed with the solvent. Extract will then be concentrated to 1 mL final volume. Following these preparation steps, the samples will be submitted for GC/MS analysis as described in Section 6.2.1.1.

The smaller portion of the extract will be K-D concentrated per Section 7.2.1.6 of Method 8151. Following concentration, and cleanup if required, the sample will be derivatized and analyzed for FENAC by GC/ECD in accordance with Method 8151.

The samples for volatile organic analysis have a recommended 14-day holding time from collection to analysis. An aliquot of each sample will be dispersed in water or other appropriate dispersant and analyzed by purge and trap GC/MS analysis per Method 8260.

The samples for TCLP metals analysis will be extracted using EPA Method 1311. A brief summary of the steps involved in this extraction procedure is given below.

- Separate any liquid phase from solid phase, if appropriate (determine relative volume of each phase)

- Perform preliminary determinations on sample aliquot (> 100 g)
  - Determine % solids
  - Determine if particle size reduction is required (not required if particles are < 1 cm in narrowest dimension)
  - Determine which extract fluid is to be used

- Reduce size by crushing or grinding if required
• Weigh out sample aliquot (> 100 g)

• Filter sample if needed (retain filtrate)

• Add proper amount of extraction fluid to solid phase (using calculation specified in Method 1311)

• Extract for 18 ± 2 hr at 30 rpm and 23 ± 2°C

• Filter extract from solid phase

• Combine extract with filtrate from previous filtration, and/or proportional amount of liquid phase from original sample

• Acidify extract with HNO₃ to < pH 2

• Transfer sample for metals analysis (analysis includes method blank and matrix spike of filtrate after TCLP extraction)

TCLP extract samples will be digested for metals analysis according to Method 3010A or 3020A in SW-846. The digest will be analyzed for 8 metals (As, Ba, Cd, Cr, Hg, Pb, Ag, and Se) by ICP or AA (SW-846-6010A or 7000 series) as needed to meet required detection limits. Since the TCLP results need to be compared with EPA's drinking water standards, the PQLs for the metals in the TCLP extract must be below the drinking water standards, which are as follows:
### Table: EPA Drinking Water Standards (mg/L)

<table>
<thead>
<tr>
<th>Metal</th>
<th>EPA Drinking Water Standards (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>As</td>
<td>0.05</td>
</tr>
<tr>
<td>Ba</td>
<td>1.00</td>
</tr>
<tr>
<td>Cd</td>
<td>0.01</td>
</tr>
<tr>
<td>Cr</td>
<td>0.05</td>
</tr>
<tr>
<td>Hg</td>
<td>0.002</td>
</tr>
<tr>
<td>Pb</td>
<td>0.05</td>
</tr>
<tr>
<td>Ag</td>
<td>0.05</td>
</tr>
<tr>
<td>Se</td>
<td>0.01</td>
</tr>
</tbody>
</table>

No additional special handling is required for the samples to be analyzed for TOC. The method for TOC analysis is briefly described in Section 6.2.8.

### 6.2 SAMPLE ANALYSIS

Analytical methods and associated procedures are summarized in the following sections.

#### 6.2.1 SV-POHC, SVOC, and VOC Analysis by GC/MS

SV-POHCs will be measured in several types of samples. These include semivolatile (MM5) emissions samples, soil feed, and ash. The ten most abundant PICs will be identified and semiquantified in the semivolatile (MM5) emissions samples. VOCs and SVOCs will be measured in the ash samples. SV-POHC, SV-PIC, SVOC, and VOC analysis will be done by GC/MS.
Surrogates appropriate for the analytes in each matrix will be spiked into the samples prior to extraction/analysis.

Labeled surrogates (d₈-naphthalene and d₄-1,4-dichlorobenzene) will be used for the SV-POHC and SV-PIC analysis of MM5 samples. Unlabeled surrogates may be used on other types of samples (e.g., soil feeds) when appropriate. In these cases, the appropriate unlabeled surrogates will be used, or one sample of each type will be spiked with the actual analyte at 3 times the expected concentration to assess recovery.

6.2.1.1 Modified Method 5 Sample Analysis

Analysis for MM5 SV-POHCs and SV-PICs will be by GC/MS using a 30-m DB-5 fused silica capillary column. MRI normally carries out analysis methods in accordance with SW-846 procedures with the following modification. The method extracts and analyzes all components separately. MRI will combine the XAD-2 resin and filter for Soxhlet extraction, and will combine the front half rinse, back half rinse, and the condensate for extraction in a separatory funnel. The two extracts are then combined and concentrated for one analysis. Only the XAD-2/filter will be spiked with labeled surrogate compounds prior to extraction. Combining all the components for a single analysis yields a single result and avoids adding together the results for individual components, which may be below the detection limit.

6.2.1.2 Analysis of Ash Samples for SV-POHCs, SVOCs, and VOCs

Ash sample extracts will be analyzed for the SV-POHCs and SVOCs selected for this trial burn by EPA Method 8270 with the same GC/MS column as
described in Section 6.2.1.1. (The list of SVOCs is provided in Table 4-2 footnote d.)

A small part of the final 1-mL extract will be analyzed for β-naphthylamine by HR GC/MS with selective ion monitoring (SIM) to achieve the required detection limit for that analysis. This method was discussed in an EPA study titled "Analytical Method Development and Results for β-Naphthylamine and 4-Nitroaniline." If there is some problem in meeting the required detection limit using that method, other techniques found suitable in the referenced study will be used (e.g., HPLC).

As noted in Section 6.1.5, a small portion of the extract will be analyzed for FENAC by GC/ECD per Method 8151.

Ash samples will be analyzed for the VOCs selected for this trial burn by purge and trap GC/MS analysis, specifically as described in SW-846 Method 8260. A megabore 625 column may be used in lieu of a packed GC column for the analysis of the VOCs in the ash samples.

6.2.1.3 Soil Feed Analysis

Soil sample extracts will be analyzed for each of the semivolatile POHCs selected for this trial burn with the same GC/MS column described in Section 6.2.1.1.
6.2.2 PCDD/PCDF Analysis

The MM5-SV samples will be analyzed for the compounds referred to as "PCDDs/PCDFs" using the procedures described in EPA Method 23, with a few minor modifications as were listed in Table 6-1. PCDDs/PCDFs means that each sample will be analyzed for all tetra- through octa-dioxin and furan congener groups and for all 2,3,7,8-isomers, specifically.

PCDD/PCDF analysis involves further concentrating the sample extract under nitrogen, then passing it through three cleanup columns (Silica Gel, Alumina, and finally Carbopak C/Celite 545). Hexane, methylene chloride, and toluene are used as eluents. Analysis is performed by high resolution gas chromatography/high resolution mass spectroscopy with selected ion monitoring (HRGC/HRMS-SIM). Dioxin and furan levels will be calculated by comparison to the internal standards per Method 23.

6.2.3 Particulate Matter Analysis

The particulate analysis will be performed by MRI according to the procedures established in EPA Reference Method 5. Particulate analysis of the filter will be done by oven drying the filter. The filter will be oven dried for 2 to 3 hr at 105°C (220°F) and cooled in a desiccator after which the filter will be weighed to a constant weight. Constant weight means a difference of no more than 0.5 mg or 1% of total weight less tare weight, whichever is greater, between two consecutive weighings, with no less than 6 hr of desiccation time between weighings.

The probe rinse containers will be checked for any leakage during transport. The liquid will be weighed or measured volumetrically to the nearest...
±1 mL. The rinses will be transferred to tared glass beakers. The probe rinse will be evaporated to dryness at ambient temperature and pressure. The beaker will be weighed to a constant weight with results reported to the nearest 0.1 mg.

Weights will be reported separately for filters and probe rinses.

6.2.4 Hydrogen Chloride and Chlorine (Cl₂) Analysis

Analysis for HCl and Cl₂ as chloride, in MM5-PH impinger aliquots will be conducted by Midwest Research Institute, by SW-846 Method 9057, a test for anions in water using ion chromatography as specified in SW-846 Method 0050. The concentration of chloride (mg/L) in the sample solution and the total volume of the solution will be reported.

6.2.5 Oxygen and Carbon Dioxide Analysis (Orsat)

An Orsat analyzer will be used to analyze the multi-point, integrated bag samples for O₂ and CO₂ according to EPA Reference Method 3B (Appendix A, 40 CFR 60). These samples will be analyzed within 4 hr of collection, and all procedures required by the method will be applied. The concentration of carbon dioxide and of oxygen will be reported in percent by volume on a dry basis.

6.2.6 Metals Analysis

Analysis for metals will apply to the solid waste feed, TCLP metals extracts of the ash sample, and stack emission samples (MM5-MM sampling train). These analyses will be directed to the following metals: As, Be, Cd, Cr,
and Pb, except for TCLP metals which consist of As, Ba, Cd, Cr, Hg, Pb, Ag, and Se.

The metals analysis procedures for the stack emission samples are summarized in the previous Figure 6-2 and will be done in accordance with the detailed procedures developed in the draft EPA Method 29 ("Determination of Metals Emissions From Stationary Sources"), with some modifications as outlined in Table 6-2.

Metals analysis for the remaining samples will be carried out following procedures in SW-846. This will include digestion of samples by Methods 3010A, 3020A, and 3050A, or microwave Method 3051 as appropriate for each sample matrix, and analysis by ICAP (Method 6010A).

If any stack gas samples or TCLP extract samples analyzed by Method 6010A are below the required detection limit for the specific metals, they will be analyzed by the appropriate 7000A series method using GFAA (or CVAA for Hg). The apparatus used for Hg by CVAA is equivalent to the closed loop system diagrammed in Method 7470. Detection limits for TCLP extracts must be below the EPA drinking water standards listed previously in Section 6.1.5. Detection limits for metals in the stack gas samples must be consistent with those given in EPA Method 29 (see Table 4-3) or a factor of 10 below the expected concentrations shown in Table 4-3.
A. Method Modifications for Draft EPA Method 29

Note: The following are the necessary modifications to the draft Method 29 for the determination of multimetals in stacks. The modifications are listed by applicable paragraph in the method and include justification for the change.

Replacement of paragraphs 4.5.14 and 4.5.37.3. Please replace these paragraphs with:

Paragraph 4.5.14 Phosphoric acid, concentrated. Minimum ACS Grade. and
Paragraph 4.5.37.3 Phosphoric acid solution. Dilute 4 mL of concentrated phosphoric acid to 100 mL with ASTM Type II water.

Justification: These paragraphs should be deleted as current EPA methods no longer use lanthanum oxide as the matrix modifier for lead by graphite furnace but instead use phosphoric acid.

(Addition) Paragraph 4.5.39 Boric Acid (0.5 M). Baker Analyzed or equivalent. Dissolve 3.1 g boric acid in ASTM Type II water. Dilute to 100 mL with ASTM Type II water. Matrix interferences may require diluting the above solution to 0.05 M boric acid when analyzing by GFAA at ppb levels.

Justification: This solution can be used with the analysis of the front half samples to make them safer for the analysts to handle as it complexes the hydrofluoric acid and has not been shown to detract from the sensitivity of the analysis.

Paragraphs 5.3.1 to 5.3.3. Front Half Sample Preparation. Check the pH of container number 3; it should be pH 2 or lower. Note the level of the liquid in the container and record any evidence of leakage. This sample should be rinsed into a beaker with ASTM Type II water and add 10 mL of concentrated HNO₃. If particulates were determined, add 10 mL of concentrated HNO₃ to the beaker which had contained the acetone rinse and redissolve the residue carefully with stirring and slight heating. Quantitatively transfer the redissolved residue into the beaker containing container 3. This combined sample should be heated on a hot plate or microwave (open vessel) at a temperature just below boiling to reduce the volume to 20 mL. If available, a ribbed watch glass should be used to cover the sample as it reduces to prevent airborne contamination. If a ribbed watch glass is not available, the sample can be reduced uncovered while taking steps to assure minimal contamination. Quantitatively transfer the filter/filter catch to an individual microwave pressure relief vessel and quantitatively transfer the volume reduced sample to the vessel with minimal rinses of ASTM Type II water. Add 6 mL of concentrated HNO₃ and 4 mL of concentrated HF to the vessel.
Seal the vessel and microwave the vessel for approximately 12 to 15 min in intervals of 1 to 2 min at 600 W.

**Notes:**
1. Suggested microwave heating times are approximate and are dependent upon the number of samples being digested. Heating times of 12 to 15 min have been found to be acceptable for simultaneous digestion of up to 12 individual samples. Sufficient heating is evidenced by sorbent reflux within the vessel.
2. If the sampling train uses an optional cyclone, the cyclone catch should be prepared and digested using the same procedures as described for the combined filter/rinse samples.

Allow the sample to cool to room temperature. Five milliliters of a 0.5 M boric acid solution can be added to complex the hydrofluoric acid matrix. Dilute to 200 mL or appropriate volume to contain digest in a volumetric flask with ASTM Type II water. A portion of this sample is used for the determination of front half mercury.

**Justification:** This procedure has been used in other test burns with no detrimental effects upon the sample preparation or analysis and has the advantage of better detection limits. No problems have been encountered with complete dissolution of the filter. The addition of the boric acid to the sample digests makes them safer for the analysts to handle as it complexes the hydrofluoric acid and has not been shown to detract from the sensitivity of the analysis.

(Replacement) Paragraph 5.3.4 Container No. 4 (Impingers 1 to 3). Note the level of the liquid in the container and record any evidence of leakage. Measure the liquid in container 3 either volumetrically to ±1 mL or gravimetrically to ±0.5 g. Remove a 50- to 100-mL aliquot for mercury analysis as Fraction 2B. (Eliminate this aliquot if Hg is not an analyte. The remaining portion of container 4 is Fraction 2A. Aliquot Fraction 2A defines the volume of 2A prior to digestion. All of the aliquot Fraction 2A (and only 2A) is digested to produce the sample for ICAP or GFAA analysis. The Fraction 2B aliquot should be prepared and analyzed for mercury as described in Section 5.4.3. The pH of aliquot fraction 2A shall be pH 2 or lower. (If necessary, adjust by careful addition of concentrated HNO₃. The sample should be rinsed into a beaker with ASTM Type II water and add 5 mL of concentrated HNO₃. This sample should be heated on a hot plate at a temperature just below boiling to reduce the volume to 20 mL. If available, a ribbed watch glass should be used to cover the sample as it reduces to prevent airborne contamination. If a ribbed watch glass is not available, the sample can be reduced uncovered while taking steps to assure
Table 6-2 (Continued)

minimal contamination. Add 10 mL of 50% nitric acid and heat for 30 min on a hot plate to just below boiling with a watch glass. Add 1 mL of 30% hydrogen peroxide and 9 mL of ASTM Type II water and heat for 20 more minutes. Add 10 mL of ASTM Type II water and reflux the sample for an additional 20 min. Cool and dilute to 100 mL in a volumetric flask with ASTM Type II water. The microwave option may be used as an alternative.

Justification: This procedure reduces the final volume of the sample, which improves detection limits, without reducing the oxidizing strength of the digestion procedure.

B. Method Modifications for EPA SW-846 (3rd Edition)

Note: The following modifications are listed by method number and applicable paragraph.

Method 3050A

Paragraph 1.1 (addition) This method may also be employed for the more rigorous digestion of liquids, with appropriate changes in sample size. This method may be used for the GFAA analysis of lead.

Paragraph 2.1 (addition) ICAP may also be performed on the digests prepared as for GFAA in this method.

Method 6010A

Paragraph 5.7 The interference check standards are prepared to contain known concentrations of interfering elements that will provide an adequate test of the correction factors. Spike the standards with the elements of interest at a 1-μg/mL level. In the absence of measurable analyte, overcorrection could go undetected because a negative value could be reported as zero. If the particular instrument will display overcorrection as a negative number, this spiking procedure will not be necessary.

Paragraph 5.8 The quality control sample(s) should be prepared in the same acid matrix as the calibration standards at a 1-μg/mL level from standards from an alternate lot than the calibration standards.
Method 7060

Paragraph 2.2 Nickel nitrate (1,000 or 10,000 µg/mL, an experimentally predetermined volume) is added as a matrix modifier by the GFAA autosampler to the graphite tube after sample addition but prior to the drying step. This solution is used without dilution.

Paragraph 7.5 Midpoint standards will be analyzed at a frequency of 1 for every 10 samples. If the value obtained varies more than 20% from the corresponding standard in the calibration curve, the instrument will be recalibrated and all samples subsequent to an acceptable midpoint standard will be reanalyzed.

Method 7421

Paragraph 5.2 Procure a certified aqueous standard from a supplier and verify by comparison with a second standard from a different lot, from the same or an alternate manufacturer.

Paragraph 7.6 (addition). A midpoint standard will be analyzed as an instrument check standard to verify calibration after each 10 analyses.

Method 7470A

Paragraph 1.1 (addition) This method may be used for the analysis of mercury in Method 3050A or 3015 digestates.

Paragraph 5.5 Stannous Sulfate. Add 25 g stannous chloride to a dry 1-L volumetric flask. Carefully add 50 mL of concentrated HCl. Allow SnCl₂ to dissolve completely, then dilute volume with Type II water.

Paragraph 5.9 Stock Mercury Solution. Procure a certified aqueous standard from a supplier. Prepare a 1-µg/mL working solution 10% nitric acid from this standard for the preparation of the standards for the calibration curve.

Paragraph 7.1 Sample Preparation. Transfer 5 to 10 mL (or appropriate volume diluted to 10 mL with Type I water) of sample to a 250-mL glass stoppered Erlenmeyer flask. Add 5 mL concentrated H₂SO₄ and 2.5 mL concentrated HNO₃, mixing after each addition. Add 20 mL of potassium permanganate solution and mix. Add additional portions of potassium permanganate solution, if necessary, until the purple color remains in all
samples for at least 15 min. Add 8 mL potassium persulfate solution to each sample and heat for approximately 2 hr in a water bath maintained at approximately 95°C. Cool and add 6 mL of sodium chloride-hydroxylamine sulfate to reduce the excess permanganate. If necessary, continue adding 6-mL increments of sodium chloride hydroxylamine sulfate solution until the KMnO₄ is completely reduced as indicated by a colorless solution. Transfer to labeled 200 mL volumetric flasks and dilute to the mark with Type II water. Continue as described in paragraph 7.3.

Paragraph 7.2 Standard Preparation. Transfer appropriate amounts of the 1-μg/mL working solution prepared in paragraph 5.9 into 250-mL glass stoppered Erlenmeyer flasks for the calibration curve. Add enough Type II water to make a total volume approximately that of the samples. Treat standards with the samples as described in paragraph 7.1.

Paragraph 7.3 Analysis. Pour an appropriate amount of sample, standard, or blank into the autosampler of the PSA Merlin Mercury Analyzer for CVAA. Perform analysis as described in the instrument operating procedure.

Paragraph 8.2 Calibration curves must be composed of a minimum of a blank and three standards. Instrument drift should be monitored by analyzing a standard at approximately the midpoint of the calibration curve after every 10 analyses.
6.2.7 Other Analysis of Solid Feed Samples

Samples of the solid waste feed will be analyzed by Galbraith Laboratories as shown below in accordance with the ASTM methods:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total solids/moisture content (%)</td>
<td>ASTM D3173</td>
</tr>
<tr>
<td>Ash content (%)</td>
<td>ASTM D3174</td>
</tr>
<tr>
<td>Healing value (BTU/lb)</td>
<td>ASTM D2015</td>
</tr>
<tr>
<td>Chlorine (%)</td>
<td>ASTM E442</td>
</tr>
</tbody>
</table>

Total chlorine will be determined for the feed samples by Galbraith Laboratories, Inc. Because chloride concentrations can vary considerably depending upon the type of sample, each sample will be screened as applicable. Samples will be analyzed according to ASTM Method E442 by a combustion/absorption/titration technique. If the result for any organic sample is low, another sample aliquot will be combusted and absorbed using ASTM Method 808 with the resulting sample matrix being analyzed by ion chromatography according to ASTM Method D4327.

6.2.8 TOC Analyses of Ash Samples

Samples of the ash will be analyzed for Total Organic Carbon by Galbraith Laboratories, in accordance with SW-846, Method 9060, which requires quadruplicate analyses of each sample.
SECTION 7

REPORTING OF RESULTS

The results will be presented in a format which meets the requirements of the USEPA and RCRA Part B Trial Burn Reporting Requirements. The results will be calculated and reported as shown in the following sections. Data will be reported for all trial burn runs in the trial burn results. Any data that are not acceptable due to technical difficulties will be indicated and an explanation of the technical problem will be given. The proposed report outline is presented in Section 7.7.

7.1 POHC DESTRUCTION AND REMOVAL EFFICIENCY

The results of the sampling and analysis procedures described above will include data on the concentration of designated SV-POHCs in the solid waste feed samples and corresponding stack gas effluent sample for each of the test runs. The DRE value will be calculated for each POHC for each test run as follows:
DRE = \frac{W_{\text{in}} - W_{\text{out}}}{W_{\text{in}}} \times 100\%

where:

\[ W_{\text{in}} = (\text{concentration of POHC in waste feed} \times \text{mass feed rate of waste}) + (\text{spiking rate for POHC}) \]

\[ W_{\text{out}} = \text{concentration of POHC in stack gas} \times \text{volumetric flow rate of stack gas} \]

Spiking rate for the POHCs will be based on the weight of the spike bags or "pillows," the number of bags spiked during test periods, and the purity of the spike POHC (to be provided by those responsible for preparing the POHC spike material).

7.2 PARTICULATE MATTER EMISSIONS

Particulate matter emissions will be presented in units of grains per dry standard cubic foot of gas, corrected based on CO₂ in stack gas as follows:

\[ P_c = P_m \times \frac{8.5}{Y} \]

in which:

\[ P_c = \text{corrected concentration of particulate matter} \]

\[ P_m = \text{measured concentration of particulate matter} \]

\[ Y = \text{measured carbon dioxide concentration (percent, dry) in the stack gas using the Orsat method} \]

This correction is based on CO₂ as explained in Appendix B.
7.3 HYDROGEN CHLORIDE EMISSIONS

Hydrogen chloride emissions will be presented in units of pounds per hour (lb/hr) and a removal efficiency will be calculated based on the chlorine content of the waste feed. The removal efficiency will be calculated from the total equivalent mass of hydrogen chloride fed into the incinerator from the soil feed material and POHCs during each run and from the total mass of hydrogen chloride emitted from the stack during the run.

7.4 METALS EMISSIONS

The concentration of each of the 5 metals (As, Be, Cd, Cr, and Pb) in the stack gas effluent samples will be reported for each of the test runs. The metal influent data will be reported in terms of lb/hr for each of the metals, while the emissions data will be reported in g/sec. If no metal is detected or the blank level exceeds the sample level, the data will be reported as "less than" value.

The results of the sampling and analysis will provide data on the concentration of each metal in the solid waste samples, and corresponding stack gas effluent sample for each of the test runs. Metal feed rates will be calculated from the feed rate and metal concentrations in the waste feed, plus the metal spike rate. Metal spike rate will be based on the weight of the bags spiked during each run and the metals content of the bags (to be provided by those responsible for preparing the metal spike materials).
7.5 PCDDs/PCDFs EMISSIONS

The concentration of PCDDs/PCDFs measured in the MM5-SV samples will be reported in units of ng/dscm. All tetra- through octa-congeners will be quantified as well as the total for each homolog group.

7.6 FEED ANALYSIS RESULTS

The concentration of the POHCs found in each composite sample will be reported in percent of weight. The total mass of the individual POHC fed to the incinerator during each run will be calculated from this concentration and the process operation data for the amount of feed material fed to the incinerator and the POHC spiking rates. The total chlorine, ash content, HHV, and total solids/moisture content, will also be reported for each composite sample.

7.7 ASH ANALYSIS RESULTS

The concentration of the TOC, SV-POHCs, SVOCs (including β-naphthylamine and FENAC), and VOCs will be reported in units of microgram per gram for the two ash samples of each type for each run. The concentration of the 8 TCLP metals will be reported for each run in mg/L.

7.8 PROPOSED REPORT OUTLINE INCLUDING APPENDICES

The final report will be in a technical report format. A proposed outline for this report is as follows:
EXECUTIVE SUMMARY

1.0 INTRODUCTION
2.0 SUMMARY OF RESULTS
3.0 INCINERATOR DESCRIPTION AND OPERATING DATA
   3.1 INCINERATOR DESCRIPTION
   3.2 OPERATING DATA
4.0 TEST RESULTS
   4.1 WASTE FEED CHARACTERISTICS
      4.1.1 POHC INPUT RATE
      4.1.2 METALS INPUT RATE
      4.1.3 Cl INPUT RATE
   4.2 METHOD 5 TEST DATA AND PARTICULATE EMISSION
   4.3 DRE FOR SEMIVOLATILE POHCs
   4.4 HCl/Cl₂ EMISSIONS
   4.5 METALS EMISSIONS
   4.6 PCDDs/PCDFs EMISSIONS
   4.7 PIC EMISSIONS
   4.8 CO and NOₓ
   4.9 ASH ANALYSES RESULTS
      4.9.1 SV POHC CONCENTRATION
      4.9.2 SV ORGANIC COMPOUND CONCENTRATION
      4.9.3 V ORGANIC COMPOUND CONCENTRATION
      4.9.4 TOTAL ORGANIC CARBON CONTENT
      4.9.5 TCLP METAL CONCENTRATION

5.0 QUALITY ASSURANCE REPORT

Volume 2—Appendices

Part A
Appendix A—Sampling and Analysis Procedures
Appendix B—List of Samples Collected
Appendix C—Field Sampling Data and Sample Traceability

Part B
Appendix D—Process and Feed Rate Data
Appendix E—Method 5 and Modified Method 5 Calculations
Appendix F—Galbraith Laboratories, Inc. Analysis Results
Appendix G—Semivolatile Organics Analysis Results
Appendix H—Volatile Organic Analysis Results
Appendix I—Metal Analysis Results
Appendix J—Calibration Data
Appendix K—CEM Data

The report will contain detailed tabulations of the test results and a description of the incineration system, waste characteristics, test site location, location of sample collection points, test conditions, sampling and analytical methods, and procedures employed to conduct the testing. The appendices will include raw field data, laboratory data, computations, incinerator operating data, copies of continuous monitor data, and equipment calibration data.