DEMONSTRATION PLAN

ROSE TWP. - DEMODE ROAD

EPA SITE PROGRAM

Submitted by:
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This plan has been developed in support of the proposed demonstration of the Shirco Infrared Systems, Inc. (Shirco) thermal treatment process under the Environmental Protection Agency (EPA) Superfund Innovative Technology Evaluation (SITE) program. The primary purpose of the SITE program is to demonstrate and evaluate the use of innovative technologies at Superfund sites as alternatives to land disposal.

The Superfund site selected for the Shirco demonstration is the Rose Township Dump in Oakland County Michigan, approximately 15 miles south of the City of Flint. The site is located in an open 20-acre field where the dumping of industrial wastes is believed to have occurred in the late 1960’s. Analyses of soil samples taken at the site indicate the presence of solvents, PCB’s, oils and greases and other organic compounds as well as moderate levels of metals.

The Shirco Demonstration unit consists of an electric heated primary chamber, electric or fossil fuel heated secondary chamber, exhaust gas scrubber, data acquisition and control systems, and heating element power centers, all enclosed within a single 45 foot van.

The Shirco unit has been used times in the past to provide information on the economic feasibility, process performance and environmental impact of destroying site-specific wastes with infrared technology. A typical demonstration consists of a limited test program designed to accomplish the following objectives:

- To provide direct experimental verification that the Shirco thermal process technology meets all applicable and appropriate EPA and State environmental standards.

- To provide direct experimental verification by analysis of the solid residues that contaminant destruction is sufficient to allow delisting of the residues as hazardous waste.

- To determine the process operating conditions required to meet the first two objectives and the attendant operating cost of larger scale units under such conditions.
To meet these objectives, the following requirements are established for each test program:

- Only samples of hazardous waste-contaminated soils, sludges or liquids are tested.
- All sampling and analysis is performed in accordance with Environmental Protection Agency (EPA) and State Agency protocols.
- All test burn process data must conform, at a minimum, to the requirements of 40 CFR Part 264, Subpart O and appropriate State standards.
- Complete test results and relevant documentation needed to verify compliance with environmental standards will be submitted after each test. Records will be kept for three years.

The following Sections of this plan describe in detail the proposed activities for a two week period of testing at the Rose Township Dump site. These descriptions include, but are not limited to, the Demonstration Unit description, proposed variations in operating conditions, operating and monitoring procedures and a site specific health and safety requirements.
2. RESEARCH UNIT DESCRIPTION

2.0 General Description

The Shirco Mobile Demonstration unit is designed and fabricated by Shirco Infrared Systems, Inc. of Dallas, Texas. The system consists of a feed metering system, infrared primary chamber, supplemental propane-fired and infrared secondary chamber, exhaust gas scrubber, data acquisition and control systems, and heating element power centers, all enclosed in a 45 foot van. A brief description of the Shirco thermal process is presented below to familiarize the reader with the general concept of the technology. Specific details of the Shirco Demonstration Unit design and operation are then presented in the following sub-sections. The reader is referred to the Process and Instrumentation Diagrams (Drawing No. 03286D) and Portable Pilot Lay-outs (Drawing Nos. 03794D and 02868D) in Appendix A for a description of unit design.

Figure 2.1 presents a generalized schematic of the Shirco technology. Waste material is fed to a hopper mounted over a metering conveyor belt. The conveyor is shrouded and equipped with rubber skirts to minimize infiltration of air or escape of furnace gases. An adjustable guillotine-type gate is provided at the conveyor discharge. The gate distributes the material across the width of the metering belt and assists in furnace sealing. Final feed area sealing is provided by an additional adjustable knife gate in the feed chute into the furnace. The metering belt is synchronized with the furnace conveyor to control the material feed rate. Figures 2.2 and 2.3 present detailed process and component descriptions.

The thermal processor conveyor, a tightly woven wire belt, moves the waste material through the insulated heating modules (primary unit) where it is brought to combustion temperature by infrared heating elements. Rotary rakes gently turn the material to ensure adequate mixing and complete burnout. When the residual material reaches the discharge end of the furnace, it drops off the belt through a chute and into an enclosed hopper. The material is then discharged by means of a screw conveyor to a sealed 55 gallon drum.

Combustion air is supplied to the primary unit through a series of overfire air ports at various points along the length of the chamber, and flows countercurrent to the conveyed waste.
Shirco Incineration System

Illustration depicts one of many possible configurations of a typical waste disposal system.

No burners are required at any point in the process.

Process Description

Conditioned waste material is fed to the furnace by means of a Waste Feed System 1, passes through the Rotary Airlock 2, and onto a Metering Conveyor 3. There the material is spread and leveled in the Metering Section 4 before entering the Incinerator Feed Module 5. The Incinerator Conveyor 6 moves the waste material through Fiber Blanket 7 insulated Heating Modules 8 where it is brought to combustion temperature by Infrared Heating Elements 9 and gently turned by Rotary Rakes 10. Ash (or processed material) passes from the Discharge Module 11 into the Ash Discharge System 12 to a receptacle 13. A Blower 14 forces air through a Combustion Air Preheater 15 to extract energy from the exhaust gases and enters the Discharge Module 11. Exhaust gases exit the furnace through the exhaust duct 16. At this point, the gases may go to the Secondary Process Chamber 17 to incinerate any combustibles remaining and on to a heat recovery device such as a Combustion Air Preheater 15 or Waste Heat Boiler (not shown). Gases are then cooled and cleaned in the Scrubber 18 and exhausted by a Blower 19 through the exhaust stack 20.
Component Description

1. **Feed System** Material may be fed to the incinerator by a conveyor, overhead hopper, drum shredder or other method.

2. **Rotary Airlock** Minimizes excess air infiltration into the incinerator.

3. **Metering Conveyor** This belt is synchronized with the incinerator belt to feed material at the desired rate.

4. **Spreading/Leveling Devices** Material is spread to the width of the incinerator belt and leveled to the optimum process thickness.

5. **Feed Module** This module contains the conveyor drive, access doors, and sightglass to observe the incineration process.

6. **Incinerator Conveyor** A woven metal belt manufactured from selected alloys is used to convey waste material constantly and at the desired rate for optimum processing.

7. **Fiber Blanket Insulation** The insulation system is immune to thermal shock, a feature that allows rapid heating and cooling of the incinerator, has superior insulating properties and contains no asbestos. Most competing designs must use firebrick or castable refractory.

8. **Heating Modules** These modules contain the incinerator heating elements and Rotary Rakes. The number of modules is determined by desired process feed rate and material composition. The modular concept allows the furnace to be expandable and transportable. The heating modules are generally controlled in zones of increasing temperature.

9. **Electric Infrared Heating Elements** Silicon carbide rods are the heat source for the incinerator. They are located above the conveyor belt to heat the material directly with infrared energy. The efficiency of the heating elements is greater than 99% and they offer stepless adjustment for precise temperature control. Electric power significantly reduces both emissions and the size of scrubbing equipment.

10. **Rotary Rakes** Strategically located to gently stir the material for maximum exposure to air and infrared radiation.

11. **Discharge Module** This module contains the discharge hopper, access doors and sightglasses. The processed material exits the incinerator at this point.

12. **Ash Discharge System** Prevents air infiltration and delivers the ash to receiving container.

13. **Receptacle** Container of customer's choice.

14. **Blower** Supplies combustion air to the system.

15. **Air Preheater** An energy recovery device that significantly lowers operating cost for the incinerator. A Waste Heat Boiler for producing steam is also available.

16. **Furnace Exhaust** Insulated with the same fiber blanket material used in the incinerator.

17. **Secondary Process Chamber** Provides residence time, turbulence and supplemental energy, if required, to destroy gaseous volatiles from the incinerator.

18. **Scrubbing Systems** Selected for individual process requirements.

19. **Blower and Damper** Controls system draft.

20. **Exhaust Stack** Provided with EPA sample ports.

FIGURE 2.3
Exhaust gases exit the primary chamber near the feed module to a secondary chamber (afterburner), where a propane-fired burner is used to ignite any combustible gases present in the exhaust stream, and burn them at a predetermined set-point temperature. Electrical heating elements may be used in lieu of the propane burner in cases where set-point temperatures of 1880°F and lower are selected. Secondary air is supplied to the afterburner to insure adequate excess oxygen levels for complete combustion. Exhaust gases from the secondary chamber then pass through a venturi scrubber/spray tower to the exhaust stack.

2.1 Primary Chamber

The primary chamber design and operation is unique to the Shirco technology. It is in this primary chamber that the waste material (solids/sludges) is brought to combustion temperature by infrared heating and conveyed through temperature-controlled zones at a predetermined rate.

The primary chamber consists of rectangular cross section "box" constructed of 1/4 inch A36 carbon steel insulated with layers of ceramic fiber blanket insulation mounted on stainless steel studs, and retained with ceramic fasteners. The insulation is manufactured by Carborundum Co., and consists of an 85% silica/15% alumina asbestos-free blend which can sustain a continuous surface temperature of 2400°F. The insulation thickness is 7" on the chamber top, sides and end plates, and 5" on the chamber bottom.

The material to be processed is conveyed through the furnace on a woven wire belt which is supported on high-temperature alloy shafts. The shafts are, in turn, supported by external flangemount bearings. A friction drive system is used to pull the belt through the furnace. The belt is woven from 16 gauge, 314 stainless steel to a thickness of 0.25". The belt speed is controlled via constant speed motor/variable speed reducer, and can be adjusted to achieve waste material residence times of 6 to 60 minutes.
Infrared energy is provided by 18 transversely-mounted silicon carbide heating elements mounted on 3.07" centers at a height of 8.75" above the furnace belt. These 1.0" OD heating elements are manufactured by Carborundum Co. and are rated at 33.1 watts/in² of radiating surface with a maximum surface temperature of 2000°F. The primary chamber is divided into two (2) temperature control zones, with nine (9) heating elements serving each zone. The temperature in each zone can be precisely controlled anywhere from 500 to 1850°F. The maximum operating temperature of the primary chamber zones is 1900°F.

Four (4) rotary rakes, transversely-mounted on 1'-0" centers, are used to gently turn the material on the belt to increase exposure. The rotary rakes consist of "L" shaped fingers (0.19" OD Inconel 601) welded to 316 stainless steel shafts which rotates at a rate of 1.8 revolutions per inch of belt travel. The shafts are synchronized with the belt speed through a chain and sprocket drive system.

Combustion air is supplied to the primary chamber through a series of sixteen (16) 1.0" diameter overfire air ports located 1.75" above the belt surface. Combustion air flow rate and distribution to each group of four (4) ports (two groups per chamber side) are controlled by manual blast gate valves. The combustion air fan is manufactured by New York Blower Co., and is rated at 185 scfm at a static pressure of 0.25 inches water column (in WC). The combustion air supply can be controlled to provide both oxidizing or reducing atmospheres.

2.2 Secondary Chamber (Afterburner)

The secondary chamber consists of a rectangular carbon steel box, lined with 12" of Carborundum ceramic fiber blanket insulation on all interior walls. The insulation type is identical to that used in the primary chamber. The internal cross sectional area of the chamber is 1.56 ft² and the internal volume is 28.9 ft³. The unit is designed for 0-200% excess air operation with a maximum continuous operating temperature of 2300°F, and a minimum residence time of 4.3 seconds at maximum actual flow conditions.
Supplemental fuel firing is supplied by a 375,000 Btu/hr, forced air nozzle mixed burner manufactured by Maxon. The burner is equipped with a continuous pilot flame monitor, automatic fuel shut-off and purge system interlocked with secondary chamber temperature, and manual fuel control valve. Combustion air supply to the burner is controlled by manually adjustable air registers. Auxiliary fuel firing is supplied by a 36,700 Btu/hr, forced air, premix gas burner manufactured by North American.

Secondary combustion air (excess air) is supplied to the afterburner through the two (2) 1.0" diameter ports located at the top of the chamber, directed at the interface of the burner flame pattern and the exhaust gas inlet flow. Secondary combustion air is supplied by the same fan used to supply the primary chamber combustion air. A splitter manifold with dampers at the fan outlet allows air distribution to both chambers. Adjustment of air flow rate to the secondary chamber is by means of a manual blast gate valve.

2.3 Emissions Control System

The emissions control system consists of a venturi scrubber and droplet separator tower. Water is used as the scrubbing liquor. The venturi section and separator tower are each equipped with two (2) water spray nozzles. The maximum rated water flow rate is 2 gpm and 10 gpm to the venturi and separator tower, respectively. The venturi section is equipped with a manually adjustable plumb bob to control gas phase pressure drop between 8 and 14 in WC and effect maximum collection efficiency.

The scrubber is equipped with an integral 45 gallon sump tank, external 50 gallon holding tank, and recirculation pump for effluent handling and disposal. Makeup water is supplied as required by a makeup water pump to account for evaporative losses. Total scrubber water blowdown will be approximately 30 to 45 gallons per day.

In addition to removing particulate, the scrubber cools the gases from their incoming temperature (1000°F - 2300°F depending on system configuration) to saturation temperature, usually about 180°F. Subcooling to a lower temperature can be performed as required, but consumes substantially more water than cooling to saturation temperature.
An induced draft fan, located downstream of the scrubber, exhausts the scrubbed gas to the stack. The fan is manufactured by New York Blower Co., and is rated at 400 acfm at static pressure of 14 in WC.

Exhaust gases are vented to atmosphere through a 4.0" ID stack which extends through the roof of the trailer to an elevation of 23.6" above grade (10' - 0" above trailer roof). The stack is equipped with two (2) standard 3.0" ID sampling ports. Access to the sampling ports is from the trailer roof.
### System Monitoring, Control, and Safety Interlocks

The objective of the thermal process monitoring and control system is to ensure that the various process operating conditions are within the appropriate range for effective thermal treatment of the waste, and to provide a means to terminate waste feed in the event that any of the normal process operating conditions deviate appreciably from design set-points.

A description of the monitoring and control system is presented below.

The Shirco Portable Demonstration Unit is fully instrumented to monitor the following process parameters:

**Temperature**

<table>
<thead>
<tr>
<th>Primary Chamber:</th>
<th>Waste Feed Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Zone A1</td>
</tr>
<tr>
<td></td>
<td>Zone A2</td>
</tr>
<tr>
<td></td>
<td>Mid-zone</td>
</tr>
<tr>
<td></td>
<td>Zone B1</td>
</tr>
<tr>
<td></td>
<td>Zone B2</td>
</tr>
<tr>
<td></td>
<td>Exhaust gas</td>
</tr>
<tr>
<td></td>
<td>Ash collection hopper</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Secondary Chamber:</th>
<th>Mid-chamber</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Exhaust gas</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stack:</th>
<th>Exhaust gas</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Recorder:</th>
<th>Six-point continuous strip chart</th>
</tr>
</thead>
</table>

**Pressure**

<table>
<thead>
<tr>
<th>Combustion air fan outlet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary chamber draft</td>
</tr>
<tr>
<td>Primary chamber exhaust draft</td>
</tr>
</tbody>
</table>
Secondary chamber draft
Secondary chamber combustion air
Scrubber differential pressure
Scrubbing liquor delivery pressure

Liquor Flow
Venturi scrubber liquor
Separator tower liquor

Exhaust Gas Analysis - Secondary Chamber Outlet
Continuous O₂ monitor w/ strip chart recorder
Continuous CO monitor w/strip chart recorder
Continuous CO² monitor w/strip chart recorder

A master control panel contains the following devices for process data monitoring, recording and control:

- Nine-point digital temperature display with rotary selector
- Six-point temperature strip chart recorder
- Primary chamber power consumption totalizers
- Primary chamber heat zone temperature controllers
- Primary chamber belt speed controller
- Annunciator
- Hand-off-auto switches for mechanical components
- Three-point strip chart recorder for continuous emission monitors

The Shirco Demonstration is also equipped with safety interlocks to automatically correct abnormal process operating conditions and maintain system performance. A description of the various interlock systems, corrective action, and corrective limits is presented in Table 2.4. The system is also equipped with an automatic waste feed cut-off system which will stop the waste feed conveyor belt motion in the event of low secondary chamber temperature. The cutoff limit for the waste feed shutdown control is adjustable.
TABLE 2.4
THERMAL PROCESSOR INTERLOCK SYSTEMS

<table>
<thead>
<tr>
<th>INTERLOCK</th>
<th>CORRECTIVE ACTION</th>
<th>CORRECTIVE ACTION LIMIT</th>
<th>INTERLOCK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low primary chamber temperature</td>
<td>Infrared heating element power center on/Waste feed belt stop</td>
<td>1600°F</td>
<td>I11, I12</td>
</tr>
<tr>
<td>High primary chamber temperature</td>
<td>Infrared heating element power center off</td>
<td>1850°F</td>
<td>I1</td>
</tr>
<tr>
<td>Low secondary chamber temperature</td>
<td>Propane burner on/Waste feed belt stop</td>
<td>1800°F</td>
<td>I17, I12</td>
</tr>
<tr>
<td>High secondary chamber temperature</td>
<td>Propane burner off</td>
<td>2300°F</td>
<td>I6</td>
</tr>
<tr>
<td>Emissions control during unit shutdown</td>
<td>Secondary chamber temperature maintained until primary chamber temperature drops below action limits</td>
<td>400°F</td>
<td>I12, I13</td>
</tr>
<tr>
<td>Excessive stack gas temperature</td>
<td>Alarm (manual adjustment of scrubbing liquor flow)</td>
<td>200°F</td>
<td>I8</td>
</tr>
<tr>
<td>Low secondary chamber exhaust O2</td>
<td>Alarm/Waste feed belt stop</td>
<td>4%</td>
<td>TBD*</td>
</tr>
<tr>
<td>High secondary chamber exhaust CO</td>
<td>Alarm/Waste feed belt stop</td>
<td>100 ppm</td>
<td>TBD*</td>
</tr>
</tbody>
</table>

*These interlocks have been installed but not yet identified on updated Process and Instrumentation diagrams.
2.5 Stack Emissions

Air pollutant emissions from the Shirco Demonstration Unit will be minimal. The results of the previous waste tests performed on the Shirco unit have already demonstrated that this technology can achieve DRE's in excess of 99.9999% while incinerating PCB's, creosote/PCP-soil mixtures, and dioxin contaminated soils.

Similarly, the unit has already demonstrated the ability to achieve the particulate emission standard of 0.08 gr/dscf, corrected to 7% O$_2$. Particulate emissions during all previous waste tests ranged from 0.007 to 0.055 gr/dscf, corrected to 7% O$_2$.

Small quantities of other non-hazardous pollutants such as CO and NO$_X$ (normal by-products of all combustion processes) will also be emitted. The oxidation reactions which convert CO to CO$_2$ occur at temperatures above 1500 to 1600°F. Since the secondary chamber will be operated at temperature in excess of 1800°F and sufficient excess air will be available for the reaction, low CO levels (<100 ppm) will be maintained in the flue gas. The two-stage, controlled-air incineration design will also inherently limit NO$_X$ emissions to extremely low levels (75-125 ppm).
2.6 General Test Conditions

- Primary Combustion Chamber Temperature

  Testing of PCB-contaminated soils, creosote and pentachlorophenol-contaminated waste and dioxin-laden soil has verified that detoxification can be achieved with a maximum primary chamber temperature of 1,600 degrees Fahrenheit. In keeping with these waste tests, the control temperature for the primary chamber shall be varied from between 900 and 1,600 degrees Fahrenheit for all test conditions so to determine the minimum required for detoxification. This will be the Zone B set point. The Zone A set point shall normally be 1,400 degrees Fahrenheit. Temperature is regulated by a control loop which includes a thermocouple, proportional controller, and dedicated power center.

- Primary Chamber Residence Time

  The primary chamber residence times are adjustable between 6 and 60 minutes. These residence times are based on a furnace effective length of 66.5 inches. The residence time shall be set by adjusting the furnace belt speed.
o Secondary Chamber Residence Time

- The previous testing of PCB, dioxin, creosote and pentachlorophenol wastes found that TSCA and RCRA destruction efficiencies were obtained with secondary chamber temperature between 1,800 degrees Fahrenheit and 2,200 degrees Fahrenheit. As noted on Table 2.7, temperatures of 1,800 degrees Fahrenheit, and 2,200 degrees Fahrenheit are generally tested to determine the minimum for required destruction. These temperatures will be maintained by manual adjustment of propane or heating element power center output and air input to the secondary chamber.

o Primary and Secondary Chamber Combustion

Air

- Combustion air input to the primary and secondary chambers will be adjusted based on chamber temperature and secondary chamber exhaust carbon monoxide and oxygen content. As feed enters the primary chamber, the operator will adjust air input to both chambers to maintain an oxygen level in excess of 5% and a carbon monoxide level below 50 ppm in the secondary chamber exhaust or lower, if necessary, to achieve a 99.9 percent combustion efficiency.
Depending on the concentration of moisture and combustibles in the feed material, the air to the primary chamber will be minimized to prevent cooling of the set point temperature or increase of that temperature heat of combustion above 1,800 degrees Fahrenheit. Thus, if the combustible content of the waste is high, a starved air combustion process will prevail. In this case, air input to the discharge end of the primary chamber will be adjusted to combust the maximum possible without exceeding 1,800 degrees Fahrenheit.

In either case, the air flow to the secondary chamber will be adjusted to maintain the set point temperature and produce an oxygen concentration above 5 percent and a carbon monoxide concentration below 50 ppm.

With the steady feed expected, once combustion air adjustment has been established, minimal adjustment will be required during the emissions sampling operation.

Waste Feed Rate

The waste feed rate to the primary chamber is controlled by the furnace belt speed setting and the gap opening of the feed conveyor guillotine gate. The speeds of the feed conveyor and furnace conveyor belts are synchronized. Both are driven by the same drive motor and are geared accordingly. The guillotine-to-belt gap shall normally be 1.5 inch. The feed rate range for the system is presented in Table 2.8.
Furnace Draft

Both the primary and secondary chamber will be operated under a slight negative pressure to assure all contaminants are destroyed before being emitted into the atmosphere. The draft pressure in the primary chamber will be maintained at -.015 inches WC. at its highest pressure point, which is above the processed soil discharge chute. The draft on the system is induced by the exhaust blower. The operator will adjust the position of four exhaust system dampers to produce the desired pressures in each system component. A damper between the primary and secondary chambers allows the draft in each to be varied. The scrubber venturi damper will be adjusted to maintain a desired scrubber pressure drop. Finally, the exhaust blower outlet damper allows adjustment of the entire system. The position of each damper will be set by the operator to obtain the desired conditions.

2.6.1 System Heat-Up

Heat-up will be initiated at least two hours prior to initiating waste feed to the primary chamber. Temperature set points shall be used for both control zones. After the primary chamber has reached the desired temperature or 1000 degrees Fahrenheit, whichever is greater, the secondary chamber heat-up will be initiated. The propane flue flow rate will be set at the maximum to minimize time required to reach operating temperature. Once the secondary and primary chambers have reached design temperature conditions, feed may commence.
2.6.2 Solid Waste Feed

Waste shall be transferred from the mixing area to the furnace feed conveyor in nominal 20-pound increments. The feed hopper container will be positioned on top of the feed conveyor hopper and the waste transferred to the hopper. The feed hopper cover will be in position except when depositing waste in the hopper. The designated data recorder will then record the time and weight of feed.

2.7 Proposed Process Operating Parameters/Rose TWP.

Three principal operating conditions affect the overall soil detoxification efficiency of the SHIRCO process. These are, in order of importance, the solid phase residence time (belt speed), the primary unit operating temperature and atmospheres, and the bed thickness. Since a portion of the organic constituents present in the waste feed is simply volatilized in the primary chamber, overall system performance also depends on the efficient destruction of the constituents in the afterburner. The primary variables which affect afterburner performance are afterburner temperature, gas residence time, and oxygen levels.

Furthermore, the characteristics of the waste itself can influence overall system performance. The difficulty of thermal destruction of certain organic constituents, the presence of organic species which are precursors to products of incomplete combustion, and the organic concentration in the waste feed must also be addressed in each test burn.

Each test program is designed to evaluate the effects of various process operating conditions and waste feed characteristics on overall system performance. Table 2.7 presents the system operating conditions proposed for the Rose Township test program. (The parameters and control limits for typical PCB incineration programs are given in Table 2.8).

Shirco currently proposes to arrive at Rose Township approximately three days prior to the initiation of testing. This will allow sufficient time for a half-day public viewing of the unit at the Township Hall and mobilization/set-up of the unit on-site the following day.
Day 1 of the test program will be utilized for system shakedown and checkout. The selection of operating parameters during this day is based upon previous experience decontaminating PCB contaminated soils. These parameters have also been tentatively selected for the three (3) replicate 8 hour runs to be conducted on Days 4, 8 and 10.

Day 2 of the program will consist of two (2) 4 hour runs with an oxidizing atmosphere in the primary chamber. The residence time in the furnace will be varied to help determine the minimum time required for detoxification. In addition the secondary combustion chamber (SCC) temperature will be varied to obtain data regarding optimization of utility requirements. Note that during one of these proposed runs, the SCC will be heated by electrical heating elements. Results of previous testing conducted with the Shirco system have met EPA required destruction and removal efficiencies for PCB's with SCC temperatures of 1800° F.

Day 3 of the program will consist of three (3) runs, one of which will be run with a non-oxidizing atmosphere in the primary furnace to determine the effect on lead fixation. Temperature in the SCC and furnace residence time will again be varied for further optimization of system operating parameters and material throughput. In addition, 2 of the runs will be conducted utilizing feed material blended with 3 to 5% fuel oil. This will provide data regarding maximization of material throughput as well as minimization of utility consumption.

Day 5 of the program will consist of two (2) runs utilizing lower temperature in the primary furnace to determine minimum operating temperature and the effect on metals present in the feed. The atmosphere in the furnace will again be varied to provide data on metals fixation and the SCC temperature will be lowered during one run to optimize utility consumption.

Days 6 and 7 will be utilized for preventive maintenance on the pilot unit and preparation for the following week's testing.
Day 9 of the program will consist of two (2) runs similar to those conducted on day 5, however, the SCC will be heated electrically to further investigate the potential minimization of utility consumption and the furnace residence time will be reduced to maximize throughput.

Day 11 of the program will consist of three (3) runs, again similar to those of days 5 and 9, however, furnace residence time will be reduced further. In addition, one of the runs will be conducted utilizing feed blended with fuel oil to determine the effect on material throughput.

Day 12 of the program will consist of three (3) runs, all of which will be conducted with an non-oxidizing atmosphere and lower temperatures in the primary furnace. The primary objective of these tests is to provide data on potential metals fixation with the Shirco process.

In order to fully evaluate the effect of proposed variations in process operating parameters it will be necessary to obtain composite samples of feed, ash and scrubber blowdown water during each of the runs.

Upon completion of testing, Shirco personnel will initiate decontamination procedures on the pilot unit and prepare for demobilization 15 days after arrival.
<table>
<thead>
<tr>
<th>DAY</th>
<th>RUN</th>
<th>TIME</th>
<th>OPERATING FURNACE (°F)</th>
<th>SCC</th>
<th>APPROXIMATE WASTE FEED (lbs.)</th>
<th>FURNACE RESIDENCE TIME (min.)</th>
<th>FURNACE ATMOSPHERE</th>
<th>MISC.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0*</td>
<td>0900-1800</td>
<td>1600</td>
<td>2200</td>
<td>40-60</td>
<td>20</td>
<td>Oxidizing</td>
<td></td>
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<tr>
<td>2</td>
<td>1</td>
<td>0900-1300</td>
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<td>1800</td>
<td>35-50</td>
<td>20</td>
<td>Oxidizing A</td>
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<td>2</td>
<td>1400-1800</td>
<td>1600</td>
<td>2200</td>
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<td>0900-1300</td>
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<td>1800</td>
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<td>Oxidizing B</td>
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<td>2200</td>
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<td>1600-1800</td>
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<td>1800</td>
<td>50-75</td>
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<td>Non-Oxidizing B</td>
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<td>4</td>
<td>6</td>
<td>0900-1800</td>
<td>1600</td>
<td>2200</td>
<td>40-60</td>
<td>20</td>
<td>Oxidizing</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>7</td>
<td>0900-1300</td>
<td>1200</td>
<td>2200</td>
<td>35-50</td>
<td>25</td>
<td>Non-Oxidizing</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>8</td>
<td>1400-1800</td>
<td>1200</td>
<td>1800</td>
<td>35-50</td>
<td>25</td>
<td>Oxidizing</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>DOWNTIME</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>DOWNTIME</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>9</td>
<td>0900-1800</td>
<td>1600</td>
<td>2200</td>
<td>40-60</td>
<td>20</td>
<td>Oxidizing</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>10</td>
<td>0900-1300</td>
<td>1200</td>
<td>2200</td>
<td>40-60</td>
<td>20</td>
<td>Non-Oxidizing</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>11</td>
<td>1400-1800</td>
<td>1200</td>
<td>1800</td>
<td>40-60</td>
<td>20</td>
<td>Oxidizing A</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>12</td>
<td>0900-1800</td>
<td>1600</td>
<td>2200</td>
<td>40-60</td>
<td>20</td>
<td>Oxidizing</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>13</td>
<td>0900-1300</td>
<td>1200</td>
<td>2200</td>
<td>50-75</td>
<td>15</td>
<td>Non-Oxidizing</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>14</td>
<td>1330-1530</td>
<td>1200</td>
<td>1800</td>
<td>50-75</td>
<td>15</td>
<td>Oxidizing</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>15</td>
<td>1600-1800</td>
<td>1200</td>
<td>1800</td>
<td>50-75</td>
<td>15</td>
<td>Non-Oxidizing B</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>16</td>
<td>0900-1300</td>
<td>900</td>
<td>2200</td>
<td>35-50</td>
<td>25</td>
<td>Non-Oxidizing</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>17</td>
<td>1330-1530</td>
<td>900</td>
<td>1800</td>
<td>40-60</td>
<td>20</td>
<td>Non-Oxidizing</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>18</td>
<td>1600-1800</td>
<td>900</td>
<td>1800</td>
<td>40-60</td>
<td>20</td>
<td>Non-Oxidizing B</td>
<td></td>
</tr>
</tbody>
</table>

* - Formal sampling not proposed. System shakedown and checkout to be performed.
A - Secondary Combustion Chamber to be heated electrically.
B - Feed to be blended with 3 to 5% fuel oil.
Table 2.8

Test Parameters and Control Limits for PCB Incineration

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Anticipated Value</th>
<th>Control Limits</th>
<th>Required Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fuel/Waste Feed</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waste feed rate (lb/hr)</td>
<td>50</td>
<td>25-150</td>
<td>NA&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>PCB concentration in feed (ppm)</td>
<td>500</td>
<td>150-30,000</td>
<td>NA</td>
</tr>
<tr>
<td>PCB feed rate (lb/hr)</td>
<td>0.025</td>
<td>0.004-3</td>
<td>NA</td>
</tr>
<tr>
<td><strong>Auxiliary fuel feed rate (MMBtu/hr)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary Chamber</td>
<td>0.04</td>
<td>0.02-0.06</td>
<td>NA</td>
</tr>
<tr>
<td>Afterburner</td>
<td>0.10</td>
<td>0.10-0.29</td>
<td>NA</td>
</tr>
<tr>
<td><strong>Combustion Conditions</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Combustion air flow rate (acf/min)</td>
<td>125</td>
<td>125-830</td>
<td>NA</td>
</tr>
<tr>
<td>Residence time (sec)</td>
<td>8</td>
<td>2-8</td>
<td>NA</td>
</tr>
<tr>
<td>Destruction temperature (°F)</td>
<td>2200</td>
<td>1800-2200</td>
<td>NA</td>
</tr>
<tr>
<td>Combustion gas oxygen (%)</td>
<td>6</td>
<td>5-10</td>
<td>NA</td>
</tr>
<tr>
<td>Combustion gas carbon dioxide (%)</td>
<td>10</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Combustion gas carbon monoxide (ppm)</td>
<td>20</td>
<td>&lt;100</td>
<td>NA</td>
</tr>
<tr>
<td>Combustion efficiency (%)</td>
<td>99.98</td>
<td>&gt;99.9</td>
<td>99.9</td>
</tr>
<tr>
<td><strong>Emissions</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Combustion gas NOx (ppm)</td>
<td>50</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>HCl removal (%)</td>
<td>Unknown</td>
<td>NA</td>
<td>NA&lt;sup&gt;*&lt;/sup&gt;</td>
</tr>
<tr>
<td>Particulate concentration (gr/dscf)</td>
<td>0.02</td>
<td>NA</td>
<td>0.08</td>
</tr>
<tr>
<td>PCB DRE (%)</td>
<td>&gt;99.9999</td>
<td>NA</td>
<td>99.999</td>
</tr>
<tr>
<td><strong>Pollution Control</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scrubber water flow (gpm)</td>
<td>9</td>
<td>5-10</td>
<td>NA</td>
</tr>
<tr>
<td>Scrubber water (pH)</td>
<td>7</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Venturi water flow (gpm)</td>
<td>1</td>
<td>1-2</td>
<td>NA</td>
</tr>
<tr>
<td>Venturi pressure drop (in. H₂O)</td>
<td>10</td>
<td>8-15</td>
<td>NA</td>
</tr>
</tbody>
</table>

<sup>a</sup>NA (not applicable)

* 99% as required by 40 CFR Part 264
3. WASTES DESCRIPTION/MATERIALS HANDLING

3.1 Wastes Description

The Shirco Mobile Demonstration Unit is designed to process solid and semi-solid materials within the primary chamber and to process liquid wastes through a burner located in the secondary chamber. Due to the nature of the waste conveyor mechanism within the primary furnace, a woven wire mesh belt, the furnace is not designed to process liquids without a solid carrier. The furnace is capable of handling a broad range of contaminated soils and sludges, however, with large variations in moisture content, inerts, volatile liquids and volatile solids content, heating valve, and inorganic constituents. The secondary chamber is capable of handling liquids within a broad range of waste feed net heating valves and feed rates.

Table 3.1 presents a range of solid/semi-solid waste characteristics suitable for processing in the Demonstration Unit. Also shown in Table 3.1 are the characteristics of waste materials processed by the unit during previous demonstration programs for comparison. For example, the waste handling capabilities of the system range from a relatively dry, low organic content soil such as that experienced at Times Beach, to a sticky, oily sludge typical of a wood preserving waste (creosote/pentachlorophenol). PCB-contaminated soils and sludges also fall within this range. Waste can also be preprocessed, if necessary, by dewatering, soils blending, and/or lime addition prior to testing to ensure a solid/semi-solid matrix suitable to the process. Pure liquids can also be processed if blended with a suitable carrier, such as soil or vermiculite, to form a semi-solid waste matrix, or by direct injection into the secondary combustion chamber.

Extensive research and development is needed in the areas of materials preparation and handling. Evaluation of various pre-treatment measures needs to be conducted in order to determine optimum material combinations and blends. Major variables to be investigated include moisture, density, BTU value, pH, and waste feed bed depth.
<table>
<thead>
<tr>
<th></th>
<th>Applicable Range</th>
<th>PCP/Cresote Test</th>
<th>Dioxin Tests</th>
<th>PCB Tes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture (% wt)</td>
<td>0-50</td>
<td>10-50</td>
<td>15-20</td>
<td>1-20</td>
</tr>
<tr>
<td>Inerts (% wt)</td>
<td>20-100</td>
<td>30-50</td>
<td>95</td>
<td>30-80</td>
</tr>
<tr>
<td>Volatile Liquid (% wt)</td>
<td>0-25</td>
<td>5-23</td>
<td>0</td>
<td>0-15</td>
</tr>
<tr>
<td>Volatile Solids (% wt)</td>
<td>0-100</td>
<td>15-55</td>
<td>5</td>
<td>3-50</td>
</tr>
<tr>
<td>Heating Value (Btu/lb)</td>
<td>0-10,000</td>
<td>2,700-6,200</td>
<td>Nil</td>
<td>0-4500</td>
</tr>
<tr>
<td>Sulfur (% wt)</td>
<td>0-4</td>
<td>0.2-1.0</td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td>Chlorine (% wt)</td>
<td>0-5</td>
<td>0.1-3.4</td>
<td>Nil</td>
<td>0.2</td>
</tr>
<tr>
<td>Density (lb/ft³)</td>
<td>30-130</td>
<td>55-75</td>
<td>60-70</td>
<td>80-120</td>
</tr>
<tr>
<td>Form</td>
<td>Solid</td>
<td>Soil</td>
<td>Soil</td>
<td>Soil</td>
</tr>
<tr>
<td></td>
<td>Semi-solid</td>
<td>Oily Sludge</td>
<td>Oily Sludge</td>
<td></td>
</tr>
<tr>
<td>Hazardous Constituent</td>
<td>0-1,000,000</td>
<td>100,000-250,000</td>
<td>0.25</td>
<td>75-2,800</td>
</tr>
</tbody>
</table>
Based on the results of all previous testing, process performance is not dependent upon the concentration of hazardous constituents in the waste material. That is, the key incineration parameters of residence time, temperature and atmosphere can be precisely controlled to completely oxidize all hazardous constituents to innocuous products regardless of concentration. The system, of course, is throughput limited within the operating range for solid and semi-solid waste streams shown in Table 3.1. Also, for liquid injection into the secondary chamber, the system is throughput limited to approximately 60 pounds/hr at a minimum residence time of 2 seconds. Liquid feed characteristics of density and net heating valve will dictate actual feed rate within the operating range of the burner.

The PCB tests conducted for Florida Steel were performed on soils and sludges contaminated with PCBs at concentrations ranging from 75 to 2,800 ppm, however, Shirco has conducted additional demonstration tests at higher PCB concentration levels (40,000 ppm) to expand the data base for this class of compounds.

In general, the quantity of waste intended for treatment for any one customer will depend on throughput of material based on characteristics and system operating ranges. During a typical research burn, the average solid feed throughput into the primary chamber is approximately 75 pounds per hour, or the equivalent of one (1) 55-gallon drum of solid waste per day.

Analyses of soil samples taken at the Rose Township Dump site indicate the presence of solvents, PCB's, oils and greases and other organic compounds as well as moderate levels of metals. Maximum levels of contaminates present on site are presented below. An additional site sampling program will be conducted to locate and select specific materials for SITE testing.

<table>
<thead>
<tr>
<th>Compound</th>
<th>Maximum Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCB's</td>
<td>980 ppm</td>
</tr>
<tr>
<td>Toluene</td>
<td>4,700 ppm</td>
</tr>
<tr>
<td>Xylene</td>
<td>1,400 ppm</td>
</tr>
<tr>
<td>Pthalates (total)</td>
<td>619 ppm</td>
</tr>
<tr>
<td>Chlorobenzene</td>
<td>570 ppm</td>
</tr>
<tr>
<td>Ethylbenzene</td>
<td>430 ppm</td>
</tr>
<tr>
<td>Naphthalene</td>
<td>81 ppm</td>
</tr>
<tr>
<td>Pentachlorophenol</td>
<td>32 ppm</td>
</tr>
<tr>
<td>Lead</td>
<td>1,480 ppm</td>
</tr>
<tr>
<td>Barium</td>
<td>3,010 ppm</td>
</tr>
<tr>
<td>Chromium</td>
<td>510 ppm</td>
</tr>
<tr>
<td>Zinc</td>
<td>2,323 ppm</td>
</tr>
<tr>
<td>Tin</td>
<td>46 ppm</td>
</tr>
<tr>
<td>Cobalt</td>
<td>148 ppm</td>
</tr>
</tbody>
</table>
3.2 Materials Sampling/Monitoring Procedures

3.2.1 General

Waste analysis of the sample material to be tested at the Shirco facility will be supplied by others. In addition to this analysis, representative samples of the waste feed stream are collected and analyzed for POHC levels during a typical trial burn of the Shirco unit. This analysis is performed to determine the overall environmental feasibility of the system.

Each test program is designed to evaluate the effectiveness of various incinerator operating conditions and waste feed characteristics on overall system performance. The test burn program will consist of eighteen (18) test runs. It is anticipated that two (2) to three (3) tests will be performed during each day of the program. However, three days will be dedicated to 8 hour runs as described in Section 2 of this plan. For each of these 3 replicate tests, samples will be collected from four process streams: waste feed, ash, scrubber effluent and flue gas. For the remaining 15 tests, samples will be collected from only waste feed, ash and scrubber water process streams. Additional samples will be obtained from the primary and/or secondary exhaust hot ducts to assist in full-scale pollution control system design. Monitoring and recording of key incinerator operating parameters will also be conducted during each test. The specific sampling and analytical approaches for the waste feed are presented elsewhere in this plan.
3.2.2 Monitoring Procedures

This section presents the sampling and monitoring plan utilized during a typical trial burn of the Shirco Mobile Test Unit. Stack emissions monitoring is conducted during each trial burn for the following parameters:

- Oxygen ($O_2$)
- Carbon Monoxide (CO)
- Carbon Dioxide ($CO_2$)
- Oxides of Nitrogen ($NO_x$)
- Hydrochloric Acid (HCl)
- Total Chlorinated Organic Content (RC1)
- POHCs
- Total Particulate Matter

In addition, the incinerator operator monitors and records specific process parameters including waste feed rate and combustion temperature of the incinerator process.

Finally, representative samples of various process streams including waste feed, incinerator ash and scrubber effluent are collected and analyzed for POHC levels to determine the overall environmental feasibility of the system.

3.2.2.1 Waste Feed

The waste feed consists of contaminated soils. A grab sampling procedure is used to obtain a representative, time-averaged sample of the waste feed. The waste sampling location is the incinerator feed hopper. Grab samples, each 50 to 100 ml in volume, is obtained at finite intervals throughout each test. These samples are composited in a 1-liter wide mouth amber glass jar with teflon lined cap.
3.2.2.2 Ash Residue

A grab sampling procedure is used to obtain a representative, time averaged sample of the incinerator ash. The Mobile Test Unit is equipped with an ash sampling drawer located directly above the ash discharge chute. A portion of the ash which drops off the incinerator conveyor belt into the ash discharge hopper is captured in the sampling drawer. The sampling drawer has a capacity of approximately 50 ml, and is emptied at 15 minute intervals throughout each test. These samples are composited in a 500 ml wide mouth amber glass jar with a teflon lined cap.

3.2.2.3 Scrubber Effluent

A grab sampling technique is used to obtain a representative, time averaged sample of the scrubber water effluent. 250 ml samples are taken at finite intervals throughout the test and composited in a liter wide mouth amber glass jar with teflon lined cap.

3.2.2.4 Flue Gas Sampling

During each test, various flue gas emissions and parameters are sampled and monitored by a stack sampling contractor. A summary of the sampling and monitoring methodologies utilized for each trial burn is presented below.

Particulate, POHC, and HCl Sampling

An EPA Method 5 sampling train is used to sample simultaneously particulates and HCl. Appropriate sampling trains are designed and utilized to sample for the POHCs of interest, including the Modified Method 5 train for collection of semi-volatile species and the VOST train for collection of volatile species.

A scaffold is set up along side the incinerator trailer to provide access to the stack for emissions sampling. The stack extends 10 feet above the trailer roof and is equipped with two (2) standard sampling ports.
Total Chlorinated Organic Content (RC1)

EPA Method 450.1 is used for the determination of total chlorinated organic content of the flue gas by carbon absorption and subsequent analysis.

NOx

NOx emissions sampling is conducted in accordance with the procedures set forth in EPA Method 7. Representative grab samples of flue gas for the NOx determination are collected from the stack sampling port during each test.

O₂, CO, CO₂

Continuous monitoring of the flue gas is conducted for O₂, CO, and CO₂. The sampling location for the Shirco continuous O₂ monitoring system is at the outlet of the incinerator afterburner. The sampling location for the continuous CO and CO₂ monitoring system is on the exhaust stack. An additional sampling location for O₂, CO and CO₂ is at the outlet of the afterburner. This location is normally used by sampling subcontractors for monitoring redundancy. All monitors are equipped with a sample conditioning system and each is calibrated prior to and during use as required.

A summary of the sampling procedures for the waste feed, ash, scrubber effluent and flue gas is presented in Table 3.2

Monitoring for fixed gases (O₂, CO₂, and CO) and NOₓ is conducted on a continuous basis throughout each test run performed. Samples are extracted from an existing, threaded fitting located between the exit of the afterburner and entrance to the venturi scrubber. The sample is delivered to the monitors by a sampling system that includes: a stainless steel probe equipped with a calibration fitting; a conditioning system consisting of an in-line filter and moisture condenser; and, leak-free sampling pump.
Table 3.2
Incinerator Sampling Procedure Summary

<table>
<thead>
<tr>
<th>Waste Feed</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sampling Location:</strong></td>
<td>Incinerator feed hopper or liquid feed line.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Number of Samples per Run:</strong></td>
<td>Grab samples of approximately 50 to 100 ml each, composited into a 1-liter amber glass jar with Teflon lined cap, are collected at finite intervals beginning with the start of each test.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Incinerator Ash</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sampling Location:</strong></td>
<td>Ash sampling drawer located at entrance to ash discharge chute.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Number of Samples Per Run:</strong></td>
<td>Grab samples of approximately 50 ml each, composited into a 500 ml amber jar with Teflon lined cap, are collected at 15-minute intervals beginning with the start of each test.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Scrubber Effluent</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sampling Location:</strong></td>
<td>Scrubber slurry recirculation tank drain.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Number of Samples per Run:</strong></td>
<td>Grab samples of approximately 250 ml each, composited into a 1 liter amber glass jar with Teflon lined cap, are collected at finite intervals beginning with the start of each test.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Flue Gas</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>
| **Sampling Location:** | (1) Sampling ports on 4" diameter stack
(2) Sampling port on afterburner exhaust duct
(3) Sampling port on furnace exhaust duct | | |
| **Number and types:** | (1) Two sampling trains for collection samples of particulates, POHC, and HCl for each test run.
(1) Integrated time-averaged sampling for NOx and RCl.
(2) Continuous monitoring for CO, O₂, and CO₂. | | |
Calibration of the monitors is conducted on a daily basis, prior to the start of and at the completion of sampling, using certified Protocol I gases. Three point calibration curves are developed for each monitor using a gas dilution system. The accuracy of the dilution system and gas concentrations is verified using the results of replicate Orsat analyses.

3.3.3 Process Monitoring

The Shirco Portable Pilot Test Unit is instrumented to continuously monitor and record (via strip chart recorder) process temperatures at the following six (6) locations:

Primary Furnace
- Feed Zone A
- Mid Zone A
- Mid Zone B
- Exhaust Gas

Afterburner Stack

In addition, the following process parameters are monitored via manual gauges and recorded at 30-minute intervals throughout the test program:

Scrubber
- venturi differential pressure
- venturi water flowrate and pressure
- separator water flowrate and pressure

Primary Chamber Draft
Afterburner Draft

Waste feed is manually fed to the incinerator hopper via 5-gallon plastic buckets. Each bucket of material is weighed and recorded and the time of depositing the weighed material into the feed hopper. Samples of the feed material is collected as previously described and later analyzed for POHC concentration to determine the POHC input rate to the incinerator for each test.
The designated Shirco operator maintains the system operating log presented in Table 3.3. Data is recorded at finite intervals for each test condition. Comments relative to changes in the system operations, interruptions, and pertinent observations are recorded as they occur.
4. INSPECTION PROCEDURES

The Portable Unit inspection schedule is outlined in Table 4.1. The inspection procedure is verification that the Portable Unit, Hazardous Waste Containers, and Safety and Emergency Equipment are operating normally, or in the state of standby readiness. Actual inspection checklists are presented in Figures 4.1, 4.2, and 4.3.
**TABLE 4.1**

Shirco Portable Unit Inspection Schedule

<table>
<thead>
<tr>
<th>Area/Equipment</th>
<th>Specific Items</th>
<th>Types of Problems</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Entire Incinerator</strong></td>
<td>All process equipment procedures,</td>
<td>Inadequate preparation to startup</td>
<td>Prior to startup at new location or after lengthy shutdown</td>
</tr>
<tr>
<td>and adjacent areas</td>
<td>and adjacent areas</td>
<td>facility</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waste feed system</td>
<td>Loose or burned belt, inoperative</td>
<td></td>
<td>Each shift</td>
</tr>
<tr>
<td>drive</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Destruction system</td>
<td>Deterioration of primary or secondary chamber</td>
<td></td>
<td>Weekly</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pollution Control System</td>
<td>Inadequate scrubber differential pressure, low scrubber water supply</td>
<td>Hourly</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annunciator Lights</td>
<td>Inoperative</td>
<td></td>
<td>Each shift</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fire Control</td>
<td>Insufficient supply of fire extinguishers, no independent supply available</td>
<td>Weekly</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drum Storage Building (If Applicable) and stacking</td>
<td>Inadequate aisle space, containers stacked too high</td>
<td>Each shift</td>
<td></td>
</tr>
<tr>
<td>Containers</td>
<td>Leakage, physical damage, not labeled or sealed, spillage</td>
<td>Each shift</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incinerator Trailer Pipes/transfer lines</td>
<td>Leakage, loose fittings</td>
<td></td>
<td>Each shift</td>
</tr>
<tr>
<td>Operator Instruments</td>
<td>Malfunctioning or suspected calibration drift</td>
<td>Each shift</td>
<td></td>
</tr>
<tr>
<td>Operator log sheets</td>
<td>Incomplete or missing data</td>
<td></td>
<td>Each shift</td>
</tr>
<tr>
<td>Utilities</td>
<td>Electric Power Supply</td>
<td>Connections Secure, Junction power lines properly routed</td>
<td>Each shift</td>
</tr>
<tr>
<td>Area/Equipment</td>
<td>Specific Items</td>
<td>Types of Problems</td>
<td>Frequency</td>
</tr>
<tr>
<td>------------------------</td>
<td>------------------------</td>
<td>----------------------------------------------------------------------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>Water supply</td>
<td>Low pressure in supply line</td>
<td>Each shift</td>
<td></td>
</tr>
<tr>
<td>Monitoring Equip.</td>
<td>Sampling/analyzers</td>
<td>Only one system on-line</td>
<td>Each shift</td>
</tr>
<tr>
<td></td>
<td>Calibration/Utility gases</td>
<td>Inadequate supply</td>
<td>Each shift</td>
</tr>
<tr>
<td></td>
<td>Calibration (daily)</td>
<td>Unacceptable results, not completed</td>
<td>Each shift</td>
</tr>
<tr>
<td>Excess emission reports</td>
<td>Inadequate oxygen or excessive carbon monoxide levels during actual sampling, not during calibration</td>
<td>Each shift</td>
<td></td>
</tr>
<tr>
<td>Wastewater Storage</td>
<td>Scrubber blowdown</td>
<td>Leakage, excessive pressure differential</td>
<td>Each shift</td>
</tr>
<tr>
<td></td>
<td>Recirculation tank</td>
<td>Leakage, excessive pressure differential</td>
<td>Each shift</td>
</tr>
<tr>
<td>Security</td>
<td>Trailer Unit</td>
<td>Damage to entrance areas</td>
<td>Each shift</td>
</tr>
<tr>
<td></td>
<td>Facility Doors</td>
<td>Structural damage, egress routes blocked</td>
<td>Each shift</td>
</tr>
<tr>
<td>Spill Control</td>
<td>Absorbent pad</td>
<td>Low stock</td>
<td>Each shift</td>
</tr>
<tr>
<td></td>
<td>Loose dry absorbent</td>
<td>Low stock</td>
<td>Each shift</td>
</tr>
<tr>
<td></td>
<td>Shovels</td>
<td>Missing or damaged</td>
<td>Each shift</td>
</tr>
<tr>
<td></td>
<td>Empty 55-gallon drums</td>
<td>Low stock</td>
<td>Each shift</td>
</tr>
<tr>
<td></td>
<td>Wrenches and tools</td>
<td>Missing or damaged</td>
<td>Each shift</td>
</tr>
</tbody>
</table>
TABLE 4.1

Shirco Portable Unit Inspection Schedule (cont.)

<table>
<thead>
<tr>
<th>Area/Equipment</th>
<th>Specific Items</th>
<th>Types of Problems</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety and Emergency Equipment</td>
<td>Fire extinguishers</td>
<td>Broken seal, inadequate pressure, access blocked</td>
<td>Weekly/after use</td>
</tr>
<tr>
<td>Safety and Emergency Equipment (continued)</td>
<td>Cartridge respirators</td>
<td>Inadequate supply of new cartridges, damaged seals or straps</td>
<td>Daily</td>
</tr>
<tr>
<td>Safety and Emergency Equipment</td>
<td>Full Face Respirators</td>
<td>Inadequate supply, damaged or scratched lenses</td>
<td>Daily</td>
</tr>
<tr>
<td>Safety and Emergency Equipment</td>
<td>Head protection and steel toe boots</td>
<td>Inadequate supply</td>
<td>Daily</td>
</tr>
<tr>
<td>Safety and Emergency Equipment</td>
<td>Gloves</td>
<td>Inadequate supply</td>
<td>Daily</td>
</tr>
<tr>
<td>Safety and Emergency Equipment</td>
<td>Chemical resistant suits</td>
<td>Inadequate supply</td>
<td>Daily</td>
</tr>
<tr>
<td>Safety and Emergency Equipment</td>
<td>Eye Wash</td>
<td>Low liquid level, accessibility blocked</td>
<td>Daily/after use</td>
</tr>
<tr>
<td>Safety and Emergency Equipment</td>
<td>First aid supplies</td>
<td>Low stock</td>
<td>Daily/after use</td>
</tr>
</tbody>
</table>
5. SPILL PREVENTION CONTROL AND COUNTERMEASURE PLAN

5.1 Solid Spills

Shirco Infrared Systems', Inc., primary concern with spill prevention is to keep contaminated soil from mixing with non-contaminated soils. Shirco personnel incorporate a thick (3-4 mil) plastic sheet to cover the work area forming an impenetrable barrier. The seams of this barrier will be completely sealed using duct tape. Any soils seen on top of the plastic barrier will be assumed to be hazardous. These soils will be immediately collected and returned to a container of hazardous waste. At the end of each day of operation the plastic will be swept with the product secured in a hazardous waste container.

Upon initiation of testing, the solid waste is taken from the container(s) and placed directly into the system feed hopper. Any spillage of waste material on the trailer floor is immediately removed and placed into the hopper or back into the container for incineration or return to the generator. Incinerator ash discharged into sealed receptacles, unused waste samples and drummed scrubber blowdown water will remain on site.

5.2 Liquid Spills

Shirco will utilize loose absorbent material (i.e., absorbent pillows, sand, "oil dry", sawdust, etc.) in the event a liquid spill occurs. Liquid spills may occur and pool on top of the plastic barrier. If this occurs, a loose absorbent barrier will be constructed on top of the plastic barrier. The liquid will then be pumped to a holding tank awaiting proper disposal. The loose absorbent will then be shoveled into containers for disposal.

The following steps will be taken upon discovery of a leak in the incinerator scrubber blowdown recirculation tank:

1. Upon discovery of a leak, the emergency coordinator shall be notified immediately.

2. The incinerator shall be shut down and all feeds into or out of the tank shall be stopped.

3. All blowdown water shall be removed and placed in drums and the tank taken out of
service until repairs are completed.

4. All leakage shall be collected using absorbents or other clean up materials and either drummed for later disposition or thermally processed on-site.

5. All leakage sites shall be decontaminated. All clean up equipment shall be decontaminated and/or refit for future use before activities are resumed.

Procedures for the prevention of and response to spills from drummed waste and incineration residues are outlined in Section 6.
6. SAFETY PLAN

I. GENERAL INFORMATION

Site: Rose Township

Location: Oakland County, Rose Township, Michigan

Plan Prepared by: Mark L. deLorimier, Shirco Infrared Systems, Inc. in cooperation with Michigan Department of Natural Resources

Date: June 1987

Objective: To conduct an innovative technology evaluation utilizing the patented Shirco Infrared Thermal Treatment Process.

This Safety Plan has been developed by Shirco for proposed on-site activities with a pilot demonstration unit. This plan is not intended to replace the DNR’s master site safety plan, but instead incorporates key aspects of the master plan.

Proposed Date of Demonstration: 1987

Overall Hazards: Moderate, Low

II. SITE/WASTE CHARACTERISTICS

Facility Description: The Rose Township site is in Oakland County, Michigan, approximately 40 miles northwest of Detroit. It is located in an open field on the property of Mr. Leonard Dorsey, 1065 Demode Road, and the adjacent property owner, Mrs. Fordia Lester. The 12-acre field (approximately 950’ x 550’) is bounded by woods to the west. Beyond the woods is a low-lying marsh. The site is on a topographic high consisting of a glacial moraine material.
In a roughly triangular area at the southwest corner of the site are seven mounds of contaminated soil, spoils from the excavation and removal of approximately 5,000 barrels from the site. It is the area of most significant known contamination. Several pools of water have been created by the excavation.

A 24-inch high pressure natural gas line owned by Consumers Power Company crosses the southern end of the site.

Approximately 75 feet from the site, on the slope descending westward to the marsh, is a groundwater seep. At least one other smaller groundwater seep is located 150 feet southwest of the site.

**Principal Disposal Method:** An unknown number of tank trucks possibly containing organics, PCBs were emptied on the site. In addition, approximately 5,000 barrels were left there. It is also possible that barrels were opened, their contents dumped on the ground, and the barrels recycled. By July of 1980, about 5,000 barrels had been removed by the MDNR.

**Status:** Inactive

**Unusual Features:** A 24-inch high pressure natural gas line owned by Consumers Power Company crosses the southern end of the site.

Maximum levels of contaminants were generally found in the soil mounds.

Approximately 75 feet from the site, on the slope descending westward to the marsh is a groundwater seep. At least one other smaller groundwater seep is located 150 feet north. There is a small pond in the woods 200 feet southwest of the site.

**Data Limitations:**

- Areal extent of surface water contamination is not clearly defined. Sampling to date has not produced a clear understanding of contaminated waters and sediments or migration pathways.

- Areal extent of contaminated soil. Data on soil is limited to the major disposal area and a few surrounding sites. The location of other "hot-spots" or areas contaminated by surface erosion has not been clearly identified. Removal of some of the contaminated soil mounds during the State of Michigan's cleanup activities may invalidate existing data in the area of major contamination.
- The extent of the contaminated groundwater plume has not been fully defined, either horizontally or vertically.

- It is not known if all buried drums have been removed.

The only known air quality measurements were recorded during a site visit on December 13, 1982. Measurements were made with an HNU Photoionization Detector. Measurements of organic vapors two to four times background levels were recorded on the site though no odors could be detected. The air temperature was 25° F and the ground was frozen. Odors at the site have been reported by MDNR personnel, especially during the summer.

- Topographic data is limited to USGS 10-foot contour intervals and elevations at well heads.

- The degree of contamination of stormwater runoff has not been defined.

- Bioaccumulation effects of contaminants on fish and wildlife has not been analyzed.

**Study Area Characteristics:** The study area is outlined on the study map (Figure 1).

The Rose Township site is in a sparsely populated rural woodland area. Generally, upland areas, such as the woods next to the main disposal area, are covered by a mixed hardwood forest.

**III. HAZARD EVALUATION**

The most significant threat to public health and safety posed by the Rose Township site is the potential contamination of residential wells by pollutants migrating in the groundwater. The presence of pollutants in the groundwater up to 650 feet offsite in sufficient concentration to be toxic or carcinogenic has been documented. The full areal extent of contaminated groundwater has not been identified.
The contamination of surface water and soil also poses a threat to public health and safety. Contamination of onsite surface water and the marsh 1,300 feet west of the site has been found. Onsite soil has also been found to be contaminated. The pollutants introduce the possibility of bioaccumulation of such substances as PCB. Wildlife commonly hunted and fish caught in surrounding lakes may accumulate contaminants and pass them on to consumers.

People walking on or near the site could also encounter a health threat either directly from contaminated soil or from contaminants in the air. Walking on contaminated soil could cause direct skin contact with the contaminants or ingestion by hand contamination. Though the presence of toxic or carcinogenic substances in the air has not been documented, contaminants from the soil, particularly volatile organics, could enter the air.

The high pressure natural gas pipeline in the highly contaminated area of the site is a potential public safety problem. The pipeline could corrode and rupture because of soil contamination from the many industrial wastes that were disposed of onsite, many of which are still unknown.

IV. ENVIRONMENTAL AND SOCIOECONOMIC FEATURES

Environment

Pollutants from the Rose Township site could significantly affect aquatic and terrestrial life. Aquatic life in the nearby lakes is threatened by contaminants in the groundwater beneath the site and by surface runoff carrying pollutants from the onsite soil. PCBs and cadmium have been found in levels far exceeding those harmful to aquatic life at the swamp 1,300 feet west of the site. PCBs have also been found at levels above aquatic life criteria in Cheese Lake 3,000 feet northwest of the site and a marsh 4,000 feet southwest of the site although some uncertainty exists as to the validity of this result.

Terrestrial life may be adversely affected by drinking contaminated waters, feeding on vegetation or other animals that have become contaminated, or by direct contact with contaminated soil.

No adverse impacts on vegetation have been found except for small areas where "tarry" substances have been found on bushes or where a hardened material covers the ground.
Socioeconomics

Several socioeconomic impacts were identified in a Southeast Michigan Council of Governments study. These are:

- Lower property values or marketability of property.
- Costs incurred for such things as laboratory tests on water supplies, attorney's fees, purchase of bottled water, telephone and auto mileage costs, and business liability insurance.
- Psychological stress due to the uncertainty of future contamination. Also the stress associated with the feeling of being unable to sell one's home and move away.

The impacts can be expected to continue until public fears and apprehensions are resolved.

V. SITE SAFETY WORK PLAN

1.0 Introduction

This safety plan is for the Shirco Infrared Systems, Inc. Portable Unit while it is being operated at the Rose Township location for the testing of hazardous material. The Portable System will be operated by Shirco personnel. The primary purpose of the project is to evaluate Shirco's patented infrared technology as a viable means in the destruction and decontamination of hazardous wastes under the U. S. EPA SITE Program.


This Safety Plan is designed to assure the Safety and the protection of health of all Shirco personnel at a test site. The Company recognizes the responsibility to conduct business in such a manner so as to not endanger anyone's health or safety.
2.0 Site Access Control

Only those persons authorized by Shirco Infrared Systems may have access to the Shirco Test Site. Anyone not meeting the medical surveillance and/or personal protective equipment requirements will be denied access to the Shirco controlled area(s). The Chief Unit Operator or designee has the authority to prevent access by any person who does not meet the requirements as stated in the site-specific Health & Safety Plan.

3.0 Emergency Coordination Agreements

Before operation of the Portable Unit, local police and fire departments, medical and local emergency response teams will be notified to provide emergency assistance if required. A copy of the letter to be sent to local authorities is attached (Figure A).

A. Local Resources

Fire Department, Holly Fire Department
Emergency (313) 634-4311
Routine (313) 634-8221

Police Department, Michigan State Police
(Brighton Post) Emergency (313) 634-6700
Routine (313) 227-1051

Ambulance
Holly Volunteer Ambulance (313) 634-8221

Oakland County Office of Emergency Medical Services and Disaster Center
(313) 858-5300

Huron Valley Hospital (313) 360-3300

Poison Control
Children’s Hospital, Detroit
(313) 494-5711 or 1 (800) 462-6642
B. Michigan DNR Contacts

Steve Luzkow, Project Administrator
(517) 373-8448

Earle Latimer, Groundwater Division Safety Officer
(517) 373-4800

Pollution Emergency, Instate
1 (800) 292-4702

Alerting System, Out-of-State
(517) 373-7660

C. Emergency Routes

From the site to Huron Valley Hospital, take Demode Road east to Rose Center, south (right) to White Lake Road, east to Ormond Road, south (right) to State Route 59 (M-59), east (left) to Bogie Lake Road, south (right) to Commerce Lake Road, west (left) to Hospital on left.

Travel time: 25 minutes
Distance: 17 miles

4.0 Personnel Safety

A. Personnel Health Monitoring

Hazardous wastes often have distinct effects on the body: a skin effect and a toxic action on the liver for instance. Contact with some wastes can cause a skin lesion known as chloracne, an often disfigurating and persistent dermatologic disorder. Many wastes are also carcinogenic and can cause the formation of neoplasms (non-metastasizing abnormal or new growths) via oral exposure.

Physical Examination

Shirco personnel working on any suspected or confirmed site must have completed a baseline physical exam, meeting the guidelines listed below for hazardous waste work, within 12 months prior to the site work. Personnel who have not had such a physical will not be authorized on the site.
Physical Examination Guidelines for Hazardous Waste Work

Medical/Occupational Questionnaire
Full Physical Examination by Physician
Vitals (height, weight, blood pressure, pulse)
Screening Audiometric Test with Otoscopic Exam of Wax
Pulmonary Function Test (Spirometry)
Resting ECG, Read by Board-Certified Cardiologist
Chest X-ray (PA) Read by Board-Certified Radiologist (once per 2 years)
Laboratory Analysis
*Blood Chemistry Profile
Complete Blood Count with Differential
Urinalysis with Microscopic Examination
Zinc Protoporphyrin
Urinary Arsenic
Urinary Mercury
Urinary Cadmium

*Blood Chemistry Profile

<table>
<thead>
<tr>
<th>Test</th>
<th>Value</th>
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<tr>
<td>Calcium</td>
<td>Direct Bilirubin</td>
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<tr>
<td>Phosphorus</td>
<td>Indirect Bilirubin</td>
</tr>
<tr>
<td>Glucose</td>
<td>Alkaline Phosphatase</td>
</tr>
<tr>
<td>Bun</td>
<td>LDH</td>
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<tr>
<td>Uric Acid</td>
<td>SCOT</td>
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<td>Cholesterol</td>
<td>Sodium</td>
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<tr>
<td>Total Protein</td>
<td>Potassium</td>
</tr>
<tr>
<td>Albumin</td>
<td>Chloride</td>
</tr>
<tr>
<td>Total Bilirubin cpk</td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

B. Personal Protective Equipment

Standards and decontamination procedures are established and enforced to minimize the potential for exposure to a contaminant.
In site specific situations where other contaminants may involve additional screening, monitoring services and equipment are available. Where site history or field experience indicates that problems may exist, specific guidance for upgrading personnel protection is provided.

1. **Respiratory Protection**

Personnel within the operational area are required to use full face respirators in conformance to 29 CFR 1910.134 equipped with combination organic vapor, high efficiency particulate cartridges or canisters. Corrective vision inserts are required for those who normally wear glasses. No facial hair interfering with the face to mask seal will be allowed. Personnel must pass qualitative fit tests for their chosen masks.

2. **Body Protection**

Personnel within the operational area are required to wear full-body, one-piece coverall suit manufactured from saran-coated spun bonded olefin. Uncoated spun bonded olefin may be worn during certain conditions.

Glove to coverall seams and boot to coverall seams will be sealed with duct tape to prevent dirt from entering at those areas. In the event clothing is ripped or torn, the clothing is to be removed and replaced at once.

All clothing provided for on-site use is to be considered disposable and handled as contaminated trash before personnel may leave the designated work area.
3. **Hand Protection**

All personnel working in the operational area are required to wear an inner glove of light-weight PVC or latex accompanied by an outer glove of buna nitrile rubber. External work gloves of cotton or leather which provides additional thermal protection, enhance a worker’s grip, and protect rubber gloves from physical damage may be used to meet individual preference.

4. **Foot Protection**

All personnel in the operational will wear safety footwear which conforms to ANSI Z41.1.

5. **Head Protection**

Hard hats, where required, conform to the latest edition of ANSI Z89.1.

6. **Eye/Face Protection**

Eye and face protection, where required, conforms to the latest edition of ANSI Z87.1.

7. **Personnel Protection Upgrading**

It is not anticipated that an upgrading to Level B protection will be required during the Rose Township demonstration. However, periodic air surveillance will be conducted with an OVA operated in the total readent mode. Should dial readings indicate possible total vapor and gas concentrations in excess of 5 ppm above back ground, work will be stopped until such time that workers upgrade to positive pressure supplied air.

C. **General First Aid**

1. **Skin Contact**

In the event of direct skin contact, the affected area is to be washed immediately and thoroughly with soap and water.
2. **Eye Contact**

Eyes are to be thoroughly flushed with water and medical attention is given as a precaution.

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**D. Heat Stress Monitoring**

It is recommended that during site operation periods where ambient daily maximum temperatures exceed 70 degrees Fahrenheit, the researchers should implement measurements of Wet Bulb Globe Temperature Index (WBGT) as described in Threshold Limit Values and Biological Exposure Indices for 1985 - 1986 by the ACGIH. Due to the levels of protective clothing worn by all personnel, the researchers should calculate the WBGT at 1 hour intervals whenever the daily maximum temperature exceeds 70 degrees Fahrenheit. All measurements and calculations should be recorded. Where possible, work hours are to be changed to cooler periods of the day to avoid unnecessary heat stress on personnel.

From the heat stress monitoring data that has been collected during the summer investigations, the following guidelines have been suggested concerning the work/rest regiment for workers wearing Level C protection:

1. **With WBGT’s from 75-85 degrees Fahrenheit,** workers shall not be allowed to work more than one hour without taking at least a 15 minute break.

2. **With WBGT’s from 85-95 degrees Fahrenheit,** workers should not be allowed to work more than 45 minutes without at least a 15 minute break.

3. **With WBGT’s exceeding 95 degrees Fahrenheit,** workers should not be allowed to work more than 15 minutes without at least a 15 minute break.

4. **Individuals definitely have variable limits as to the amount of heat they can tolerate.** Employees should be informed that they are responsible for their own physical well-being. Monitors judge heat stress only by what they see. Only the individual knows how he feels and what his limits are.
It is recommended that at the end of each work period the workers remove their protective clothing and do the following:

1. Take their oral temperature and proceed as below:
   a. 99 degrees Fahrenheit - no action.
   b. 99 degrees Fahrenheit to 99.7 - cool them off with a water spray and do not allow a return to work unless their temperature is 99 degrees Fahrenheit at the end of the rest period.
   c. 99.7 degrees Fahrenheit to 100.4 - cool them off with a water spray, double their rest period, and do not allow a return to work unless their temperature is 99 degrees Fahrenheit or below. If heat exhaustion or heat stroke symptoms are present, seek medical attention.
   d. 100.4 degrees Fahrenheit - cool them off immediately with a water spray, begin standard first-aid procedures, and seek medical attention.

2. Take and record Blood Pressure
   a. Upper limit 140/90
   b. Low limit -/60

3. Take and record Pulse Rate
   a. greater than 120 beats per min.
   b. less than 60 beats per min.

4. Take and record body weight
   a. weight loss greater than 5% body weight. Skip rotation until weight is replenished.

5. Check each worker carefully for symptoms of heat illness and react accordingly.
6. Drink slowly, cool but not cold, eight (8) ounces of water, six (6) ounces of water plus two (2) ounces of a natural unsweetened fruit juice, or eight (8) ounces of 0.1% saline solution.

Weather Variations: During cold weather, employees are provided with insulated safety footwear and oversized impervious suites to facilitate additional clothing required for thermal protection.

5.0 Decontamination

Decontamination procedures are included as part of site-specific Health & Safety Plans. These are developed in accordance with NIOSH Publication #85-115-Occupational Safety & Health Guidance Manual for Hazardous Waste Site Activities (1985). The objective of decontamination efforts is to prevent personal contact with hazardous materials and to prevent their spread into "clean" areas. Through sequential removal of protective clothing and equipment and disposal or cleaning of it, this objective is accomplished. The specific methods are dependent upon the individual contaminants and their physical forms.

5.1 Procedures For Level C Decontamination

Station 1: Exit trailer and deposit equipment used (tools, sampling devices and containers, etc.) on plastic drop cloth. During hot weather operations, a cool down station may be set up within this area.

Station 2: #3 galvanized wash tubs at station (one with soapy water and one with rinse water). Scrub boots and outer gloves with detergent and water; rinse using copius amounts of water in rinse tub.

Station 3: Remove tape around boots and gloves and dispose of in 55-gallon drum.

Station 4: Remove outer gloves and dispose of in 55 gallon drum.
Station 5: Remove Tyvek suit and dispose of in 55-gallon drum. Suit must be rolled inside out when removed or torn off.

Station 6: Remove safety boots and store in final decontamination area.

Station 7: Plastic wash tubs at station (one with detergent and water and one with rinse water). Wash inner gloves in detergent and water and rinse with water.

Station 8: Remove face mask and clean as needed. Deposit mask in plastic liner. Avoid touching face with fingers.

Station 9: Remove inner gloves and dispose of in 55-gallon drum.

Station 10: Wash hands and face.

6.0 Emergency Plan

A. Emergency Coordinators

<table>
<thead>
<tr>
<th>Title</th>
<th>Local Address</th>
<th>Local Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site Manager</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Shift Supervisor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chief Operator</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Process Engineer</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Local addresses and phone numbers will be provided at the start of testing procedures.

B. Emergency Cleanup Equipment

All of the equipment, material, and personnel will be available during an emergency situation. Required sources that may not be available at the site will be obtained from local commercial process.
Emergency Equipment

In case of a fire, or release of hazardous waste, the following fire fighting, containment, and emergency equipment is available at the process staging area:

1. Fire extinguishers - 5# and 2.5# - dry chemical type ABC, capable of extinguishing fires involving ordinary combustible material such as wood, cloth, paper, rubber, and many plastics; fires involving flammable liquids, oils, greases, tars, oilbase paints, lacquers, and flammable gases; and fires involving energized electrical equipment. All extinguishers comply with National Fire Code standards for portable fire extinguishers.

2. A dedicated water source with sufficient water pressure will be accessible for a foam delivery system provided by local fire department.

3. Spill or containment equipment located on the site includes:
   a. Loose dry absorbent (e.g., sawdust, vermiculite, or multi-purpose sorbent) - this material will be stored on-site and available to be used to contain and absorb spills.
   b. Shovels with wooden handle, steel type. This equipment, also stored on-site, is to be used in the physical containment of any released hazardous constituents.
   c. Wrenches and other tools for tightening fittings and valves. These will be readily available for emergency use.

4. Emergency Alarm Systems

Due to the small size of the Portable Unit, voice communications will be the means of emergency alarm.
5. First Aid Supplies
   a. Bandage material
      - Band aids
      - Gauze pads and rolls
      - Adhesive tape
      - Butterfly bandages
   b. Antibacterial ointments
   c. Splints
   d. Aspirin
   e. Emetic - Syrup of Ipecac
   f. Local and topic anesthetics
   g. Eyewash bottle and solution

6. Emergency eye, face and body wash. An eye wash unit and a shower will be located in the staging area.

7. Protective Clothing and Equipment
   a. Rubber and neoprene rubber boots.
   b. Short and long neoprene rubber gloves.
   c. Chemical-resistant suits (Tyvek)
   d. Viton gloves
   e. Hard hats, steel-toed boots
   f. Face shields and protective eyeglasses
   g. Chemical cartridge respirators with cartridges for organic vapors and dust; half and full-face types.
Post-Emergency Equipment Maintenance

After an emergency event, all emergency equipment will be cleaned so that it is serviceable for use or it will be replaced. Before operations are resumed, an inspection of all safety equipment will be conducted. The Regional Administrator, state and/or local authorities, as appropriate, will be notified that post-emergency equipment maintenance has been performed and operations can be resumed.

C. Emergency Response Procedures

1. Notification

If the Emergency Coordinator determines that the facility has had an uncontrolled situation, such as a spill or fire which could threaten human health or the environment, he must report his findings as follows:

a. Alert site personnel by voice communications and/or telephone paging system. Due to the small size of the Portable Unit, voice communication will be used to direct personnel after any alert is sounded.

b. If his assessment indicates that evacuation of the work area may be advisable, he must immediately sound the evacuation alert, stop the operation and notify the Local Fire Department, Ambulance Service, and Police Department. He must be available to help appropriate officials decide whether adjacent areas should be evacuated.
2. Implementation of the Emergency Plan

The Emergency Coordinator must assess possible hazards to human health or the environment that may result from any emergency situation. This assessment must consider both direct and indirect effects of the incident (e.g., the effects of toxic, irritating, or asphyxiating gases that are generated, or the effects of any hazardous surface water runoffs from the water used to control fires).

The Emergency Plan will be implemented in any of the following situations:

a. Fire

1) A fire causes, or could cause, the release of toxic fumes.

2) The fire could possibly spread to off site areas.

3) Use of water, or water and chemical fire suppressants, could result in uncontained contaminated runoff.

b. Spills or Materials Release

1) The spill could cause the release of toxic vapors or fumes into the atmosphere in concentrations higher than the Threshold Limit Values recommended by the American Conference of Governmental and Industrial Hygienists.

2) The spill can be contained on-site, but a potential exists for ground water or surface water contamination.

3) The spill cannot be contained on site, resulting in a potential for off-site soil contamination or ground or surface water pollution.
c. Severe Weather Conditions Requiring Emergency Shutdown

1) A tornado has been sighted in the area.

2) A tornado warning is in effect for the area.

3) A lightning storm is underway in the area (storm center less than 5 miles away).

3. Emergency Coordinators

If an emergency situation develops while the Portable Unit is processing material, the first person becoming aware of the emergency will contact an Emergency Coordinator in the order listed in Figure B.

a. Identification of Hazardous Materials

The Emergency Coordinator will immediately identify the character, exact source, amount and extent of any release. The initial identification method will be to utilize visual analysis of the material and location of the release. If for some reason the released material cannot be identified, actual samples will be taken for analysis.

b. Hazard Assessment

The Emergency Coordinator will assess possible hazards to human health or the environment that may result from the release, fire, or severe weather conditions. The Emergency Coordinator will assess the hazards posed by an incident through the following steps, as appropriate:

- First, identifying the material involved in the incident;
- Second, consulting the appropriate Safety Data Sheets to determine the potential effects of exposure/releases, and appropriate safety precautions; and
- Third, identifying exposure and/or release pathways and the quantities of materials involved.

This assessment will consider both the direct and indirect effects of the release, fire, or severe weather conditions (e.g., the effects of any toxic, irritating, or asphyxiating gases that are generated or the effects of any hazardous surface water runoff from water used to control fire and heat-induced explosions).

Based on this assessment, the Emergency Coordinator will determine what risk is posed to workers and neighboring populations. If the incident cannot be controlled by operating personnel without incurring undue risk, the Emergency Coordinator will order the evacuation of all workers at risk and notify appropriate response agencies of the situation and the assistance required. If the Emergency Coordinator determines that any persons outside of the Shirco Portable Unit area are at risk as a result of the incident, he will contact the appropriate agencies and department and advise them of the risk and the need or potential need to institute off site evacuation procedures.

The health effects of contaminants present at the Rose Township site are presented in the Master Safety Site Plan prepared by the Michigan Department of Natural Resources. This information will summarize the possible direct and indirect effect(s) of the material being tested on human health and the environment, and will aid the Emergency Coordinator in his assessment.
c. Control Procedures

Potential accidents fall under three general classifications: (1) fire (2) releases to the atmosphere, soil and/or surface waters and (3) severe weather conditions such as tornado and lightning storms. The following sequence of events constitute the specific responses and control procedures to be taken in the event of a fire, or release of hazardous waste to air, land or water.

E. Response

The initial response to any emergency will be to protect human health and safety, and then the environment. Secondary response to the emergency will be identification, containment, treatment, and disposal assessment.

1. Fire

When an uncontrolled fire outside the unit appears imminent or has occurred, all activity related to the system will cease.

The Emergency Coordinator will assess the severity of the situation and decide whether the emergency event is or is not readily controllable with existing portable fire extinguishers or site equipment and materials at hand. Fire fighting will not be done if the risk to operating personnel appears high. The Fire Department will be called in all situations in which fires have occurred.

If the situation appears uncontrollable, and poses a direct threat to human life, a warning will be sounded to all personnel to secure their emergency equipment and immediately evacuate the testing area.

The Emergency Coordinator will alert all personnel when all danger has passed, as determined by fire department personnel.
All equipment used in the emergency will be immediately cleaned and refurbished for use in the event of any future emergency.

2. Spill or Material Release

If a hazardous waste spill or material release is noted, the information will be immediately relayed to the Emergency Coordinator.

The Emergency Coordinator will assess the magnitude and potential seriousness of the spill or release by reviewing the following information:

a. Safety Data Sheets on the material spilled or released.

b. Source of the release of spillage of hazardous material.

c. An estimate of the quantity released and the rate at which it is being released.

d. The direction in which the spill or air release is moving.

e. Personnel who may be or may have been in contact with material, or air release, and possible injury or sickness as a result.

f. Potential for fire resulting from the situation.

g. Estimate of area under influence of release.

If the accident is determined to lie within the on-site emergency response capabilities, the Emergency Coordinator will implement the necessary remedial action.

If the accident is beyond the capabilities of the operating crew, the Emergency Coordinator will notify the appropriate governmental agencies.
In the event of an emergency spill or release, all personnel not involved with emergency response activity will be evacuated from the immediate area.

The area will be roped or otherwise blocked off. All waste feed systems to the incinerator, and the incinerator system will have emergency shutdown procedures imposed.

The following evacuation guidance, to allow for safe emergency response activities, will be employed:

Incident: Small spills from the incinerator, drums, containers.

Action: Evacuation of at least 50 feet in all directions.

Incident: Volatile material spill, toxic vapor cloud, large rupture of the incinerator.

Action: Downwind clearance of an area of at least 500 feet wide and 1,000 feet long.

3. Severe Weather Conditions Requiring Emergency Shutdown

When a tornado is sighted in the area, when a tornado warning has been issued, or when a lightning storm occurs, the information will be immediately relayed to the Emergency Coordinator.
The Emergency Coordinator will immediately institute emergency shutdown procedures in the case of a tornado sighting, and all personnel shall proceed indoors after completing appropriate shutdown procedures. In the case of a tornado warning, or lightning storm, waste feed shall be stopped, and all personnel shall standby for emergency procedures. When the storm passes, the Emergency Coordinator will inspect all of the on-site equipment to insure its readiness of operation. If any emergency equipment, or equipment which affects the process interlocks or vessel integrity has been damaged, the system will not be restarted until the equipment has been repaired or replaced.

If the Emergency Coordinator's inspection indicates a fire or release has occurred as the result of a severe weather condition, he will follow the procedures outlined above.

F. Storage and Treatment of Released Material

Immediately after an emergency, the Emergency Coordinator will make arrangements for treatment, storage, or disposal of recovered wastes, contaminated soil, surface water, or any other contaminated materials. Recovered wastes will be processed only if their characteristics are such that they are permitted under the Permit issued.

If the concrete in the vicinity of the storage area or the staging area is involved in the emergency and has been contaminated, the clean-up crew will use high pressure water sprays on the surface of the pad. This procedure will be repeated until any residues are gone. Rinsings will be collected and disposed of as hazardous wastes.

Inert material to contain, divert and cleanup the spills will be used if they have not been contained by a dike or sump. Spills contained within the dike or sump will be pumped back into the appropriate storage drums.
All contaminated containment and cleanup material will be placed in drums for proper disposal. All recovered liquid wastes and contaminated soil will be placed in drums for processing in the Portable Unit or return the generator.

G. Prevention of Recurrence or Spread of Fires, Explosion or Releases

The Portable Unit contains built-in standard operating safeguards to control the system during an emergency situation to ensure that fires, or releases do not recur or spread to other hazardous wastes at the facility.

7.0 Evacuation Plan

The first person recognizing an emergency situation that threatens human health or the environment shall notify the Emergency Coordinator, who will initiate a site evacuation. The evacuation plan consists of:

A. The signal to evacuate will be by voice communication.

B. Leave the area quickly by the nearest safe exit. Operating personnel are to escort visitors out of the immediate area. Personnel are to take note, before leaving, of where the emergency situation exists so they do not jeopardize their safety by walking into that area.

C. Assembly in the area designated by the Shift Supervisor during the tailgate safety meeting for head count and further instructions.

D. The Emergency Coordinator will further direct actions as necessary and initiate the proper notification procedures for the agencies involved. No one is to return to the site unless so instructed by the Emergency Coordinator or until the Emergency Coordinator or other recognized official in charge issues an "all clear."

The test unit is totally enclosed with a tractor trailer and such small quantities of waste are handled during testing, that any release could immediately be contained and cleaned up. If a fire was to occur, it would most likely be contained within the trailer. If a fire could not be contained within the trailer, an evacuation of the general area would take place. In the case of unit system(s) failure, waste feed to the unit is automatically stopped via an interlock system.

8.0 Reports

A. Local Report

The Emergency coordinator's report to local authorities must include:

1. Name and telephone number of reporter;
2. Name and address of facility;
3. Name and type of incident (e.g. release, fire);
4. Name and quantity of materials or material involved to extent known;
5. The extent of injuries, if any;
6. The possible hazards to human health or the environment, and cleanup procedures.

B. Project Reports

The Emergency Coordinator must note in the operating record the time, date, and details of any incident that requires implementing the emergency plan. Within five days after the incident, he must submit a written report on the incident to the Project Manager.

The report must include:

1. Date, time, and type of incident (e.g., fire, explosion, etc.);
2. Name and quantity of material(s) involved;
3. The extent of injuries, if any;
4. An assessment of actual or potential hazards to human health or the environment, where this is applicable;

5. Estimate quantity and disposition of recovered material that resulted from the incident;

6. Actions taken during the situation;

7. Evaluation of the cause;

8. Recommendations for corrective actions; and

9. Identification of modifications to the system operating procedures or the spill plan.

Within 15 days of the incident, the Project Manager must submit a written report of the incident to the EPA Regional Administrator.
Dear:

As (company officer, title, company name, location) I am requesting your assistance in the event of an emergency at our Portable Thermal Process Site located at (processing site).

The Portable Unit will be used to demonstrate thermal processing of limited (pilot) amounts of (waste) generated at (processing location). Please review the attached layout map and facility drawing for our location and indicate your organization’s intent and ability to provide assistance if required.

Please provide written response (or site visit) to this letter within 30 days. We appreciate your efforts in this matter.

Sincerely,

Company Official
Title

Enclosure
7.0 TRAINING

The information contained in this section outlines the personnel training program for the Shirco Portable Unit.

7.1 Outline of Training Program

The test coordinator who is familiar with the Portable Unit and with the overall plant facility, will be responsible for directing the training program. The project will be accomplished by on the job training and include safety, spill prevention and control, and operation procedures. Operating directives, safety directives, and Contingency Plans are reviewed by all operating personnel. Files of these documents are always available to operating personnel.

7.1.1 Job Titles and Duties

The organization of personnel associated with the Portable Unit is shown in Figure 7.1.

7.1.2 Training Content, Frequency and Techniques

During the on-the-job training program (Figure 7.2 Training outline), employees are instructed on the following major topics: (1) the hazardous nature of chemicals and chemical wastes in general, (2) the purpose of the Toxic Substance Control Act (TSCA) and the Resource Conservation and Recovery Act (RCRA) and importance of maintaining compliance with TSCA and RCRA regulations, (3) the hazardous nature of the wastes being tested, (4) proper handling and storage procedures for wastes, (5) emergency procedures and the safety plan related to the process, and (6) emergency procedures and the continency plan. Other specific training topics include:

- Appropriate personnel protective equipment, levels A, B, C & D;
- Hazardous materials handling procedures for PCB’s and RCRA wastes;
- Hazards of hazardous wastes;
- System operating conditions;
- System safety and monitoring interlocks;
- Spill prevention and control.
Position Title: Test Coordinator

Position Responsibilities and Duties:

- Emergency Coordinator for all hazardous waste testing activities.
- Directs Shirco Personnel in areas involving emergency action.
- Responsible for direct supervision of unit components and control system.
- Supervises the maintenance of operating logs, monitoring records, maintenance records, inspection records, training records, and other required records.
- Regularly inspects facilities for status of air, water, and solid/hazardous waste emissions and controls.
- Notifies proper authorities in emergency situations.
- Directs training of personnel in the proper handling of hazardous wastes and in the use of the demonstration unit.
- Drafts and submits to site manager, all required reports to EPA or the State.
Position Title: Operators

Position Responsibilities and Duties:

- Reports to Test Coordinator.
- Operates demonstration unit and auxiliary systems.
- Monitors and logs operating conditions of the system and auxiliary equipment.
- Inspects the unit and surrounding area for evidence of leaks and spills, or potential problems.
- Notifies test coordinator of process operation problems.
- Carries out emergency response activities under direction of Test Coordinator.
- Takes emergency actions on own authority in accordance with established procedures.
Figure 7.2 OUTLINE FOR SAFETY TRAINING PROGRAM

1. Policy
   1.1 General Policy, Purpose and Importance of RCRA and TSCA
   1.2 Management Responsibility
   1.3 Individual Responsibility

2. General Safe Work Practices

3. Personnel Protective Equipment
   Head, eyes, feet, skin, respiratory

4. Safety Meetings, Inspections, and Record Keeping
   4.1 Meetings - pre-startup and tailgate
   4.2 Inspections - pre-startup and daily
   4.3 Record Keeping
   Meetings, inspections, forms, accidents/illness, training industrial hygiene/medical surveillance

5. Equipment Safety
   5.1 Mechanical Equipment Safety
   5.2 Electric Equipment Safety
   5.3 Cylinder and Drum Handling
   5.4 Sight Glass, Feed, Discharge, Surface Temperatures

6. Chemical Safety and Industrial Hygiene
   6.1 Types of Dangers - toxic/corrosive
   6.2 Specific Material being tested
   6.3 Sampling Protocols - solids, liquid, gases

7. Hazard Recognition

8. Emergency Equipment and Procedures
   8.1 Equipment - description and use
   8.2 Personnel Emergency Procedures (eye wash, etc.)
   8.3 Alarm Procedures
   8.4 Evacuation Procedures
   8.5 Summoning Emergency Assistance

9. Spill Prevention, Cleanup, and Waste Disposal
10. First Aid/Fire Training, Equipment Location
The training program is tiered in some areas to provide training to personnel at levels that are relevant to their positions within the system operation. On-the-job training is used to provide the additional specialized training.
7.1.3 Training Director

The personnel training program is directed by Mr. Ken Johansen. Mr. Johansen has been with Shirco for 7 years. He received a B.S. degree in Mechanical Engineering from Oklahoma State University. Records of his previous experience and ongoing training are kept on file by the Vice-President of Personnel Shirco Infrared Systems, Inc., 1195 Empire Central, Dallas, Texas 75247 (630-7511).

All on-the-job training is supervised by the Training Director.

7.1.4 Training for Emergency Response

The emergency response training program is designed to ensure that personnel not only handle hazardous waste testing in a safe manner but also properly respond to emergency situations. The program trains incinerator hazardous waste handling management personnel to maintain compliance under normal operating and emergency conditions.

Training elements addressing non-routine and emergency situation (unscheduled process shutdowns and start-ups related to storms, power outages, fires, explosions, spills) include:

- Procedures for locating, using, inspecting, repairing, and replacing emergency and monitoring equipment

- Emergency communication procedures and alarm systems

- Response to fires or explosions

- Response to ground water contamination incidents and procedures for containing, controlling, and mitigating spills

- Procedures for evacuation
7.2 Implementation of Training Program

All program personnel will have successfully completed the training program as outlined in Section 7.1 before operation of the demonstration unit on hazardous wastes. All new operating personnel will be required to successfully complete the training program upon assignment to the project, or to a new position within the project. Employees will not work in unsupervised positions until they have completed the training outlined in Figure 7.2.

As a minimum, on-the-job training reviews will be conducted at a frequency not less than once a year. The subjects of these reviews will include:

(a) The status of process operating conditions and procedures, noting areas where there are problems or the potential for problems. Employees participate in development of effective solutions.

(b) The requirements contained in the RD&D permit, noting any changes that have occurred during the past year. Areas where compliance was a problem are identified and discussed; and effective solutions are sought.

(c) Incidents that have occurred in the past year that warranted use of safety plans and/or emergency action. This review focuses on the cause of the incident and identification of steps to be taken to prevent or to ensure better handling of such events in the future.
Shirco has previously demonstrated its equipment capability in several on-site hazardous waste test burns utilizing the Portable Demonstration Unit. Three test burns directly applicable to this permit application included an on-site dioxin contaminated soils test burn performed in July 1985 at Times Beach, Missouri, a pentachlorophenol/creosote-contaminated soils test burn performed for International Paper Company at their Joplin, Missouri wood treating facility in November 1985 and a PCB-contaminated soils test burn performed for Florida Steel Corporation at their Indiantown mill in May 1986. During all programs, Shirco had full responsibility for all process operations and overall program safety. The success of these programs clearly demonstrates the efficacy of the technology from the standpoint of both personnel safety and environmental protection.

Test results of the Times Beach program are presented in Table 8.1. As shown, the Shirco Portable Demonstration Unit achieved dioxin destruction and removal efficiencies (DRE’s) well above the 99.9999% standard required under RCRA. In addition, residual dioxin in the soil was non-detectable at a level of 33 to 38 parts per trillion (ppt). Equally impressive results were achieved during the International Paper pentachlorophenol/creosote tests as shown in Tables 8.2 and 8.3. Note that the DRE’s for pentachlorophenol, which is more difficult to destroy than any of the PCB isomers, based on the incinerability hierarchy, were in excess of 99.9999%. A summary of the Florida Steel PCB test results are presented in Table 8.4. These test results demonstrate that the Shirco technology can meet the TSCA requirements for PCB incineration and reduce PCB concentrations in treated soils and sludges to non-hazardous levels.
SUMMARY OF PERFORMANCE DATA

ON-SITE INCINERATION TESTING ON SHIRCO PORTABLE PILOT TEST UNIT

TIMES BEACH DIOXIN RESEARCH FACILITY
TIMES BEACH, MISSOURI

During the period of July 8-12, 1985, the Shirco Infrared Systems Portable Pilot Test Unit was in operation at the Times Beach Dioxin Research Facility operated by the Missouri Department of Natural Resources (DNR). The purpose of the testing was to demonstrate the Shirco technology's capability to successfully decontaminate soil laden with 2, 3, 7, 8, tetrachloro-dibenzo-p-dioxin (TCDD). Equipment set-up, preliminary operation, test operation, decontamination, and equipment removal were performed in this period. Operation of the furnace and discharge streams was accomplished on July 10 and 11. The DNR Environmental Division coordinated the site preparation. Emissions sampling and final analysis was performed by Environmental Research & Technology, Inc. (ERT) while laboratory analysis of the emissions and soil samples was performed by Roy F. Weston, Inc. Shirco Infrared Systems prepared the test protocol and operated the furnace system.

Results of the testing performed by Shirco Infrared Systems using the Portable Test Unit have proven the infrared process and technology to be a successful method of decontaminating the dioxin-laden soil present at Times Beach, Missouri. Presented below is a summary of the results of the testing performed. An expanded report may be obtained from Shirco Infrared Systems, Inc., 1195 Empire Central, Dallas, Texas 75247-4301, (214) 630-7511.

<table>
<thead>
<tr>
<th></th>
<th>EPA STANDARD</th>
<th>30 MINUTE RESIDENCE</th>
<th>15 MINUTE RESIDENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Composite feed soil</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2, 3, 7, 8 TCDD</td>
<td>227 ppb</td>
<td>156 ppb</td>
<td></td>
</tr>
<tr>
<td>Concentration</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Composite discharge soil</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2, 3, 7, 8 TCDD</td>
<td>&lt;1 ppb</td>
<td>Not detected</td>
<td>Not detected</td>
</tr>
<tr>
<td>Concentration</td>
<td></td>
<td>at 38 ppt</td>
<td>at 33 ppt</td>
</tr>
<tr>
<td>Particulate emissions</td>
<td>.08 gr/dscf</td>
<td>0.001 gr/dscf</td>
<td>0.0002 gr/dscf</td>
</tr>
<tr>
<td>at 7% O2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gas phase DRE</td>
<td>&gt;99.9999%</td>
<td>&gt;99.999996%</td>
<td>&gt;99.999989%</td>
</tr>
<tr>
<td>of 2, 3, 7, 8 TCDD</td>
<td></td>
<td></td>
<td></td>
</tr>
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</table>
TABLE 8.2
ON-SITE PILOT TEST RESULT
WOOD PRESERVING WASTE
POHC DESTRUCTION AND REMOVAL EFFICIENCY

<table>
<thead>
<tr>
<th>Compound</th>
<th>Waste Concentration (ppm)</th>
<th>Flue Gas DRE (%)</th>
<th>Waste Concentration (ppm)</th>
<th>Flue Gas DRE (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acenaphthene</td>
<td>1,700</td>
<td>&gt; 99.99996</td>
<td>4,200</td>
<td>&gt; 99.99996</td>
</tr>
<tr>
<td>Anthracene</td>
<td>4,600</td>
<td>&gt; 99.99998</td>
<td>11,000</td>
<td>&gt; 99.99998</td>
</tr>
<tr>
<td>Benzo (a) anthracene</td>
<td>470</td>
<td>&gt; 99.99985</td>
<td>1,300</td>
<td>&gt; 99.99998</td>
</tr>
<tr>
<td>Carbazole</td>
<td>2,700</td>
<td>&gt; 99.9997</td>
<td>5,400</td>
<td>&gt; 99.99997</td>
</tr>
<tr>
<td>Chrysene</td>
<td>720</td>
<td>&gt; 99.9999</td>
<td>2,200</td>
<td>&gt; 99.99993</td>
</tr>
<tr>
<td>Fluoranthene</td>
<td>4,000</td>
<td>&gt; 99.9998</td>
<td>14,000</td>
<td>99.99997</td>
</tr>
<tr>
<td>Fluorene</td>
<td>2,400</td>
<td>&gt; 99.9997</td>
<td>4,600</td>
<td>&gt; 99.99997</td>
</tr>
<tr>
<td>Penthachlorophenol</td>
<td>12,000</td>
<td>&gt; 99.9999</td>
<td>11,000</td>
<td>&gt; 99.99998</td>
</tr>
<tr>
<td>Phenanthrene</td>
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<td>99.99998</td>
<td>22,000</td>
<td>99.99996</td>
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<tr>
<td>Pyrene</td>
<td>2,200</td>
<td>&gt; 99.9997</td>
<td>7,400</td>
<td>&gt; 99.99998</td>
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</tbody>
</table>

TEST 1
Afterburner Temperature: 2200°F

TEST 2
Afterburner Temperature: 1800°F
<table>
<thead>
<tr>
<th>Compound</th>
<th>Waste Concentration (ppm)</th>
<th>Ash Concentration (ppb)</th>
<th>Waste Concentration (ppm)</th>
<th>Ash Concentration (ppb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acenaphthene</td>
<td>1,700</td>
<td>ND</td>
<td>4,200</td>
<td>ND</td>
</tr>
<tr>
<td>Anthracene</td>
<td>4,600</td>
<td>ND</td>
<td>11,000</td>
<td>ND</td>
</tr>
<tr>
<td>Benzo (a) anthracene</td>
<td>470</td>
<td>ND</td>
<td>1,300</td>
<td>ND</td>
</tr>
<tr>
<td>Carbazole</td>
<td>2,700</td>
<td>ND</td>
<td>5,400</td>
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</tr>
<tr>
<td>Chrysene</td>
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<td>ND</td>
<td>2,200</td>
<td>ND</td>
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<tr>
<td>Fluoranthene</td>
<td>4,000</td>
<td>ND</td>
<td>14,000</td>
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</tr>
<tr>
<td>Fluorene</td>
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<td>4,600</td>
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</tr>
<tr>
<td>Pentachlorophenol</td>
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<td>11,000</td>
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<tr>
<td>Phenanthrene</td>
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<td>ND</td>
<td>22,000</td>
<td>ND</td>
</tr>
<tr>
<td>Pyrene</td>
<td>2,200</td>
<td>ND</td>
<td>7,400</td>
<td>ND</td>
</tr>
</tbody>
</table>

ND = Not detected at an average detection limit of 30 ppb.
## TABLE 8.4
### PCB CONTAMINATED SOIL
DEMONSTRATION TEST SUMMARY

<table>
<thead>
<tr>
<th>TEST</th>
<th>OPERATING PARAMETERS:</th>
<th>1</th>
<th>2</th>
<th>3</th>
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<tr>
<td>OPERATING PARAMETERS:</td>
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<tr>
<td>Average Process Temp. (°F)</td>
<td></td>
<td>1603</td>
<td>1573</td>
<td>1471</td>
</tr>
<tr>
<td>Average Oxygen (%)</td>
<td></td>
<td>12.20</td>
<td>8.58</td>
<td>9.49</td>
</tr>
<tr>
<td>Particulate Conc. @ 7% O2 (gr/dscf)*</td>
<td></td>
<td>0.055</td>
<td>0.023</td>
<td>0.017</td>
</tr>
<tr>
<td>Waste Feed Rate (lb/hr)</td>
<td></td>
<td>61.5</td>
<td>61.5</td>
<td>79.8</td>
</tr>
<tr>
<td>PCB Concentration (ppm) Feed</td>
<td></td>
<td>2790</td>
<td>2560</td>
<td>2840</td>
</tr>
<tr>
<td>Ash**</td>
<td></td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>Destruction and Removal (%)</td>
<td></td>
<td>&gt;99.9999</td>
<td>&gt;99.9992</td>
<td>&gt;99.9991</td>
</tr>
</tbody>
</table>

* Federal Standard .08 (gr/dscf)
** Not Detectable at 5 ppb
9.0 OPERATIONAL PLAN

This section presents the operational plan which will be followed for equipment setup at the site, start-up, normal shutdown, and Emergency Shutdown Procedures. A sample operations data log sheet is presented in Figure 9.1.

9.1 Portable Unit Setup

1. Chalk and level the trailer.

2. Connect 480V/60hz 175 amp supply wire to the Heating Element Power Center (HEPC) distribution panel.

3. Connect 120V/60hz 20 amp supply wire to the heater terminal panel if weather requires trailer heating.

4. Loosen the transformer mounting in the heating element power centers which were secured for transport.

5. Connect a 1-inch supply water line capable of 20 gpm at 25 tp 30 pounds per square inch (psi) to the scrubber connection through the bottom of the trailer.

6. Connect a 1-inch drain line to the scrubber connection through the wall of the trailer.

7. Install heating elements in furnace and light bulbs in the trailer.

8. Replace the temperature recorder, timers, and relays removed for transport.

9. Install exhaust stack.

10. Assure the scrubber shutdown drain port is plugged.

11. Using a flashlight, inspect the thermocouple (T/C) protection tubes (if applicable) for breakage during transport. If any are broken, disconnect the T/C and allow the tube to be carried by the furnace belt to the discharge chute. If a corrosive material is to be processed, have the broken tubes replaced.

12. Inspect combustion and exhaust blowers for transport damage and wheel blockage.
13. Connect a propane gas source with regulator to the secondary combustion chamber burner supply line at the right side of the trailer. The source should be 20-gallon capacity minimum. Normally the burner will use 1.3 gallons per hour.

14. Inspect material feed inlet for obstructions, and open the feed gate to give a 1/8 inch gap between it and the furnace belt.

15. Check all furnace and HEPC electrical connections for tightness. Also verify power wires to the HEPCs are undamaged from shipping or overheating.

16. Assure the belt tensioning device is moving freely and the belt is centered in the furnace.

17. Assure all furnace and exhaust duct access ports are secure.

18. Verify the ash collection hopper is clean.

19. Assure all wireway covers are secure.

20. Measure the incoming voltage to the HEPC distribution panel, and connect the incoming power to each HEPC continuing to the appropriate primary tap. Magnetics drawing KD-4470-2 presents the primary tap voltages. The tap used should be that closest to the measured voltage.

9.2 Test Unit Startup

The following procedure will produce an automatic startup of the furnace system and prepare it to process material:

1. Switch the system main breaker at the power distribution panel to the "ON" position.

2. Switch the breaker handles on the Zone A and B HEPC to the "ON" or "UP" position.

3. In the breaker cabinet doors, switch the following breakers to the "ON" position.
   - Scrubber exhaust blower
   - Furnace primary and secondary chamber combustion air blower
   - Furnace belt drive
   - Wireway cooling drive blowers
4. Open the secondary combustion chamber fuel valve one-third. Solenoid valves upstream will open when the furnace temperature reaches 400 degrees Fahrenheit.

5. Adjust furnace belt speed control on the EURODRIVE to 50 percent.

6. Press "Control Panel Power" to the "ON" position. This provides power to the control circuitry only.

7. Turn on the following components to assure their correct operation. Turn each "Hand-off-Automatic" (HOA) switch individually to "Hand."
   - Furnace belt
   - Combustion air blower
   - Exhaust gas blower
   - Scrubber water pump

8. Turn all the HOA switches to the "Auto" position, including:
   - Furnace belt
   - Zone A HEPC
   - Zone B HEPC
   - Wireway cooling blowers
   - Secondary combustion chamber HEPC (if used)
   - Scrubber water pump (Quench water)
   - Secondary combustion chamber burner (if used)
   - Combustion air blower
   - Exhaust gas blower

9. Set temperature set points as follows:
   - Primary furnace chamber Zone A - 1600 degrees Fahrenheit
   - Primary furnace chamber Zone B - 1600 degrees Fahrenheit
   - Second combustion chamber - 1800 degrees Fahrenheit

10. Close all primary furnace combustion air jets and the main damper.

11. Open the secondary combustion air damper one-half.
12. Press furnace power "ON" button.

At this time, the furnace begins a heat-up cycle. The operator should inspect to see that the following are "ON" and operating correctly:

- Furnace belt
- Zone A - HEPC
- Zone B - HEPC
- Wireway cooling blower

When either the Zone A or Zone B temperature reaches 400 degrees Fahrenheit, the following occurs:

- Furnace exhaust blower turns "ON"
- Combustion air blower turns "ON"
- After a 2-minute purge, the pilot, then the burner lights to the SCC.
- Scrubber water

13. Adjust the exhaust blower damper and the scrubber water and the secondary combustion chamber combustion air blower to maintain a zero pressure in the furnace and adequate exhaust from the afterburner.

14. Adjust the burner input gas as required to maintain the desired secondary combustion chamber temperature.

15. When the primary furnace temperature has reached 1400 degrees Fahrenheit in Zone A, the operator may commence feed.

9.3 Normal Shutdown Procedures

To initiate a normal shutdown of the Portable Unit, the following sequence is used:

1. Feed hopper empty
2. All product off belt
3. Gas burner switch off
4. HEPC Secondary Combustion Chamber off (if applicable)
5. HEPC Zone B off
6. HEPC Zone A off
7. Feed motor off
8. HEPC Zone A Disconnect Off
9. HEPC Zone B Disconnect Off
10. Propane bottle valve closed
11. Loosen belt tension

Allow unit to cool down slowly from operating temperature to 1100 F. Utilize the final control settings used during operation to assure a slow rate of cooling.
When the furnace temperature reaches 1100°F:

12. Open combustion air gates to primary chamber
13. Balance draft throughout system to -0.015 inch wc in furnace
14. Loosen belt tension

When the furnace temperature reaches 800°F:

15. Open site glasses on furnace
16. Remove cover on feed hopper
17. Open afterburner damper fully
18. Maximize flow through venturi
19. Loosen belt tension

When the furnace temperature reaches 400°F:

20. Recirculation pump off
21. Feed conveyor off
22. Exhaust blower off
23. Combustion blower off
24. Furnace belt off
25. Furnace control power off
26. Panel control power off
27. Main power disconnect off
28. Drain stack condensate
29. Blowdown scrubber water
30. Leave trailer fan on
31. Trailer lights off
32. Secure trailer doors
33. Secure discharged product in waste storage facility

9.4 Emergency Shutdown Procedures

1. Sound Evacuation Alarm
2. Main power disconnect into "off" position.
3. Exit trailer
10. PUBLIC INVOLVEMENT

Shirco Infrared Systems strongly supports public involvement both in the permitting process and during the planning and testing phases of all research and demonstration projects. Shirco is uniquely able to participate in equipment and process demonstrations due to the existence of its mobile demonstration unit. In addition, other test facilities are available at Shirco's Dallas, Texas, headquarters where small (100 grams or greater) samples of waste materials can be analyzed for material response to thermal treatment. In this manner, several questions/issues of concern to communities, individuals, and other interests can be addressed prior to the presence of on-site research and demonstration testing.

Shirco respects the right of individuals and communities to have concerns about the safety and environmental impacts of on-site thermal treatment. Shirco believes that its patented infrared process offers a degree of safety and effectiveness exceeding what is available from other existing technologies; and, is fully ready to demonstrate this in the openness of an active public involvement program.

Shirco operates within the following guidelines when participating in public involvement activities:

1) Shirco will work with designated public involvement coordinators. Shirco will not manage the public involvement process as this may be viewed as biasing the demonstration process.

2) Shirco will work with officials of both government and private party clients.

3) Shirco will provide printed informational literature including equipment and process descriptions, test results, test specific data and plans. In addition, slides and audio-visual tapes are available upon request.

4) Shirco personnel are normally available to attend public meetings, other organized informational workshops, and conferences held for technology oriented purposes.

5) Shirco employs a full-time Communications Coordinator who serves as a focal point for public involvement activities. This individual is Mr. Ralph Morrison (telephone number 214/630-7511).
11.0 CLOSURE PLAN

11.0 Introduction

Closure procedures will be the responsibility of Shirco’s test coordinator and the clients’ representative on-site. The three areas involved in closing a site are:

- Decontamination of Portable Demonstration Unit
- Site clean-up activities relating to Shirco’s Portable Demonstration Unit
- Relinquishing responsibility of on-site wastes

11.1 Decontamination of Portable Demonstration Unit

Decontamination activities commence after the final demonstration condition is complete. With no feed entering the primary chamber, the primary chamber temperature will be held at 1600°F and the secondary chamber temperature will be at 1800°F for a minimum of four hours. During this four-hour "bakeout," all residual hazardous compounds accumulated inside the furnace will be destroyed.

Decontamination of the trailer and outside skin of the furnace system will be performed on a thick plastic sheet. The plastic sheet will entrap all the liquid and solid wastes which all will be displace while cleaning. The cleaning procedures will consist of a soap and water scrub followed by a high pressure steam rinse. The trailer will be sloped so the decontamination waters will channel out through the back doors with collection in a sump. Visual inspection of the trailer will confirm the decontamination process successful, releasing the trailer to a "clean" area for drying.

The support equipment used during the demonstration that was contaminated will then be placed on the thick plastic sheet and decontaminated following the same sequence used in decontaminating the trailer’s surfaces. Following a confirming visual inspection, the support equipment will be moved into a clean area for drying. Examples of support equipment: shovels, propane burner hose, stairs, etc.
11.2 Site Clean-Up Procedures

All containers containing hazardous or potentially hazardous compounds will be relinquished to the client. Shirco will secure, clean the outsides of any visual waste, and label each container. Shirco chain of custody forms relinquishing Shirco's responsibility of any wastes will be kept with the job file under the test coordinator's custody.

11.3 Waste and Waste Residues

Shirco's shift of site responsibility will be complete with the signing of the job file by Shirco's Test Coordinator and the client's representative personnel. The signing of the job file will act as a binder of Shirco's relinquishing responsibility of on-site testing for specific wastes at a specific waste location.
APPENDIX A

Process and Instrumentation Diagrams
and Portable Pilot Layout Diagrams