Final Design Report/ Start-Up, Operation & Maintenance Manual Interim Remedial Measure Erdle Perforating Company Site NYSDEC Site #828072 Town of Gates, New York

Prepared for:

Erdle Perforating Company
100 Pixley Industrial Parkway
Rochester, New York

Prepared by:

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March 31, 1997

Radian Engineering Inc.

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1.0 INTRODUCTION

1.1 Background

This document presents the Design Report and Start-up, Operation, and Maintenance plan for the proposed Interim Remedial Measure (IRM) at the Erdle Perforating Company (Erdle), located in the Town of Gates, New York. This document has been prepared to meet the requirements of Section V, Interim Remedial Measures, of the endorsed Administrative Order on Consent (AOC), Index Number B8-0185-87-05, between the New York State Department of Environmental Conservation (NYSDEC) and Erdle. The AOC addresses a Remedial Investigation and Feasibility Study of the site to characterize and eliminate health and environmental hazards attributable to the presence of volatile organic compounds (VOCs) in soils and groundwater under the site.

1.2 Summary of Site Conditions

Remedial Investigations (RIs) to date have identified a source area of residual VOCs from former underground storage tanks (USTs) which had held used solvent. These tanks were removed in 1987 by Day Engineering, in accordance with a NYSDEC-approved Work Plan. VOC migration from this source area has led to the presence of VOCs in groundwater downgradient (south) of the location of the former USTs, as shown on Drawing C-1 in the design drawing package. The RIs concluded that the principal site-related compounds of concern were volatile organic compounds (VOCs), specifically:

- Trichloroethene;
- 1,2-Dichloroethene;
- Vinyl Chloride;
- Xylenes; and
- Toluene.

These VOCs have been detected in soil samples from the overburden and groundwater samples from overburden and bedrock monitoring wells. The hydrogeology of the site consists of silty clay glacial till overburden materials, underlain by calcareous bedrock of the Lockport Formation. Groundwater in the overburden flows southwest away from the former UST area, while bedrock groundwater flow is to the south. The overburden materials have a low hydraulic conductivity (averaging $3.4X10^{-5}$ cm/sec) while the bedrock is highly permeable (averaging $1.7X10^{-1}$ cm/sec). More-detailed information on the investigations performed to date and the site conditions is provided in the June 1995 report entitled "Remedial Investigation Report for Erdle Perforating Company, Site No. 828072" and the December 1996 report entitled "Phase II Remedial Investigation Report for Erdle Perforating Company, Site No. 828072."

To reduce future liabilities, Erdle has decided to proceed with an IRM to provide immediate protection to human health and the environment against continued migration of the compounds of concern from the source area. The IRM Program has been designed to meet the following objectives:

- Decrease the concentrations of the site-related compounds of concern in the overburden in the identified source areas;
- Reduce future migration of site-related compounds of concern via groundwater pathways, through hydraulic control of the overburden groundwater aquifer; and
- Reduce the scope of the final remediation program, if necessary, at the completion of the RI/FS Program.

The proposed IRM was described conceptually in the February 1996 report entitled "Interim Remedial Measure Work Plan, Erdle Perforating Company, Site No. 828072."

In order to accomplish the IRM objectives, the IRM Work Plan recommended and provided justification for using the 2-PHASE™ technology patented by Xerox Corporation. This relatively new technology uses a high vacuum to simultaneously extract liquid and vapor through a single pipe lowered inside of extraction wells installed in a contaminated area. This process has several advantages:

- Recovery is significantly improved in 2-PHASE™ Extraction wells, as groundwater is actively drawn into the well borehole under a high vacuum;
- With 2-PHASE™ Extraction, the water table is drawn down more effectively because of enhanced groundwater recovery, increasing the volume of the unsaturated zone;
- The increased unsaturated zone exposes more soils to vapor stripping, which is a more efficient process of contaminant removal relative to other methods;
- The application of high vacuum results in increased vapor and groundwater flow by enhancing the pressure/vacuum gradients in the subsurface; and
- The 2-PHASE™ Extraction process does not require the installation of remote groundwater pumps, controls, or other equipment normally required with conventional remedial methods.

The 2-PHASE™ Extraction system has been designed to remove the site-related compounds of concern from the saturated and unsaturated zones of the source area and will be focused on the overburden. By removing the source of these compounds, further movement from the unsaturated soils into the groundwater will be reduced, thereby decreasing further migration of these contaminants away form the source areas. As the process is expected to depress the overburden water table, residual contamination in the newly-expanded vadose zone will be exposed and then removed by vapor extraction. Contaminated groundwater that remains below the well screen will be drawn upward by the effects of the vacuum; this flushing action of groundwater from the shallow bedrock groundwater will remove residual contaminants below the base of the extraction wells. Additionally, the natural upward hydraulic gradient from the shallow bedrock to the overburden will be used to advantage, accentuating the upward flushing created by the 2-PHASE™ extraction system.

Another reason for applying 2-PHASE™ only to the overburden is that the high hydraulic conductivity and groundwater yield of the shallow bedrock groundwater flow zone would generate substantial quantities of groundwater, which would subsequently have to be managed. Also, the RI results indicate that the majority of the VOC mass exists in the overburden.

It is anticipated that the bedrock groundwater concentrations will decrease once the mass of contaminants in the overburden is diminished. Operational data collected during the IRM will confirm these conditions.

The 2-PHASE™ Extraction system will be operated for a period of six months; however, operation may be extended if necessary. During the operational period of the 2-PHASE™ Extraction system, system parameters will be continuously measured and monitored to track the IRM's effectiveness. Details of the proposed monitoring efforts are presented in Section 7. The IRM will be operated to decrease soils and groundwater concentrations. Site data will be obtained during the IRM to monitor soil and groundwater VOC reduction trends and, four months into operation, these data will be evaluated to ascertain when the contaminant mass removal rate will level off indicating that it is technically impracticable to continue operation. The final decision to terminate the IRM will take into account the standards, criteria, and guidelines for the site and the concentration reductions which will be achieved at that time.

1.3 Purpose

This Design Report/Construction, Operation and Maintenance (CO&M) Manual has been prepared to facilitate implementation of the IRM by providing guidance on the operation and maintenance of the 2-PHASE™ Extraction and treatment system, and containing project-specific information that will be used in the field to monitor the system's operation and the soil and groundwater conditions in the vicinity of the former UST. This manual also details the field sampling methods, laboratory analytical methods, and associated quality assurance/quality control (QA/QC) procedures.

1.4 Discharge Permitting

1.4.1 Vapor Discharge Permitting

Vapor emissions from the 2-PHASE™ Extraction process will be treated with granular activated carbon (GAC) to reduce emission levels to below New York State Air Guide 1 requirements. Permit application materials for the proposed vapor discharge have been prepared and are presented in Appendix B-1. Because the IRM is being conducted pursuant to an AOC, an air permit will not be required; however, the substantive requirements of the air permitting program will be met. Vapor VOC concentrations are expected to decrease as the IRM progresses. When verified by analytical results for the vapor samples from the inlet to the first vapor-phase GAC unit (described in Section 7), and if approved by the NYSDEC, vapors from the 2-PHASE™ process may be discharged directly into the atmosphere.

The permit application materials are based on anticipated vapor emissions of trichloroethene, 1,2-dichloroethene, and vinyl chloride. While xylenes and toluene were also detected during the RIs, the concentrations of xylenes and toluene present were below the applicable standards, criteria, and guidelines. Also, xylenes and toluene were not detected in overburden groundwater during the most-recent sampling of the site. Therefore, only the three major VOCs present in the subsurface at the site (i.e. trichloroethene, 1,2-dichloroethene, and vinyl chloride) were considered to be potentially subject to air discharge regulation.

1.4.2 Request to Discharge Water to the Monroe County Pure Waters District Sewer

Groundwater extracted by the 2-PHASE™ Extraction will first be vacuum stripped as it is brought to the surface in the drop pipes of the system. This will remove up to 95% of the VOCs from the groundwater. The groundwater will be separated from the vapor in the mobile 2-PHASE™ Extraction trailer and will be treated with granular activated carbon before discharge to the Monroe County Pure Waters District (MCPWD) sewer via a sanitary drain in the Erdle facility. A request for permission to discharge to the MCPWD sewer has been submitted; a copy of this request is presented in Appendix B-2. Extracted groundwater from the

IRM will be treated to reduce VOCs in the 2-PHASE™ discharge water to below the MCPWD requirements.

1.5 Manual Organization

Sections 2.0 through 6.0 of this O&M Manual describe the design, operation, and maintenance of the 2-PHASE™ extraction and treatment system's components. This information includes the manufacturer, control specifications, troubleshooting, Lock-Out/Tag-Out, etc., for each of the system components.

Section 7.0 presents the system monitoring and sampling procedures which will be used to evaluate the system's effectiveness in removing subsurface contamination. Included in this section are the water and vapor sampling procedures which will be used to monitor the system's operation and satisfy the regulatory requirements for the discharge of treated groundwater and vapors.

Design plans for the 2-PHASE™ IRM are presented in the attached design drawings package. Operation and maintenance manuals provided by the manufacturers of the 2-PHASE™ extraction and treatment system's components are included in Appendix A of this O&M Manual. The vapor discharge permit application and the request to discharge to the MCPWD sewer are presented in Appendices B-1 and B-2, respectively. The Health and Safety Plan for the IRM is presented in Appendix C. The Microseeps sampling procedure and analytical Method AM4.03 for vapor sampling are presented in Appendix D.

2.0 COMPONENTS AND PROCESSES OF THE 2-PHASE™ EXTRACTION AND TREATMENT SYSTEM

The 2-PHASE™ IRM will consist of an extraction well network, a 2-PHASE™ Extraction trailer, and an onsite treatment system. Extraction wells designed to target the overburden source area will be constructed when the IRM is implemented. The 2-PHASE™ Extraction system is self-contained in an 18-foot trailer that will be fully operational when connected to utilities and piping. The 2-PHASE™ trailer and ancillary equipment to be used on this site was selected based on three criteria: 1) the site geology; 2) the expected water and vapor production from each extraction well; and 3) the availability of equipment. The construction of the 2-PHASE™ extraction system was performed by B&A Environmental Services Company (B&A). B&A is a specialty environmental contractor knowledgeable of the 2-PHASE™ equipment and process. The treatment system will be constructed onsite in the Erdle Perforating building under the supervision of Radian.

A total of four extraction wells are proposed for the IRM and will be installed at the locations shown on Drawing C-2 in the design drawing package. These extraction wells will be screened only in the overburden material and are positioned to develop a vacuum influence within the entire source area. Detailed information on the design and construction of the extraction wells is presented in the following section.

The 2-PHASE™ extraction and treatment system consists of four individual unit processes, as follows:

- The *vacuum extraction process* produces a high vacuum to remove liquid and vapor from the subsurface and separates the phases for subsequent treatment and discharge;
- The *vapor conditioning process* decreases the relative humidity of the vapor stream so that carbon adsorption may take place more efficiently;
- The *vapor treatment process* removes organic contaminants from the vapor stream through adsorption onto a granular activated carbon medium; and

- The *water treatment process* removes suspended solids and organic contaminants from the liquid stream through adsorption onto a granular activated carbon medium.

The general layout of the treatment system, with relation to the site, is presented on Drawing C-2 in the design drawing package. The process flow directions associated with the 2-PHASE™ Extraction process is presented in the process and instrumentation diagram (Drawing I-1) in the design drawing package. The operation, control and maintenance of each of these processes is described in this section. The troubleshooting of typical process operating problems is addressed in Section 5.0.

2.1 Extraction Wells

2.1.1 Description

The extraction wells are designed to focus the vacuum extraction effort on the low-permeability overburden materials. A wirewound screen design will be used to promote well efficiency. Wells will be screened across the deeper portions of the overburden to facilitate dewatering of the overburden and to prevent short-circuiting of vacuum to the surface. The bottom of the wells will be completed approximately 2 feet above the bedrock-overburden interface to prevent excessive influx of water from the shallow bedrock groundwater flow zone.

The location of the wells throughout the source area was based on an assumed vacuum radius of influence of 25 ft. This radius of influence was derived from Radian's 2-PHASE™ operational experience at other sites with similar hydrogeologic conditions. Significant groundwater drawdown is also expected to develop as the 2-PHASE™ system operation progresses. Typically the groundwater radius of influence of 2-PHASE™ extraction is substantially greater than the vacuum radius of influence. Radius-of-influence will be determined by collecting vacuum and water-level data from nearby existing monitoring wells. As overburden soils are dewatered, the subsurface contaminant removal via the vapor phase is expected to be the dominant contaminant mass transfer mechanism. Therefore, the extraction well network was designed to optimize subsurface vapor removal.

2.1.2 Major Components

The major components associated with the four (4) extraction wells are:

- The extraction wells consisting of PVC screen and riser pipe; and
- Extraction well surface completion box and piping connections.

Extraction well design and surface completion details are shown on Drawing P-1. Well construction procedures are presented below.

2.1.3 Extraction Well Construction

The extraction wells will be drilled with 6-in ID hollow stem augers to a total depth of approximately 11 feet. The screened interval of the extraction wells will extend from 11 to 6 feet below ground. Wells will be constructed of 4-in ID PVC riser and 0.020-in slot wirewound PVC screen. The screened interval will be backfilled with #0 Morie silica sand or equal. The filter zone will be sealed with a bentonite slurry/Benseal® grout, placed in the borehole via tremie, followed by tremied neat cement/bentonite grout. The wells will be completed at the surface with a 2-foot by 2-foot concrete pad and a type 4X Hoffman enclosure. Following installation, extraction wells will be developed using a pump or surge block and bailer to remove heavy sediment and to promote an effective connection between the well and the overburden.

Soil cuttings from the well installation will be spread over the former UST excavation, covered with topsoil, and seeded per the requirements of NYSDEC Technical and Administrative Guidance Memorandum (TAGM) #4032. Development water will be contained in 55-gallon drums and processed through the 2-PHASE™ Extraction system after system start-up.

2.2 Vacuum Extraction

2.2.1 Description

The vacuum extraction process removes groundwater and vapor from the subsurface via extraction wells through the application of a high vacuum. The vacuum will be induced through the operation of two liquid-ring vacuum pumps. Both groundwater and soil vapor will be extracted in the form of two-phase flow. The water phase is separated from the vapor phase in the system's inlet separator.

An extraction system tailored to the Erdle site conditions was selected from Radian's fleet of mobile 2-PHASE™ Extraction trailers. Vapor flow rates of up to 200 standard cubic feet per minute (scfm) and water flow rates of up to 25 gallons per minute (gpm) can be handled by the system. Based on site conditions, actual vapor flow rates are expected to range from 10 to 30 scfm per well (i.e., total system flow ranging from 40 to 120 scfm for 4 wells). Water flow will range from 1 to 5 gpm per well, for a total system flow ranging up to 20 gpm for 4 wells. Excess system capacity is available for additional extraction wells during the IRM, if needed.

Vacuum levels in the system may reach 28 inches of mercury (in-Hg). However, flow rate is inversely proportional to vacuum level; therefore, if higher vacuum levels are induced in the subsurface formation due to low permeability sediments, then lower system flow rates will be observed. Note that the vapor flow is divided evenly among the operating pumps and each portion of flow is processed separately through its respective vacuum pump.

2.2.2 Major Components

The major components associated with the vacuum extraction process include:

- Inlet separator
- Two liquid ring vacuum pumps

The layout of this equipment within the trailer is presented on Drawing M-1 in the design drawing package. Details of each component are presented below.

Inlet Separator

Manufacturer:	Travaini Pumps, USA
Liquid Capacity:	120 gallons

Vacuum Pumps (2)

Manufacturer:	Travaini Pumps, USA
System Model:	TRO300V-1A-XP
Pump Model:	TRVA65-450/1C/GH
Motor Horsepower:	20
Power:	480 VAC, 3-phase
Vapor Capacity (each):	100 scfm

2.2.3 Component Operation and Maintenance

Inlet Separator

A manufacturer's operation and maintenance manual was not included with the inlet separator. However, little O&M should be necessary.

Vacuum Pumps (2)

The operations and maintenance manual provided by the manufacturer for the vacuum pumps is located in Appendix A-1.

2.3 Vapor Conditioning

2.3.1 Description

The vapor conditioning process is designed to lower the relative humidity of the vapor stream prior to treatment with granular activated carbon. As the saturated vapor extracted from the subsurface is compressed in a vacuum pump, heat is produced and absorbed by both the vapor and the seal oil (pump sealing fluid). The hot vapor is discharged to a seal oil reservoir/knock-out pot where it is separated from any entrained seal-oil droplets carried over from the compression stage. The vapor from each vacuum pump is then combined and passed through an air-to-air heat exchanger where it undergoes primary cooling. After passing through the primary heat exchanger, the vapor stream passes through an air-to-water heat exchanger for secondary cooling. Water vapor is condensed out of the vapor stream in both cooling stages and is separated from the vapor in a condensate knock-out pot just after the air-to-water heat exchanger. The cooled vapor is then re-heated in an oil-to-air heat exchanger to produce a final vapor stream with a lower relative humidity than that exiting the vacuum pump.

2.3.2 Major Components

The major components associated with the vapor conditioning process are:

- 1 Air-to-air heat exchanger
- 1 Air-to-water heat exchanger
- 1 Oil-to-air heat exchanger
- 1 Water transfer pump
- 1 Oil circulating pump

The layout of this equipment within the trailer is presented on Drawing M-2 in the design drawing package. Details of each component are presented below.

Air-to-Air Heat Exchanger (1)

Manufacturer:	Motivair
Model:	AC0350-S
Fan Diameter:	18 inches
Air Flow:	2500 scfm
Motor Horsepower:	1/2 HP
Power:	120 VAC, single-phase

Air-to-Water Heat Exchanger (1)

Manufacturer:	Motivair
Model:	CSC0860BY1
Water Flow:	4 gpm
Air Flow:	200 scfm

Oil-to-Air Heat Exchanger (1)

Manufacturer:	Motivair
Model:	CSC0836BY1
Oil Flow:	4 gpm
Air Flow:	200 scfm

Water Transfer Pump

Manufacturer:	Robbins and Meyers
Pump Type:	Single-stage close coupled progressive cavity pump
Construction:	Cast iron housing
Model:	BIE-CDQ-SAA
Motor Horsepower:	1.5 HP
Power:	230/460 VAC, 3-phase, 60 Hz
Revolutions per minute:	360 RPM

Oil Circulation Pump

Manufacturer:	Price
Pump Type:	Close coupled centrifugal pump
Construction:	Bronze
Model:	LT25-AB-225-21-211-33-35-1X60
Motor Horsepower:	1/3 HP
Power:	120 VAC, single phase
Revolutions per minute:	3450 RPM

2.3.3 Component Operation and Maintenance

Air-to-Air Heat Exchanger (1)

The operations and maintenance manual provided by the manufacturer for the air-to-heat exchanger is located in Appendix A-2.

Air-to-Water Heat Exchanger (1)

A manufacturer's operations and maintenance manual was not included for the air-to-water heat exchanger, however, little O&M should be necessary.

Oil-to-Air Heat Exchanger (1)

A manufacturer's operations and maintenance manual was not included for the oil-to-air heat exchanger, however, little O&M should be necessary.

Water Transfer Pump

The operations and maintenance manual provided by the manufacturer for the water circulation pump is located in Appendix A-5.

Oil Circulation Pump

The operations and maintenance manual provided by the manufacturer for the oil circulation pump is located in Appendix A-3.

2.4 Vapor Treatment

The major components associated with the vapor treatment process are:

- Two vapor-phase granular activated carbon (GAC) canisters.

Activated carbon will be used as it was determined to be the most cost effective method of treating the contaminated vapor stream.

2.4.1 Description

After the relative humidity of the vapor stream has been lowered, the vapor stream will pass through two 1,800-pound granular activated carbon units connected in series to remove organic contaminants via adsorption. The treated vapor will then be discharged to the atmosphere.

As the concentrations of contaminants in the vapor phase decline, the vapor emissions will likely decrease to below NYSDEC guideline levels. When verified by the analytical results for the vapor samples from the inlet to the first vapor-phase GAC unit, approval will be obtained from the NYSDEC to take both vapor-phase GAC units off line. The vapors will then be discharged directly to the atmosphere.

2.4.2 Major Components

The major component associated with the vapor treatment process is the vapor phase granular activated carbon units. The location of the vapor phase carbon units is shown on Drawing C-2 (General System layout) in the design drawing package.

Vapor-Phase Granular Activated Carbon Units (2)

Supplier:	Carbtrol Corporation
Model:	G-6
Capacity:	up to 600 scfm
Carbon Load:	1,800 pounds per bed
Carbon Type:	CSV
Carbon Size:	4x8 (US Sieve)

2.4.3 Component Operation and Maintenance

Vapor-Phase Granular Activated Carbon Units (2)

The manufacturer's equipment data sheets for the vapor-phase GAC units are located are Appendix A-4.

When a vapor phase GAC has been loaded to the point of breakthrough, a change-out of the spent canister will be required. Breakthrough is defined as the point at which the quantifiable concentration of VOCs detected at the outlet of the carbon bed exceeds the quantifiable concentration at the inlet (to be determined by the monitoring program described in Section 7.0), and may be less than or equal to the maximum absorption capacity of the canister.

When breakthrough conditions are observed at the primary vapor phase GAC, the carbon canister should be changed-out. This will be accomplished by the following procedure:

a) Shut the 2-PHASE™ system down using the red STOP button on the wall of the trailer.
b) Remove the primary GAC canister from operation and label is as follows:
   - Place a "HAZARDOUS WASTE" label on the canister and fill in all appropriate blanks.
   - Place a DOT Primary Shipping Label on the canister designating it as MISCELLANEOUS DANGEROUS GOODS.
c) Place the GAC canister from the secondary position in the primary position.
d) Place the new canister in the secondary position.
e) Re-start the 2-PHASE™ system as detailed in Section 4.1.2.
f) Install plugs in the inlet and outlet ports in preparation for shipping.

All used vapor carbons will be stored in the hazardous waste accumulation area located inside the plant in the storage room adjacent to the treatment room. Waste will be stored on site for no more than 90 days from the date on which the waste was generated (carbon change-out date).

2.5 Water Treatment

The major components associated with the water treatment process are:

- 1 Bag filter
- 4 Aqueous phase granular initiated carbon units

Activated carbon will be used as it was determined to be the most cost effective method of treating the contaminated water system.

The location of the bag filter is shown on Drawing M-2 (Mobile 2-PHASE™ Trailer Layout) in the design drawing package. The location of the aqueous phase carbon units is shown on Drawing C-2 (General System Layout) in the design drawing package.

2.5.1 Description

After the water stream is isolated in the inlet separator, it will be pumped through bag filters to remove suspended solids and then pumped through the air-to-water heat exchanger for cooling water purposes. The liquid stream will then be passed through two parallel trains of two 200-pound aqueous-phase GAC units connected in series for organic contaminant removal. After passing through the carbon units, the effluent will be discharged to the sanitary sewer.

2.5.2 Major Components

Bag Filter (1)

Manufacturer:	ISP
Vessel Model:	LD-1-BSL
Vessel Construction:	316 Stainless Steel
Filter Model:	PE25US-P2S-H
Filter Construction:	25 Micron Polyester
Flow Capacity:	80 GPM
Maximum Operating Pressure:	85 psi

Aqueous-Phase Granular Activated Carbon Units (4)

Supplier:	Carbtrol Corporation
Model:	L-1
Capacity:	10 gpm for sufficient residence time
Carbon Load:	200 pounds per bed
Carbon Type:	CSL
Carbon Size:	8x30 (US Sieve)

2.5.3 Component Operation and Maintenance

Bag Filter (1)

A manufacturer's operation and maintenance manual was not included for the bag filters; however, little operation and maintenance should be necessary other than changing out the bag when the pressure at the inlet of the bag filter exceeds 50 psi.

Aqueous-Phase Granular Activated Carbon Units (4)

The manufacturer's equipment data sheets for the aqueous-phase GAC units are located in Appendix A-4.

When a liquid phase GAC has reached its maximum adsorption capacity, a change-out of the spent canister will be required. Maximum adsorption capacity, commonly called breakthrough, is defined as the point at which the concentration of VOCs detected at the outlet of the carbon exceeds the concentration at the inlet (to be determined by the monitoring program described in Section 7.0).

When breakthrough conditions are observed at the primary carbon canister, the following procedure should be followed:

1. De-gas a new carbon canister in preparation for change-out. For complete instructions on carbon degassing, refer to the document "Installation and Operating Instructions, Carbtrol® L-1 Liquid Phase Canisters" located in Appendix A of this manual.

2. Shut down 2-PHASE™ system using the red STOP button on the wall of the trailer.

3. Remove the spent primary carbon and replace it with the carbon from the secondary position. Label this carbon as follows:
   - Place a "HAZARDOUS WASTE" label on the canister and fill in all appropriate blanks.
   - Place a DOT Primary Shipping Label on the canister designating it as MISCELLANEOUS DANGEROUS GOODS.

4. Install the new carbon in the secondary position.

5. Re-start the 2-PHASE™ system as detailed in Section 4.1.2.

6. Completely drain all water from the spent carbon. This will be accomplished by the following procedure:

a) Remove the 3/4" drain bung on the lower side and place a bucket under the port.
b) Puncture the plastic drum lining with a sharp object and collect the discharge water in the bucket.
c) Replace the 3/4" drain bung.
d) Process all water through the 2-PHASE™ systems using the suction wand located at the inlet separator.

7. Install plugs in the inlet and outlet ports in preparation for shipping.

All used water carbon canisters will be stored in the hazardous waste accumulation area located inside the plant in the storage room adjacent to the treatment room. Waste will be stored on site for no more than 90 days from the date on which the waste was generated (carbon change-out date).

2.6 Hazardous Waste Accumulation Area

The Hazardous Waste Accumulation Area will be located inside the plant in the storage room adjacent to the treatment room. The area will be approximately 15 feet by 15 feet and shall be outlined on the floor with grey duct tape. A sign labeled "HAZARDOUS WASTE ACCUMULATION AREA" will be posted near the area.

2.7 System Controls

Operating temperatures, pressures and fluid levels are maintained using appropriate instrumentation, transducers, and control valves located at key control points. Any signals detected above normal operating limits within any process will cause the entire system to shut down. After the alarm condition is acknowledged and corrected by the operator, the system can then be manually restarted. Controls and system interlocks are illustrated on the process and instrumentation diagram (Drawing I-1) located in the design drawing package.

3.0 SYSTEM OPERATIONS

3.1 Normal Operation

During normal operation of the 2-PHASE™ extraction and treatment system, either one or both of the vacuum pumps may be in operation at a given time, based on subsurface conditions, liquid and vapor flow rates, and system status. The maximum anticipated water production rate is 20 gpm and the maximum anticipated vapor flow rate is 100 scfm. The system is capable of fully automated operation but will be checked periodically by an operator to ensure proper operation and for preventative maintenance.

3.2 Alternate Operation

Because no emergency power will be supplied to the 2-PHASE™ extraction and treatment system, there is no alternate operation during power failure. The system must be manually restarted after a power failure.

3.3 Emergency Operation and Fail-Safe Features

3.3.1 Power Failure

Because there is no emergency power, the 2-PHASE™ extraction and treatment system will be shut down during a power failure. In the event of cold weather, care should be taken to prevent the system's temperature from falling below freezing as this may cause water-containing process lines and vessels to freeze and burst. In the event of a prolonged shut down, process lines and equipment should be drained of all condensate/water. The system must be manually restarted after a power failure.

3.3.2 Fail-Safe Features

The 2-PHASE™ extraction and treatment system is interlocked with many fail-safe features. Temperature, pressure and level-sensing devices are installed at all key control locations and are configured to trigger an automatic system shut down in the event that signals above normal operating limits are detected. Normal operating limits for the 2-PHASE™ extraction and treatment system are presented in Table 3-1.

3.4 System Monitoring

Operators will be on site each day during the first week of operation to check for proper operation of all system components and to phase in operations of the extraction wells. After the first week of operation, an operator will visit the site once during each week to monitor the system's operation. During routine system monitoring, the operator will record operating parameters on system instrumentation data forms. An example of this form is presented in Figures 3-1a and 3-1b. The operators will also perform weekly inspections of the integrity of the treatment facility (i.e., inspect for leaks, corrosion, etc.), the presence and integrity of emergency equipment, and the presence and integrity of any drummed materials. Operators will record their findings on facility inspection logs, equipment inspection logs, and drummed material inspection logs, which are presented in Figures 3-2, 3-3, and 3-4, respectively.

Table 3-1

Normal Operating Limits of the 2-PHASE™ System

Location	Description	Units	Skid	System
Pressure Readings	Pressure, Seal Oil Reservoir	psig	<5	
	Pressure, Outlet of Oil Circulation Pump	psig	<25	
	Pressure, Inlet to Bag Filters	psig		<50
	Pressure, Outlet of Bag Filters	psig		<25
	Pressure, Inlet to Aqueous-Phase GAC #1	psig		<10
	Pressure, Outlet of Aqueous-Phase GAC #1	psig		<10
	Pressure, Outlet of Aqueous-Phase GAC #2	psig		<10
Temperature Readings	Vapor Temperature, Outlet of Vacuum Pump	°F	<180	

Note: System will be shut down in the event that signals above normal operating limits are detected.

System Instrumentation Data Form

(Page 1 of 2 Pages)

Date: ______________________________ **Time:** ________________________

Measurement	Description	Units	Vacuum Pump #1	Vacuum Pump #2	System
Run Time	Hour Meter Reading	hours			
Vapor Flow	Vapor Flow Meter #1	acfm			
	Vapor Flow Meter #2	acfm			
	Vapor Flow Meter #3	acfm			
	Vapor Flow Meter #4	acfm			
	Total Volumetric Flow	acfm			
Water Flow	Water Totalizer Reading	gallons			
Vacuum/ Pressure Reading	Vacuum at Inlet Separator	in-Hg			
	Vacuum at Pump Inlets	in-Hg			
	Pressure, Seal Oil Reservoirs	psig			
	Pressure, Outlet of Oil Circulation Pump	psig			
	Pressure, Inlet to Bag Filters	psig			
	Pressure, Inlet to Aqueous-Phase GAC #1	psig			
	Pressure, Outlet of Aqueous-Phase GAC #1	psig			
	Pressure, Outlet of Water Transfer Pump	psig			
	Pressure at Stack	psig			
Temperature Readings	Temperature at Inlet Separator	°F			
	Temperature at Outlet of Vacuum Pumps	°F			
	Temperature at Outlet of Air-to-Air HEX	°F			
	Temperature at Outlet of Water/Air HEX	°F			
	Temperature at Outlet of Oil/Air HEX	°F			
	Temperature Inside Trailer	°F			
	Temperature of Ambient Air outside Trailer	°F			
	Temperature at Stack	°F			

Figure 3-1a. System Instrumentation Data Form

System Instrumentation Data Form

(Page 2 of 2 Pages)

Date: ______________________________ **Time:** ______________________

Location	Description	Units	EW-1	EW-2	EW-3	EW-4
Extraction Wells	Well in Operation? (Yes/No)	—				
	Vacuum at Well Head	in-Hg				
	Straw Tip Depth Below PVC	ft				
	Aspiration Air Valve Position	—				

Samples Collected(?): Inlet First Aqueous-Phase GAC (W1) __ Outlet First Aqueous-Phase GAC (W2)__ Outlet Second Aqueous-Phase GAC (W3) __
Inlet First Vapor-Phase GAC (V1) __ Outlet First Vapor-Phase GAC (V2) __ Outlet Second Vapor-Phase GAC (V3) __

QA/QC Samples Collected(?): ____

Other Samples Collected(?): ____

Inspector: ______________________________ (Print)

______________________________ (Signature)

Comments: ____

____

____

Figure 3-1b. System Instrumentation Data Form

Facility Inspection Log

2-PHASE™ TRAILER	Yes	No
Deterioration of floor, curbing, or walls/roof (e.g., cracks, spalling, corrosion)		
Deterioration of equipment in facility (e.g., corrosion)		
Deterioration of piping or valves (e.g., cracks, seeps)		
Any signs of releases from equipment in facility (e.g., seeps, standing water, staining)		
Ventilation system working?		
Any unusual odors or smells?		
Comments: ____________________		

VAPOR AND LIQUID PHASE TREATMENT AREA	Yes	No
Deterioration of vapor-phase GACs (e.g., corrosion, seeps)		
Deterioration of concrete slab (e.g., cracks, corrosion)		
Deterioration of piping or valves (e.g., cracks, seeps)		
Any signs of releases from vapor-phase GACs, piping, valves		
Deterioration of liquid phase GACs (e.g., corrosion, seeps)		
Deterioration of concrete slab (e.g., cracks, corrosion)		
Deterioration of piping or valves (e.g., cracks, seeps)		
Any signs of releases from liquid-phase GACs, piping, valves		
Deterioration of secondary containment (e.g., cracking)		
Comments: ____________________		

Date: ____________________

Inspector: ____________________ (Print)

____________________ (Signature)

Figure 3-2. Facility Inspection Log

Equipment Inspection Log

EMERGENCY AND MONITORING EQUIPMENT	Yes	No
ABC Fire Extinguishers charged		
Telephone in operating condition		
All Alarms functioning		
Comments:		

SPILL RESPONSE EQUIPMENT	Quantity
Absorbent materials	
Containment pillows/pads	
Nitrile gloves and rubber boots	
Tyvek coveralls	
Safety goggles	
Comments:	

Date: ______________________

Inspector: ______________________ (Print)

______________________ (Signature)

Figure 3-3. Equipment Inspection Log

Drummed Material Inspection Log

Contents	Quantity	Labeled (Yes/No)	Leaks (Yes/No)	Closed (Yes/No)
Soil				
Groundwater				
Decon. Water				
Personal Protective Equipment				
Other				
Empty				
Comments: ______				

Date: ______________________

Inspector: ______________________ (Print)

______________________ (Signature)

Figure 3-4. Drummed Material Inspection Log

4.0 SYSTEM START-UP AND SHUT-DOWN PROCEDURES

4.1 Pre-Start-Up Inspection

Before initial start-up of the 2-PHASE™ system, a complete inspection of the 2-PHASE™ system and all ancillary equipment shall be performed. Tasks to be performed are discussed in the following subsections.

4.1.1 Extraction Wells

Prior to start-up of the extraction wells, the following items will be visually inspected and checked for completeness:

1. The general condition of the well casings, wellhead fittings, and piping from the wells to the 2-PHASE™ system shall be inspected for defects and deficiencies and corrected prior to start-up.

2. The ball valves used for turning the extraction wells on and off shall be completely closed.

3. The aspiration air valve on the wellhead shall be completely closed.

4. The locking boxes installed at each extraction well shall be inspected for proper installation and to ensure that each box is supplied with a lock.

5. Static water levels from each of the extraction wells and all monitoring wells shall be collected.

6. Piping will be checked to verify that it is properly supported.

7. Piping insulation and lagging will be checked to verify that it is attached and in good repair.

4.1.2 2-PHASE™ System

The following items will be performed prior to start-up of the 2-PHASE™ system:

1. All flanges and fittings that connect process piping to the 2-PHASE™ system shall be inspected for defects and proper installation. Any deficiencies shall be corrected prior to start-up.

2. All electrical connections to the trailer and ancillary equipment shall be checked to ensure that they have been made in accordance with all applicable electrical codes.

3. The pump motor shall be bump tested for proper rotation.

4. Drain valve on inlet separator and bag filter is closed.

5. The valve from the inlet separator to the water transfer pump, and the valve from the pump to the bag filter is opened completely.

6. The inlet separator shall be filled with city water and then emptied via the water transfer pump, checking operation of the level switches, including the high-high level switch. All piping and equipment associated with water transfer (i.e. piping from inlet separator to GACs, piping from GACs to sanitary sewer tie-in, liquid phase GACs, etc.) shall be inspected for leaks and any deficiencies shall be corrected prior to start-up.

7. Fluid levels in both seal oil reservoirs shall be checked to ensure that they are at the correct operating levels.

8. The system shall be started in accordance with the procedure outlined in section 4.2 below entitled, Cold-Start Procedure Following Extended Shut-Down of Both Vacuum Pumps.

4.2 Cold-Start Procedure Following Extended Shut-Down of Both Vacuum Pumps

This cold-start procedure should be followed whenever both of the vacuum pumps have been shut down for an extended period of time, such that the seal oil temperature has dropped below 130°F. This procedure is described as follows:

1. All extraction wells are turned off, and the butterfly valve on the vacuum header, just after the outlet of the inlet separator, is closed. The isolation valve between pumps are also closed.

2. The ambient air bleed valve on each of the vacuum pumps is opened slightly.

3. The valve on the oil circulation loop for each of the vacuum pumps is opened to allow the oil to circulate through the oil-to-air heat exchanger.

4. The valve on the piping from the first vacuum pump seal oil reservoir to the oil circulation pump is opened fully. The same valve on the second vacuum pump is completely closed.

5. The valve from the bag filter to the aqueous-phase carbon units, the valves between the aqueous-phase carbon units, and the valves between the second aqueous-phase carbon units and the sanitary sewer tie-in, are all opened completely.

6. The switch for the transfer pump is in the "AUTOMATIC" position on the control panel set.

7. The switch for the exhaust fan is set to "ON". At this point, all disconnects for equipment should be in the ON position. All circuit breakers should be in ON position.

8. The vacuum pumps are started one at a time and are run on ambient air for approximately 30 minutes to allow the oil in the seal oil reservoir to reach operating temperature (150-160°F).

9. Once the oil has reached operating temperature, the well isolation valve at an extraction well is opened. Next, the butterfly valve on the outlet of the inlet separator and the isolation valves between the pumps are opened. Vapor flow, vacuum readings at the inlet separator, and other process parameters should be monitored to ensure that they are all within operating range.

10. If all operating parameters are within operating range, extraction wells are turned on sequentially at approximately 5 minute intervals. As more wells are brought on line, the ambient air bleed valve at the vacuum pumps are slowly closed until the system in running entirely on the extraction wells.

4.3 Cold-Start Procedure Following Extended Shut-Down of One Vacuum Pump

This cold-start procedure should be followed whenever one of the vacuum pumps have been shut down for an extended period of time, such that the seal oil temperature has dropped below 130°F. This procedure is described as follows:

1. The isolation valve on the shut-down pump is closed.
2. The ambient air bleed valve on the shut-down pump is opened slightly.
3. The valve on the oil circulation loop for the shut-down pump is opened to allow the oil circulation through the oil-to-air heat exchanger.
4. The valve on the piping from the vacuum pump seal oil reservoir to the oil circulation pump is opened fully.
5. The bypass valve on the shut-down pump air-to-air heat exchanger is closed to ensure that the vapor flow from the vacuum pump is routed through the heat exchanger.
6. The pump is started and is run on ambient air for approximately 30 minutes to allow the oil in the seal oil reservoir to reach operating temperature (150-160°F).
7. Once the oil has reached operating temperature, the isolation valves are opened. Vapor flow, vacuum readings at the inlet separator, and other process parameters should be monitored to ensure that they are all within operating range.
8. If all operating parameters are within operating range, the ambient air bleed valve at the vacuum pump is slowly closed until the system in running entirely on the extraction wells.

4.4 Start-Up Procedures Following a Short-Term Shut-Down Period

The start-up procedure presented below should be followed only if the vacuum pumps have been shut down for a limited time period, such that the seal oil is still within operating range. This procedure is described as follows:

1. The well isolation valves at the well-heads of the various extraction wells are closed on two of the four extraction wells.
2. The vacuum pumps are sequentially brought on line. Operating parameters are monitored to ensure that they are within normal operating range.
3. Once the operator is satisfied that the system is running normally, the remaining two extraction wells are brought on line sequentially at approximately 5 minute intervals.

4.5 Shut-Down Procedure for Extended Periods

The following shut-down procedure presented below should be adhered to when an extended shut-down period is anticipated.

1. The well isolation valves will be closed and the union furthest away from each well-head shall be slightly opened to allow ambient air to enter the system. The system shall be run in this configuration for approximately 5 minutes to purge the lines of any and all free-standing water.
2. The vacuum pumps will be turned off.
3. The inlet separator will be drained and flushed with clean water.
4. The air-to-air heat exchanger, air-to-water heat exchanger, and condensate knock-out pot will be drained of water.
5. The bag filter will be cleaned and/or changed out and drained.

4.6 Shut-Down Procedure For Short-Term Shut-Down Periods

When shutting the vacuum pumps down for short durations, the pumps may simply be turned off using the red STOP button located on the wall of the trailer. No other actions are required.

4.7 Emergency Shut-Down Procedure

In case of emergency, the 2-PHASE™ extraction and treatment system may be shut down using the red STOP button located on the wall of the trailer. No other actions are required.

5.0 TROUBLESHOOTING

Table 5-1 outlines typically encountered system operation problems, probable causes, and corrective actions. Additional troubleshooting procedures for individual system components are described in the manufacturer's literature in Appendix A.