2R - 34

# REPORTS

# DATE:

Aug. 3, 1995

DANIEL B. STEPHENS & ASSOCIATES, INC.
ENVIRONMENTAL SCIENTISTS AND ENGINEERS

August 3, 1995

0859-5150-95



Mr. George Robinson
ENRON Operations Corp.
Environmental Affairs Department
1400 Smith St., Suite 3AC-3142
Houston, Texas 77002

Dear George:

Enclosed please find six copies of the final conceptual corrective action plan for the former liquid storage area at Atoka-1 Compressor Station. An associated cost estimate for system implementation is also included.

Please review the plan at your convenience and feel free to contact me with any questions at (505) 822-9400.

Sincerely,

DANIEL B. STEPHENS & ASSOCIATES, INC.

Bob Marley

Bob Marley
Project Manager

BM/et
Enclosure



SOIL AND GROUND-WATER INVESTIGATIONS • REMEDIAL ACTION • LITIGATION SUPPORT • VADOSE ZONE HYDROLOGY
6020 ACADEMY NE • SUITE 100 • ALBUQUERQUE, NM 87109 • (505) 822-9400 • FAX (505) 822-8877
ALBUQUERQUE • SANTA FE

# CONCEPTUAL CORRECTIVE ACTION PLAN FOR SOIL REMEDIATION
# ATOKA-1 COMPRESSOR STATION
# ARTESIA, NEW MEXICO

## INTRODUCTION

Daniel B. Stephens & Associates, Inc. (DBS&A) has been retained by ENRON Operations Corp. (EOC) to prepare a conceptual corrective action system design for the remediation of contaminated soils at Transwestern Pipeline Company's (TPC) Atoka-1 Compressor Station. The facility is located approximately 10 miles southeast of Artesia, New Mexico, and is accessed by way of U.S. Highway 82 (Figure 1).

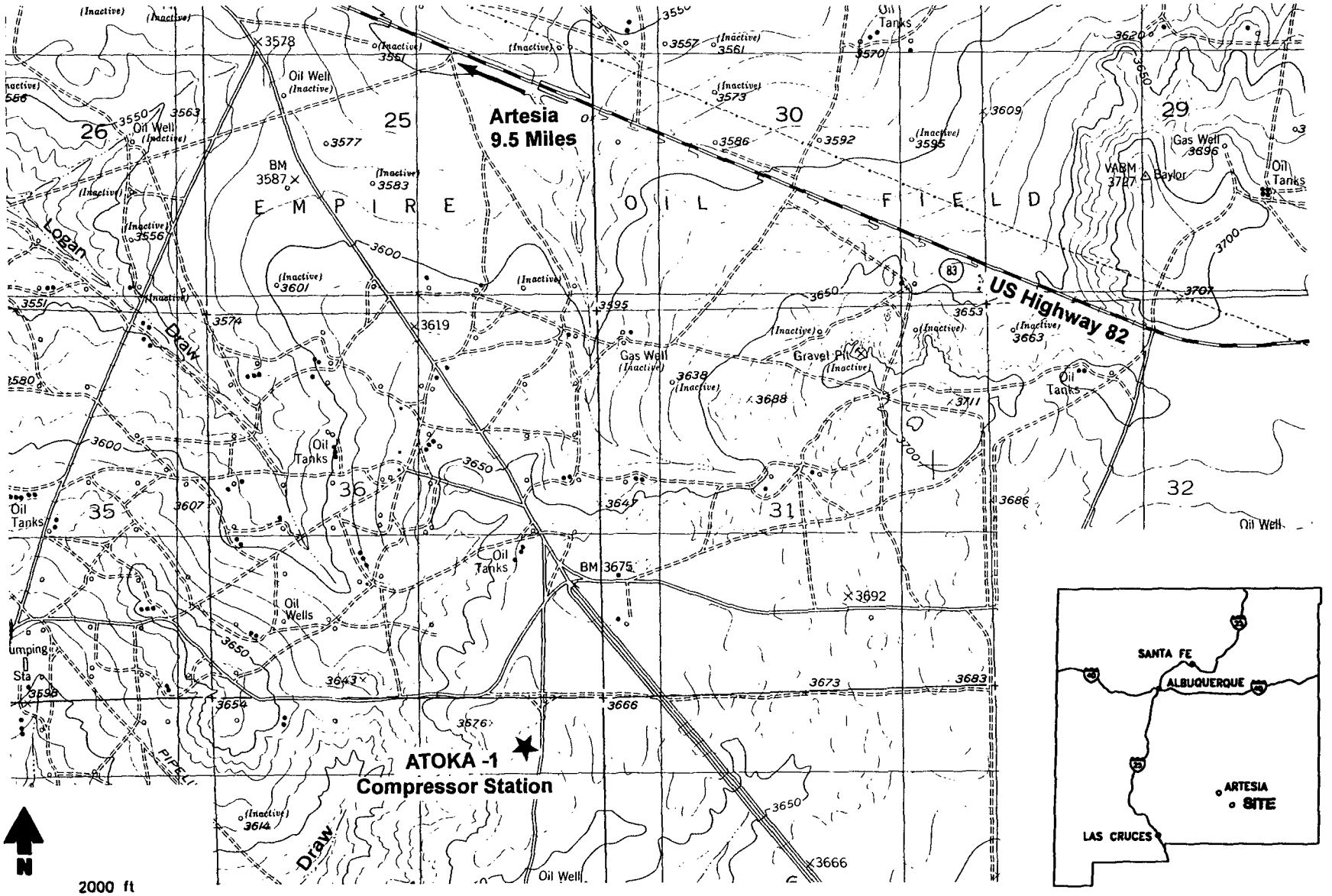
The area of contamination addressed by this corrective action system design is located along the southern side of the site (Figure 2). In the past, pipeline liquids consisting primarily of petroleum distillates were stored near the southeast corner of the site in two locations: (1) an aboveground storage tank (AST) within an earthen bermed area and (2) a concrete-lined surface impoundment. Liquids released from these former storage areas resulted in subsurface contamination. Presently, all waste liquids removed from the pipeline system are collected and stored in ASTs within secondary concrete containment structures prior to off-site disposal.

## PROJECT BACKGROUND

To date, two previous hydrogeologic investigations have been conducted to delineate the extent of subsurface impacts (Brown & Root Environmental [B&R], 1993; Brown and Caldwell [B&C], 1995). In addition to the delineation of subsurface impacts, Cypress Engineering Services, Inc. (CES) implemented a work plan to excavate and treat near-surface soils underlying the former liquid storage areas. A brief summary of these activities is provided below.

The first investigation was performed by B&R during the months of June and July 1993. They advanced a total of 12 soil borings and completed 4 of the borings as monitor wells, shown as MW-1 through MW-4 on Figure 2. Soil and ground-water samples were collected and analyzed for total petroleum hydrocarbons (TPH), volatile organic compounds (VOCs), and semivolatile organic compounds (SVOCs).

V\5150\5150010.DWG

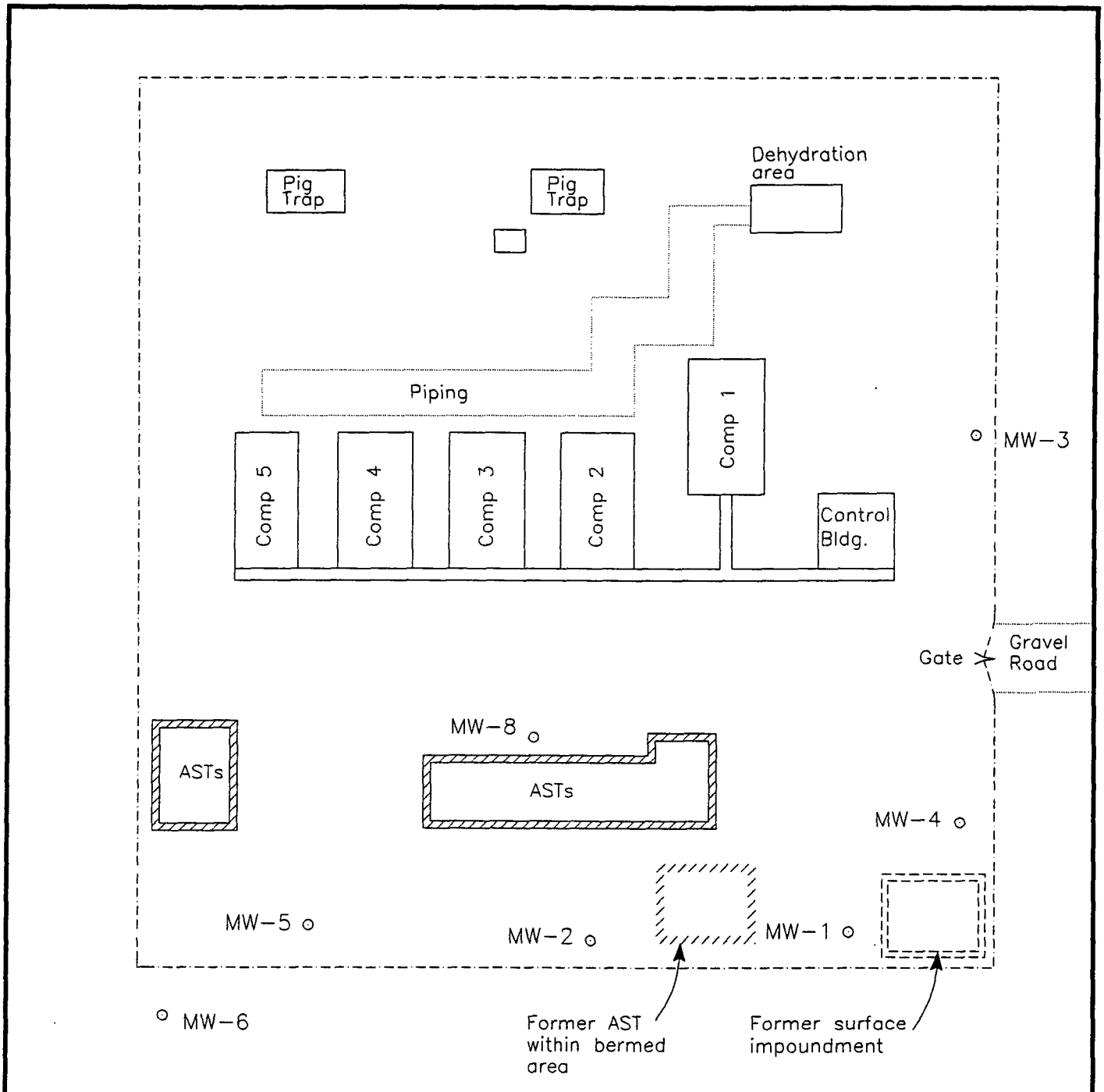



**Source:** Adapted from USGS, 1955 Red Lake, NM 7.5 Minute Topographic Quadrangle Map

ATOKA-1 COMPRESSOR STATION
**Location Map**

Figure 1

DANIEL B. STEPHENS & ASSOCIATES, INC.
7-95 JN 5150




ATOKA-1 COMPRESSOR STATION

**Site Map**

V:\5150\515002C.DWG

DANIEL B. STEPHENS & ASSOCIATES, INC.

7-27-95

JN 5160

**Figure 2**

Based on the analyses of samples collected by B&R, the primary VOCs exceeding the New Mexico Oil Conservation Division guidelines (NMOCD, 1993) are benzene, toluene, ethylbenzene, and xylene (BTEX). In addition, the investigation indicated that soil contamination is present between monitor wells MW-1 and MW-2 (Figure 2). The soil beneath the former liquid storage areas appears to be impacted from near ground surface to at least 60 feet below ground surface (bgs). In addition, B&R determined that phase-separated hydrocarbons (PSH) are present in contact with the perched water near monitor well MW-1.

In October and November 1994, B&C advanced 11 additional soil borings and completed 4 of these borings as monitor wells (MW-5 through MW-8 on Figure 2). The investigation defined the extent of shallow soil contamination near the former liquid storage areas and determined that a measurable thickness of PSH is also present in monitor well MW-2.

The site hydrogeology and extent of subsurface contamination, based on the data gathered to date, are described below:

- Borings advanced during the investigations intersected sediments consisting primarily of fine-grained silts and clays. Discontinuous perched water lenses are present at depths ranging from 36 to 60 feet bgs. As evidenced by several borings that did not encounter ground water, the perched system appears to be of limited extent and likely originates from station operations rather than from natural recharge.

- Field headspace and laboratory analyses indicated that soil contamination is present near the former storage areas from near ground surface to at least 60 feet bgs (i.e., the entire soil column above the perched water). The vertical extent of contaminated soil diminishes as one moves away from the two former storage areas.

- As evidenced by the PSH measured in monitor wells MW-1 and MW-2 and total BTEX concentrations of 27,700 µg/L in monitor well MW-5, PSH are present along the southern fence line.

- The majority of the contaminant mass is present in the sorbed and vapor phase within the soil and as PSH in contact with the perched water.

In October and November 1994, CES implemented a work plan to remediate near-surface soils below the two former liquid storage areas. This remediation program included the excavation of approximately 3,200 cubic yards of soil underneath the former AST and surface impoundment. Soils were excavated to depths of approximately 10 to 15 feet bgs. The excavated soil was then processed through a Royer soil shredding plant, augmented with a nutrient solution to enhance biodegradation of hydrocarbons, and placed back into the excavated area.

## PROPOSED CORRECTIVE ACTION SYSTEM

The proposed correction action will focus on the removal of PSH and the reduction of elevated TPH in the shallow (0 to 60 feet bgs) soils in the vicinity of the former liquid storage areas. The proposed technology for removal of subsurface contaminants is soil vapor extraction. This process will recover sorbed-phase, vapor-phase, and PSH contamination. Because the dissolved-phase contamination is a small fraction of the total contaminant mass, no action is proposed to address the dissolved-phase contamination present within the limited perched system. Following cleanup of soil contamination and PSH, dissolved-phase ground-water contamination is expected to naturally attenuate.

### Soil Vapor Extraction System

Soil vapor extraction is a proven technology for the removal of VOCs from unsaturated soils. In addition to removing VOCs, the process enhances aerobic microbial degradation of residual sorbed soil contaminants by increasing subsurface oxygen levels.

Due to the presence of fine-grained soils, which likely have low to moderate air permeability, the SVE well field has been conservatively designed to ensure that the impacted area is effectively covered. The SVE system will consist of 13 SVE wells, two independent soil vapor conveyance circuits, and a 200-standard-cubic-feet-per-minute (scfm) thermal oxidizer. An estimated flow rate of approximately 0.5 scfm per linear foot of well screen should be attainable from each of the proposed 2-inch-diameter SVE wells.

The proposed SVE well field consists of wells placed on 40-foot centers corresponding to an estimated radius of influence of 25 feet (Figure 3). The anticipated design assumes 0.5 scfm and 30 feet of screened interval per well for a total flow rate of 15 scfm per well. Typically the SVE wells will be screened from approximately 20 feet bgs to the top of the perched water. However, actual screen placement will be determined based on field observations.

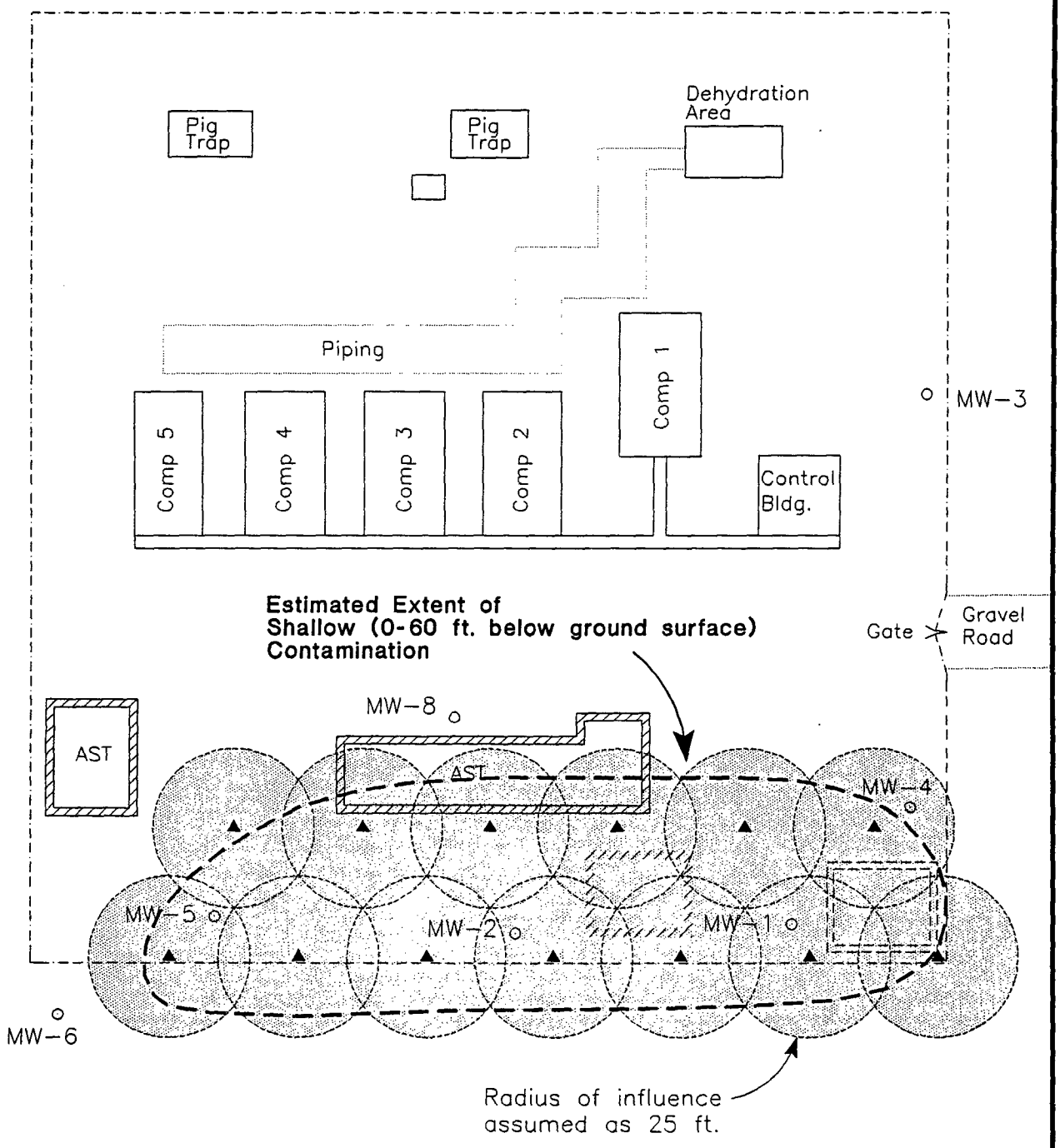
Based on estimated contaminant mass removal rates, emission control will be required for full-scale operation of the SVE system. TPC will obtain the necessary air quality permit from the New Mexico Environment Department Air Quality Bureau.

Vapor conveyance piping will consist of high-density polyethylene (HDPE) pipe in various diameters selected on the basis of head loss calculations along the two circuits. The proposed piping and SVE circuit configurations are shown in Figure 4. Due to the remoteness of the location and the short-term nature of the project, it is proposed that the piping be laid on the ground surface rather than in trenches. HDPE piping is better suited to this application than PVC because it is more flexible and less likely to be damaged by ultraviolet radiation or vehicular traffic.

**Equipment**

The proposed treatment system for the extracted soil vapors is a thermal oxidizer manufactured by Baker Furnace, Inc. (Attachment 1). The 200-scfm oxidizer will extract soil vapors using a 7.5-hp positive displacement pump. Extracted vapors are passed through a moisture separator and then into a combustion chamber where the operating temperature is maintained at or above 1400°F. After destruction of the VOCs, the exhaust stream is vented to the atmosphere.
To ensure that the combustion temperature is maintained within the required operating range, the oxidizer is equipped to use natural gas as a supplemental fuel. The 7.5-hp positive displacement pump will require a 3-phase, 220-volt electrical hookup. These required utilities will be connected to the thermal oxidizer.

When emission control is no longer required, the turnkey thermal oxidizer may be replaced with a low-flow-rate regenerative blower if continued corrective action is warranted. The blower will



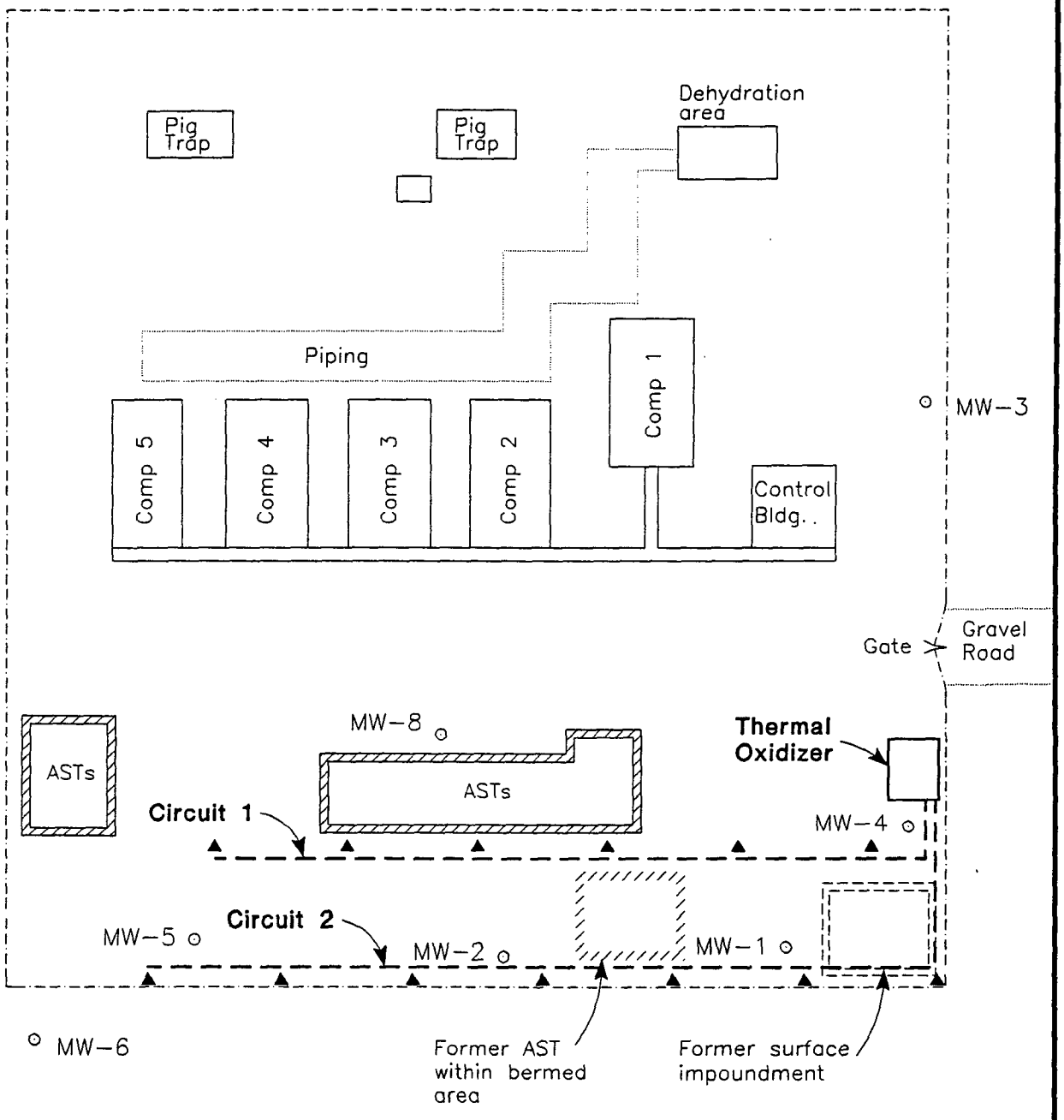

V:\5160\515003C.DWG

ATOKA-1 COMPRESSOR STATION

**Location of Proposed Soil Vapor Extraction Wells**

DANIEL B. STEPHENS & ASSOCIATES, INC.
7-27-95
JN 5160

**Figure 3**




Note: Soil vapor extraction piping to be laid on the ground surface rather than in trenches.

N

MW-7

0 50 Feet

**Explanation**

- Monitor well
- Fence
- Piping
- Soil vapor extraction well
- Containment wall

ATOKA-1 COMPRESSOR STATION

**Proposed Piping Plan for Soil Vapor Extraction Wells**

DANIEL B. STEPHENS & ASSOCIATES, INC.

7-27-95

JN 5160

**Figure 4**

\\5150\5150004C.DWG

be used to circulate air in the subsurface, thereby continuing to enhance the in-situ biodegradation of contaminants by maintaining adequate oxygen levels in the subsurface. Implementation of continued venting after removal of the thermal oxidizer will be evaluated at a later date.

**Corrective Action Activities and Performance Milestones**

The following tasks will be required to implement the proposed corrective action.

- File air quality permit application
- Finalize SVE system design and prepare construction plans; solicit contractor bid quotations and select construction contractors
- Construct SVE well field and order equipment
- Construct SVE conveyance system and equipment compound; install equipment

In addition, the following tasks will be required following system startup:

- Operate and maintain system
- Collect confirmation soil samples
- Achieve OCD soil standards and terminate SVE

**Performance Reporting**

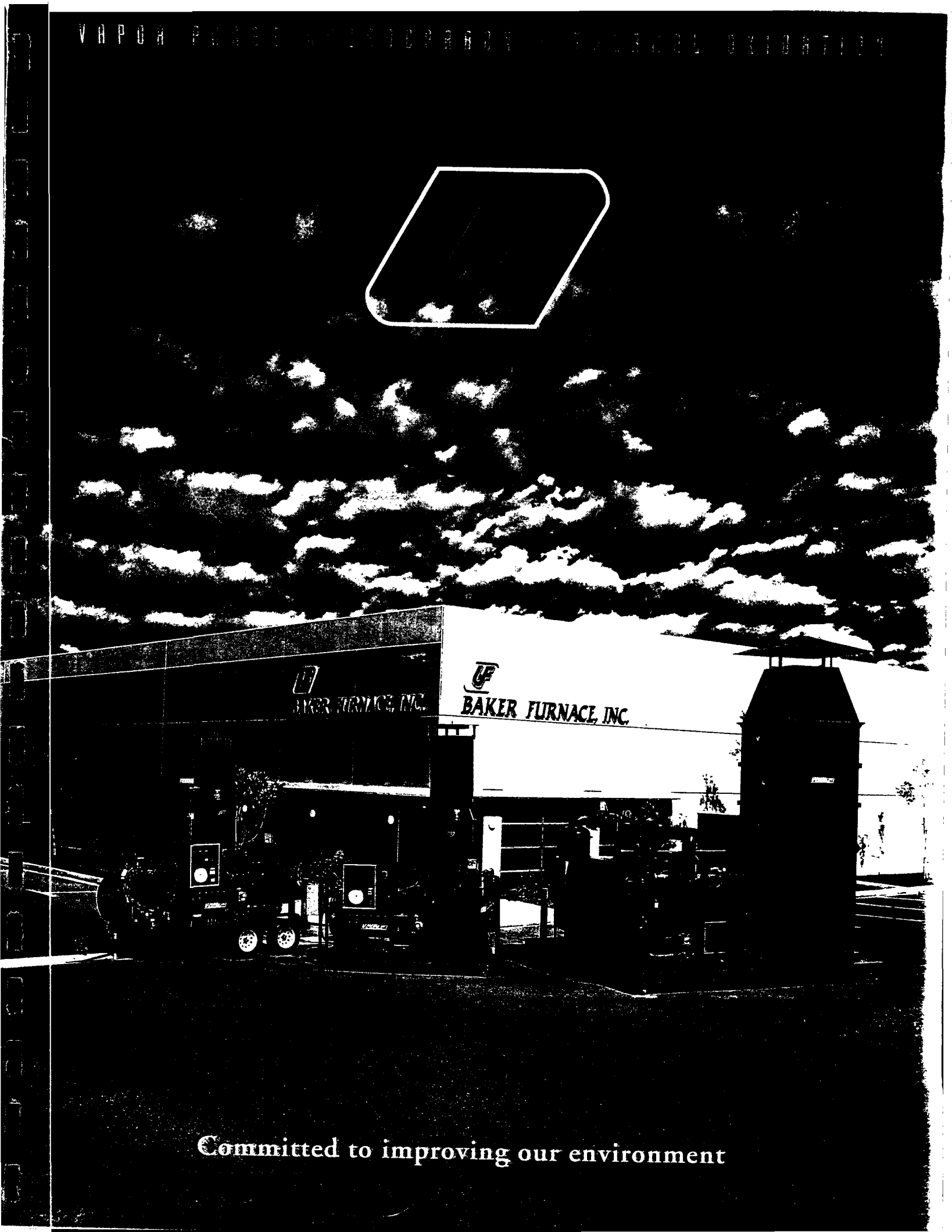
During the first year of operation, TPC will prepare semiannual reports detailing the operation and maintenance (O&M) activities and system performance. These reports will summarize quarterly activities, which will include sampling of monitor wells near the former source area for BTEX, checking these wells for the presence of PSH, and sampling the emissions from the SVE well field for TPH. After the first year of operation, TPC proposes to submit annual reports on O&M activities. Performance reporting will continue until site closure is obtained.

## REFERENCES

Brown and Caldwell. 1995. Additional Investigation and Closure Activities at the Transwestern Pipeline Company Atoka 1 Compressor Station, Artesia, New Mexico, March 1995.

Brown and Root Environmental. 1993. Subsurface Investigation, Atoka 1 Compressor Station, Atoka, New Mexico, October, 1993.

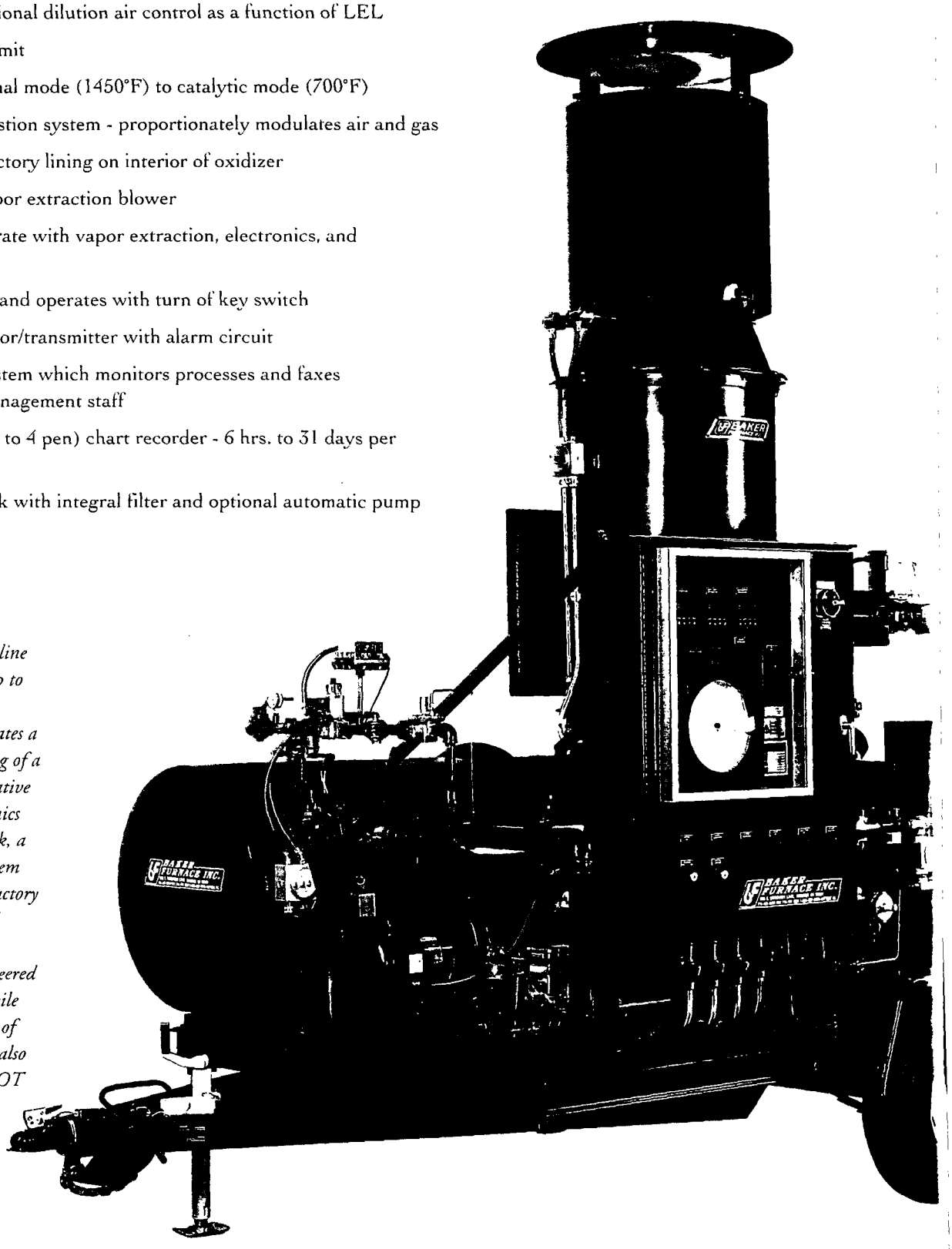
New Mexico Oil Conservation Division (OCD). 1993. Unlined Surface Impoundment Closure Guidelines (February 1993). Tab 7b. *In* Environmental Regulations, State of New Mexico Energy, Minerals, and Natural Resources Department, Oil Conservation Division, Santa Fe, New Mexico.

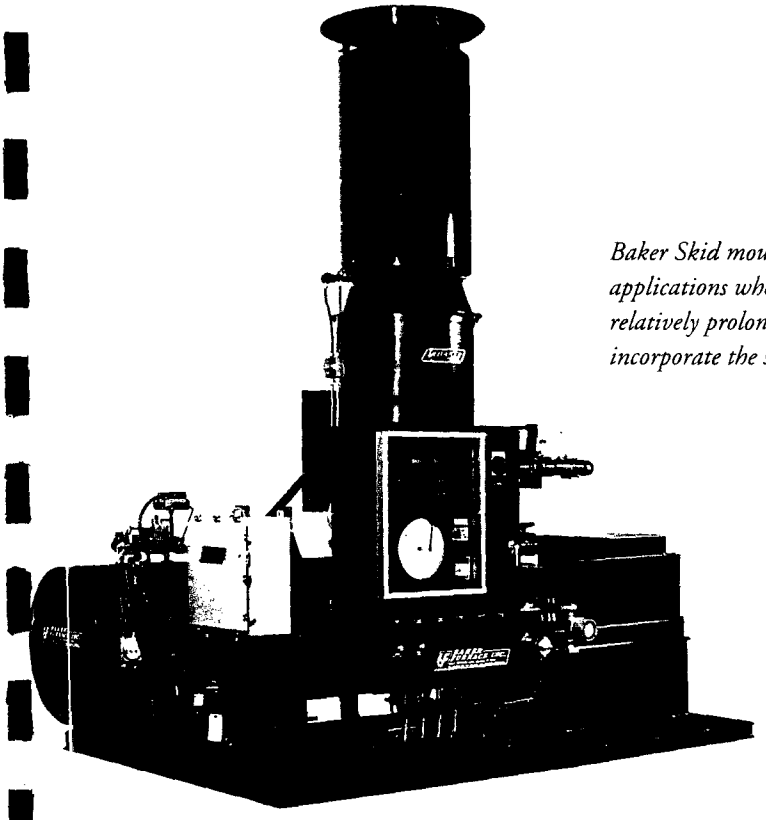



Committed to improving our environment

- Five separate safety interlocks
- AGA (American Gas Association) engineering report on Baker Oxidizers
- Automatic and proportional dilution air control as a function of LEL
- SCAQMD general permit
- Convertible from thermal mode (1450°F) to catalytic mode (700°F)
- Highly efficient combustion system - proportionately modulates air and gas
- Highly insulating refractory lining on interior of oxidizer
- Silence package for vapor extraction blower
- Complete ready to operate with vapor extraction, electronics, and combustion system
- Fully automatic- starts and operates with turn of key switch
- LEL combustibles sensor/transmitter with alarm circuit
- On board telemetry system which monitors processes and faxes information back to management staff
- Three pen (expandable to 4 pen) chart recorder - 6 hrs. to 31 days per revolution
- Moisture knockout tank with integral filter and optional automatic pump with level switches

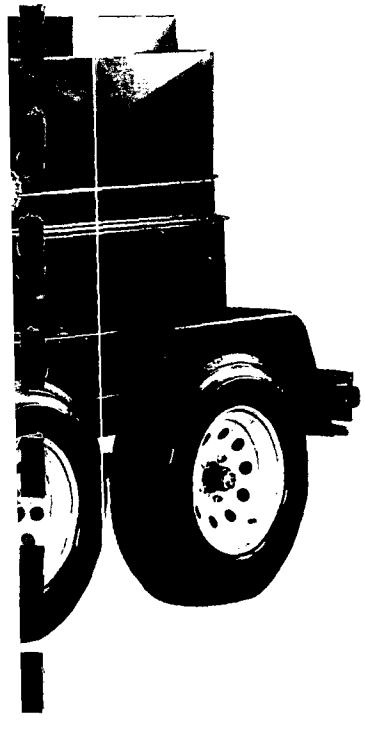
*Baker manufactures a standard line of Trailer mounted Oxidizers up to 500 cfm flow rate in 100 cfm increments. Each unit incorporates a vapor extraction system consisting of a positive displacement or regenerative blower, a U.L. classified electronics panel, a moisture knock-out tank, a complete combustion burner system and 5 safety interlocks with a Factory Mutual (FM) supplemental fuel train. The trailered (and skid mounted) units have been engineered to fit in a minimum of space while still retaining a full compliment of equipment. The trailered units also have electric brakes and meet DOT (Department of Transportation) specifications.*

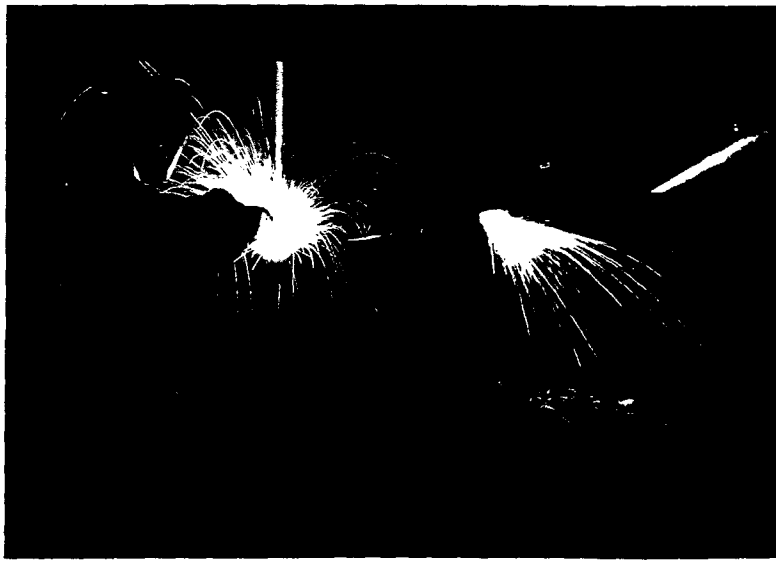




*Baker Skid mounted Oxidizers are designed for those remediation applications where the Thermal Oxidizer is going to be stationary for a relatively prolonged period of time. Skid and trailer mounted units both incorporate the same design features.*

*In addition to Thermal Oxidizers, Baker Furnace also manufactures Carbon Systems (either skid or trailer mounted). These systems are complete, ready to operate with Vapor Extraction Blower, LEL combustibles sensor, Electronic Control Panel and Carbon canisters.*





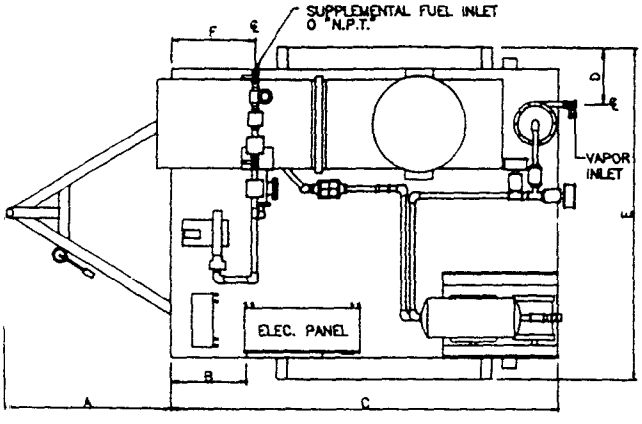
*Baker Furnace maintains a complete fabrication/assembly shop and constructs each Oxidizer from the ground up. We do not utilize sub-contractors and as such have tight quality and production controls. Baker Oxidizers are subjected to rigorous tests before shipment and every component group (Electronics, Combustion and Vapor Extraction) is assembled on our premises.*

## TRAILER MOUNTED THERMAL OXIDIZERS
dimensions in inches

| OXIDIZER | A | B | C | D | E | F | G | H | J | K | L | M | N | O | P | Q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100 CFM | 51 | 20 | 120 | 20 | 91 | 18 | 82.5 | 171 | 19.5 | 162 | 56 | 60.5 | 2 | 1 | 8 | 75 |
| 200 CFM | 51 | 20 | 120 | 20 | 91 | 18 | 82.5 | 171 | 19.5 | 162 | 56 | 60.5 | 2.5 | 1 | 8 | 75 |
| 300 CFM | 60 | 20 | 144 | 20 | 97 | 18 | 87 | 204 | 24 | 162 | 56 | 60.5 | 3 | 1 | 8 | 81 |
| 400 CFM | 60 | 20 | 168 | 20 | 97 | 18 | 87 | 204 | 24 | 162 | 70 | 75.5 | 4 | 1.5 | 8 | 81 |
| 500 CFM | 60 | 20 | 168 | 20 | 97 | 18 | 87 | 228 | 24 | 162 | 70 | 75.5 | 5 | 1.5 | 8 | 81 |

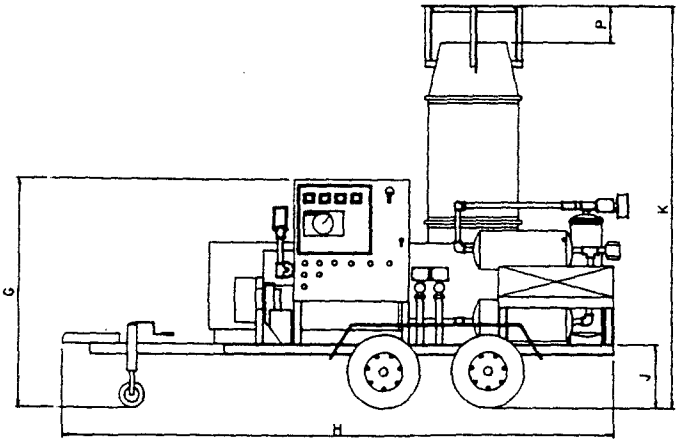
## SKID MOUNTED THERMAL OXIDIZERS
dimensions in inches

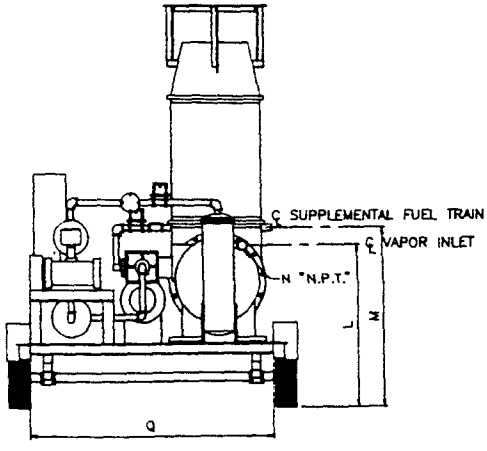
| OXIDIZER | A | B | C | D | E | F | G | H | J | K | L | M | N | O | P | Q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100 CFM | N/A | 20 | 120 | 18 | N/A | 18 | 69 | N/A | 6 | 162 | 39 | 39 | 2 | 1 | 8 | 84 |
| 200 CFM | N/A | 20 | 120 | 18 | N/A | 18 | 69 | N/A | 6 | 162 | 39 | 39 | 2.5 | 1 | 8 | 84 |
| 300 CFM | N/A | 20 | 132 | 18 | N/A | 18 | 69 | N/A | 6 | 162 | 39 | 42 | 3 | 1 | 8 | 84 |
| 400 CFM | N/A | 20 | 168 | 18 | N/A | 18 | 69 | N/A | 6 | 162 | 53 | 45 | 4 | 1.5 | 8 | 96 |
| 500 CFM | N/A | 20 | 168 | 18 | N/A | 18 | 69 | N/A | 6 | 162 | 53 | 50 | 5 | 1.5 | 8 | 96 |




## OXIDIZER
Weights in lbs. (approximate)

| TYPE | 100 CFM | 200 CFM | 300 CFM | 400 CFM | 500 CFM |
|---|---|---|---|---|---|
| Skid | 4600 | 4800 | 5100 | 5700 | 5900 |
| Trailer | 5800 | 5900 | 6500 | 6800 | 7100 |

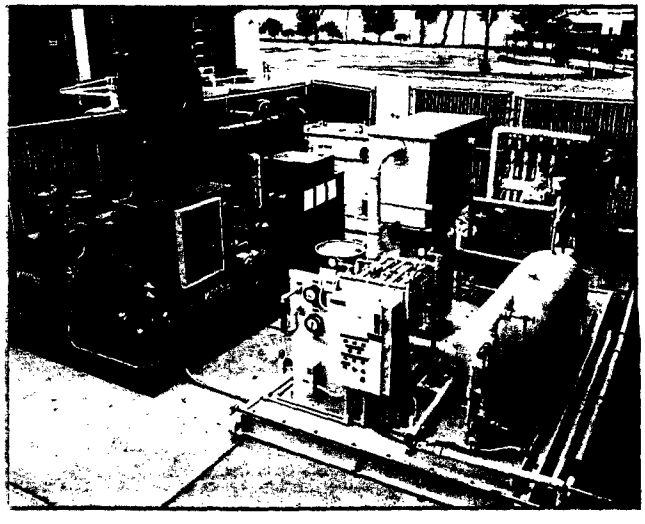




*One day pilot study performed at active retail service station. 200 cfm trailer mounted units are available for short or long term rental periods. Factory trained personnel are available to operate equipment on pilot studies, perform onsite field service, or provide technical assistance over the telephone.*

*Trailer mounted 200 cfm oxidizer remediating gasoline storage tank leak at active retail service station.*

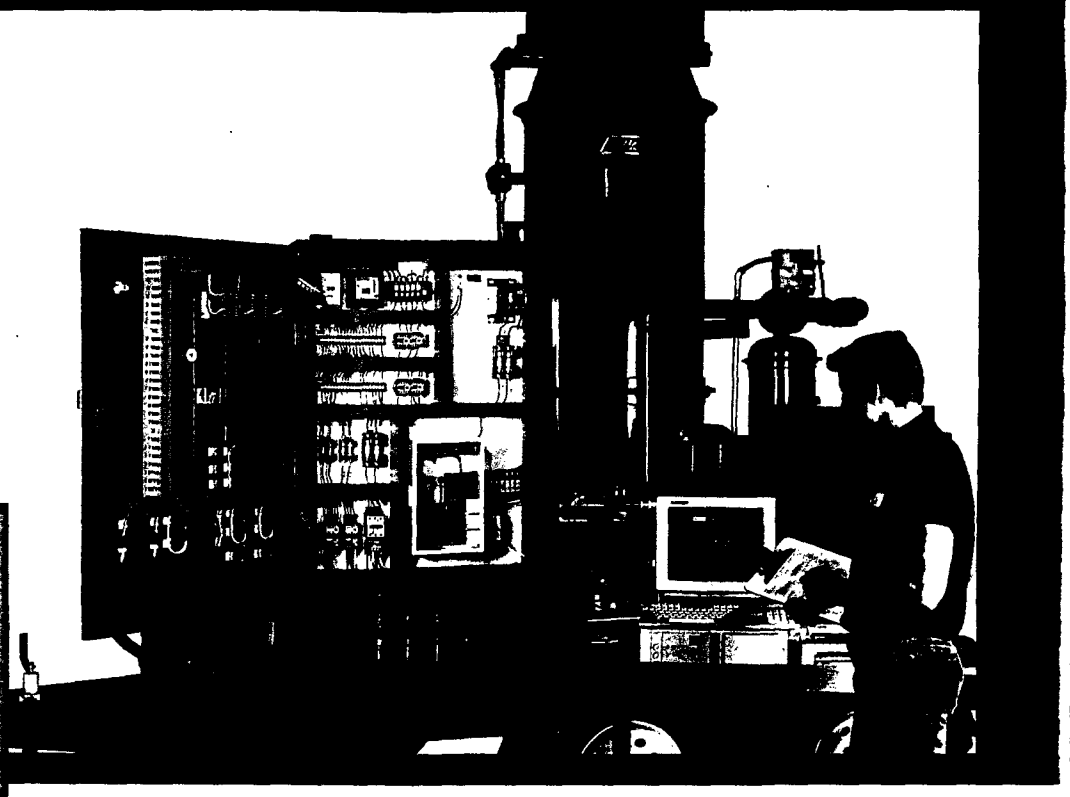
*Skid mounted 400 cfm Baker Oxidizer being utilized to remediate hydrocarbon contaminated soil concurrently with water filtration system. Soil contaminant's include gasoline and diesel fuel.*



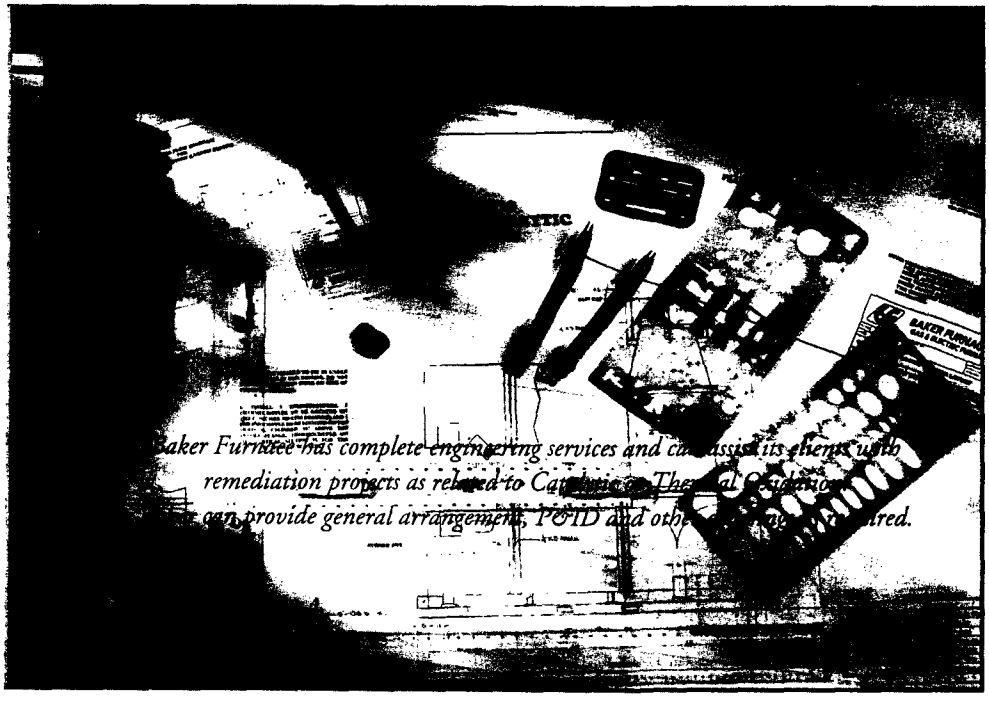
Applications for Baker Oxidation systems include:

- Underground storage tank remediation
- Paint spray booths and drying ovens
- Lithographic printing
- Bakeries - (ethyl alcohol)
- Other industrial processes which emit volatile organic compounds

*Baker Furnace Thermal Oxidizers are equipped with a U.L. (Underwriters Laboratory) classified control panel. A U.L. Classification sticker is applied after a thorough diagnostics check via our computer software.*



ENCLOSED FLAME CONTROL PANEL
CLASSIFIED BY
Underwriters Laboratories Inc.®
AS TO ELECTRICAL FIRE
& SHOCK HAZARD ONLY
No. AD-72027
Klockner MOELLER 61/6-7
HAUL-1113



*Baker Furnace has complete engineering services and can assist its clients with remediation projects as related to Catalytic or Thermal Oxidation. We can provide general arrangement, P&ID and other [illegible] required.*

**BAKER FURNACE INC.**

1015 E. Discovery Lane, Anaheim, CA 92801 • (714) 491-9293
Fax (714) 491-8221 • 800-237-5675 (Outside CA)

DISTRIBUTED BY

# Baker Thermal Oxidizer Specifications

## *100 through 500 CFM Units* *(600 through 10,000 CFM quoted on request)*

Baker Thermal Oxidizers are designed for vapor extraction based soil remediation projects and other VOC destruction applications where burning the volatiles has been specified as the most cost effective method. Baker Oxidizers feature fully automatic operation, and use either natural gas or propane as supplemental fuel. The VOC destruction rates achieved by our Direct Fired and Catalytic units are excellent. (Please refer to the section on destruction rates for actual quantified rates.) The units are equipped with 6 separate safety interlocks and feature U.L. (Underwriters Laboratory), F.M. (Factory Mutual) and C.S.A. (Canadian Standards) approved components where applicable. Our 100 – 500 CFM units have been approved by A.G.A. (American Gas Association) Laboratories. Selected units have been granted general approval by the South Coast Air Quality Management District (responsible for greater Los Angeles area.) Baker Furnace was the first oxidizer manufacturer to secure this type of approval. Each unit is carefully sized for the correct volume of air and correct residence time for the vapors being oxidized. We size our Thermal Oxidizers for 1 full second of residence time to ensure a thorough destruction of the vapors being introduced into the Oxidizer.

## *Dimensions*

For specific dimensions on the #100 through #500 CFM Thermal Oxidizers (either skid or trailer mounted), please refer to our general arrangement drawing #101212 enclosed with these specifications.

## *Oxidizer Weights in lbs.*

| TYPE | 100CFM | 200CFM | 300CFM | 400CFM | 500CFM |
|---|---|---|---|---|---|
| Skid | 3400 | 3600 | 4100 | 4300 | 4300 |
| Trailer | 4200 | 4300 | 4900 | 5100 | 5100 |

## *Vapor Extraction Blower*

A positive displacement blower with a 208/230/460 volt three phase (or 220 volt single phase) sixty (60) HZ. motor to deliver a correct volume of air at 4" of Hg. will be provided. Higher vacuums are available on request in the 10 to 12" Hg. range. The blower is belt driven and is equipped with an O.S.H.A. approved guard over the belts and sheaves. The blower also is fitted with inlet and outlet silencers and a "Kunkle" vacuum relief valve. Baker Furnace can provide a regenerative blower in lieu of the positive displacement blower if so desired.

**Blower Horsepower and Amperage Ratings at 4" HG Vacuum**

| Oxidizer | 100CFM | 200CFM | 300CFM | 400CFM | 500CFM |
|---|---|---|---|---|---|
| Horsepower | 2 | 3 | 5 | 5 | 7.5 |
| Amperage 230 V. 1 Ph. | 12 | 17 | 28 | 28 | 40 |
| 208 V. 3 Ph. | 7.8 | 11 | 17.5 | 17.5 | 25.3 |
| 230 V. 3 Ph. | 6.8 | 9.6 | 15.2 | 15.2 | 22 |
| 460 V. 3 Ph. | 3.4 | 4.8 | 7.6 | 7.6 | 11 |

## *Knock Out Pot*

A 12" or 16" diameter knock out pot with a manual drain is an integral part of the vapor extraction train. The pot is equipped with a sight glass and a brass ball cock for draining off liquid. An automatic pump with level switches can be fitted to the knock out pot on request. (See also high level knockout drain/shutoff in options section).

## *Air Filters*

Replaceable air filters are furnished with the unit and are located in the knock out pot and on the two dilution air inlets. The knock out pot filter can be readily changed by removing the top of the knock out pot. The air dilution filters are external and can also be readily changed. Baker Furnace maintains a supply of replacement filters in stock at all times.

## *Three Way Valving with Automatic Air Dilution*

Motor actuated three-way valves are installed to supply clean air to purge the combustion system prior to ignition of the pilot and to restrict VOC laden air from entering the Thermal Oxidizer until it reaches its operating temperature. The valves automatically switch over at a preset temperature which is configured into the process temperature controller. Two of the valves are proportionally modulated and are linked to oxygen and L.E.L. sensors. The sensors are connected to digital microprocessor based P.I.D. controllers which proportionately modulate the butterfly valves around a setpoint which has been selected. L.E.L. and oxygen levels are simply set on the P.I.D. controllers and then maintained automatically by the amount of dilution air which enters the Oxidizer.

## *Supplemental Fuel and Vapor Inlet Pipe Sizes*

Please refer to our general arrangement drawing #101212 included with these specifications for specific pipe sizes for the #100 through #500 Thermal Oxidizers.

## *Air Flow Measurement*

Post dilution process air flow to the combustion chamber is measured via a pitot tube and electronic air flow transmitter. An averaging pitot tube measures differential pressure, which is translated into an electronic signal by the transmitter, and sent to the chart recorder. Air flow is one of the three process variables monitored and recorded continuously by our Honeywell 3-pen chart recorder.

## *Combustion System*

An Eclipse MVTA (medium velocity tempered air) combustion burner will be supplied with the Thermal Oxidizer utilizing a combustion blower, modulating gas butterfly valve, spark ignition, piloting and FM approved flame safety relays. The combustion burner is also equipped with a FM approved gas fuel train. The burner will fire on propane or natural gas. Inlet gas pressure should be 2-5 PSI at the regulator on the fuel train. Please refer to the fuel usage charts provided with these specifications for data regarding the use of supplemental fuel versus VOC concentrations at the influent to the Oxidizer. The charts are available for both Catalytic and Direct fired operation.

## *Control Panel*

A complete, U.L. Approved Three Phase control panel is included with a choice of 208/230/460 volts (or 220 volt Single Phase if required) and would consist of the following component parts:

1. Honeywell 3 pen chart recorder (4 pen available)
2. Honeywell digital microprocessor based process controller
3. Honeywell high limit temperature controller
4. Honeywell L.E.L. controller with alarm setpoint -4-20 output
5. Honeywell $O_2$ controller -4-20 milliamp output
6. Totalizing hour meter - up to 9999 hours
7. Nema four panel with 3 Phase or 1 Phase disconnect
8. Step down transformer for 120 V. circuitry (3 ph. panels)
9. Alarm contacts in process and high limit controllers
10. FM approved flame safety relays
11. Combustion purge timer
12. All necessary fuses, terminal strips, wiring
13. Complete wiring schematic
14. Locking glass enclosure over instruments

## *Refractory Lining*

A 5" thick 2300° F. ceramic fiber lining is installed in the Thermal Oxidizer to keep the exterior surface at a safe temperature. The ceramic fiber material has a very low K value which means it is an excellent insulator (does not store or transfer heat readily). A ceramic throat is fitted within the Oxidizer at a specific location and is sized for velocity of 15 ft/sec. The combustion chamber is sized for 10 ft/sec.

## *Steel Construction*

All components are manufactured from heavy grades of hot rolled A-36 steel plate. Weldments are accomplished under an argon $CO_2$ purge to assure gas free homogeneous bonding of components. The Oxidizer is to be of a cylindrical design with flanged connections for maintenance purposes in the future. All components will be skid mounted on a heavy channel base with slots for forklift access.

## *Operating Temperatures*

Direct fired Oxidizers are designed to operate at 1450° F. (AQMD requires minimum 1400° F.) while the Catalytic units are designed to operate at 700° F. (at the entry to the Catalyst).

## *Residence Time for Vapors*

Our Oxidizers are designed for 1 full second of residence time. Los Angeles AQMD requires 0.7 seconds for Thermal Oxidizers.

## *Destruction Efficiencies*

Direct fired units have destruction efficiencies above 99% while the Catalytic units are advertised to have rates above 97%. We generally see higher than 97% destruction efficiency for Catalytic operation and we are still exceeding the criteria set forth by AQMD at 97% destruction.

# Options:

## *Catalytic "Plug In" Module*

Baker Furnace has developed a "plug in" Catalytic Module which can be installed in our existing direct fired Oxidizer with a minimum of effort. The catalyst inside the module is a monolithic material which significantly reduces the pressure drop across it and provides maximum surface area for the gasses which are to be catalyzed.

Each module is designed to fit down inside the Thermal Oxidizer chamber and bolt in place between the cone and stack section. Please refer to our enclosed drawing which shows the relationship of the Catalytic Module to the Thermal Oxidizer.

Once the Module is bolted in place, the only remaining task is to reduce the temperature setting on the process temperature and high limit controllers. The entire process to install the Catalytic Module should only take 1 – 2 hours.

The use of the Catalytic Module Option will greatly reduce supplemental fuel usage when the concentrations of VOC's are at low levels because the temperature requirement for a catalyst based system is approximately one-half that of a direct fired unit. The incoming vapors need only be heated to 700° prior to the catalyst versus 1450° in the direct fired unit. The delta T (change in temperature) is reduced by almost one-half, which results in a significant reduction in supplemental fuel usage.

Our Thermal Oxidation unit is configured with a "High Limit" temperature controller, as standard equipment, which will protect the catalyst in the event the catalytic process becomes overly exothermic and the temperature attempts to run away.

Baker Furnace can provide installation (on site) of the Catalytic Module at a nominal cost. Please refer to the charts provided with these specifications for supplemental fuel usage at various VOC concentrations for both Catalytic and Direct Fired Oxidizers to project the savings you might achieve by using the Catalytic Module.

## *Trailer*

We can mount the Oxidizer on a tandem axle trailer with a steel deck. Each oxidizer component is mounted securely with bolts, which allows the component to be removed for maintenance if required. The trailer is equipped with electric brakes and all lights necessary for licensing the unit for the road. Please refer to our general arrangement drawing #101212 for specific overall dimensions on the trailer. The trailer, as well as the Thermal Oxidizer, is painted with federal safety blue enamel.

## *Telemetry "Remote Monitoring" Fax System*

The Oxidizer can be equipped with a remote monitoring and reporting system which interfaces with the control instrumentation on the unit. This information can be faxed to a maximum of three locations. The IBM compatible operating software is extremely user friendly and allows you to select the destination of the fax reports, the number of reports you wish to receive each day, and the time of day at which you receive them. The fax reports are typically configured to show process combustion temperature, process air flow to the combustion chamber, and the percent of L.E.L. in the process vapor stream. In addition to the "routine" faxes, the system will also send an alarm fax in the event the unit shuts down for any reason. This report will specify which one of four failure conditions caused the unit to shut down. The addition of the telemetry system requires a dedicated phone line at the site and a fax machine at the receiving end.

### *Silence package*

If you anticipate installing the Oxidizer in an area where noise levels are a critical issue, i.e. residential area etc., the unit can be configured with a quiet design blower package. The blower inlet and exhaust silencers, as well as the blower itself are enclosed with a soundproofed material.

### *Vacuum Upgrade*

Our standard unit will generate a maximum of 4" hg vacuum. Per your specifications we can provide up to 10" hg vacuum in 2" increments. Proper vacuum sizing is very important to ensure that your unit can operate at the engineered flow rate.

### *High Water Level Shutoff/Pump*

If you believe that water will be a problem at the site(s) where you install the Oxidizer, we can install a shutoff switch in the knockout tank which will shut the Oxidizer down if the knockout tank fills up with water. In addition, we can also install a pump which will automatically drain the knockout tank if it fills up with water. Assuming appropriate secondary storage was in place, this process would only require your attention when the secondary holding tank filled up.

---

## Safety Interlocks and Safety Devices on Baker Thermal Oxidizers

### *Air Proving Switch*

Two U.L., FM and CSA approved air proving switches are provided to ascertain that the positive displacement vapor extraction blower and combustion blower are operational. In the event that either blower fails, the air proving switch will "open" the limits circuit thereby causing the unit to shut down the supplemental fuel line and to close the vapor line to the Oxidizer.

### *High/Low Gas Pressure Switch*

A U.L., FM and CSA approved gas pressure switch is provided in the supplemental fuel train which will also "open" the limits circuit in the event an unusually high or low gas pressure condition exists.

### *High Temperature Limit Controller*

A U.L. and FM approved high temperature limit controller has been engineered into the limits circuit to shut down the Oxidizer in the event a high temperature condition exists. The limit controller must be manually reset (per FM requirement) before the Oxidizer can be rendered operational. While in the high limit condition, the Oxidizer will not utilize supplemental fuel nor will vapors be allowed to enter the Oxidizer until the controller is manually reset.

## *FM Approved Flame Safety Device*

Our Thermal Oxidizers utilize a FM approved and U.L. recognized flame safety device which lights the combustion burner on the Thermal Oxidizer after a 60 second purge (5 air changes) of the combustion chamber. The burner has a 15 second ignition trial which lights pilot only. In the event the pilot does not light, the flame safety device locks out the supplemental fuel train thereby reducing the potential for an explosion. The main gas valve in the supplemental fuel train cannot open unless the pilot has been established. Flame monitoring is accomplished via a 3/16" diameter inconel flame rod.

## *L.E.L. Combustibles Sensor and Controller*

A catalytic bead L.E.L. sensor and controller have been integrated into the limits circuit. In the event that the alarm set point for L.E.L. has been exceeded, the L.E.L. controller "opens" the limits circuit which subsequently closes the vapor butterfly valve and temporarily shuts down the combustion burner until the L.E.L. returns to a safe level below the alarm setpoint.

## *Flame Arrester*

A U.L. approved flame arrester has been piped into the vapor extraction discharge line in close proximity to the Thermal Oxidizer. The flame arrester prevents propagation of flame back to the source.

## *FM Approved Supplemental Fuel Train*

A FM supplemental fuel train is provided with the Oxidizer and is fitted with an approved safety shut off valve for the main gas. The shut off valve will close in 0.3 seconds in the event of flame failure. The main gas valve is held shut with a 150 lb. force to assure a tight closure.

## *Oxygen Sensor and Proportional Dilution Valve*

A $O_2$ sensor and P.I.D. controller is provided to monitor oxygen content in the vapor stream. We require 18% oxygen (minimum) in the stream for sufficient combustion of volatiles. In the event the oxygen content of the vapor stream drops off significantly the $O_2$ controller opens a proportionally modulated butterfly valve and lets in dilution air to bring the oxygen content up to a satisfactory level.

## *Alarm Card in Process Temperature Controller*

We have integrated an alarm card into the process temperature controller to restrict the entry of volatiles into the Oxidizer until it reaches its correct operating temperature (1400° F.). This is accomplished by setting an alarm value equal to 1400 in the controller. When this value (in temperature) is reached, the process controller sends a signal to a butterfly valve drive motor which opens the valve and allows the vapor stream to enter the Oxidizer. Vapors cannot enter the Oxidizer at any temperature below which the alarm value has been set. This prevents the incomplete burning of hydrocarbons which occurs at lower operating temperatures.

# Catalytic Oxidizer

## BTU's/hr of Supplemental Fuel Required to Raise Air Temperature of Influent Vapor Stream from 100° F. to 700° F. at Various PPM VOC Concentrations

| PPM VOC'S | % LEL | AIR FLOW SCFM | | | | |
|---|---|---|---|---|---|---|
| | | 100 | 200 | 300 | 400 | 500 |
| 0 | 0 | 79,000 | 158,000 | 237,000 | 316,000 | 395,000 |
| 250 | 1.8 | 72,500 | 145,000 | 217,500 | 290,000 | 362,500 |
| 500 | 3.6 | 65,000 | 130,000 | 195,000 | 260,000 | 325,000 |
| 750 | 5.4 | 57,500 | 115,000 | 172,500 | 230,000 | 287,500 |
| 1000 | 7.3 | 52,500 | 105,000 | 157,500 | 210,000 | 262,500 |
| 1500 | 10.9 | 39,000 | 78,000 | 117,000 | 156,000 | 195,000 |
| 2000 | 14.5 | 25,000 | 50,000 | 75,000 | 100,000 | 125,000 |
| 2500 | 18.1 | 12,500 | 25,000 | 37,500 | 50,000 | 62,500 |
| 3000 | 21.7 | 0 | 0 | 0 | 0 | 0 |

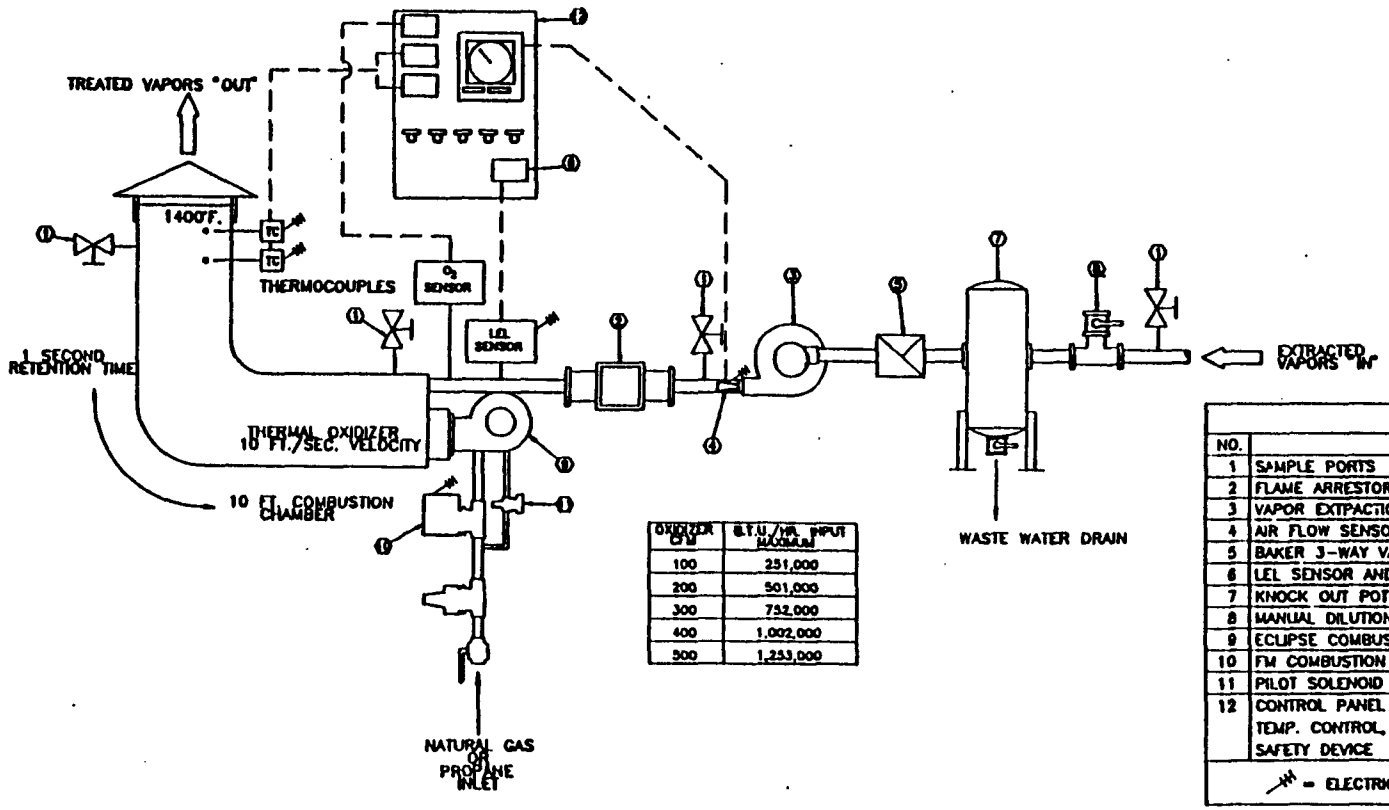
# Direct Fired Oxidizer

## BTU's/hr of Supplemental Fuel Required to Raise Air Temperature of Influent Vapor Stream from 100° F. to 1400° F. at Various PPM VOC Concentrations

250
370,000 410,000

| PPM VOC'S | % LEL | 300,000 AIR FLOW SCFM | | | | |
|---|---|---|---|---|---|---|
| | | 100 | 200 | 300 | 400 | 500 |
| 500 | 3.6 | 134,000 | 268,000 | 402,000 | 536,000 | 670,000 |
| 1000 | 7.3 | 120,000 | 240,000 | 360,000 | 480,000 | 600,000 |
| 1500 | 10.9 | 108,000 | 216,000 | 324,000 | 432,000 | 540,000 |
| 2000 | 14.5 | 92,500 | 185,000 | 277,500 | 370,000 | 462,500 |
| 2500 | 18.1 | 80,000 | 160,000 | 240,000 | 320,000 | 400,000 |
| 3000 | 21.7 | 67,500 | 135,000 | 202,500 | 270,000 | 337,500 |
| 3500 | 25.4 | 57,500 | 115,000 | 172,500 | 230,000 | 287,500 |
| 4000 | 29.0 | 40,000 | 80,000 | 120,000 | 160,000 | 200,000 |
| 4500 | 32.6 | 26,000 | 52,000 | 78,000 | 104,000 | 130,000 |
| 5000 | 36.2 | 14,000 | 28,000 | 42,000 | 56,000 | 70,000 |
| 5500 | 39.9 | - 0 - | - 0 - | - 0 - | - 0 - | - 0 - |
| 6000 | 43.5 | - 0 - | - 0 - | - 0 - | - 0 - | - 0 - |

# GENERAL ARRANGEMENT DRAWING




| OXIDIZER CFM | B.T.U./HR. INPUT MAXIMUM |
|---|---|
| 100 | 251,000 |
| 200 | 501,000 |
| 300 | 752,000 |
| 400 | 1,002,000 |
| 500 | 1,253,000 |

| LEGEND | |
|---|---|
| NO. | DESCRIPTION |
| 1 | SAMPLE PORTS |
| 2 | FLAME ARRESTOR |
| 3 | VAPOR EXTPACTION BLOWER |
| 4 | AIR FLOW SENSOR – SIGNAL TO CHART RECORDER |
| 5 | BAKER 3-WAY VALVING W/ PROPORTIONAL AIR DILUTION |
| 6 | LEL SENSOR AND LEL CONTROLLER WITH ALARM SETPOINT |
| 7 | KNOCK OUT POT WITH INTEGRAL SENSOR & OPTIONAL AUTO. PUMP |
| 8 | MANUAL DILUTION VALVE |
| 9 | ECLIPSE COMBUSTION BURNER & SUPPLEMENTAL BLOWER |
| 10 | FM COMBUSTION FUEL TRAIN |
| 11 | PILOT SOLENOID VALVE |
| 12 | CONTROL PANEL WITH CHART RECORDER, TEMP. CONTROL, OVER TEMP. CONTROL, AIR MONITOR, LEL AND FM APPROVED FLAME SAFETY DEVICE |
| | = ELECTRICAL SIGNAL = SAMPLE PORTS |

# THERMAL OXIDIZER PROCESS AND INSTRUMENTATION DIAGRAM

***Confidential***

**Cost Summary for**
**Implementation of Corrective Action Plan**
**Atoka-1 Compressor Station**

| Task Description | Cost |
|---|---|
| *File air permit* | |
| Professional services | $ 3,000 |
| Expenses | 1,300 |
| Subcontractors | 0 |
| Subtotal | $ 4,300 |
| *Prepare system design and specifications and select subcontractors* | |
| Professional services | $ 3,950 |
| Expenses | 150 |
| Subcontractors | 0 |
| Subtotal | $ 4,100 |
| *Construct SVE wells* | |
| Professional services | $ 6,200 |
| Expenses* | 1,400 |
| Subcontractors* | 23,450 |
| Subtotal | $ 31,050 |
| *Construct conveyance system and install equipment* | |
| Professional services | $ 7,500 |
| Expenses[1]* | 8,500 |
| Subcontractors* | 12,000 |
| Subtotal | $ 28,000 |
| Total direct cost | $ 67,450 |
| * Markup on third party services @ 10% | 2,190 |
| Project total | $ 69,640 |
| New Mexico gross receipts tax | 4,048 |
| **GRAND TOTAL** | **$ 73,688** |

[1] Excludes $48,000 cost for purchase of Baker Furnace.