Applied GeoSystems, Inc.
A RESNA Company

RESNA
Working To Restore Nature

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January 30, 1992
60000-12

Mr. Chuck Carmel
ARCO Products Company
P.O. Box 5811
San Mateo, California 94402

Subject: Transmittal of Addendum Two to Work Plan for Preliminary Design of a Vapor Extraction System at ARCO Station 771, 899 Rincon Avenue, Livermore, California.

Mr. Carmel:

As requested by ARCO Products Company (ARCO), RESNA Industries, Inc. (RESNA) (formerly Applied GeoSystems [AGS]) has prepared the attached Addendum Two to Work Plan for review, comment and approval by ARCO, the California Regional Water Quality Control Board (CRWQCB), the Alameda County Health Care Services Agency (ACHCSA), and the City of Livermore Fire Department (LFD). The original Work Plan for Subsurface Investigation and Remediation was submitted to ARCO, the CRWQCB, the ACHCSA and the LFD on May 17, 1991.

This Addendum Two to the above mentioned Work Plan summarizes previous work performed at the subject site, the preliminary design the proposed vapor extraction system (VES), RESNA's approach to work, and project tasks recommended to design, permit and install a VES for interim soil remediation at this site. The proposed work includes engineering design, permitting, construction, and startup of a VES at the subject site.

RESNA recommends that copies of this Addendum Two to Work Plan be submitted for review and approval to the following regulatory agencies:

Mr. Eddy So
Regional Water Quality Control Board
San Francisco Bay Region
2101 Webster Street, Suite 500
Oakland, California 94612

Ms. Susan Hugo
Alameda County Health Care Services Agency
Department of Environmental Health
80 Swan Way, Room 200
Oakland, California 94621

Ms. Danielle Stefani
Livermore Fire Department
4550 East Avenue
Livermore, California 94550

If you should have any questions or comments about this Addendum Two to Work Plan, please call us at (408) 264-7723.

Sincerely,
RESNA

Valli Voruganti
Project Engineer

Joel Coffman
Project Geologist

Joan E. Tiernan, Ph.D., P.E.
Engineering Manager

cc: Mr. H.C. Winsor, ARCO Products Company
Mr. Michael Hodges, RESNA

FEDERAL EXPRESS

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92 JAN 31 AM 10:05

TRANSMITTAL

TO: MS. SUSAN HUGO
ALAMEDA COUNTY HEALTH CARE SERVICES
DEPT OF ENVIRONMENTAL HEALTH
80 SWAN WAY, ROOM 200
OAKLAND, CALIFORNIA 94621

DATE: 1/30/92
PROJECT NUMBER: 60000.12
SUBJECT: ARCO STATION 771 AT 899 RINCON AVENUE, LIVERMORE, CALIF.

FROM: JOEL COFFMAN
TITLE: PROJECT GEOLOGIST

WE ARE SENDING YOU ☒ Attached ☐ Under separate cover via ________ the following items:

☐ Shop drawings ☐ Prints ☒ Reports ☐ Specifications

☐ Letters ☐ Change Orders ☐ ________

COPIES	DATED	NO.	DESCRIPTION
1	1/30/92		FINAL-ADDENDUM TWO TO WORK PLAN FOR
			PRELIMINARY DESIGN OF A VAPOR EXTRACTION
			SYSTEM AT THE ABOVE SUBJECT SITE.

THESE ARE TRANSMITTED as checked below:

☐ For review and comment ☐ Approved as submitted ☐ Resubmit ___ copies for approval

☐ As requested ☐ Approved as noted ☐ Submit___ copies for distribution

☐ For approval ☐ Return for corrections ☐ Return ___ corrected prints

☐ For your files ☐ ________

REMARKS: THIS ADDENDUM TWO TO THE WORK PLAN HAS BEEN FORWARDED TO YOU AT THE REQUEST OF MR. CHUCK CARMEL OF ARCO PRODUCTS COMPANY.

Copies: 1 to project file no. 60000.12

*Revision Date: 11/21/91
*File Name: TRANSMT.PRJ

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ADDENDUM TWO TO WORK PLAN FOR PRELIMINARY DESIGN OF A VAPOR EXTRACTION SYSTEM

at
ARCO Station 771
899 Rincon Avenue
Livermore, California

60000.12

Prepared for
ARCO Products Company
P.O. Box 5811
San Mateo, California 94402

by
RESNA Industries, Inc.

Valli Voruganti
Project Engineer

Joel Coffman
Project Geologist

REGISTERED PROFESSIONAL ENGINEER
JOAN E. TIERNAN
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Exp. 3-31-94
CIVIL
STATE OF CALIFORNIA

Joan E. Tiernan, Ph.D., P.E.
Engineering Manager

January 30, 1992

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ADDENDUM TWO TO WORK PLAN
for
PRELIMINARY DESIGN OF A VAPOR EXTRACTION SYSTEM
at
ARCO Station 771
899 Rincon Avenue
Livermore, California
for
ARCO Products Company

INTRODUCTION

As directed by Mr. Eddy P. So of the California Regional Water Quality Control Board (CRWQCB) and by Ms. Susan Hugo of the Alameda County Health Care Services Agency (ACHCSA) in a meeting with ARCO Products Company (ARCO), and RESNA Industries, Inc. (RESNA) personnel on January 17, 1992, RESNA has prepared this Addendum Two to Work Plan for **interim remediation** of onsite hydrocarbon-impacted soils at the above subject site. The original Work Plan for Subsurface Investigation and Remediation was submitted to the CRWQCB, the ACHCSA and the City of Livermore Fire Department (LFD) on May 17, 1991.

This Addendum Two to the above mentioned Work Plan summarizes previous work performed at the subject site, the preliminary design the proposed vapor extraction system (VES), RESNA's approach to work, and project tasks recommended to design, permit and install a VES for interim soil remediation at this site. The proposed work includes engineering design, permitting, construction, and startup of a VES at the subject site.

This Addendum Two has been prepared for review, comment and approval by the CRWQCB, the ACHCSA and the LFD, prior to installation and operation of the proposed VES. The subject site, ARCO Station 771 is located at the intersection of Pine Street and Rincon Avenue in Livermore, California as shown on the Site Vicinity Map, Plate 1. The location of the existing monitoring wells, station building, underground storage tanks (USTs) and other pertinent features are shown on Plate 2, the Generalized Site Plan.

PREVIOUS WORK

Waste Oil Tank Removal

In August 198[illegible] 240 gallon [illegible] containing waste-oil was removed from the site by Crosby and Overton Environmental Management, Inc. The tank pit was excavated to a depth of 10 feet and a soil sample was collected by Brown and Caldwell (B&C) for laboratory analyses. Results of soil analysis indicated 378 parts per million (ppm) total petroleum hydrocarbons (TPH) levels. Volatile organic compounds (VOCs), benzene, toluene, ethyl benzene and total xylene isomers (BTEX), and polychlorinated biphenyls (PCBs) were not detected above laboratory detection limits. B&C further excavated the tank pit and collected a soil sample from a depth of 12 feet. Hydrocarbons were not detected in the soil sample (B&C, September 1987).

Initial Subsurface Investigation

In February 1990, RESNA drilled and sampled three soil borings (B-1 through B-3) in the area adjacent to the four then existing USTs; T1, T2, T3 and T4, prior to ARCO's planned tank replacement at the site. The locations of the borings are shown on Plate 2. Groundwater was encountered at a depth of 33 feet below grade. Floating product was noted in boring B-1. Concentrations of total petroleum hydrocarbons reported as gasoline (TPHg) of 190 ppm was reported in soils at 32 feet below grade in B-3 (RESNA/AGS, June 1990). Summarized in Table 1 are the cumulative results of laboratory analysis of soil samples collected during this initial subsurface investigation and additional investigations conducted at later dates.

Installation of Groundwater Monitoring Wells

In December 1990, RESNA drilled three soil borings (B-4 through B-6) and installed three 4-inch diameter groundwater monitoring wells (MW-1 through MW-3) in each of the borings. Subsurface soils encountered consisted primarily of clayey to sandy gravels interbedded with some gravelly and sandy clays. Maximum TPHg soil concentration of 2,800 ppm was reported at 43 feet below grade in B-4 (Table 1). Groundwater was encountered within sandy gravels at a depth of 37 feet below grade. The groundwater gradient is interpreted to be to the north-northeast. Floating product was seen in MW-1 and MW-2, while MW-3 reported a TPHg concentration of 230 parts per billion (ppb) TPHg. On February 27, 1991, no free product was observed in MW-1 or MW-3, but 0.02 feet of free product was present in MW-2 (RESNA/AGS, April 12, 1991).

Monitoring well MW-1 continues to collect floating product; well MW-5 contains sheen, and well MW-2 contained floating product and sheen until it was reported to be dry on November 13, 1991. Floating product has been removed from MW-1 and MW-2 on a monthly basis since January 1991 and from MW-5 since August 1991, as shown on Table 2, Approximate Cumulative Product Removed. To date, a cumulative total of 2.6 gallons of floating product has been removed from the three onsite wells.

Subsurface Investigation

In June and July 1991, RESNA drilled five soil borings (B-7 through B-11), and constructed wells MW-4 through MW-7 in borings B-7 through B-10 (RESNA, October 1991). Results of this subsurface investigation indicated that the majority of TPHg at concentrations above 100 ppm in soils at the site appear to be located in the southern half of the site at depths between 32 and 43 feet below grade (Table 1). Detectable levels of TPHg were also reported in soils at depths greater than 43 feet below grade. Plate 4 shows the soil TPHg concentration contours for the site.

The extent of soil TPHg has not been delineated at the site with the exception of the northern portion of the property where soils from borings B-6 (MW-3), B-9 (MW-6), and B-11 contained trace to below laboratory detection limits of TPHg and BTEX. Soil samples from boring B-11 located in the former waste oil tank pit reported below laboratory detection limits of waste-oil related hydrocarbons.

Groundwater beneath the site has been impacted by gasoline hydrocarbons. The groundwater samples from monitoring wells MW-3, MW-4, MW-6 and MW-7 contain elevated concentrations of TPHg and BTEX, as summarized in Table 3, Cumulative

Laboratory Results of Groundwater Samples. The State Maximum Contaminant Level (MCL) for benzene and xylenes were exceeded in all wells, and for ethyl benzene in well MW-7. Toluene concentrations exceeded the State Recommended Action Level (AL) in all wells. The extent of gasoline hydrocarbons in groundwater at the site has not been delineated, and is likely to have migrated offsite.

Vapor Extraction Test

A vapor extraction test was conducted by RESNA on December 12, 1991. Five existing groundwater monitoring wells in the southern half of the site were tested. MW-4 was used as an extraction well, while MW-1, MW-2, MW-5, and MW-7 were used as observation wells. The locations of the wells are shown on Plate 4. The results indicated a highly porous soil, and a high average soil vapor TPHg concentration, with a range of 8,600 to 62,000 milligrams per cubic meter (mg/m^3). Tables 4 and 5 summarize field data collected and results of laboratory analysis of influent and effluent air samples collected during the VET.

RESNA concluded that vapor extraction is a practical and cost effective soil remediation alternative at this site. RESNA estimated that the approximate average initial TPHg concentration of the combined vapor-extraction wells to be about 8,000 parts per million by volume (ppmv). RESNA estimated an effective radius of influence of 30 to 40 feet for each well at an applied vacuum of 50 inches of water column and at a flow rate of 60 cubic feet per minute (cfm) from each vapor-extraction well, based on a one year operation of the proposed VES.

Product Tank Removal

The USTs containing gasoline (T1, T2 ,T3 and T4) were removed from the site, beginning December 28, 1991. This work was supervised by Roux Associates of Concord, California and performed by Golden West Builders of Walnut Creek, California. ARCO was granted approval to replace the USTs on January 17, 1992 in a meeting with CRWQCB, ACHCSA, ARCO and RESNA personnel. Approval was granted contingent upon ARCO submitting an Addendum Two, a preliminary design of the proposed VES at the site, and initiating design, installation and operation of the interim soil remediation system (the VES) upon receiving approval of the Addendum Two and upon approval of all state and local permits to construct and operate the VES. Plate 3 depicts the approximate location of the four new 10,000 gallon USTs to be installed.

On January 8, 1992, three Horner EZY Floating Product Skimmers were installed in monitoring wells MW-1, MW-2, and MW-5 as an interim remediation system.

Future Work

An Addendum Three to the Work Plan to install four offsite wells (B-12/MW-8, B-13/MW-9, B-14/MW-10, B-15/MW-11), an onsite vapor well (VW-1), a groundwater recovery well (RW-1), and to perform an aquifer pump and recovery test on RW-1, will be submitted in February 1992 to the CRWQCB and ACHCSA for approval. Plate 3 depicts the location of the proposed vapor well, the offsite monitoring wells and the groundwater recovery well. The investigation will assist further delineation of the lateral and vertical extent of hydrocarbon-impacted subsurface soils and groundwater, the groundwater gradient and direction, and the achievable capture zone and groundwater extraction rate.

DESCRIPTION OF PROPOSED INTERIM VAPOR EXTRACTION SYSTEM

The purpose of the proposed VES is to function as an interim soil remediation system at the present time. Upon installation and operation of the VES, the adequacy of the VES to remediate soils beneath the subject site to hydrocarbon concentration levels acceptable to the regulatory agencies involved in the closure of the site will be reassessed. Additional vapor wells if necessary will then be installed to remediate hydrocarbon-impacted soils.

Extraction Wells and Piping

Plate 5 shows the locations of the proposed vapor extraction system piping and the proposed location of the remediation compound. Based on the estimated effective radius of influence detailed above, and on the known lateral extent of impacted soils (Plate 4), the proposed interim VES will consist of five existing groundwater monitoring wells MW-1, MW-2, MW-4, MW-5, MW-7, and a proposed vapor extraction well VW-1. Well VW-1 is necessary to extract vapor from the central, downgradient part of the site. The additional 4-inch diameter vapor extraction well VW-1 will be screened 25 to 40 feet below grade to act primarily upon the hydrocarbon bearing soil, and to maximize the efficiency of the VES. This vapor well will be installed upon approval of Addendum Three to the Work Plan.

As shown on Plate 5, existing onsite wells MW-1, MW-2, MW-4, MW-5 and MW-7, and a proposed well VW-1, will be piped underground and will terminate at the off-gas abatement unit located in the remediation compound. Installation of subgrade piping will be conducted in conjunction with the ongoing tank replacement at the site. Two 4-inch diameter, Schedule 40 (Sch. 40), polyvinyl chloride (PVC) pipes will be installed as subgrade vapor and water conduits at a depth of about 24 inches below grade. The additional 4-inch conduit will serve as a double containment pipe for a water pipe and necessary air, electrical and bubbler lines for use with a groundwater remediation system which will be designed at a later date.

The wells used for vapor extraction will be equipped with a vacuum gage, a sample port, and a shut-off valve so that flow through each well can be adjusted to maximize the total pounds of petroleum hydrocarbons being extracted from the soil. This will also allow for easy expansion of the VES at a later date if assessment of VES operation indicates additional vapor extraction wells are necessary to remediate hydrocarbon-impacted soils. Well vaults with traffic rated covers will be installed at each vapor well.

Treatment Processes

System piping will direct extracted vapors from onsite soils to the off-gas abatement unit located at the remediation compound. Components of the VES located in the remediation compound will include: a vapor extraction blower that will extract vapor from the wells through the subgrade piping; a flow indicator that measures extracted flow; a condensate separator and a double contained condensate storage tank to remove any moisture in extracted vapor; a 500 cfm catalytic oxidizer; two 1,000 pound vapor phase activated carbon canisters; a set of associated piping, control valves, instrumentation and controls; a remote monitoring system to transmit operations and alarm status data; and a fenced remediation compound to preclude public access. Plate 6 depicts a process flow schematic of the proposed VES.

Based on ARCO's recommendation, a catalytic oxidizer will be used to treat the TPHg soil-vapors encountered at this site on vapor extraction (Table 5). The use of a catalytic oxidizer is dependent upon maintaining influent TPHg concentrations to the unit below 3,500 ppmv. The catalytic oxidizer will be able to use the influent hydrocarbon-bearing vapor, and the electric or gas fired preheater to preheat influent air by recovery of heat from the exhaust gases to achieve a lower supplemental fuel (electric or gas) cost. An operational advantage of using a catalytic oxidizer is that the operating temperature, the supplementary fuel required, and bleed air, is adjusted by an automatic control system. This control system will enable the unit to operate with a minimum of adjustment and maintenance. Enclosed in Appendix A are typical manufacturer's specifications for the recommended 500 cfm catalytic oxidizer units, with gas or electric fired preheaters. Either the King, Buck & Associates, Inc. MultiMode™ Combuster (MMC), Model MMC-8A, 500 cfm CatOx w/gas-fired preheater, or an equivalent ORS Environmental Equipment Catalytic Scavenger™ Vapor Abatement System, 500 cfm unit with an electrical fired preheater will be used at this site. The type of catalytic oxidizer unit to be used and the associated vapor extraction blower will be determined during the design phase of this interim RAP. The recommended unit will meet the Bay Area Air Quality Management District's (BAAQMD) off-gas emission limits of 15 pounds volatiles per day (lbs volatiles/day), 1 lb/day of benzene and a cancer risk value of 1 x 10^{-6} for exposure to benzene emissions.

Typical destruction efficiency per manufacturer's specifications averages 98% and above for petroleum hydrocarbons at an operating temperature of 650 to 950 degrees Fahrenheit. The maximum influent hydrocarbon vapor concentrations to the catalytic oxidizer, per manufacturer's specifications, is approximately 25 percent of the Lower Explosive Limit (LEL); i.e., 3,500 ppmv TPHg (15,615 mg/m^3). RESNA used a molecular weight of 100 for gasoline when converting vapor concentrations in mg/m^3 to equivalent concentrations in ppmv. To meet the maximum influent hydrocarbon vapor concentration the catalytic oxidizer can handle (3,500 ppmv TPHg), the unit will automatically dilute the incoming extracted vapor from onsite vapor extraction wells with fresh air. Thus the flow from each well will be reduced to meet the 3,500 ppmv TPHg influent concentration limit of the catalytic oxidizer. The emission rate calculations attached in Appendix C and discussed in the next section, describe how the TPHg concentration in the extracted vapor will be reduced. The TPHg concentration of the combined extracted hydrocarbon-bearing vapors will be monitored at the remediation compound. Valves in the vapor extraction piping can be adjusted to change the extraction rate from the individual wells to maximize the rate at which hydrocarbons are removed from the soil. The initial high influent TPHg concentration in extracted vapor will decrease with ongoing VES operation (typically 90% after the first three to four months of operation).

The off-gas treatment system will be modified as shown on Plate 6 to an activated carbon adsorption system or an ambient venting system when the hydrocarbon concentrations of the vapor approach 50 - 100 ppmv. It is estimated, based on soil volume and average TPHg concentrations, that this threshold value will be reached after about the first twelve months of VES operation. The estimated duration of operation of twelve months for the catalytic oxidizer does account for the unit operating at lower flows to maintain influent TPHg concentrations within the recommended unit's capacity (3,500 ppmv) and within BAAQMD emission limits. The catalytic oxidizer will continue to run if this threshold value is not reached in twelve months, or it may be shut down sooner, if the threshold value is reached sooner. The VES will still continue running if remediation of offsite soils is needed.

The activated carbon adsorption system will consist of two in-series 1,000 pound activated vapor phase carbon canisters. Enclosed in Appendix B are manufacturer's specifications on the vapor phase carbon likely to be used. Carbon vessels to be used will be Sun-Ag, Inc. mild steel construction vessels filled with 1,000 pounds of West-States, Inc. "Vapor-Carb", or equivalent. Either the catalytic oxidizer or the vapor-phase carbon canisters will serve as an off-gas abatement device, if needed, when the groundwater treatment system is brought on line at a later date.

Emission Rate Calculations

Emission rate calculations conducted for average system startup benzene and TPHg concentrations are enclosed in Appendix C. The approximate average startup emission rates, after abatement, for TPHg and benzene at a total flow rate of 500 cfm with fresh air dilution while on a 24-hour operation, are 14 and 0.29 pounds per day (lbs/day), respectively. These concentrations will decrease with continued system operation.

Spill Prevention Plan

As a part of spill prevention and containment (safety measures), the catalytic oxidizer will be equipped with; a low and a high temperature shutdown; continuous temperature measuring instrumentation consisting of at least two thermocouple probes at the inlet in event one shall fail; a strip chart recorder for continuous temperature recording; a flash back flame arrestor; a fuel high and low pressure system shutdown switch; and a low pressure switch and indicator influent to the blower to shut the VES off in event of blower failure. These safety features will ensure that the catalytic oxidizer will never operate under conditions of low temperatures thus lowering system destruction efficiency, under high temperature runaway conditions resulting in melt-down of the catalyst and in creating an explosive atmosphere; and when no air flow exists. A remote monitoring system will be installed to continuously monitor and periodically report the process variables which can influence the systems' performance and cause an alarm or shut-down condition. When any of these conditions are triggered the remote monitoring system will notify RESNA's San Jose office personnel by facsimile so that the condition can be rectified prior to system restart. Any system failure causing a violation of the BAAQMD permit will be reported immediately to the BAAQMD and a written report will be filed with BAAQMD within five working days of any such release.

Spill prevention measures when the vapor phase carbon system is brought on-line will include: a pressure indicator installed on the first carbon canister to prevent over-pressurizing the carbon canisters; a low pressure switch and indicator influent to the blower to shut the VES off in event of blower failure; two high temperature switches for prevention of explosive conditions; and a remote monitoring system to continuously monitor and periodically report the process variables which can influence the systems' performance and cause an alarm or shut-down condition. When any alarm conditions are triggered the remote monitoring system will notify RESNA's San Jose office personnel by facsimile so the condition can be rectified prior to system restart.

Additional spill prevention measures will include; a double containment pallet for the condensate knockout drum; a double contained condensate storage tank; and high level indicators in the double containment pallet and drum to shut the VES down thus preventing spillage.

PROPOSED SCOPE OF WORK

Based on the results of previous subsurface investigations, RESNA proposes the following project Tasks 1 through 8 listed below, as a method of approach to design and permit the VES described above. These tasks outlined below are described in detail in ensuing sections:

o	Task 1.	Interim Remedial Action Plan
o	Task 2.	Design of Plans and Specifications
o	Task 3.	Building and Discharge Permits
o	Task 4.	Bid Package and Evaluation
o	Task 5.	Equipment Procurement
o	Task 6.	Construction and Construction Inspection
o	Task 7.	System Startup and Operation
o	Task 8.	System Startup Report (Performance Evaluation)

Task 1. Interim Remedial Action Plan

As requested by the RWQCB and ACHCSA in their meeting with ARCO and RESNA personnel on January 17, 1992, RESNA will submit this Interim Remedial Action Plan, Addendum Two to the Work Plan for the preliminary design of a VES at this site for review and approval by January 31, 1992. This Addendum Two describes the proposed interim soil remedial action to be implemented including the design, construction, and proposed operation, maintenance and monitoring of the interim VES (discussed under Task 8) to be installed at this site. A preliminary schedule of work, including a construction schedule, is presented at the end of this report. Engineering drawings are included as appropriate. A brief description of previous work is also included. This Addendum Two to Work Plan will need to be approved by the ACHCSA and RWQCB, prior to installation of the proposed remediation system.

Task 2. Design of Plans and Specifications

This phase of the proposed scope of work will include: engineering calculations; specification and list of equipment, materials and instrumentation; preparation of Plans and Specifications including site and remediation compound layouts, trench and section details, process and instrumentation diagram (P&ID) and a one line electrical diagram; in-house plan check and review; one set of revisions to the Plans and Specifications by ARCO; and one by the City of Livermore Building Department. Also under this task, RESNA personnel will meet with Pacific Gas & Electric Company (PG & E) and City of Livermore personnel to discuss electrical service requirements, natural gas hookup, take site measurements and other City requirements. Under this phase of work after determining electrical and natural gas service availability, the vapor extraction blower and the off-gas abatement unit (either the King, Buck & Associates, Model MMC-8A unit or the ORS Environmental Catalytic Scavenger™ Vapor Abatement Unit) will be sized, selected and permitted.

Task 3. Building and Discharge Permits

An Authority to Construct/Permit to Operate application will be completed and submitted to the BAAQMD to allow for construction and installation of the proposed interim VES. The application will include a site history, VES specifications, and analytical results for known and suspected pollutants.

The complete set of Plans and Specifications will also be submitted to the City of Livermore Building, Planning and Fire Departments for review, comment and approval prior to construction and installation of the interim VES. As a part of the permit approval process, the City Building Department will inspect all open utility trenches carrying water and vapor lines prior to their closure and tie-in to the aboveground interim VES. A Potentially Hazardous Waste Storage Permit for onsite storage of the condensate collected in the condensate separator will also be required by the Fire Department. One set of revisions to the permits to incorporate regulatory agency comments is planned.

Task 4. Bid Package and Bid Evaluation

After the design is completed, a bid package will be prepared for submittal to construction contractors for installation of the proposed interim VES. A minimum of three pre-qualified contractors will receive the bid package. One meeting with each contractor is included in the scope of work, as well as time to answer contractor questions and assist them in preparation of their bids. This will not be a publicly advertised Bid Period with sealed bids. Contractor bids will be evaluated and recommendations made for Award of Contract.

Task 5. Equipment Procurement

After engineering design is completed, permits have been obtained, and a contractor selected, RESNA will then provide ARCO with a list of long-lead time capital equipment (greater than 4 weeks) to be ordered. Either ARCO or RESNA will directly order the equipment from the vendor. Possible capital equipment to be ordered include the catalytic oxidizer, vapor extraction blower, and vapor phase carbon. Other equipment including process equipment (valves, pipes, etc), and instrumentation will be purchased by the contractor.

Task 6. Construction and Construction Inspection

Upon approval of the Addendum Two to Work Plan, after having secured the City Building, Fire and Planning Department Permits, after selection of a general contractor, and after equipment procurement, system installation in accordance with the approved Plans and Specifications will be initiated. This phase of the work will include: construction of utility trenches to contain all necessary water, vapor, gas, and electrical lines; installation of necessary underground pipes and electrical conduits to and from the proposed treatment compound; pressure testing of lines for leaks; City inspection of utility trenches prior to closure; construction of the remediation compound; electrical service and natural gas hookup; and installation and plumbing of all soil remediation equipment including electrical and other instrumentation.

Construction of the remediation system will be conducted in two phases to speed up interim VES installation. During the design phase in conjunction with currently ongoing tank replacement all subsurface vapor collection piping will be installed. After design of the VES is completed, and process permits have been obtained, construction of the remediation compound and installation of the VES will begin.

During the first phase of construction, RESNA personnel will direct contractors (Golden West and Roux Associates) in construction of the subsurface piping for the VES during the ongoing tank removal and replacement at the site. Work will include three site visits to determine location of subgrade piping, location of remediation compound that piping will terminate to, size and amount of piping required, and one meeting with regulators to coordinate subsurface piping installation. During the second phase of construction, process equipment, electrical and instrumentation will be installed after Plans and Specifications are completed and all process permits have been obtained. Construction inspection will be conducted to ensure that the VES is constructed in accordance with the approved Plans and Specifications.

Task 7. System Startup and Operation

This section and the ensuing sections detail a monitoring plan to verify the effectiveness of the proposed interim VES at this site as requested by Ms. Susan Hugo of the ACHCSA in a January 7, 1992 letter addressed to ARCO.

System Monitoring

After completion of system installation, operation of the proposed interim VES will be initiated in compliance with all applicable regulatory agencies. Startup procedures will include system monitoring, maintenance and sampling for the first five days of operation. Operation and maintenance of the VES as described above, typically include: daily site inspections the first five days of operation; and site visits once every week for the first month. After the first months of operation, site visits will be made at a minimum once every two weeks for the remainder of the life of the remediation system. Modifications to this typical schedule will be made if additional requirements are specified by the guidelines set forth by the BAAQMD in the Authority to Construct/Permit to Operate for this site, and as necessary.

Site inspections will include: monitoring and adjustment of systems parameters to optimize VES system efficiency; periodic sampling and field monitoring of influent and effluent as required by the BAAQMD; other periodic maintenance procedures including inspection and cleaning of all lines, process equipment, ensuring that the continuous measuring temperature and recording instrumentation are functional, etc. Parameters monitored and adjusted in the field will include: field measurement of vapor extraction flowrates, induced vacuum responses at onsite wells, and hydrocarbon vapor concentrations with an organic vapor monitor approved by the BAAQMD, to ensure that an adequate radius of influence is being achieved, and that BAAQMD emission requirements are being met.

A remote monitoring system will be installed to continuously monitor and periodically report the process variables which can influence the systems' performance and cause an alarm condition. The monitoring system will also notify RESNA's San Jose office when an alarm condition exists so that the condition can be rectified prior to restart of the system.

System Sampling

Typical BAAQMD guidelines require that during the startup phase, influent and effluent air samples to the VES will be taken daily for the first three days of operation to demonstrate system efficiency, and every two weeks thereafter for the next one month after which sample collection will be performed once every month for the life of the remediation system. With the exception of influent and effluent air samples collected and analyzed as detailed above, during the first two days of operation and later on a biweekly and monthly basis, all other sampling of the VES will be conducted using a field volatile organic compound monitoring instrument approved by the BAAQMD. If at any time the results of laboratory analyses or field monitoring readings show emission limits to be exceeded, a confirmation air sample will be taken immediately and analyzed on a 24 hour turnaround basis. If emission limits are still exceeded, the system will be shut down and any necessary corrective action will be performed before repeating the startup sequence. BAAQMD will be notified that emission limits were exceeded within 24 hours of such indication.

The off-gas treatment system will be modified to an activated carbon adsorption system (two, in-series 1,000 pound activated vapor phase carbon canisters) when the hydrocarbon concentrations of the vapor approach 50 ppmv. Typical BAAQMD guidelines require that extracted vapors influent to and effluent from the carbon system will be monitored with a field instrument approved by the BAAQMD on a daily basis for the first five days of operation to determine frequency of carbon changeout required. Influent and effluent vapor samples to the carbon canisters will be collected once during the five days of operation to verify field data collected. System monitoring frequency will be changed to once every two weeks with a field instrument and monthly verification with bag samples upon receiving BAAQMD approval.

Task 8. System Startup Report (Performance Evaluation)

An initial startup report will be prepared and submitted to ARCO, RWQCB, ACHCSA, and BAAQMD within one month of system startup per BAAQMD's reporting requirements. This report may include the following: hours of operation; system influent and effluent field monitoring readings collected; temperature record strip charts that show a continuous measurement of inlet temperature; laboratory results of influent and effluent air samples collected and analyzed; total and individual vapor extraction well flow rates; induced vacuum responses recorded in observation wells; all other relevant field data collected; and results obtained such as observed radius of influence, system destruction efficiency, etc. Recommendations will then be made to further optimize system performance and expedite remediation of subsurface impacted soils. Recommendations may include tie-in of additional vapor extraction wells to the remediation system, upgrading of the off-gas abatement unit, etc. Thereafter monthly reports detailing all field data collected and results, as well as recommendations if needed, as described above, will be submitted for the life of the remediation system.

SCHEDULE OF OPERATIONS

Plate 7 shows the preliminary time schedule to complete Tasks 1 through 8 as requested by Ms. Susan Hugo of the ACHCSA in a January 7, 1992 letter addressed to ARCO. The time frames for the appropriate regulatory agencies to review and approve the RAP, permits, and construction Plans and Specifications are also estimated in the schedule. The permitting time frame is expected to take about as long as the engineering time frame. This preliminary time schedule will be delayed, if review of the Addendum Two to Work Plan is delayed or, if after review of the addendum, the regulatory agencies involved have comments and require a resubmittal of a revised addendum, if a resubmission of the BAAQMD air permit application is necessary due to any design changes, if long-lead equipment cannot be delivered within the estimated timeframe, if system installation gets delayed due to inclement weather, negotiations with lessor, and delays in utility installation. The estimated schedule also assumes that results of the offsite investigation will not impact onsite soil remediation.

The schedule assumes that soil remediation with the catalytic oxidizer can be completed in one year, if no offsite wells are needed to complete remediation; and no significant equipment breakdowns occur. The progress and expected duration of the soil cleanup is dependent on physical factors such as: fluctuating groundwater levels both naturally and/or artificially induced (pumping of other wells near the site), and the correlation of data from specific points (wells and borings) with the actual conditions across the site. Fluctuating groundwater levels in onsite wells may decrease the effective screen available to vent from and hence reduce the effectiveness of the VES. Operation of the groundwater remediation system may then be necessary to drawdown the water table thus exposing the hydrocarbon-impacted soils. Duration of cleanup can be more accurately predicated after a performance evaluation of the VES system has been completed.

The schedule assumes that the performance evaluation will show that the remediation system will effectively remove hydrocarbons from areas of impacted soil and will reduce extracted concentrations significantly over time. It also assumes that additional on or offsite vapor extraction wells are not required to effectively remediate impacted areas, once the treatment system is operational. Installation of additional wells will require submittal of a work plan to regulatory agencies (approved typically in one month), well permits to install wells (two weeks), and installation and tie in of wells to the existing VES (two weeks).

To verify cleanup of previously impacted soil, verification borings will be drilled and samples collected and analyzed to show that the soil has been remediated below currently known State cleanup levels. Site closure for soils will be initiated in conjunction with closure for onsite groundwater; i.e., after completion of the installation and operation of the groundwater remediation system.

LIST OF REFERENCES CITED

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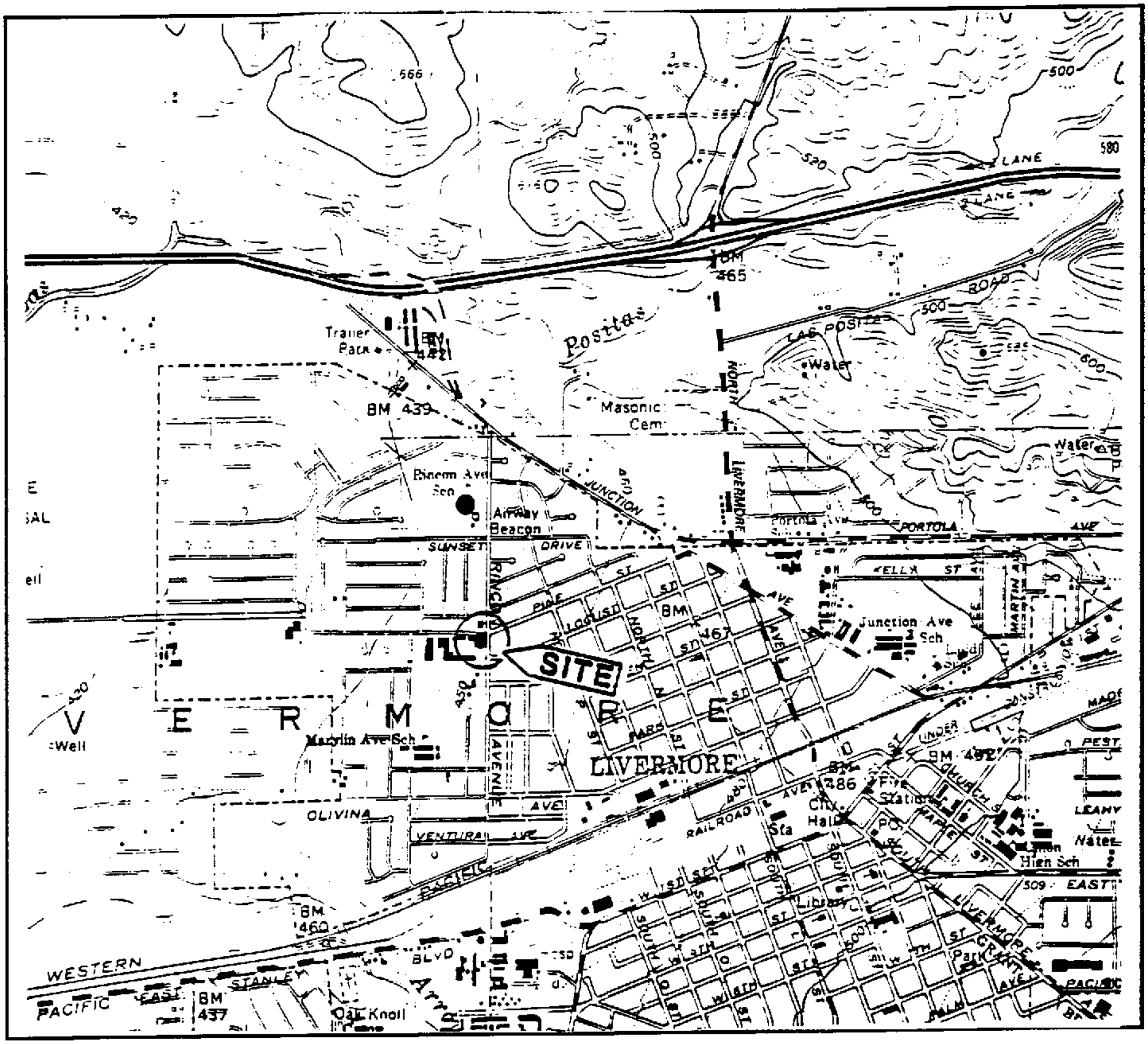
RESNA. October 21, 1991. Additional Environmental Investigation at ARCO Station 771, 899 Rincon Avenue, Livermore, California. 60000.06

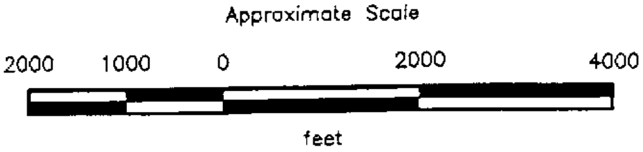
RESNA/Applied GeoSystems. January 1992. Vapor Extraction Test at the ARCO Service Station No 771, 899 Rincon Avenue, livermore, California. 60000.07



Base: U.S. Geological Survey
7.5–Minute Quadrangle
Livermore, California
Photorevised 1980

LEGEND

(●) = Site Location



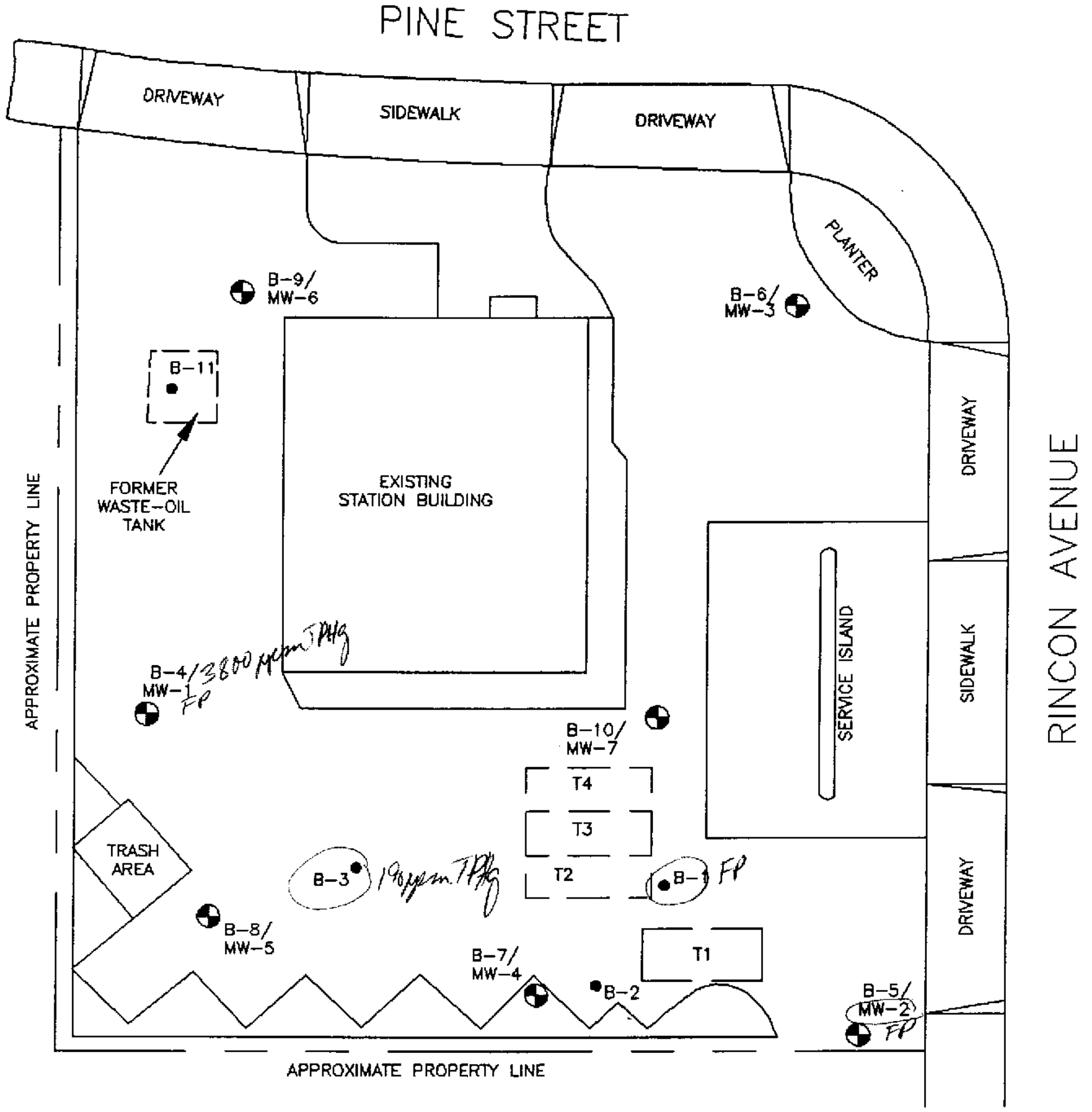
RESNA

PROJECT 60000.12

SITE VICINITY MAP
ARCO Station 771
899 Rincon Avenue
Livermore, California

PLATE

1

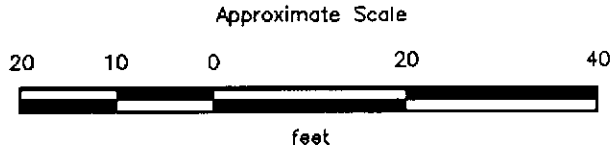


EXPLANATION

B-10/ MW-7 ◐ = Monitoring well (RESNA, December 1990 and June and July 1991)

B-11● = Soil boring (RESNA, February 1990 and July 1991)

T4 = Former underground gasoline-storage tank



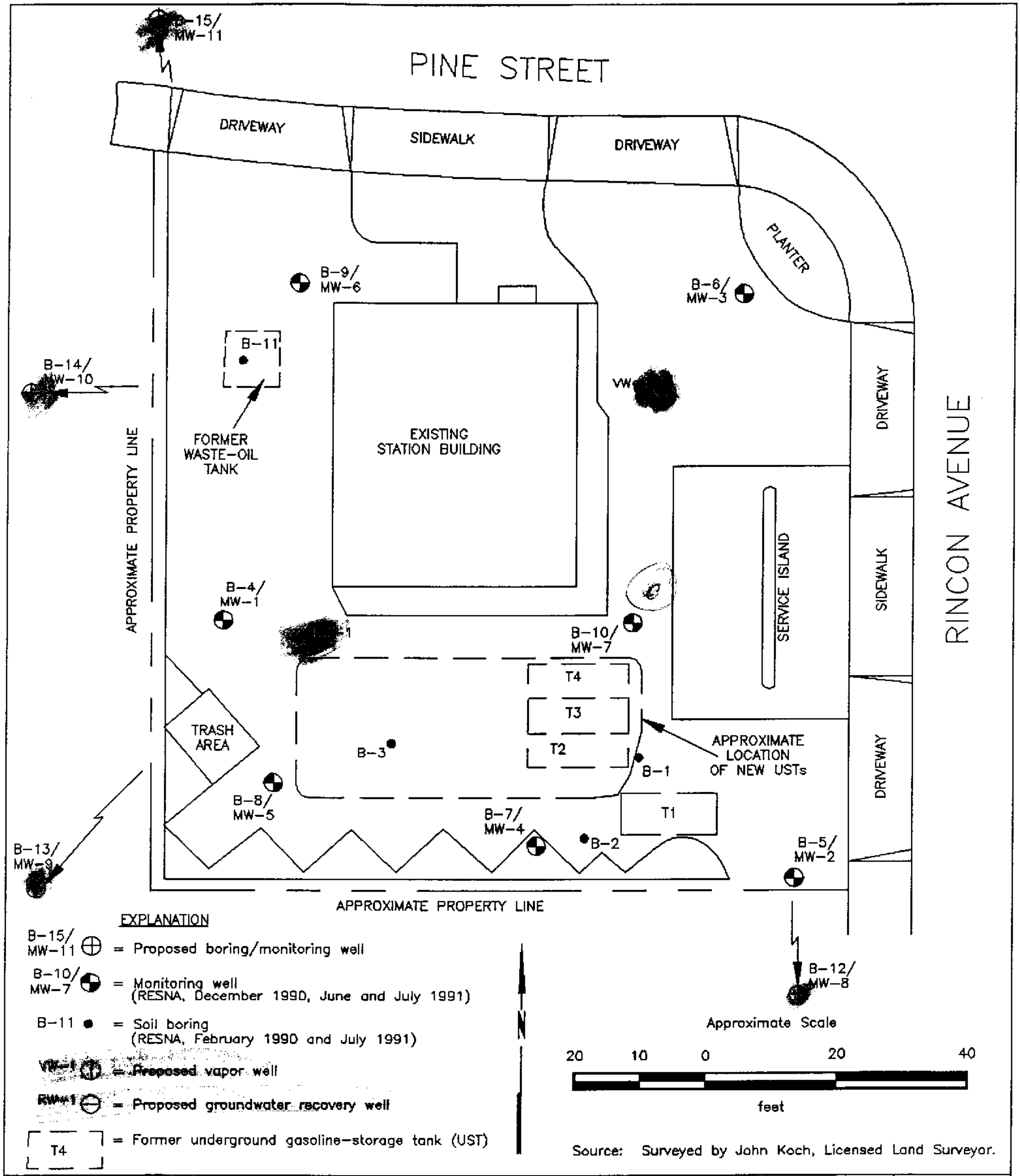
Source: Surveyed by John Koch, Licensed Land Surveyor.

RESNA

PROJECT 60000.12

GENERALIZED SITE PLAN
ARCO Station 771
899 Rincon Avenue
Livermore, California

PLATE
2

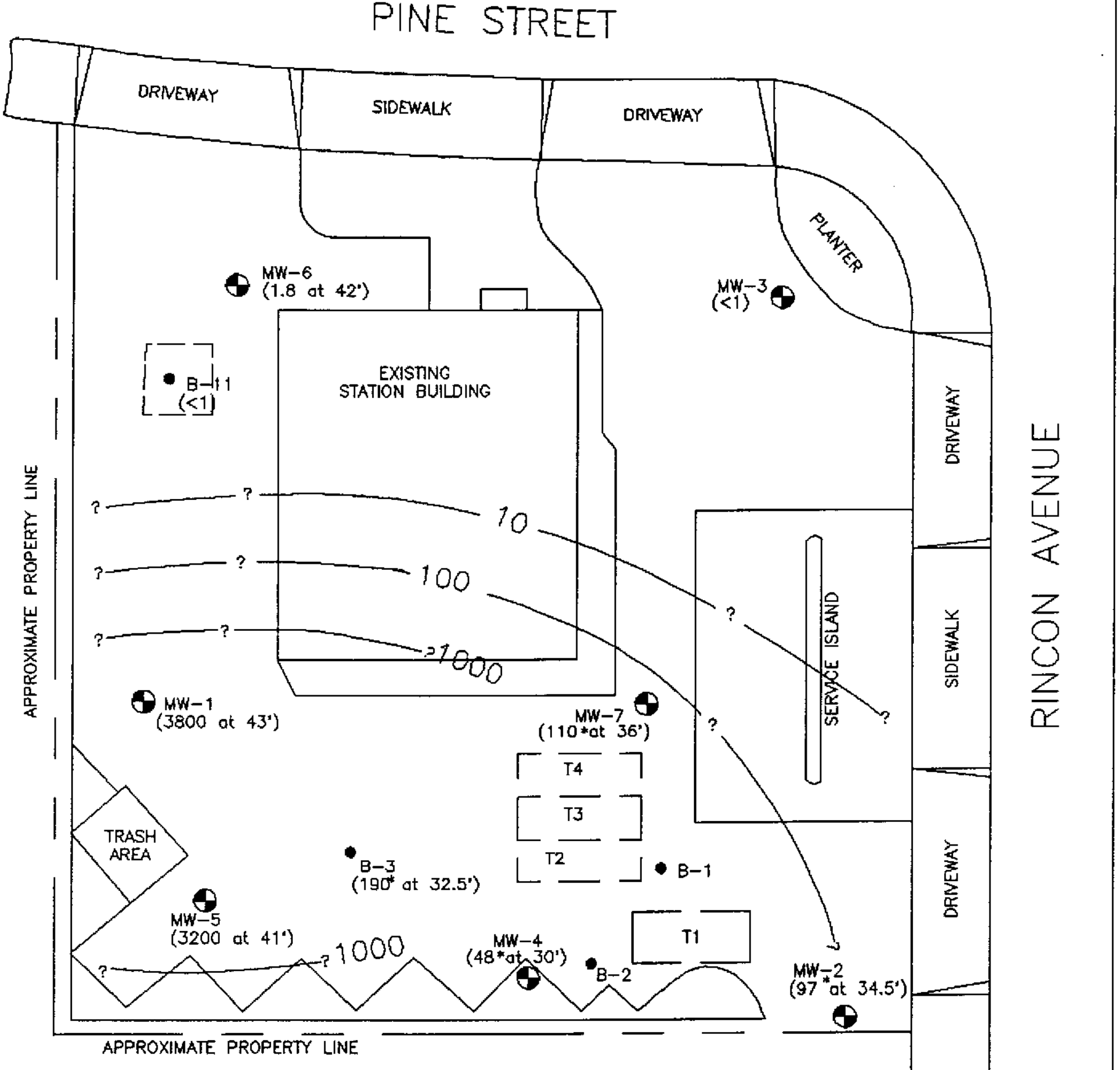


RESNA

PROJECT 60000.12

**PROPOSED BORING/
MONITORING WELL LOCATIONS
ARCO Station 771
899 Rincon Avenue
Livermore, California**

**PLATE
3**



EXPLANATION

1000 = Line of equal concentration of TPHg in soil, in ppm

3800 = Concentration of TPHg in soil in ppm, at stated depth, 1990, 1991

B-11 ● = Soil boring (RESNA, February 1990 and July 1991)

MW-7 ⊕ = Monitoring well (RESNA, December 1990 and June and July 1991)

T4 = Former underground gasoline-storage tank

* = Concentration may be greater at 42 feet, but boring drilled to shallower depth

N

Approximate Scale

20 10 0 20 40

feet

Source: Surveyed by John Koch, Licensed Land Surveyor.

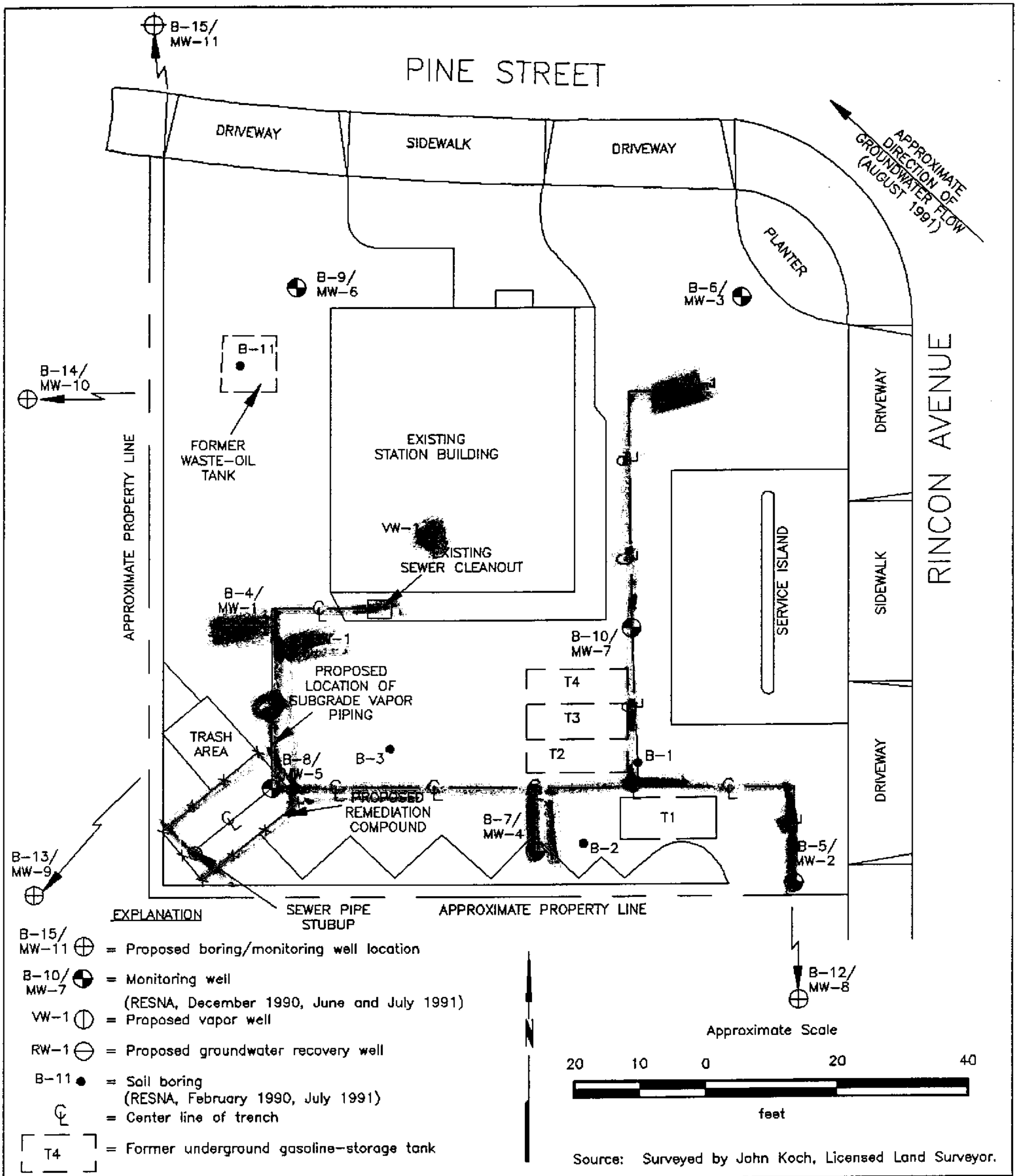
RESNA

PROJECT 60000.12

TPHg CONCENTRATIONS IN SOIL
At 30 to 43 feet Depth
ARCO Station 771

899 Rincon Avenue
Livermore, California

PLATE
4



EXPLANATION

B-15/MW-11 ⊕ = Proposed boring/monitoring well location

B-10/MW-7 ◐ = Monitoring well
(RESNA, December 1990, June and July 1991)

VW-1 ⦶ = Proposed vapor well

RW-1 ⊖ = Proposed groundwater recovery well

B-11 ● = Soil boring
(RESNA, February 1990, July 1991)

℄ = Center line of trench

T4 = Former underground gasoline-storage tank

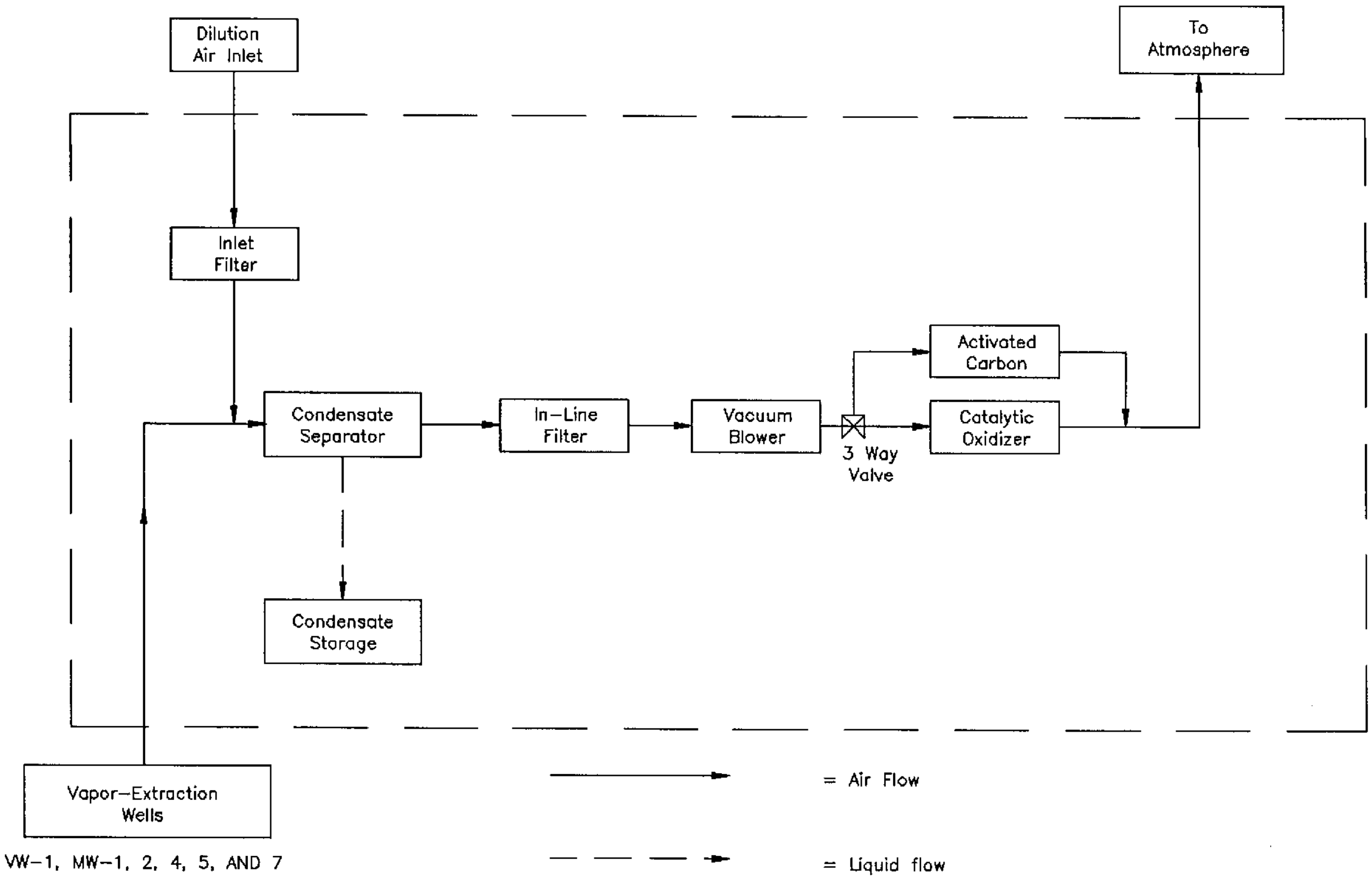
Source: Surveyed by John Koch, Licensed Land Surveyor.

RESNA

PROJECT 60000.12

**PROPOSED REMEDIATION SITE PLAN
ARCO Station 771
899 Rincon Avenue
Livermore, California**

**PLATE
5**



PLATE

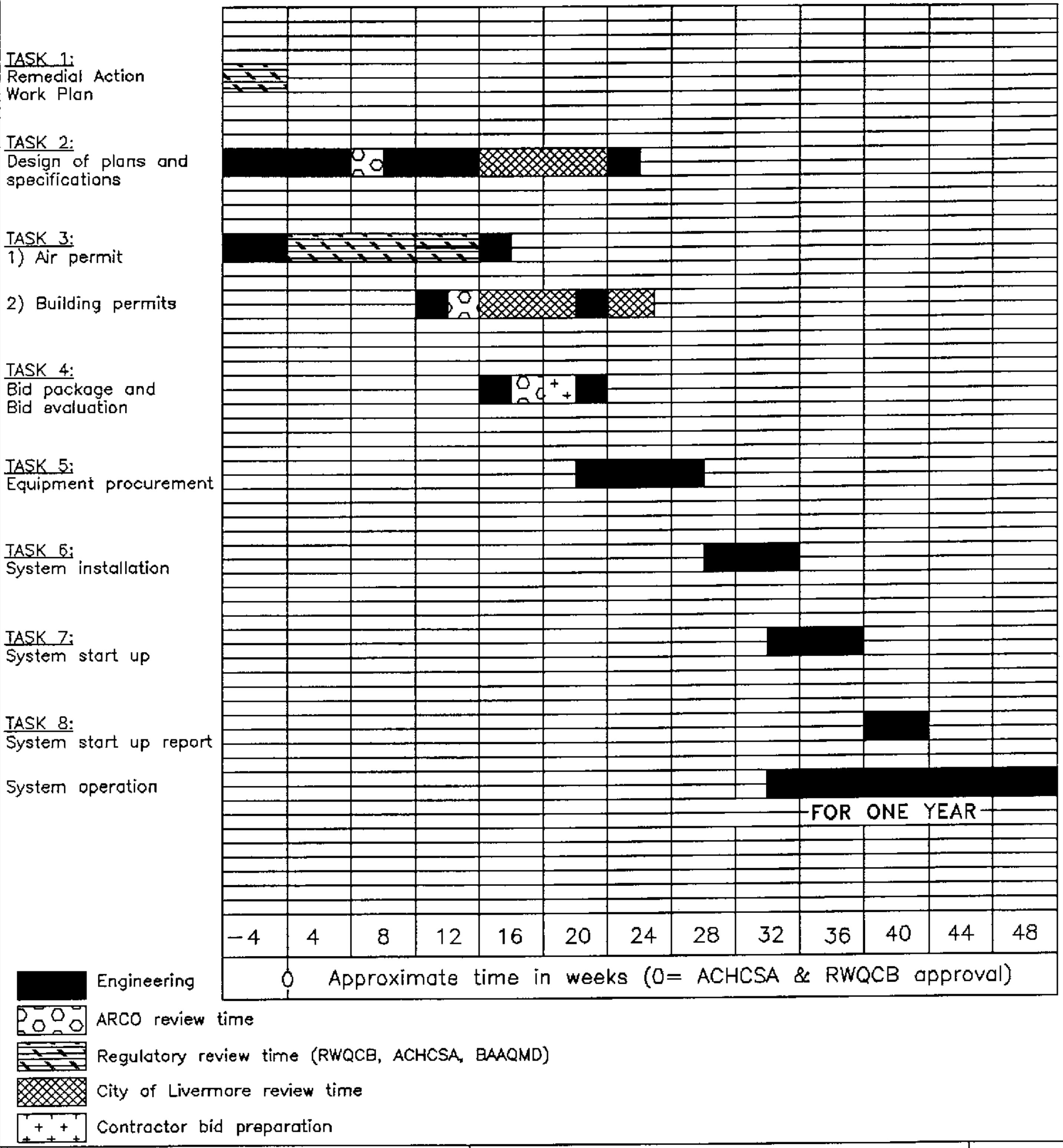
6

PROCESS FLOW DIAGRAM

ARCO Station 771
899 Rincon Avenue
Livermore, California

RESNA

PROJECT **60000.12**



RESNA

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PRELIMINARY TIME SCHEDULE
ARCO Station 771
899 Rincon Avenue
Livermore, California

PLATE

7

TABLE 1
CUMULATIVE RESULTS OF LABORATORY ANALYSES OF SOIL SAMPLES
ARCO Station 771
Livermore, California
(page 1 of 3)

Sample Identification	TPHg	TPHd	B	T	E	X	TOG
February 1990							
S-10-B1	<1.0	NA	<0.005	<0.005	<0.005	<0.005	NA
S-19.5-B1	<1.0	NA	0.022	0.024	<0.005	0.022	NA
S-24.5-B1	<1.0	NA	0.022	0.015	0.010	0.048	NA
S-29.5-B1	<1.0	NA	<0.005	<0.005	<0.005	<0.005	NA
S-10-B2	<1.0	NA	<0.005	<0.005	<0.005	<0.005	NA
S-20-B2	<1.0	NA	0.016	0.020	<0.005	0.025	NA
S-25-B2	1.4	NA	<0.01	<0.01	<0.01	0.018	NA
S-31-B2	<1.0	NA	<0.005	<0.005	<0.005	<0.005	NA
S-10-B3	<1.0	NA	<0.005	<0.005	<0.005	<0.005	NA
S-19.5-B3	<1.0	NA	0.028	<0.005	<0.005	0.017	NA
S-25-B3	4.5	NA	0.047	<0.01	0.011	0.038	NA
S-32.5-B3	190	NA	<1.0	<1.0	<1.0	1.7	NA
December 1990							
S-20-B4	<1.0	NA	0.006	<0.005	<0.005	<0.005	NA
S-30-B4	<1.0	NA	<0.005	<0.005	<0.005	<0.005	NA
S-32-1/2-B4	<1.0	NA	<0.005	<0.005	<0.005	<0.005	NA
S-36-1/2-B4	140	NA	<0.15	0.80	1.7	4.2	NA
S-43-B4	3,800	NA	<1.5	130	50	280	NA
S-45-1/2-B4	5.5	NA	0.16	0.51	0.11	0.82	NA
S-20-B5	<1.0	NA	0.068	0.013	0.009	0.026	NA
S-30-B5	<1.0	NA	<0.005	<0.005	<0.005	<0.005	NA
S-34-1/2-B5	97	NA	<0.005	0.13	0.087	0.22	NA
S-39-1/2-B5	13	NA	0.15	0.66	0.16	1.5	NA
S-45-B5	<1.0	NA	<0.005	0.006	<0.005	0.009	NA
S-20-B6	<1.0	NA	<0.005	<0.005	<0.005	<0.005	NA
S-30-B6	<1.0	NA	<0.005	<0.005	<0.005	<0.005	NA
S-36-1/2-B6	<1.0	NA	<0.005	<0.005	<0.005	0.006	NA
S-41-B6	<1.0	NA	<0.005	<0.005	<0.005	<0.005	NA
S-44-1/2-B6	<1.0	NA	<0.005	<0.005	<0.005	<0.005	NA
S-011591-1ABCD*	31	NA	0.25	0.67	0.34	2.8	NA
June, July 1991							
S-10-B7	<1.0	NA	<0.005	<0.005	<0.005	<0.005	NA
S-20-B7	2.2	NA	0.074	0.12	0.061	0.43	NA
S-25-B7	<1.0	NA	<0.005	<0.005	<0.005	<0.005	NA
S-30-B7	48	NA	0.064	0.15	0.41	1.9	NA

See notes on page 3 of 3.

TABLE 1
CUMULATIVE RESULTS OF LABORATORY ANALYSES OF SOIL SAMPLES
ARCO Station 771
Livermore, California
(page 2 of 3)

Sample Identification	TPHg	TPHd	B	T	E	X	TOG
June, July 1991 cont.							
S-33-B7	<1.0	NA	<0.005	0.006	<0.005	0.010	NA
S-40-B7	19	NA	0.019	0.059	0.14	0.74	NA
S-44-B7	<1.0	NA	0.049	0.020	0.021	0.024	NA
S-10.5-B8	<1.0	NA	<0.005	<0.005	<0.005	<0.005	NA
S-20.5-B8	<1.0	NA	0.013	<0.005	<0.005	<0.005	NA
S-25.5-B8	3.5	NA	<0.005	0.007	0.015	0.028	NA
S-34.5-B8	210	NA	0.27	1.0	2.0	12	NA
S-41-B8	3,200	NA	10	70	37	170	NA
S-43-B8	4.9	NA	0.26	1.2	0.13	0.67	NA
S-10.5-B9	<1.0	NA	<0.005	<0.005	<0.005	<0.005	NA
S-15.5-B9	<1.0	NA	<0.005	<0.005	<0.005	<0.005	NA
S-25.5-B9	<1.0	NA	<0.005	<0.005	<0.005	<0.005	NA
S-34.5-B9	<1.0	NA	<0.005	<0.005	<0.005	<0.005	NA
S-36-B9	<1.0	NA	<0.005	<0.005	<0.005	<0.005	NA
S-42-B9	1.8	NA	0.049	0.006	0.020	0.030	NA
S-45-B9	<1.0	NA	<0.005	<0.005	<0.005	<0.005	NA
S-10.5-B10	<1.0	NA	<0.005	<0.005	<0.005	<0.005	NA
S-20.5-B10	<1.0	NA	0.042	<0.005	0.007	<0.005	NA
S-25.5-B10	27	NA	0.44	0.74	0.36	2.0	NA
S-34.5-10	88	NA	0.20	0.50	0.84	0.96	NA
S-36-B10	110	NA	0.28	0.51	0.86	2.7	NA
S-42-B10	<1.0	NA	0.008	<0.005	<0.005	0.021	NA
S-7-B11	<1.0	<1.0	<0.005	<0.005	<0.005	<0.005	<30
S-8.5-B11	<1.0	<1.0	<0.005	<0.005	<0.005	<0.005	<30
S-15.5-B11	<1.0	<1.0	<0.005	<0.005	<0.005	<0.005	<30
S-20.5-B11	<1.0	<1.0	<0.005	<0.005	<0.005	<0.005	<30
S-25.5-B11	<1.0	<1.0	<0.005	<0.005	<0.005	<0.005	<30
S-35.5-B11	<1.0	<1.0	<0.005	<0.005	<0.005	<0.005	<30
S-40-B11	<1.0	<1.0	<0.005	<0.005	<0.005	<0.005	<30
August 12, 1991							
SP1-ABCD*	<1.0	NA	<0.005	<0.005	<0.005	<0.005	NA

See notes on page 3 of 3.

TABLE 1
CUMULATIVE RESULTS OF LABORATORY ANALYSES OF SOIL SAMPLES
ARCO Station 771
Livermore, California
(page 3 of 3)

Results measured in part per million (ppm).
TPHg: Total petroleum hydrocarbons as gasoline (analyzed by EPA Method 5030/8015/8020).
TPHd: Total petroleum hydrocarbons as diesel (analyzed by EPA Method 5030/8015).
B: benzene; T: toluene; E: ethylbenzene; X: xylenes.
BTEX: Analyzed by EPA Method 5030/8015/8020.
TOG: Total oil and grease (analyzed by Standard Method 5520 E&F (Gravimetric).
*: Composite sample of four soil samples obtained from stockpiled soil.
<: Less than the laboratory detection limit.
NA: Sample not analyzed.

Sample Identification: S-44-1/2-B6
B6 — Boring number
44-1/2 — Depth of boring in feet
S — Soil sample

TABLE 2
APPROXIMATE CUMULATIVE PRODUCT REMOVED
ARCO Station 771
Livermore, California

Date	Floating Product Present (feet)	Floating Product Removed (gallons)
MW-1		
01-15-91	Sheen	0.1 (sheen)
02-27-91	None	None
03-20-91	Sheen	0.1 (sheen)
04-10-91		
5-20-91	Sheen	0.1 (sheen)
06-20-91	Sheen	0.1 (sheen)
07-25-91	0.10	0.06
08-13-91	0.20	0.12
09-12-91	0.23	0.14
10-30-91	0.20	0.13
11-13-91	0.03	0.1
MW-2		
01-15-91	0.16	0.1
02-27-91	0.02	0.01
03-20-91	0.02	0.01
04-10-91	0.05	0.03
05-20-91	NM	0.01
06-20-91	0.15	0.5
07-25-91	0.49	0.29
08-13-91	0.47	0.28
09-12-91	0.45	0.27
10-30-91	Sheen	None
11-13-91	Dry	None
MW-5		
08-13-91	0.01	0.01
09-12-91	0.05	0.03

TABLE 3
CUMULATIVE RESULTS OF LABORATORY ANALYSIS OF GROUNDWATER SAMPLES
ARCO Station 771
Livermore, California
(Page 1 of 2)

Sample	TPHg	B	T	E	X
MW-1					
01-15-91	Not sampled–sheen				
04-10-91	98,000	11,000	18,000	2,800	20,000
07-25-91	Not sampled–floating product				
10-30-91	Not sampled–floating product				
MW-2					
01-15-91	Not sampled–floating product				
04-10-91	Not sampled–floating product				
07-25-91	Not sampled–floating product				
10-30-91	Not sampled–sheen				
MW-3					
01-15-91	230	<0.5	<0.5	2.2	2.1
04-10-91	530	12	8.4	4.0	7.0
07-25-91	110	0.32	0.75	1.2	1.0
10-30-91	Not sampled–dry				
MW-4					
07-25-91	23,000	590	730	360	3,500
10-30-91	19,000	320	340	230	180
MW-5					
07-25-91	57,000	2,300	4,200	77	14,000
10-30-91	Not sampled–sheen				
MCLs	**—**	**1**	**—**	**680**	**1,750**
Als	**—**	**—**	**100**	**—**	**—**

TABLE 3
CUMULATIVE RESULTS OF LABORATORY ANALYSIS OF GROUNDWATER SAMPLES
ARCO Station 771
Livermore, California
(Page 2 of 2)

Sample	TPHg	B	T	E	X
MW-6					
07-25-91	10,000	3,000	200	340	1,000
10-30-91	970	150	4.4	4.9	6.6
MW-7					
07-25-91	45,000	1,500	2,700	1,200	9,200
10-30-91	93,000	1,800	770	780	6,700
MCLs	—	**1**	—	**680**	**1,750**
Als	—	—	**100**	—	—

Results in parts per billion (ppb).

TPHg:	Total petroleum hydrocarbons as gasoline (measured by EPA Method 5030/8015).
B: Benzene	T: toluene E: ethylbenzene X: total xylene isomers
BTEX:	Measured by EPA Method 8020/602.
NS:	Not sampled due to floating product or sheen.
<:	Less than the laboratory detection limit.
MCL:	State Maximum Contaminant Level in ppb.
AL:	State Recommended Action Level in ppb.

TABLE 4
VAPOR-EXTRACTION TEST FIELD MONITORING DATA
ARCO Station 771
Livermore, California

Influent Air Stream					Observation Wells			
Flow	Concentration	Applied Vacuum	Temp.	Elapsed Time (min)	MW-2 Induced Vacuum	MW-5 Induced Vacuum	MW-7 Induced Vacuum	MW-1 Induced Vacuum
53.4	NM	39	50	0	1.0	0.8	0.7	NM
87.2	>10,000	>100	55	30	4.3	5.8	3.7	NM
89.4	>10,000	98	57	60	4.8	6.9	5.0	NM
91.6	>10,000	105	57	90	4.9	7.2	5.7	NM
91.6	>10,000	105	60	120	4.9	7.3	6.0	NM
91.6	>10,000	105	60	150	4.9	7.3	6.0	NM
63.2	>10,000	49	64	30	4.8	5.0	5.1	NM
63.2	>10,000	49	63	60	4.8	5.0	5.1	>3
				Distance from extraction well MW-4 (feet):	40.0	40.0	35.0	60.0

Influent Air Stream					Observation Wells			
Flow	Concentration	Applied Vacuum	Temp.	Elapsed Time (min)	MW-1 Induced Vacuum	MW-4 Induced Vacuum	MW-2 Induced Vacuum	MW-7 Induced Vacuum
81.6	>10,000	96	56	0	2.0	0.9	0.04	0.0
81.6	>10,000	81.8	55	30	5.0	3.3	0.5	1.1
				Distance from extraction well MW-5 (feet):	30.0	40.0	80.0	60.0

Influent Air Stream					Observation Wells		
Flow	Concentration	Applied Vacuum	Temp.	Elapsed Time (min)	MW-2 Induced Vacuum	MW-4 Induced Vacuum	MW-5 Induced Vacuum
82.8	>10,000	95	57	0	2.0	2.0	1.2
82.8	>10,000	100	54	30	2.0	2.3	1.3
				Distance from extraction well MW-7 (feet):	44.0	35.0	57.0

Flow measured in cubic feet per minute (CFM).
Concentration measured in parts per million by volume (ppmv) on Lower Explosion Level (LEL) Meter.
Vacuum measured in inches of water column vacuum.
Temperature measured in degrees Fahrenheit.
NM = Not Measured.

TABLE 5
LABORATORY ANALYSIS OF AIR SAMPLES
ARCO Station 771
Livermore, California

Sample ID	Sample Location	Elapsed Time of Sample	TPHg	B	T	E	X
60000.07-AS1	MW-4	30	62,000	1200	150	28	48
60000.07-AS2	MW-4	150	58,000	1100	180	43	86
effluent	Outlet*	30	1,000	19	14	6.4	18
60000.07-AS3	MW-4	30	14,000	180	23	<12	<12
60000.07-AS4	MW-7	30	30,000	740	150	15	87
60000.07-AS5	MW-5	30	8,600	220	<12	<12	<12

Concentrations reported in milligrams per cubic meter (mg/m^3)

< : Below the minimum laboratory detection limit for air.

NA: Not analyzed.

TPHg: Total petroleum hydrocarbons as gasoline (analyzed by EPA Methods 8015 and 8020).

B: benzene, T: toluene, E: ethylbenzene, X: total xylene isomers

BTEX: Analyzed by EPA Methods 8015 and 8020

*: Outlet effluent vapors sampled after abatement by the internal combustion engine.

APPENDIX A

MANUFACTURER'S SPECIFICATIONS ON CATALYTIC OXIDIZERS

GENERAL SPECIFICATIONS AND WARRANTY
THE KING,BUCK/HASSTECH MULTIMODE™ COMBUSTER

GENERAL SPECIFICATIONS All MultiMode Combuster (MMC) systems consist of a vacuum pump/compressor and electric drive motor, a recycle loop with dilution air valve and silencer, and all necessary instruments and operating controls housed in weather resistant cabinets. For safe operation, the blower is interlocked to the oxidizers. Thermal oxidizers have a heat capacity of 1.8 million Btu/hr and include a servo-valve for automatic regulation of supplementary fuel when VOC concentrations fall below the LEL. Catalytic oxidizers include a multi-stage catalyst section, electric or gas-fired preheater with thermocouple temperature controller, and recuperative heat exchanger for added efficiency.

Off-plots supplied by the customer

1. Natural gas or propane for the pilot flame and supplementary fuel to the ThermOx, at a pressure of 1 1/2 - 2 psig.
2. Most systems can be designed for either single or 3-phase power, depending on customer preference. Amperage will depend on phase selection. 230v power is needed for preheater and VCU, 110v for control circuits.

Capacity and Efficiency All MMCs will operate with a destruction efficiency of hydrocarbons exceeding 95%. Higher destruction efficiencies of the order of 99% for the ThermOx and 96% to 98% for the CatOx are routine under most conditions. At all times the MMC can meet an alternative operating limit of a maximum hydrocarbon emission rate of 10 lbs/day.

Construction Standards All MMC equipment has been inspected and meets the requirements of local fire and electrical codes. The City of Los Angeles Fire Department has granted "General Approval" to the design and construction of the MMC-5, under L.A.F.D. Permit No. 30-90-1. Also, several MMC systems, both ThermOx and CatOx, have been examined and tested by the American Gas Association Laboratories; the conclusions in the AGAL reports are that the procedures and designs of the MMC systems satisfactorily comply with recognized standards and safety practices.

WARRANTY King,Buck/Hasstech will correct, either by repair or replacement, any defects of materials or workmanship in components it manufactured that develop within one year. For purchased components, the original equipment manufacturers' warranties for freedom of defects in material and workmanship shall apply.

This warranty does not apply to parts that have been modified, defaced, or operated in an abnormal manner. As specific examples, the warranty would not apply to the catalyst if the process gas contained catalyst poisons or deactivators such as volatile lead, phosphorus, halogens, etc.; nor would it apply to electrical preheaters that had been operated at an excessively high temperature without a process gas flow rate adequate to remove the heat flux.

The warranty covers all parts returned to the factory prepaid, or all parts and labor for service visits made to other locations with travel expenses charged to the Buyer's account. Repaired or replaced parts will be returned pre-paid to the Buyer.

10-18-91

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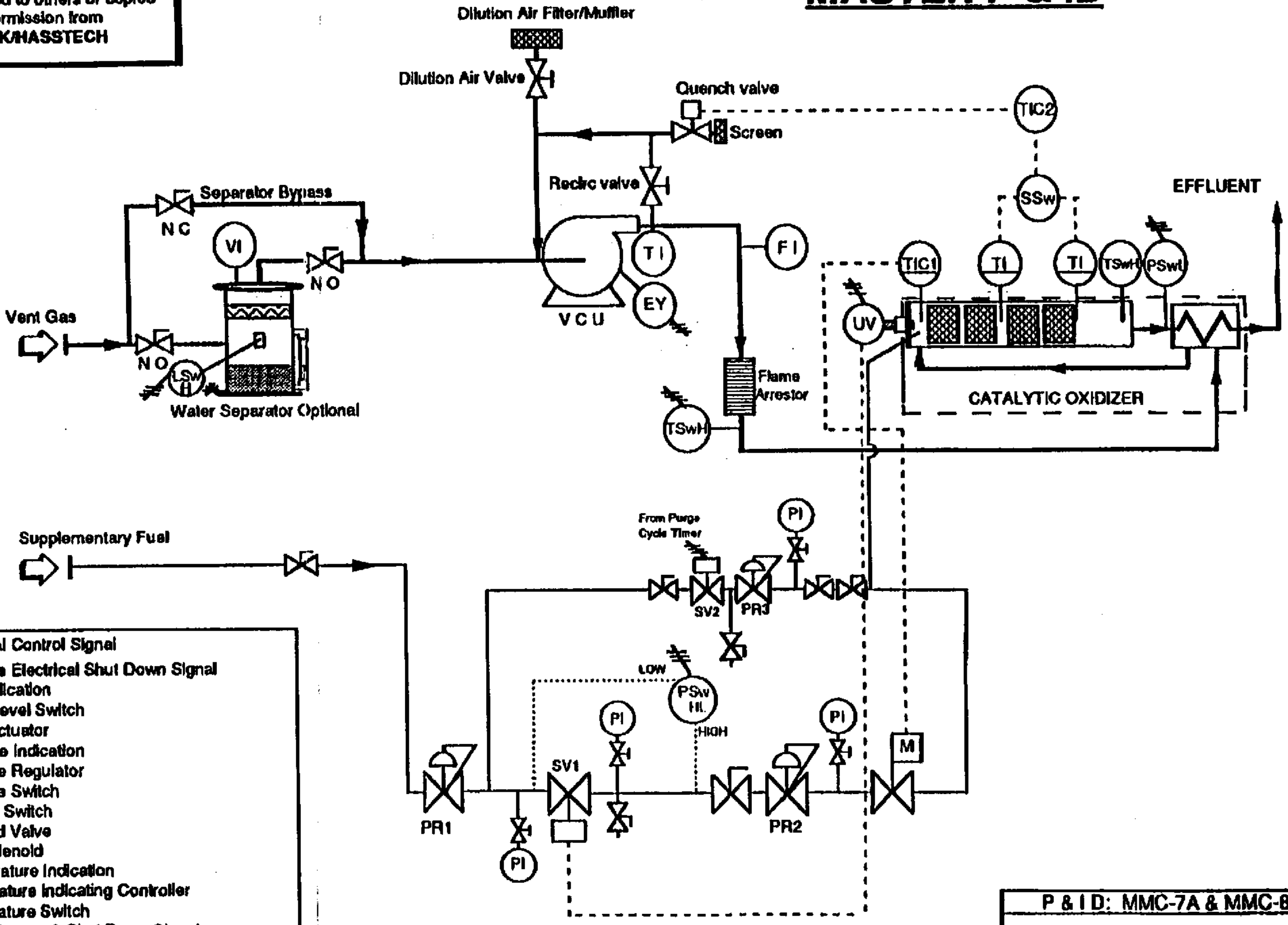
MASTER P & ID



LEGEND

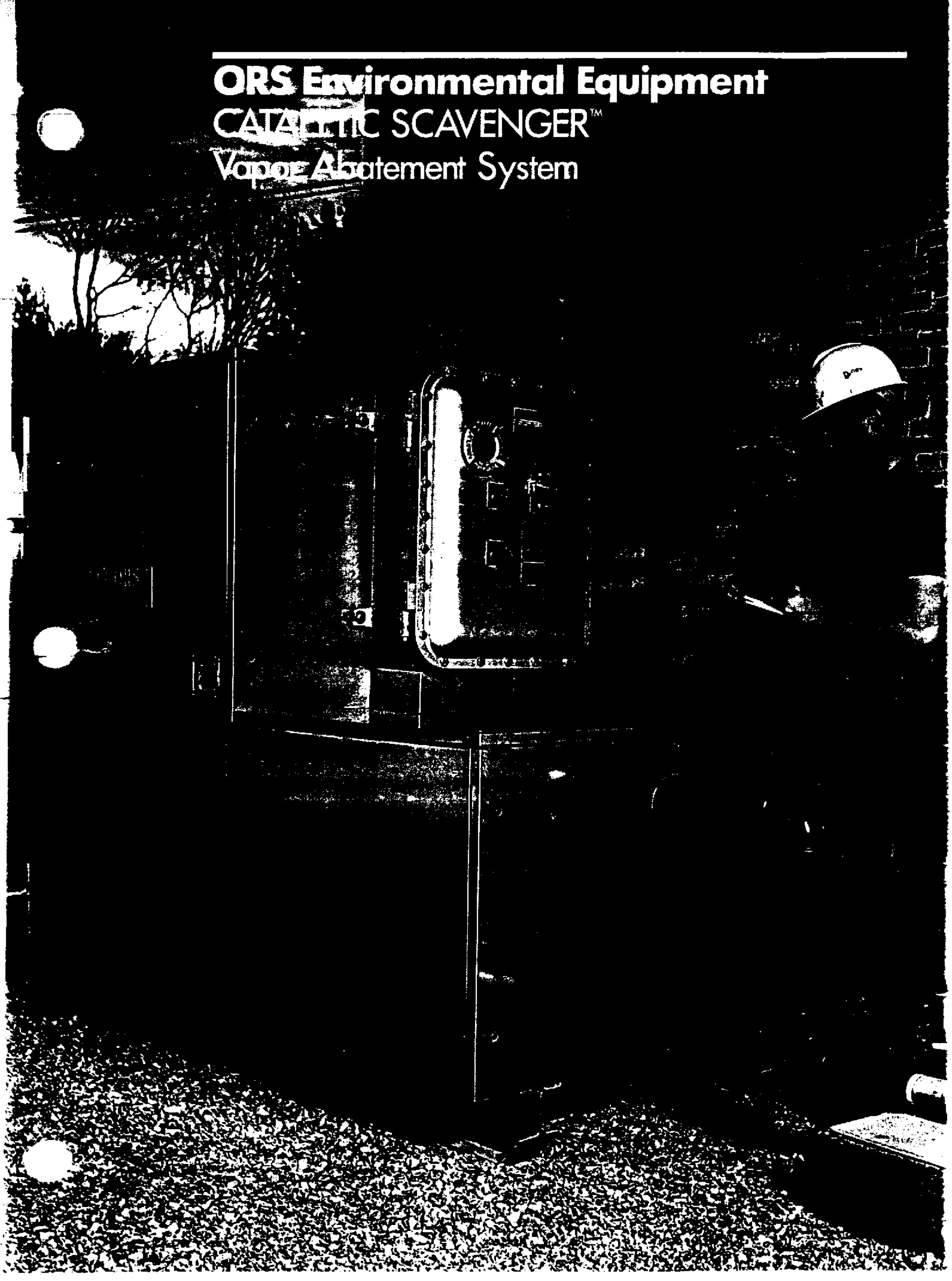
	Electrical Control Signal
Y	Receives Electrical Shut Down Signal
I	Flow Indication
Sw*	Liquid Level Switch
I	Motor Actuator
I	Pressure Indication
R	Pressure Regulator
Sw*	Pressure Switch
Sw	Selector Switch
V1	Solenoid Valve
V2	Pilot Solenoid
I	Temperature Indication
IC	Temperature Indicating Controller
Sw*	Temperature Switch
V	Flame Sensor & Shut Down Signal
CU	Vacuum Compressor Unit
I	Vacuum Indicator

P & I D: MMC-7A & MMC-8A

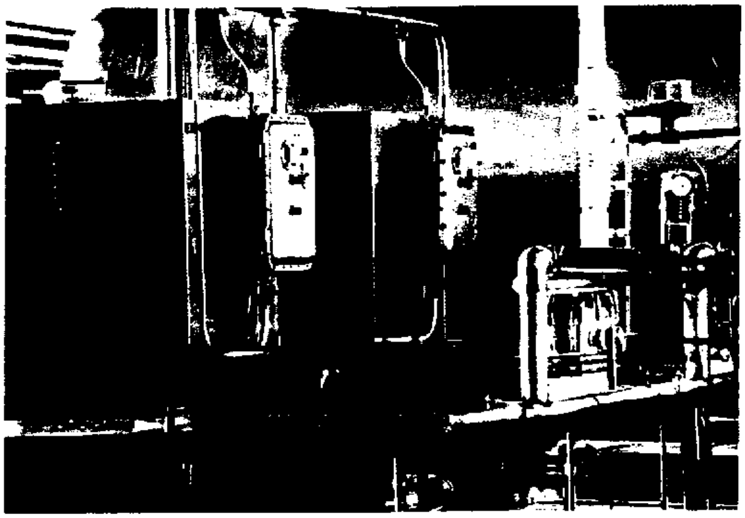
KING,BUCK/HASSTECH

P30 1-2

ORS Environmental Equipment
CATALYTIC SCAVENGER™
Vapor Abatement System



ORS Environmental Equipment
CATALYTIC SCAVENGER™
Vapor Abatement System



Two CATALYTIC SCAVENGER systems work in series to destroy high levels of VOCs in vapors from an above ground storage tank.

When Clean Air Matters

Most site remediation projects start off with contaminated soil and groundwater. But they often end up with a contaminated air stream from the very systems that are doing the cleanup! Now, ORS Environmental Equipment has combined proven catalytic conversion technology with years of site remediation experience to create the CATALYTIC SCAVENGER™ system. This unique state-of-the-art system is specifically designed to handle the vapors emitted from air strippers and soil vent systems during site cleanups.

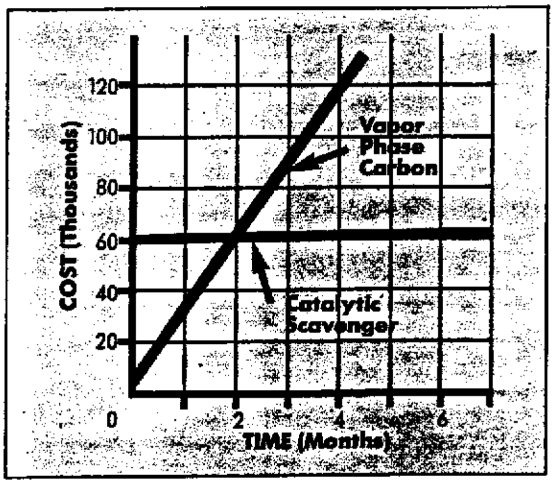
Cost Effective And Efficient

The ORS CATALYTIC SCAVENGER system is highly cost effective because of its unique design. At the heart of the system is a durable platinum-coated catalytic element. This unit operates at temperatures which efficiently destroy organic contaminants. Special ceramic insulation retains the heat, which is recovered during the process and recycled to pre-heat the inlet gases. Reusing this energy greatly reduces operating costs.

The CATALYTIC SCAVENGER system can be equipped with a remote monitoring system. By adding this option and a phone line, the status of the blower, influent LEL (Lower Explosive Limit) levels and the current temperature of the unit can be monitored from any personal computer with a modem. The number of costly on-site field checks is lowered to the minimum number required by state regulations.

Meets Environmental Standards

Contaminated air streams that have been processed through the CATALYTIC SCAVENGER system may be safely released into the atmosphere. High destruction rates meet state and federal VOC and air toxics emissions standards. Since the CATALYTIC SCAVENGER system runs on convenient electricity and creates no emissions of its own, it is an extremely clean unit. Unlike activated carbon, which merely transfers contaminants to an expensive medium, the CATALYTIC SCAVENGER system destroys contamination on site, avoiding chain-of-custody and other lingering liability issues.



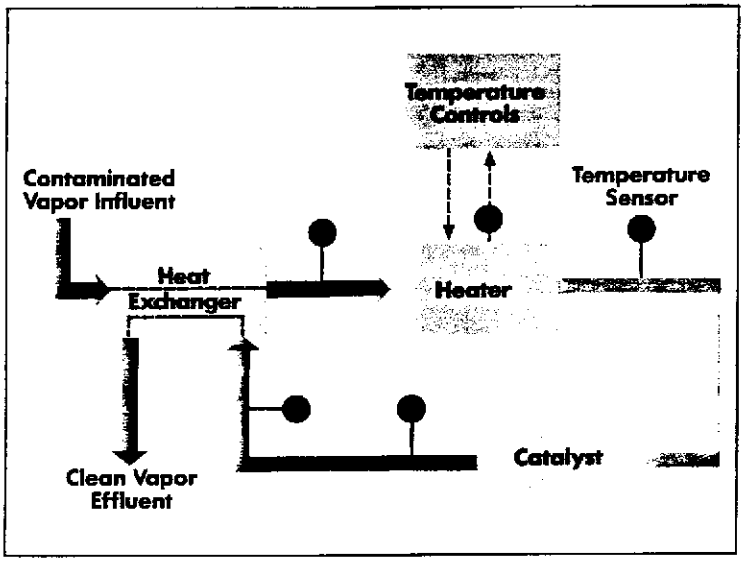
Graph shows comparative costs of carbon and catalytic conversion. In this example, the Scavenger system saved the client $30,000 over 3 months. Carbon was regenerated off-site.

Safe

Safety precautions have been built into the CATALYTIC SCAVENGER Vapor Abatement System at every level. Digital output displays provide quick, easy-to-read references for site personnel. The CATALYTIC SCAVENGER system comes equipped with an Automated Safety Valve Assembly (ASVA) that automatically diverts purge air into the unit when LEL levels reach preset limits. From its explosion proof design to its gas monitoring and temperature sensing systems, the CATALYTIC SCAVENGER Vapor Abatement System has been designed to provide completely safe operation.

Reliable

ORS Environmental Equipment has been designing, manufacturing and installing innovative systems for site remediation and contaminant recovery since 1975. ORS systems have been field-proven on thousands of projects worldwide. From the innovative FILTER SCAVENGER™ Oil/Water Separator, to our ambient monitoring units, to our full-scale remediation systems, ORS equipment has operated reliably on virtually every kind of remediation project. This experience is built into every CATALYTIC SCAVENGER system and is part of what you can depend on with every ORS product.



Process flow diagram showing path of gas from remediation system to discharge. Contaminated vapors are preheated in the heat exchanger by hot exhaust released from the catalyst. Gas passes through the heater to the catalyst where combustion takes place. The clean vapor effluent is discharged after being cooled in the heat exchanger.

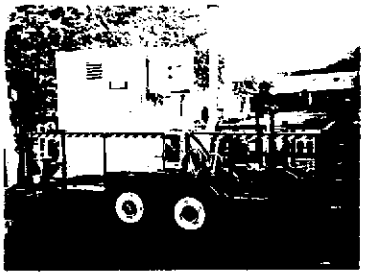
Benefits

- Proven technology expedites permitting process
- On-site contaminant destruction
- No off-site hauling or disposal
- No long-term liability
- Flexible design accommodates multiple applications
- Low operating costs

When environmental regulations require clean emissions, put the CATALYTIC SCAVENGER system to work for you.

Options

- Technology on Wheels (TOW)
- Automatic influent process control
- Remote monitoring
- Natural gas fired unit
- Flow temperature recording
- Leasing



The TOW program allows ORS equipment to be transported from one site to another.

At a service station on the West Coast, the ORS CATALYTIC SCAVENGER system was used for on-site destruction of contaminated vapors emitted from a Soil Vent System. The unit achieved a 99% destruction rate for benzene, which met California Air Pollution Control District requirements. Operating costs were less than $300 per month.

The CATALYTIC SCAVENGER system was used on site to destroy the vapors from an underground fuel spill in Maryland. The unit was installed to replace a carbon tank, which cost the client $15,000 in just three days. In five months, the CATALYTIC SCAVENGER destroyed approximately 6000 lbs. of vapor phase contaminants, and saved the client thousands of dollars in operating costs.

ORS Environmental Equipment
CATALYTIC SCAVENGER™
Features and Specifications

Model Information	#1282001	#1282002
	20 kw	35 kw
Air Flow Rate*	100-300 SCFM	200-500 SCFM
Power Requirements**	230V (1 or 3 Ph.) or 460V (3 Ph.†)	230V/460V (3 Ph.)
Dimensions	69"h×80"l×44"w	62"h×132"l×62"w
Weight	~1200 lbs.	~2000 lbs.
Operating Temp. Range	400°-900°F	400°-900°F

* For higher flow rates, consult factory.
** Up to 125 amp service depending on voltage and phase. Consult factory for specific requirements.
† Special order, consult factory.

Features

Applications: Can be used with Air Strippers, Soil Vent Systems, or other vapor streams.
Portable: Lightweight, skid mounted unit is easily transported.
Durable: Precious metal catalyst is designed for long life with proper maintenance.
Efficient Operation: Up to 65% heat recovery by heat exchanger.
Explosion Proof Design: Control system and heater meet NFPA standards for use in Class 1, Division 2, Group D hazardous environments.
Sensor Redundancy: System features two LEL sensors wired in series.
Control Mechanism: Allows interruption of other site operations during alarm conditions.
Manual Temperature Monitoring: Thermocouples and hand-held thermometers provide additional monitoring capabilities.
Manual Reset: After an alarm condition or shutdown, system will not restart without operator intervention. This feature prevents restarting before the cause of the shutdown has been investigated.
High and Low Temperature Shutoffs: Prevent overheating and release of untreated vapors.
Continuous Gas Monitoring: LEL sensors and controller shut down system if flammable gas concentrations rise beyond adjustable limits.
Gas Sensor Failure Alarm: Shuts system down and triggers audible/visible alarm with audible shut-off.
Automatic Damper: Diverts potentially explosive vapors away from catalyst during alarm conditions.
Minimal Temperature Drift: System electronics provide tight temperature control of gas entering the catalyst.

Specifications

Catalyst: Platinum coated.
Enclosure: 15 gauge sheet aluminum.
Gas Exposed Components: 304 stainless steel.
Inlet Pipe: 4" female PVC flange.
Outlet Pipe: 6" O.D. stainless steel discharge port.
Insulation: 3" ceramic blanket.
Patent: USSN 078,779. Catalytic technology used in conjunction with air stripping.

Partial List of Destructible Compounds

Aromatics:
Benzene
Toluene
Xylenes
Ethyl benzene
Naphthalene
Styrene
Isobutyl benzene
Ketones:
Methyl ethyl ketone (MEK)
Methyl isobutyl ketone (MIBK)
Acetone
Alcohols:
Isopropanol
Methanol
Butanol
Ethanol
2 methyl-1-butanol
Esters:
Ethyl acetate
Propyl acetate
Isobutyl acetate
Cyclohexyl acetate
Alkenes:
Propylene
Ethylene
Alkanes:
Butane
Heptanes
Hexanes
Pentanes
Octane
Aldehydes:
Formaldehyde
Benzaldehyde
Other Gases:
Acetylene
Carbon monoxide
...and other organic compounds

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For more information or to place an order, please call **(800) 228-2310 or (603) 878-2500.** Sales and service facilities are located throughout the U.S., Canada, and overseas.

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CS 5/90 7.5K

CATALYTIC SCAVENGER

SECTION 13: CATALYTIC SCAVENGER SYSTEM

The Catalytic Scavenger provides an effective means of cleaning contaminated air emitted by an Air Stripper or Soil Vent System. After passing through the Catalytic Scavenger, this air may be safely released into the atmosphere.

Standard ORS Catalytic Scavengers are rated at 20 KW for 100 - 200 CFM service or 35kW for up to 700 SCFM service.

The explosion proof control module houses the electrical circuits which turn the blowers and heaters on and off, and open or close the vent damper.

As contaminated air leaves the Air Stripper or Soil Vent System, it is monitored by an explosive gas sensor. This sensor may be located at the top of the air stripper or at the output of the Soil Vent System.

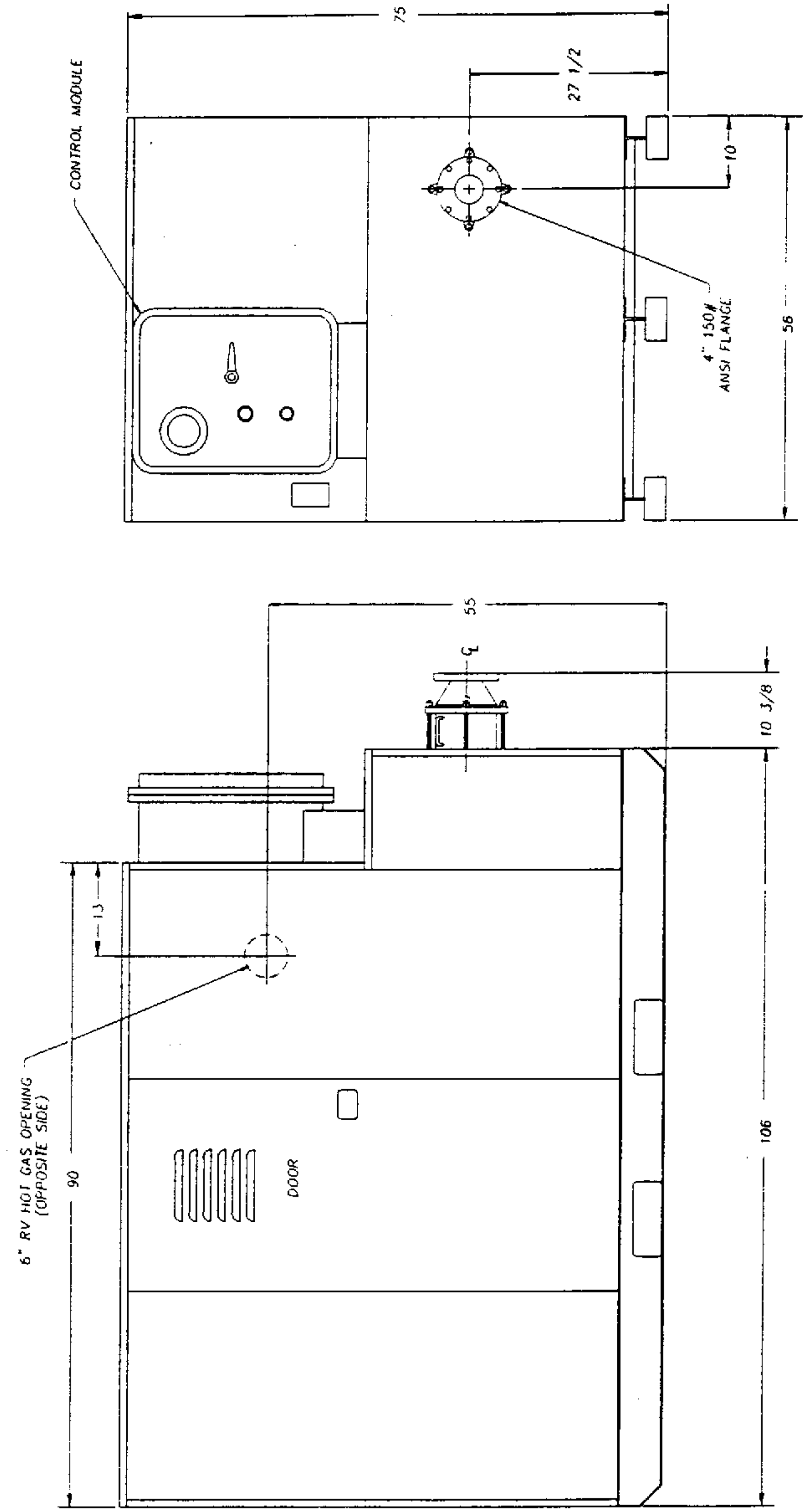
The sensor itself has two filaments; one platinum coated and the other uncoated. When voltage is supplied to the filaments in the presence of a contaminated air stream, the coated filament will cause combustion of the contaminants. This process results in the disproportionate heating of the coated filament with respect to the uncoated one. The difference in temperature between the two filaments is used to determine the concentration of explosive gases present.

If the concentration of explosive gases in the air leaving the Air Stripper or Soil Vent System exceeds a certain level (a predetermined percentage of the LEL*), the sensor will signal a relay that will shut down the system. The sensor will also signal the explosion proof vent damper to open or close. The damper will close to prevent gases from reaching the catalytic unit. The vent damper is motor actuated and is powered through the control module. Wiring is such that the damper closes when any alarm condition exists. This system reduces the possibility of volatile gases passing into the Catalytic Scavenger and exploding.

* LEL (lower explosive limit) is the lowest concentration of a gas that can still cause an explosion. The sensor is set to turn off the system when a predetermined LEL is reached. This level is site specific but must never exceed 25% LEL. This gives the system a wide margin of safety.

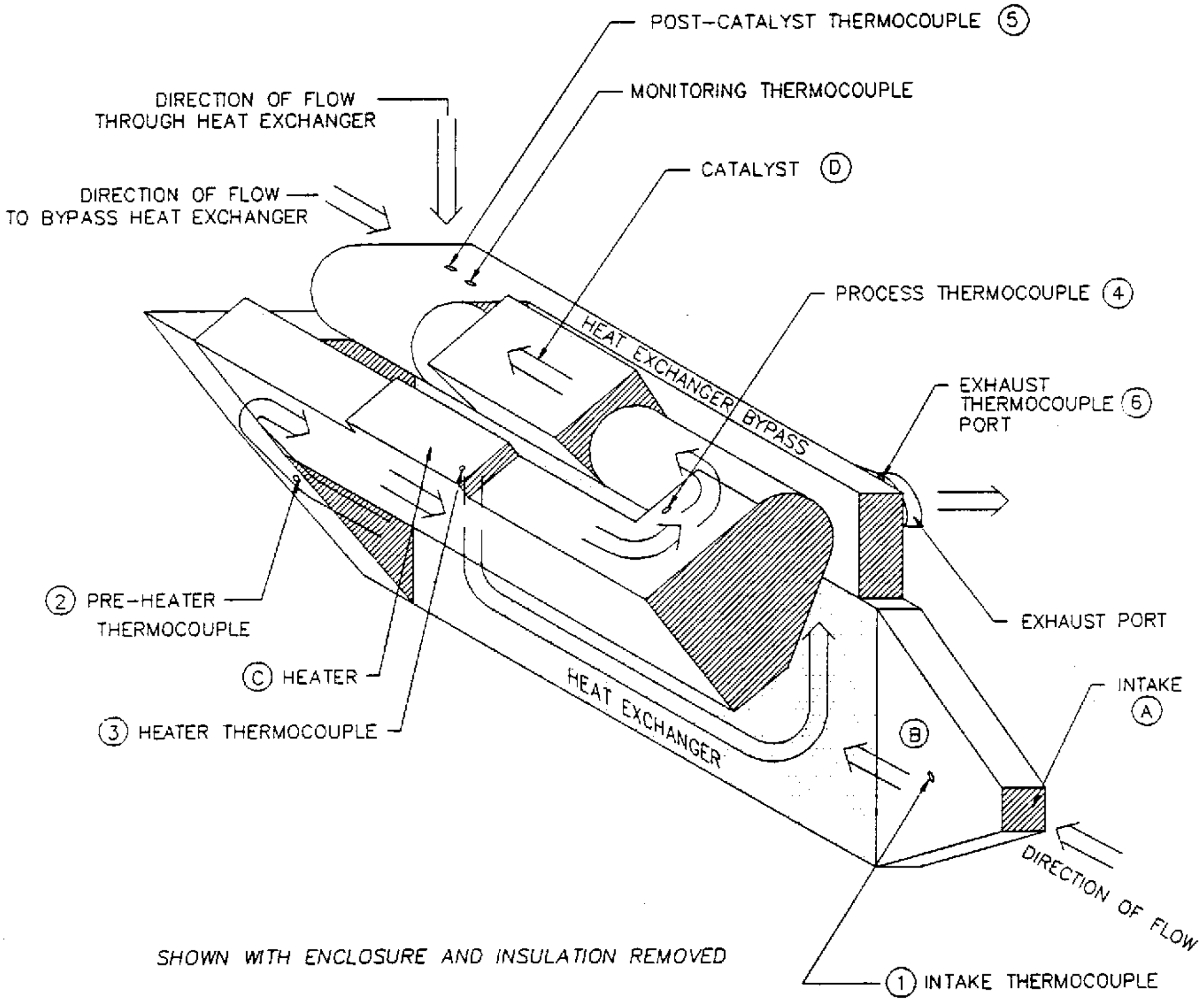
The explosive gas sensor is equipped with a 50' cable to be wired into the gas alarm box (LEL meter). The alarm box is connected to the control module through a second cable.

ECAT-9



35kW Catalytic Scavenger – Overall Dimensions.

E5065-29



SHOWN WITH ENCLOSURE AND INSULATION REMOVED

FLOW PATH:

A. CONTAMINATED AIR ENTERS SYSTEM.
B. AIR PASSES THROUGH HEAT EXCHANGER AND RECOVERS HEAT FROM HOT EXHAUST AIR.
C. AIR IS HEATED AS IT PASSES THE HEATER.
D. HEATED AIR PASSES THROUGH CATALYST AND OXIDATION TAKES PLACE.

The 35kW Catalytic Scavenger.

Contaminated air from the Air Stripper or Soil Vent System is directed into the catalytic unit at the intake of the heat exchanger. The air is then preheated by the exchanger. In the next step, contaminated air is circulated past the heater where its temperature is further increased.

When the contaminated air contains high levels of combustible gases, it may be difficult to keep the system temperature below the predetermined set point (see below). In such cases, it may be necessary to adjust the manual vent dampers to vent preheated air before it reaches the heat exchanger. This reduces the efficiency of the heat exchanger and lowers the operating temperature of the system.

If the temperature of the heater element exceeds the Hi-Temperature Limit set point, a Hi-Temperature Limit override will turn the system off.

In the event of a heater malfunction, power to the heaters will be shut off by the Lo-Temperature Limit control. This control shuts off power when the temperature of the unit falls below a level which has been preset by the operator.

The Process Temperature control can also be adjusted by the operator. This control monitors a sensor located at the catalytic element. The process temperature is therefore the temperature of the catalyst.

The contaminated air is heated before it moves into contact with the catalytic element. This element is constructed of platinum coated stainless steel. The platinum acts as the catalytic agent, causing incineration of the contaminants in the air stream. The decontaminated air travels from the catalytic element back into the heat exchanger where it will transfer its heat to the stainless steel membranes of the exchanger. This, in turn, will heat the incoming contaminated air to repeat the purification process. Clean air is then vented to the atmosphere.

13.1 SYSTEM INSTALLATION

The Catalytic Scavenger should be installed and operated by authorized personnel only. Groundwater technology field personnel should follow standard operating procedures.

13.2 MATERIALS OF CONSTRUCTION

Enclosure	Aluminum (6061-T6) sheet/alum. angle frame
I-Beams	Aluminum (6061-T6)
Mounting hardware	Grade 8 carbon steel

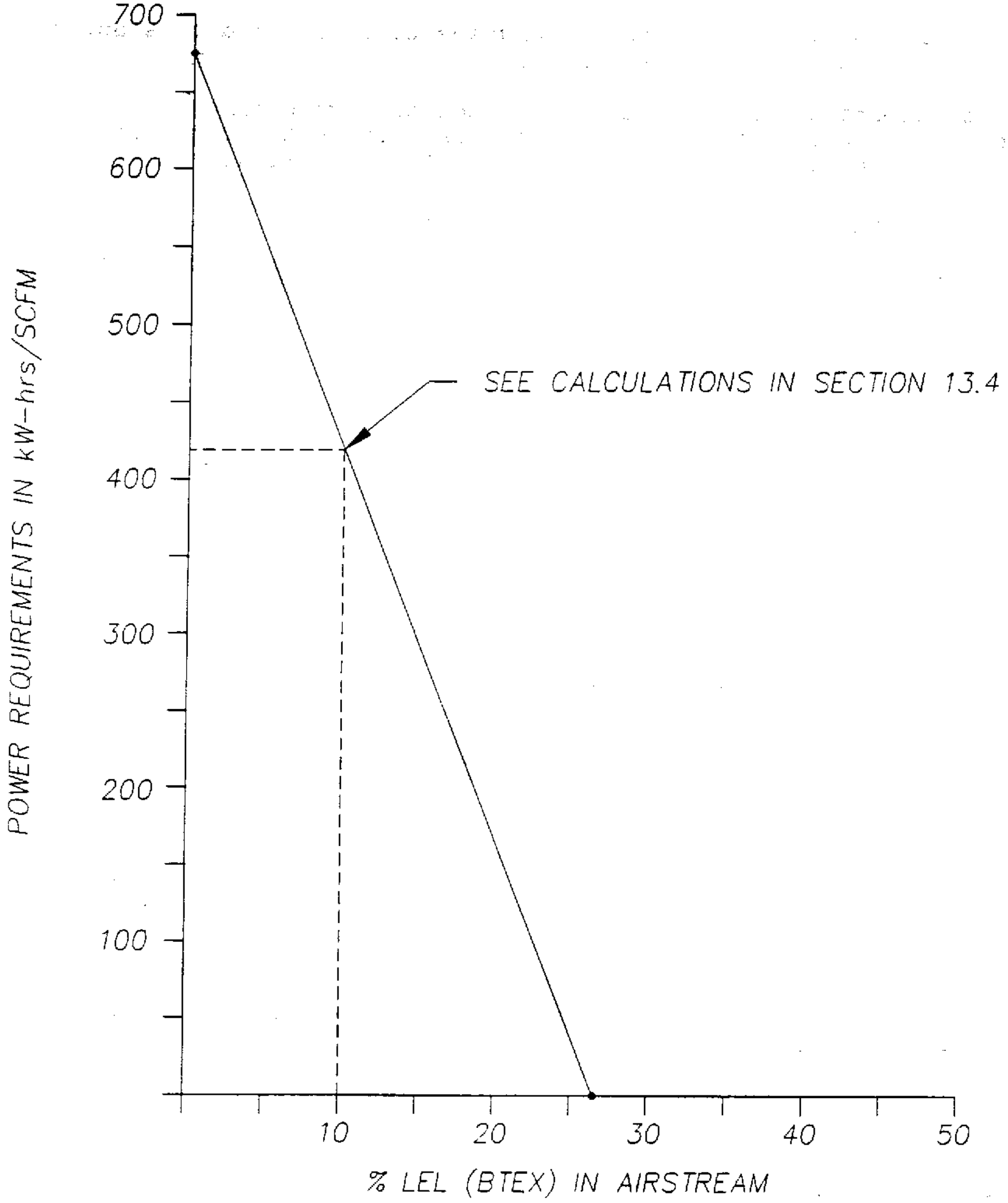
Ductwork	304L 16 GA./12 GA. flanges
Gaskets	Heat expandable ceramic mat
Insulation	Alumina-Silica ceramic refractory blanket
Heat Exchanger	304 St. Stl. counter flow plate
Flange hardware	Stainless steel
Catalyst	Precious metal, stainless steel core
Heater	20 KW St. (25, 35, 40 KW)
Thermocouple cables	Type K - nickel-chromium vs. nickel aluminum with copper tinned overlaid
Power cables	Silicone Rubber - High temp. insulation copper conductors
Conduit	Aluminum
Control module	Aluminum enclosure
Inline damper	PVC/Stainless valve body aluminum housing on actuator
Thermocouples	Type K, stainless steel sheathed with ceramic connectors

13.3 OPERATING COSTS

The operating costs of a Catalytic Scavenger are directly related to the amount of additional electrical energy required to maintain the catalyst process temperature at 600°F. When the influent gas stream contains a high LEL, the heat exchanger will recover large amounts of heat which will reduce the need for additional energy. Conversely, a low influent LEL will reduce heat recovery by the heat exchanger and increase the need for additional energy. The graph on the next page shows the relationship between energy requirements and influent LEL. The graph is based on the following calculations.

To calculate the operating costs (energy consumption) of a Catalytic Scavenger, we need to know the temperature of the gas stream entering the heat exchanger (T1), the temperature after the heat exchanger but before the heater (T2), the temperature between the heater and the catalyst (the process temperature, T3) and the temperature after the catalyst (T4).

ETHERM-2



Based on 1 year of operation per SCFM of Process Flow.

Annual Operating Cost of Catalytic Oxidation Vs. % LEL.

T1 is easily obtained by direct measurement, T3 is held constant at 600°F and T4 can be estimated as follows:

T4 is dependent on the influent LEL since the hydrocarbon concentration will determine the heat rise across the catalyst. To estimate T4, assume a 20°F heat rise per 1% LEL. For example, if the LEL of the influent gas stream is 5%, the heat rise will be 100°F. Adding this to T3 (600°F) gives a T4 of 700°F.

To calculate T2 for a given influent LEL, we must know the heat exchanger efficiency (e). We define e as follows:

$$e = \frac{T2 - T1}{T4 - T1} = \frac{\text{Heat Absorbed}}{\text{Heat Available}}$$

Solving for T2:

$$T2 = e(T3 - T1) + T1$$

Assuming a T1 of 60°F, a T4 of 700°F and an e of 50%:

$$\begin{aligned} T2 &= 0.50(700 - 60) + 60 \\ &= 380^\circ F \end{aligned}$$

NOTE: Heat exchanger efficiency is usually closer to 60% but over all system efficiencies run close to 50%.

Now that we have determined values for T1, T2, T3 and T4, we can calculate the actual energy requirements of the system.

Q energy required (in BTU/hr)	=	M mass of air	x	Cp heat capacity of air	x	T heat rise of air stream required

$$Q = 0.075\ \text{lb/ft}^3 \times \text{SCFM} \times 60\ \text{min/hr} \times 0.24\ \text{BTU/lb}^\circ F \times (600 - T2)$$

For example, using the above calculations and assuming a 100 SCFM air flow rate:

$$Q = 0.075 \times 100\ \text{SCFM} \times 60\ \text{min/hr} \times 0.24 \times (600 - 380)$$

$$Q = 23{,}760\ \text{BTU/hr}$$

To convert to kW-hr, divide Q by 3412.

13.3.1 ESTIMATING OPERATING COSTS: AN EXAMPLE

The relationship between system operating costs (power consumption) and process stream concentration (LEL) is represented graphically on the previous page. The following cost calculation refers to the dashed line on the graph.

GIVEN: A Catalytic Scavenger operating at 200 SCFM with an influent process stream concentration of 10% LEL.

PROBLEM: Find the annual operating cost of the system.

SOLUTION: Simply draw a line from 10% LEL up to the point of intersection with the sloping regression line. Then draw a horizontal line to intersect the power consumption axis. The result is an annual power requirement of 420 kW-hr per SCFM of process flow.

To obtain the annual power requirement for 200 SCFM, multiply annual power/SCFM by total process flow.

Annual power = 420 kW-hr/SCFM x 200 SCFM

= 84,000 kW-hr

Since electricity costs approximately $0.08/kW-hr, annual power consumption costs would be:

84,000 kW-hr x $0.08/kW-hr

= $6700

13.4 CONVERSION EFFICIENCY OF CATALYST

There is an inverse relationship between conversion efficiency and process flow. The higher the conversion efficiency desired, the lower the flow rate that can be processed. The following examples illustrate this relationship.

For 95% conversion, a single catalyst will handle up to 184 SCFM.

For 98% conversion, a single catalyst will handle up to 125 SCFM.

For conversion efficiencies above 98%, a single catalyst will handle up to 104 SCFM.

Higher flow rates can be handled by installing multiple catalysts.

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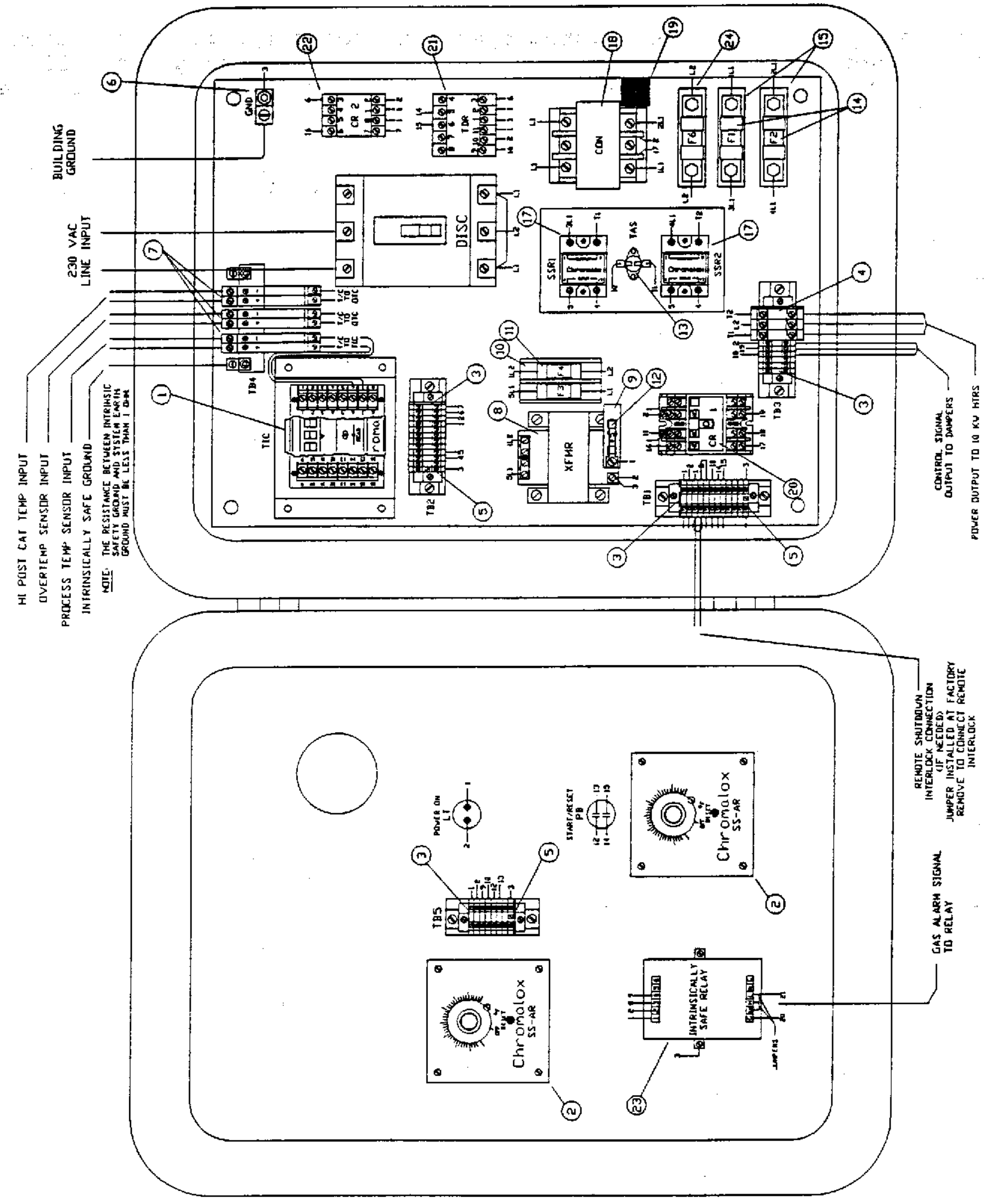


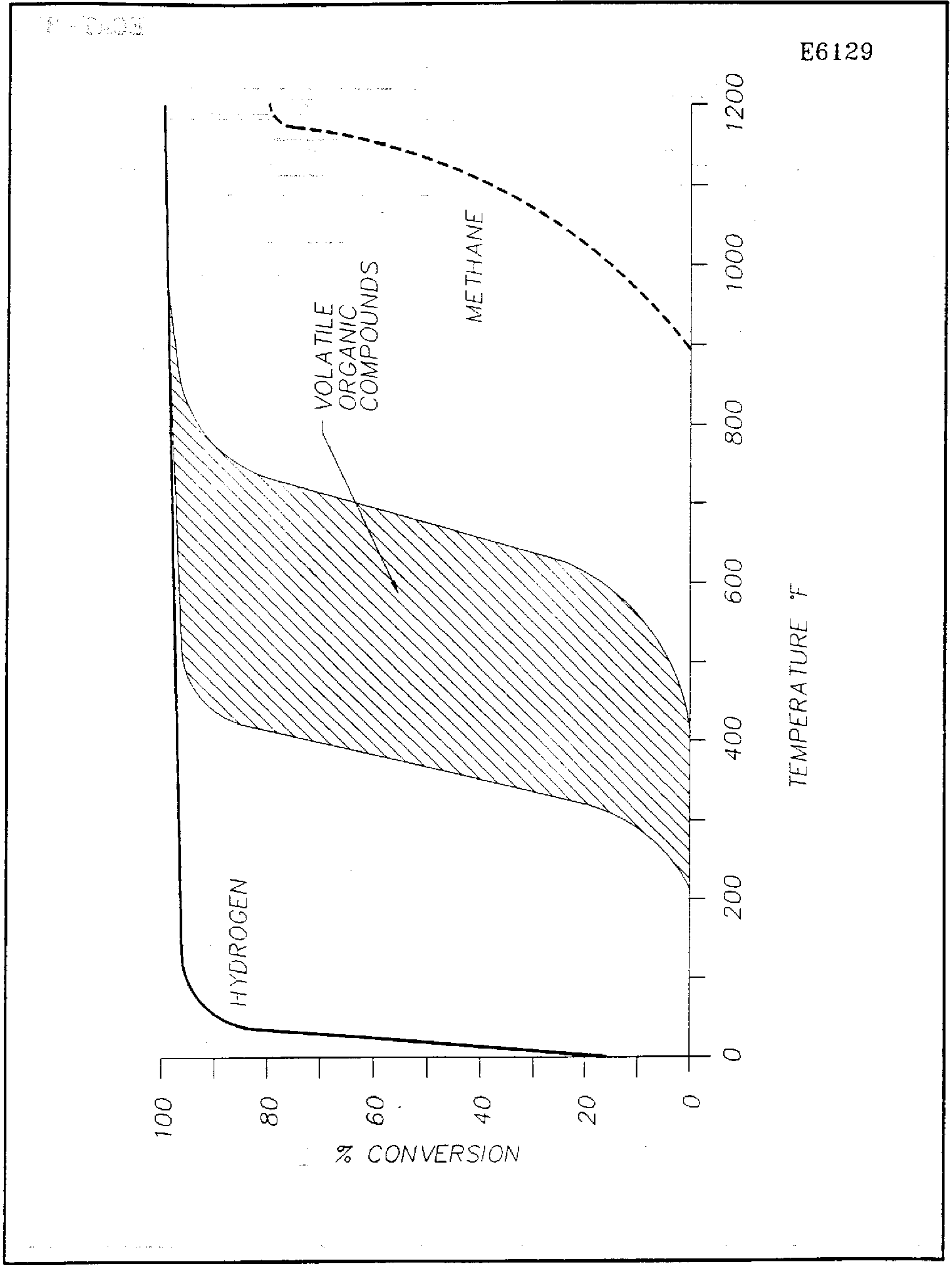
Contents of Control Module. See next page for key.

LIST OF MATERIAL - CONTROL MODULE

ITEM NO.	QTY. REQ'D.	DESCRIPTION
1	1	PROCESS/TEMP CONTROLLER
2	2	SS-AR HIGH TEMP LIMIT ELECTRONIC CONTROLLER
3	35	TERMINAL BLOCK, SECTIONAL
4	3	TERMINAL BLOCK, SECTIONAL
5	3	GND LUG SECTIONAL
6	1	GROUND LUG
7	3	INTRINSICALLY SAFE TERMINAL FOR GRD'D OR UNGND'D THERMOCOUPLE
8	1	TRANSFORMER, 100VA
9	1	FUSEBLOCK KIT FOR HEVI-DUTY TRANSFORMER
10	1	FUSEBLOCK
11	2	FUSE, 1A, 500 V, TIME DELAY (F3 & F4)
12	1	FUSE, 1A, 250 V, SLO-BLO (F5)
13	1	SNAP-ACTION THERMOSTAT
14	2	FUSE 60A 500V "FAST-BLOW" (F1 & F2)
15	2	FUSE HOLDER, MODULAR STUD TYPE FOR RECTIFIER FUSE.
16	1	ENCLOSURE NEMA 7, 18X24X8
17	2	SOLID STATE POWER CONTROLLER 480V, 90AMPS
18	1	CONTACTOR, 90 AMP
19	1	SNUBBER
20	1	MACHINE TOOL RELAY, 8-POLE, 120 VAC COIL
21	1	TIMING RELAY, SINGLE-SHOT, KNOB ADJUSTABLE, 7 - 600 SECONDS
22	1	CONTROL RELAY, DPDT, 10 AMP CONTACTS, 120 VAC COIL
23	1	RELAY, INTRINSICALLY SAFE
24	1	FUSE, 100 AMP, 600 V (F6)
25	1	FUSE BLOCK SINGLE POLE

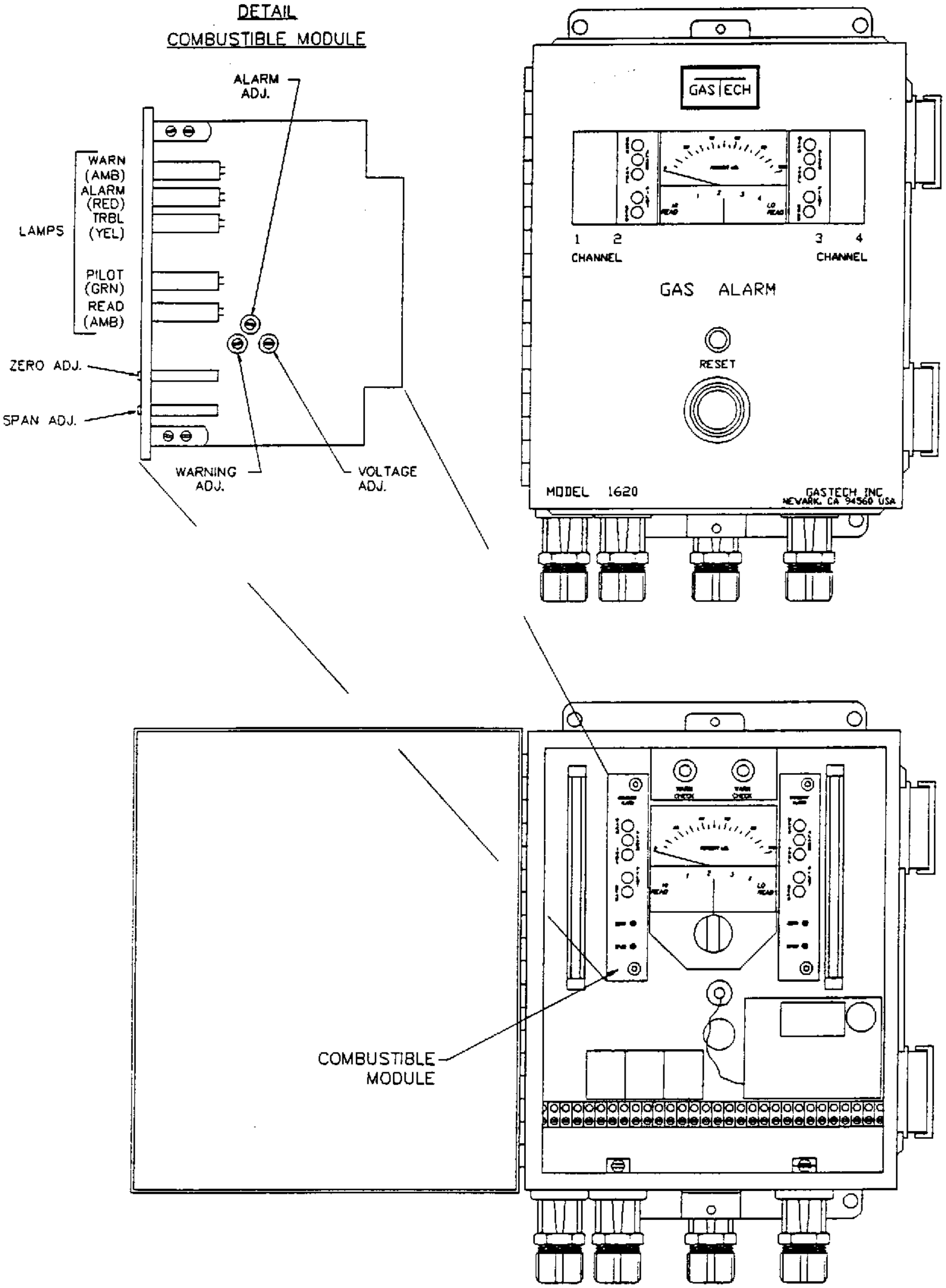
E9108-59

Key to Contents of Catalytic Scavenger Control Module.

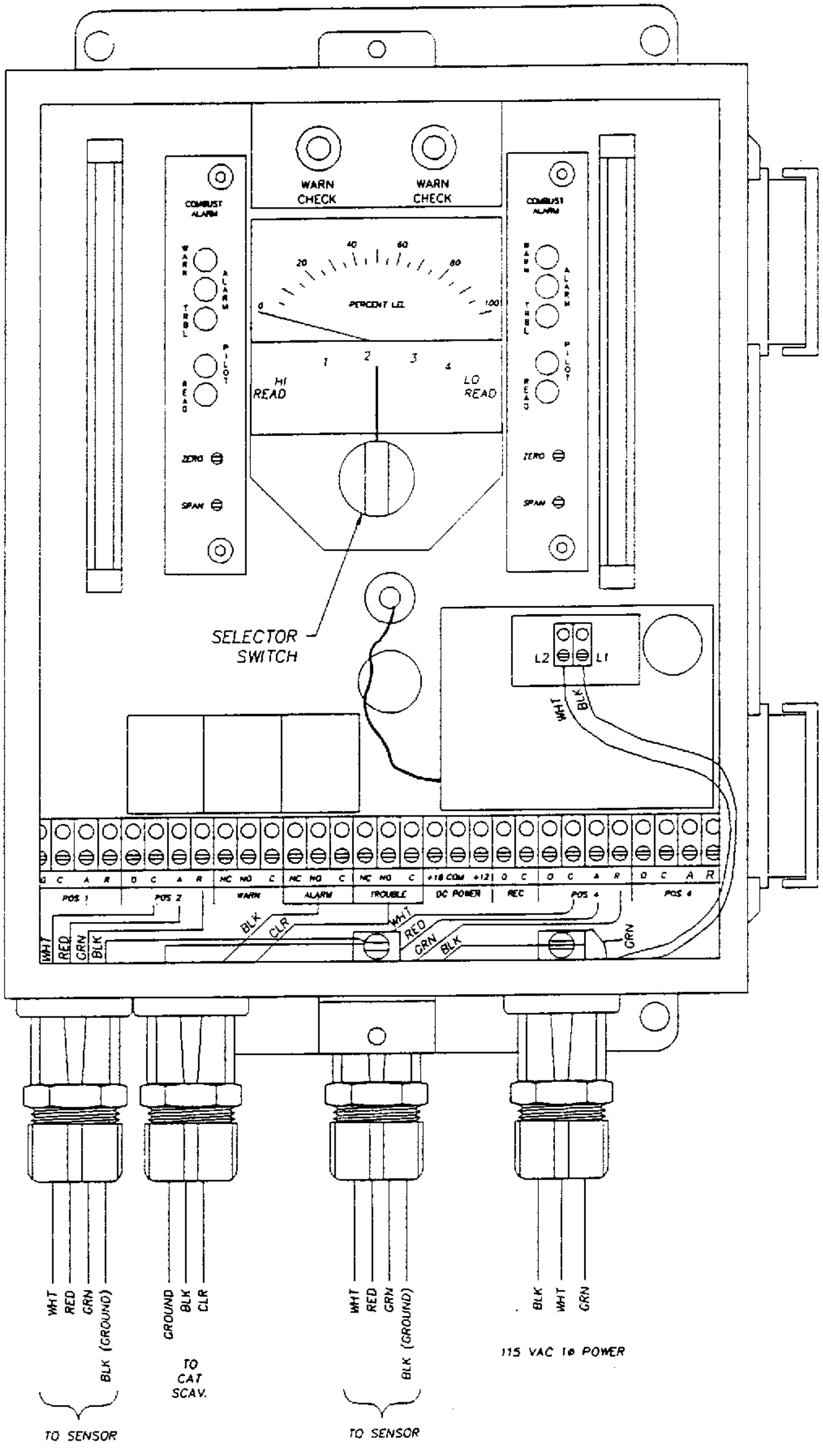


VOC CATALYTIC OXIDATION LIGHT-OFF CURVES

ECAT-3



Gas Alarm Controller.



Internal Components of Gas Alarm Controller.

APPENDIX B

MANUFACTURER'S SPECIFICATIONS ON VAPOR PHASE CARBON

Quality Certified

VOCarb™
Air Purification Carbon

DESCRIPTION

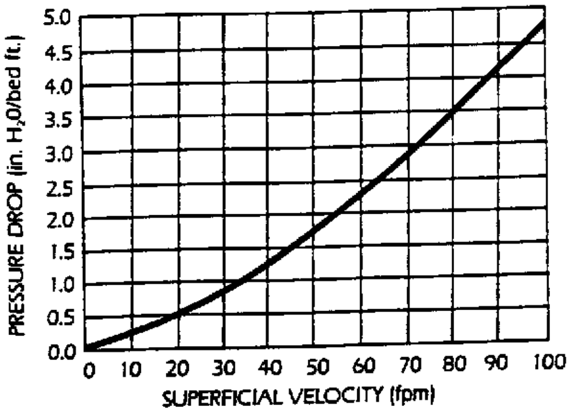
Westates' VOCarb™ activated carbon is the premier activated carbon for air purfication applications. VOCarb activated carbon's high retentivity results in VOC adsorption capacities as much as 40% greater than coal based activated carbons. This high retentivity combined with exceptional hardness makes VOCarb activated carbon the best choice for most vapor phase adsorption applications.

QUALITY CERTIFIED

The manufacturing process for activated carbons is a procedure with many variables that require strict quality control. Westates maintains a modern ASTM quality control laboratory to certify that Westates products meet or exceed the required specifications.

Westates VOCarb at 2.2 Kx ma

PRESSURE DROP



SAFETY

Under certain conditions, some chemical compounds may oxidize, decompose, or polymerize in the presence of activated carbon. This could result in temperature increases sufficient to cause ignition. As a result, particular care must be taken with compounds having peroxide-forming tendencies.

WESTATES CAPABILITIES

Westates manufactures, regenerates and tests activated carbon in our own facilities, in addition to selectin carbon from other sources. The com pany has more than 20 years experience in the design of activated carbon adsorption systems. Our technical staff provides expert guidance in selecting the appropriate system for your needs. Our in-house laboratory is fully equipped to provide complete quality control and a continuing analysis of your carbon to maintain maximum adsorption efficiency.

SPECIFICATIONS

Size (U.S. Sieve)	4 x 8
Type	Coconut Shell
CTC - Typical	65%
Retentivity - Typical	39%
Pore Volume - Typical	.55 cc/gm
Surface Area (B.E.T.) Min.	1250 m²/g
Ash Max.	2%
Hardness Min.	97%
Abrasion Min.	98%
Moisture Max.	2%
Mean Particle Diameter	3.4mm
Apparent Density - Typical	.48 gm/cc 29 lb/ft³

APPLICATIONS

- VOC Adsorption Tanks
- Industrial Air Cleaners
- HVAC Adsorption Filters
- Odor Control Systems
- Clean Room Air Purifiers
- VOC Vapor Capture Systems

All information presented here is believed to be reliable and in accordance with accepted engineering practice. However, Westates makes no warranties as to the completeness of the inform tion. Users should evaluate the suitability of eac product to their own particular application. In r case will Westates be liable for any special, indi rect, or consequential damages arising from the sale, resale, or misuse of its products.

WESTATES carbon ACTIVATED CARBON SYSTEM

WESTATES CARBON, INC.
2130 Leo Ave., Los Angeles, CA 90040
PHONE: (213) 722-7500
FAX: (213) 722-8207 TWX: 910-321-2355

SUN-AG INC.
ENVIRONMENTAL PRODUCTS & SERVICES

SUN-AG

105 AVENIDA DE LA ESTRELLA
SUITE 3
SAN CLEMENTE, CALIF. 92672
(714) 498-4834
FAX # (714) 498-3847
TELEX # 681338

Activated Carbon Adsorption Vessel

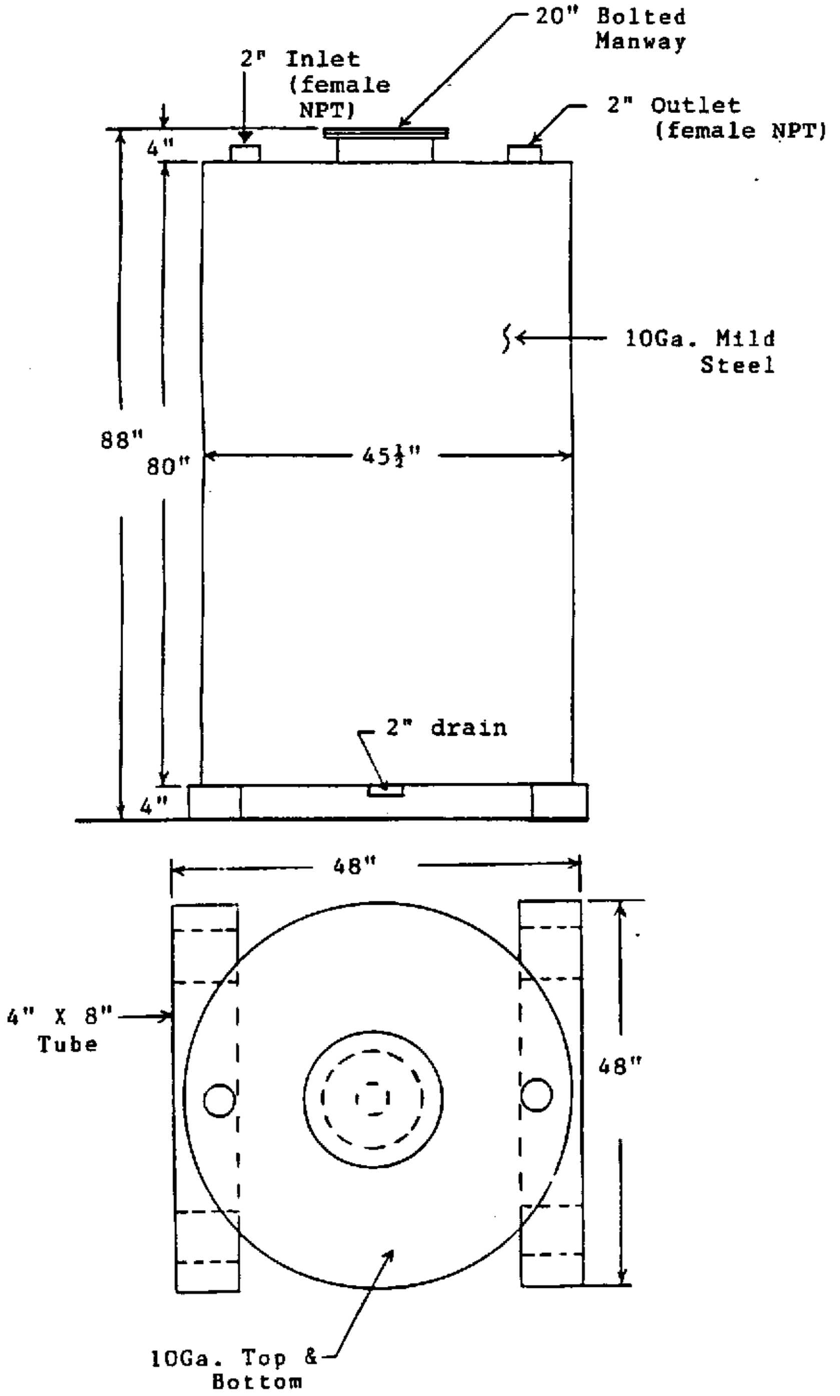
Model SA1000-V

Vapor Phase

- ***Mild-steel construction***
- ***1000 pounds total activated carbon capacity***
- ***Standard 2-part epoxy internal coating***
- ***Optional fused epoxy internal coating***
- ***Standard 6" flanged inlet/outlet***
- ***Skid mounted for simplified maneuverability***
- ***PVC manifold system - high efficiency***
- ***Low pressure drop/high flow***
- ***Fully serviceable for on-site change out and replacement of adsorption media.***

Typical Applications:

- ***Vapor extraction systems***
- ***Tank venting***
- ***VOC control***
- ***Post air stripper***



APPENDIX C

EMISSION RATE CALCULATIONS FOR SYSTEM STARTUP

EMISSIONS RATE CALCULATIONS AT SYSTEM STARTUP

For the following emission calculations, the average influent concentrations observed during the vapor extraction test were used for the initial TPHg and benzene concentrations (Table 5). Additionally, the limitations of the recommended 500 cubic feet per minute (cfm) catalytic oxidizer unit (i.e., maximum influent TPHg concentration of 3,500 parts per million by volume [ppmv]) were also used to determine the below estimated emission rates.

TPHg Extraction Rate Calculation at Startup

$$\frac{34{,}520\ \text{mg TPHg}}{1\ \text{m}^3}\ \frac{1\ \text{g}}{1{,}000\ \text{mg}}\ \frac{1\ \text{mole TPHg}}{100\ \text{g TPHg}}\ \frac{22.414\ \text{l}}{1\ \text{mole}}\ \frac{1\ \text{m}^3}{1{,}000{,}000\ \text{cm3}}\ \frac{1\ \text{cm}^3}{1\ \text{ml}}\ \frac{1{,}000\ \text{ml}}{1\ \text{l}} = \frac{7337}{1{,}000{,}000\ \text{l}} = 7337\ \text{ppmv TPHg}$$

The average initial TPHg concentration is 7337 ppmv. To meet the above specified maximum influent concentration the 500 cfm catalytic oxidizer unit can handle (3,500 ppmv TPHg), fresh air dilution in an approximate ratio of 1.1:1 of the extracted vapors will be necessary. This will result in a total extracted vapor flow of 238.1 cfm from onsite soils and a fresh air flow of 261.9 cfm. Hence, the approximate initial TPHg mass extraction rate is estimated in either of the two following ways:

$$\frac{7{,}337\ \text{l (vapor)}}{1{,}000{,}000\ \text{(l air)}}\ \frac{238.1\ \text{ft}^3}{\text{min}}\ \frac{1{,}440\ \text{min}}{\text{day}}\ \frac{28.32\ \text{l (air)}}{1\ \text{ft}^3}\ \frac{1\ \text{mole (gas)}}{22.414\ \text{l (vapor)}}\ \frac{100\ \text{grams}}{1\ \text{mole (gas)}}\ \frac{1\ \text{lb}}{454\ \text{grams}}$$

$$= \frac{701\ \text{lbs TPHg}}{\text{day}}$$

or

$$\frac{3{,}500\ \text{l (vapor)}}{1{,}000{,}000\ \text{(l air)}}\ \frac{500\ \text{ft}^3}{\text{min}}\ \frac{1{,}440\ \text{min}}{\text{day}}\ \frac{28.32\ \text{l (air)}}{1\ \text{ft}^3}\ \frac{1\ \text{mole (gas)}}{22.414\ \text{l (vapor)}}\ \frac{100\ \text{grams}}{1\ \text{mole (gas)}}\ \frac{1\ \text{lb}}{454\ \text{grams}}$$

$$= \frac{701\ \text{lbs TPHg}}{\text{day}}$$

TPHg Emission Rate at Startup after Abatement

The approximate initial TPHg mass emission rate after abatement is as follows:

$$\frac{701\ \text{lbs TPHg}}{\text{day}} \times 0.02\ \text{(for a 98\% destruction efficiency)} = \frac{14\ \text{lbs TPHg}}{\text{day}}$$

Benzene Extraction Rate Calculation at Startup

$$\frac{688\ \text{mg benzene}}{1\ \text{m}^3}\ \frac{1\ \text{g}}{1{,}000\ \text{mg}}\ \frac{1\ \text{mole benzene}}{78\ \text{g benzene}}\ \frac{22.414\ \text{l}}{1\ \text{mole}}\ \frac{1\ \text{m}^3}{1{,}000{,}000\ \text{cm3}}\ \frac{1\ \text{cm}^3}{1\ \text{ml}}\ \frac{1{,}000\ \text{ml}}{1\ \text{l}} = \frac{198\ \text{l}}{1{,}000{,}000\ \text{l}} = 198\ \text{ppmv benzene}$$

The average initial benzene concentration is 198 ppmv. The approximate initial benzene mass extraction rate after fresh air dilution is as follows:

$$\frac{198\ \text{l (vapor)}}{1{,}000{,}000\ \text{(l air)}} \times \frac{238.1\ \text{ft}^3}{\text{min}} \times \frac{1{,}440\ \text{min}}{\text{day}} \times \frac{28.32\ \text{l (air)}}{1\ \text{ft}^3} \times \frac{1\ \text{mole (gas)}}{22.414\ \text{l (vapor)}} \times \frac{78\ \text{grams}}{1\ \text{mole (gas)}} \times \frac{1\ \text{lb}}{454\ \text{grams}}$$

$$= \frac{14.7\ \text{lbs benzene}}{\text{day}}$$

Benzene Emission Rate at Startup after Abatement

The approximate initial benzene mass emission rate after abatement is as follows:

$$\frac{14.7\ \text{lbs benzene}}{\text{day}} \times 0.02\ \text{(for a 98\% destruction efficiency)} = \frac{0.29\ \text{lbs benzene}}{\text{day}}$$