PROGRESS REPORT
SVE PILOT TEST AT BUILDING 406, PARCEL E
HUNTERS POINT NAVAL SHIPYARD
SAN FRANCISCO, CALIFORNIA

Contract No. N67474-98-D-2076
Contract Task Order No. 0033

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June 21, 2001

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U.S. Department of the Navy
Southwest Division
Naval Facilities Engineering Command
1220 Pacific Highway
San Diego, California 92132-5190

Submitted by:

IT Corporation
4005 Port Chicago Highway
Concord, California 94520-1120

IT CORPORATION
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NAVFACENGCOM-SWDIV
Michelle Crook, 02R1.MC
1230 Columbia St., Suite 1100
San Diego, CA 92101

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FROM:
Mike Garant
Project Manager

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Acronyms and Abbreviations

cfm	cubic feet per minute
EPA	U.S. Environmental Protection Agency
Hg	mercury
HPNS	Hunters Point Naval Shipyard
IR	Installation Restoration
IT	IT Corporation
lb	pound
lb/hr	pound(s) per hour
PID	photoionization detector
ppmv	parts per million by volume
ROI	radius of influence
scfm	standard cubic feet per minute
SVE	soil vapor extraction
TCE	trichloroethene
TtEMI	Tetra Tech EM, Inc.
VM	vapor monitoring
VOC	volatile organic compound
wc	water column

1.0 Introduction

This field activity report is prepared to provide information to the Department of the Navy, Southwestern Division, concerning the progress of the soil vapor extraction (SVE) treatability testing being conducted at Building 406 in Parcel E, within the Hunters Point Naval Shipyard (HPNS) in San Francisco, California. The treatability pilot testing is currently being performed by IT Corporation (IT) under Remedial Action Contract No. N62474-98-D-2076, Contract Task Order 0033.

This report covers the period from system installation to the first month of constant rate testing. Field activities performed are summarized in Section 2.0. Test data collected were reduced and are presented in Section 3.0. Subsequent activities to be covered in the next reporting period are highlighted in Section 4.0. Data summary tables and figures are included in the appendices.

2.0 Activities Completed During Reporting Period

Activities completed were (1) completion of the SVE pilot-scale system and (2) performance of constant rate testing at Building 406. Construction of the pilot-scale system was initially completed in March 2001. Due to new findings obtained during well step testing, a slight modification of the SVE equipment was made. The new SVE system was completely installed in early May 2001. Further details on system construction are provided in Section 2.1. Following system construction were baseline wellhead vapor sampling, step testing, and constant rate testing. Descriptions of the activities are also presented in the following subsections.

2.1 Pilot-Scale System Installation

During the construction of the pilot test system, IT installed three SVE wells and 15 vapor monitoring (VM) wells. All of the wells are located inside the building. The SVE wells are screened from near floor surface to the lowest depth above the groundwater table. The VM wells are screened in two depths in all except one location. IR36SG012 is the one location with only a shallow well installed due to refusal in the vadose zone. The shallow and deep VM wells are located adjacent to one another in separate boreholes. The location and identification of the SVE and VM wells are in general accordance with the *Phase II Soil Vapor Extraction Treatability Study Work Plan* prepared by Tetra Tech EM, Inc. (TtEMI), for HPNS, dated July 28, 2000. The physical locations of the wells were adjusted in the field to accommodate actual site conditions.

the field to accommodate actual site conditions. A summary of the as-built well construction details is presented in Attachment 1 of Appendix A, "Data Summary Tables."

In addition to well construction, a pilot-scale SVE blower system was installed. The system consisted of a skid-mounted blower unit (equipped with a liquid-vapor separator, a condensate discharge pump, air filters, and silencers) and vapor-phase carbon vessels connected in series. All SVE equipment was placed outside the building.

A 200-cubic feet per minute (cfm) blower unit was initially installed at the building site. The unit capacity was based on an assumed design value of 50 cfm per well and 150 cfm for three wells. For lack of pertinent site-specific information on the subsurface characteristics at Building 406 during the equipment design and selection stage, results obtained by a different contractor in a previous treatability study conducted in other building sites were used to establish this design value. This assumed value had been proven rather valid and appropriate for the other Parcels B and C building sites at which SVE treatability studies were ongoing. The airflow yields per well at those sites varied from 10 to 50 cfm, as summarized in the previous SVE progress reports for Parcel B and Parcel C IR sites prepared by IT.

This design basis, however, was found not applicable to Building 406. During the performance of step testing using the 200-cfm blower unit, each of the three SVE wells showed an airflow yield from 80 cfm at 2½ inches water column (wc) to 200 cfm at 10 inches wc. At the maximum flow yield measured at the SVE well, none of the nearest VM wells (i.e., located less than 10 feet away) showed observable vacuum influence. The new findings necessitated the replacement with a blower unit of greater capacity. The blower capacity and carbon quantity later installed for the pilot-scale SVE system are summarized in Table 1, "Blower Capacity and Carbon Quantity for the SVE Treatability Study Site," as follows:

Table 1
Blower Capacity and Carbon Quantity for the SVE Treatability Study Site

IR Site	Building Number	Blower Capacity	Carbon Quantity
36	406	600 cfm at 8 inches Hg	2,000 pounds

Hg denotes mercury.

2.2 Baseline Wellhead Vapor Sampling

Prior to starting the pilot test, wellhead vapor samples from the SVE wells were collected. Samples were contained in SUMMA™ canisters and shipped to Smart Chemistry (formerly JPB Corporation) of Sacramento, California for analysis using U.S. Environmental Protection

Agency (EPA) Method TO-14. Photoionization detector (PID) readings were also taken at the wellheads during vapor sampling. Analytical data and PID readings for each site are presented in Attachment 2 of Appendix A.

2.3 Step Testing

Step testing was conducted after the completion of equipment installation inspection. The SVE blower unit installed was used for the testing. As previously discussed, the initial step testing conducted in March resulted in the installation of a new blower system of greater capacity. A blower with an operating capacity of 600 cfm was later acquired for system testing. In the initial step testing, the SVE wells were tested from 2½ inches wc to 10 inches wc. After the blower replacement, the SVE system was tested at 2½ inches mercury (Hg), 3½ inches Hg, and 4½ inches Hg. Each test run lasted for at least 2 hours. At the end of each test, oxygen content and PID readings were taken at the wellheads of each SVE well and VM well using field instruments. The oxygen level in the SVE and VM wells were measured at approximately 20 percent prior to well step testing. No substantial increase in the oxygen level was noted in each of the wells during and after step testing. Influent and effluent vapor samples were collected from the vapor-phase carbon adsorption units to determine carbon treatment efficiencies. The samples were shipped in SUMMA™ canisters to Smart Chemistry for EPA TO-14 analysis.

While conducting step testing at 4½ inches Hg, a maximum flow of 600 cfm was reached at the test well, IR36VW02. However, only slight vacuum influence was observed in most of the VM wells. The highest vacuum measured at the nearest observation well (i.e., a VM well) was 0.2 inches wc. Similar responses were noted at the other two SVE wells. Because the observation wells are located primarily east, north, and south of the test well and none of them experienced significant vacuum influence when the test well induced a substantially high airflow yield, much of the airflow is suspected to have come from outside the building on the west. A plot of extraction airflow yield from the test well versus vacuum applied during the step testing is presented in Appendix B, "Soil Vapor Extraction System Performance Plots" (see Figure 1, "Plot of Vacuum vs. Extraction Airflow for SVE Wells During Step Test at IR36"). The plot also included data collected during the initial step testing conducted in March.

2.4 Constant Rate Testing

The constant rate testing started on May 14. The SVE system was placed on 24-hour continuous run, except for a short-term shutdown period around the Memorial Holiday. System operations were monitored at various frequencies since the startup of the equipment: from once every 2 hours for the first 8 to 10 hours on the first day of operation to once every 8 hours on the

third day of the operation. Beginning the fourth day of the operation, system monitoring was reduced to once daily. Carbon treatment system samples were collected once daily for the first three days of operation and once a week thereafter for the subsequent two weeks of operation.

3.0 Data and Results Presentation

This section reviews the performance of the SVE pilot test system based on the following four areas: (1) radius of vacuum influence, (2) extraction flow rate and mass removal, (3) carbon treatment, and (4) well performance.

3.1 Radius of Vacuum Influence

The estimated average radius of vacuum influence observed at the building site is presented in Table 2, "Estimated Radius of Vacuum Influence at the SVE Treatability Study Site." The radius of influence (ROI) is determined based on a minimum vacuum reading of 0.1 inch wc observed at the furthermost observation well from the SVE well.

Table 2
Estimated Radius of Vacuum Influence at the SVE Treatability Study Site

IR Site	Building Number	Vacuum Operated for Constant Rate Test (inches Hg)	Estimated Average ROI[(a)] (feet)
36	406	2.5 to 4.0	15

(a) Determined based on vacuum observed in VM wells located nearest an SVE well.

The average ROI shown is considered the minimum since the SVE wells could only be operated at 2½ inches Hg vacuum at best given the high airflow yield. Enhancement of the ROI, if desired, may be achieved with a blower unit of even greater capacity. However, further investigations of the extent of the subsurface soil/soil gas contamination and vadose zone characteristics would be necessary to determine the most appropriate approach for enhancing the ROI.

3.2 System Extraction Flow Rate and Volatile Organic Compound Mass Removal

The extraction airflow yield measured during the constant rate testing was approximately 530 cfm (see Table 2). The airflow yield was maintained rather steadily since the commencement of the test. Significant moisture entrainment was not noted at this site. IR36VW02 was operating at near full capacity (i.e., 2½ inches Hg) because of its relatively high,

baseline total vapor concentration (see Appendix A, Attachment 2). IR36VW01 and IR36VW03 were also operating but at lower vacuum. The two SVE wells were primarily used to assist in recovering the contaminants from the subsurface soil.

Together, all three SVE wells recovered as much as 1½ pounds of volatile organic compound (VOC) with approximately 300 hours of system operation. The predominant VOC detected in the soil vapor was trichloroethene (TCE). The rate of VOC mass removal from the vadose zone was found gradually decreasing after 24 hours of continuous operation (see Appendix B, Figure 3, "Plot of VOC Mass Extraction Rate Over Hours of System Operation at IR36"). Mass removal data are summarized in Table 3, "Summary of Volatile Organic Compound Mass Removal Rate and Cumulative Mass Removal," presented as follows:

Table 3
Summary of Volatile Organic Compound Mass Removal Rate and Cumulative Mass Removal

IR Site	Building Number	Average Airflow Yield (scfm)	VOC Mass Removal Rates (lb/hr)	Predominant VOC Species Detected	Cumulative VOC Mass Removal (lb)
36	406	530	0.004 to 0.011	TCE	1.5

lb denotes pound.
lb/hr denotes pounds per hour.
scfm denotes standard cubic feet per minute.

A PID was also used to monitor the soil vapor concentration at the SVE system inlet. Measured PID readings were plotted against hours of system operation. In spite of the apparent differences between the PID measurements and the laboratory data, the changes in the influent soil vapor concentration over time based on PID readings mirrored those observed in the VOC mass extraction rates established using the laboratory analytical results (see Appendix B, Figure 2, "Plot of Influent Soil Vapor Concentration Over Hours of System Operation at IR 36"). All mass removal rates were calculated using the influent vapor sample analytical data. Appendix B contains plots on VOC mass extraction rate and cumulative VOC mass extraction over time (see Appendix B, Figure 3 and Figure 4, "Plot of Cumulative VOC Mass Extraction vs. Hours of System Operation at IR36."

3.3 Vapor-Phase Carbon Treatment

Based on the analytical results of the influent and effluent vapor samples collected from the vapor-phase carbon treatment units, the vapor treatment efficiencies for the SVE system were generally maintained above 90 percent (see Appendix B, Figure 5, "Plot of Carbon Treatment Unit Influent and Effluent Concentrations vs. Hours of System Operation at IR36"). PID readings were also used to provide qualitative monitoring of the carbon treatment efficiency and signs of carbon bed breakthrough. PID measurements were generally consistent with the laboratory results, except when the instruments experienced interference that resulted in erroneous readings. Much of the interference was apparently caused by the presence of excess fine solid particles in the vapor stream when a relatively large volume of air was yielded from the SVE wells. As such, frequent maintenance of the PID instrument was required to ensure that proper measurements were obtained. In summary, during the operating period, no carbon breakthrough was believed to have occurred. Vapor-phase carbon continued to effectively treat the soil vapor removed from the vadose zone.

3.4 Well Performance

All three SVE wells were operating during this reporting period. Although each SVE well could yield the maximum flow, only IR36VW02 was operating at a higher vacuum of 2½ inches Hg. IR36VW01 and IR36VW03 were operating at lower vacuum to assist in balancing system airflow and recovering VOC from the vadose zone. Since system startup, the SVE and VM wells experienced significant fluctuations in the wellhead vapor concentrations. Most of the fluctuations occurred in the 100^{th} and 200^{th} hours of operation. It is not readily known what caused the fluctuations. This phenomenon will be continuously monitored as the system testing progresses.

Generally, PID readings taken from the wells were mostly lower than 20 parts per million by volume (ppmv). IR36SG013D was the only one with most of the PID readings above 20 ppmv. This well would be a good candidate to assist in evaluating SVE treatment effectiveness based on the reduction of total VOC concentrations measured at the wellhead. Although with fluctuations, most of the wellhead PID readings showed gradual decreases over time, similar to the decrease in the VOC mass removal rate measured at the blower system inlet.

4.0 Activities Anticipated for Next Reporting Period

Constant rate testing of the SVE pilot-scale system is expected to continue. Routine system monitoring will continue to be conducted weekly, with biweekly system vapor sampling for laboratory analysis. Vapor-phase carbon treatment will be monitored based on PID readings and laboratory vapor sample results. Laboratory data will also be used to confirm if carbon breakthrough occurs. To verify if carbon breakthrough occurs, a 24-turnaround time will be requested of the system samples collected.

APPENDIX A
DATA SUMMARY TABLES

Appendix A contains the following:

Attachment 1: Soil Vapor Extraction Well Construction As-Builts

Attachment 2: Baseline Wellhead Vapor Concentrations for Soil Vapor Extraction Wells

ATTACHMENT 1
SOIL VAPOR EXTRACTION WELL CONSTRUCTION AS-BUILTS

Soil Vapor Well Construction Details

				Direct Push / Continuous Soil Sampling			Well Completion				
Vapor Extraction Wells											
Parcel	RU	Well No.	Well Type	Boring drill date	TD of Boring (feet bgs)	Comments	Date of Well Completion	Well TD	Screen Interval	Well Diameter (in.)	Comments
	IR-36	IR36VW01	VEW	11/06/2000	6		11/13/2000	6.0	2 - 6 '	4 "	Refusal at 6 '
	IR-36	IR36VW02	VEW	11/07/2000	6		11/28/2000	8.5	2 - 8.5 '	4 "	Refusal at 8.5 '
	IR-36	IR36VW03	VEW	11/06/2000	5	Refusal at 5 '	11/28/2000	10.0	2 - 10 '	4 "	Aboveground completion
Vapor Monitoring Points (Lower Zone)											
	IR-36	IR36SG007	VMP-U	11/06/2000	6		11/14/2000	5.0	2 - 5 '	2 "	Aboveground completion
	IR-36	IR36SG008	VMP-U	11/06/2000	6		11/13/2000	3.5	2 - 3.5 '	2 "	Refusal at 3.5 '
	IR-36	IR36SG009	VMP-U	11/06/2000	6		11/27/2000	4.0	2 - 4 '	2 "	Refusal at 4 '
	IR-36	IR36SG010	VMP-U	11/06/2000	7		11/27/2000	5.0	2 - 5 '	2 "	Aboveground completion
	IR-36	IR36SG011	VMP-U	11/07/2000	4.5		11/14/2000	5.0	2 - 5 '	2 "	Aboveground completion
	IR-36	IR36SG012	VMP-U	11/06/2000	5.5	Refusal at 5.5 '	11/15/2000	5.0	2 - 5 '	2 "	Aboveground completion
	IR-36	IR36SG013	VMP-U	11/07/2000	6		11/29/2000	5.0	2 - 5 '	2 "	Aboveground completion
	IR-36	IR36SG014	VMP-U	11/06/2000	6		11/15/2000	5.0	2 - 5 '	2 "	Aboveground completion
Vapor Monitoring Points (Upper Zone)											
	IR-36	IR36SG007	VMP-L	same as lower zone wells; one boring done for each lower/upper zone well			11/14/2000	8.0	6 - 8 '	2 "	Refusal at 8 '
	IR-36	IR36SG008	VMP-L				11/13/2000	6.0	4 - 6 '	2 "	Refusal at 6 '
	IR-36	IR36SG009	VMP-L				11/27/2000	10.0	6 - 10 '	2 "	Aboveground completion
	IR-36	IR36SG010	VMP-L				11/27/2000	10.0	6 - 10 '	2 "	Aboveground completion
	IR-36	IR36SG011	VMP-L				11/15/2000	9.4	6 - 9.4 '	2 "	Refusal at 9.4 '
	IR-36	IR36SG012	VMP-L				----	----	----	----	Refusal at 5 '
	IR-36	IR36SG013	VMP-L				11/15/2000	10.0	6 - 10 '	2 "	Aboveground completion
	IR-36	IR36SG014	VMP-L				11/15/2000	10.0	6 - 10 '	2 "	Aboveground completion
9											

Legends:

VEW = vapor extraction well
VMP-L = vapor monitoring well, lower zone
VMP-U = vapor monitoring well, upper zone

ATTACHMENT 2
BASELINE WELLHEAD VAPOR CONCENTRATIONS FOR SOIL VAPOR EXTRACTION WELLS

Baseline Wellhead Vapor Concentrations
for SVE Wells at IR36, Building 406
Hunters Point Naval Shipyard, SF, CA

SVE Well ID	PID Reading (PPMv)	Laboratory Results of Detected VOC (PPMv)				Total Detected VOC (PPMv) (a)	Ratio of Field to Lab Results (b)
		2-Butanone	cis-1,2-Dichloroethene	Methylene Chloride	Trichloroethene		
IR36VW01	130	ND	0.237	0.323	1.43	2.0	65.3
IR36VW02	205	ND	3.47	ND	12.2	15.7	13.1
IR36VW03	245	1.74	0.811	ND	4.94	7.5	32.7

Explanations:

(a) The total volatile organic concentration is the sum of the concentrations of only detected volatile organic compounds (VOC), including those with "J" qualifier.

(b) The ratio of field to lab results for the vapor sample collected at each SVE well is determined by dividing the PID reading by the total volatile organic concentration measured in the offsite laboratory.

ND = Not detected at the method quatitation limit.

PPMv = Parts per million by volume

APPENDIX B
SOIL VAPOR EXTRACTION SYSTEM PERFORMANCE PLOTS

Appendix B contains the following:

Attachment 1: System Performance Plots for Building 406

ATTACHMENT 1
SYSTEM PERFORMANCE PLOTS FOR BUILDING 406

Figure 1 -- Plot of Vacuum vs. Extraction Airflow for SVE Wells During Step Test at IR36, Building 406, HPS, SF, CA

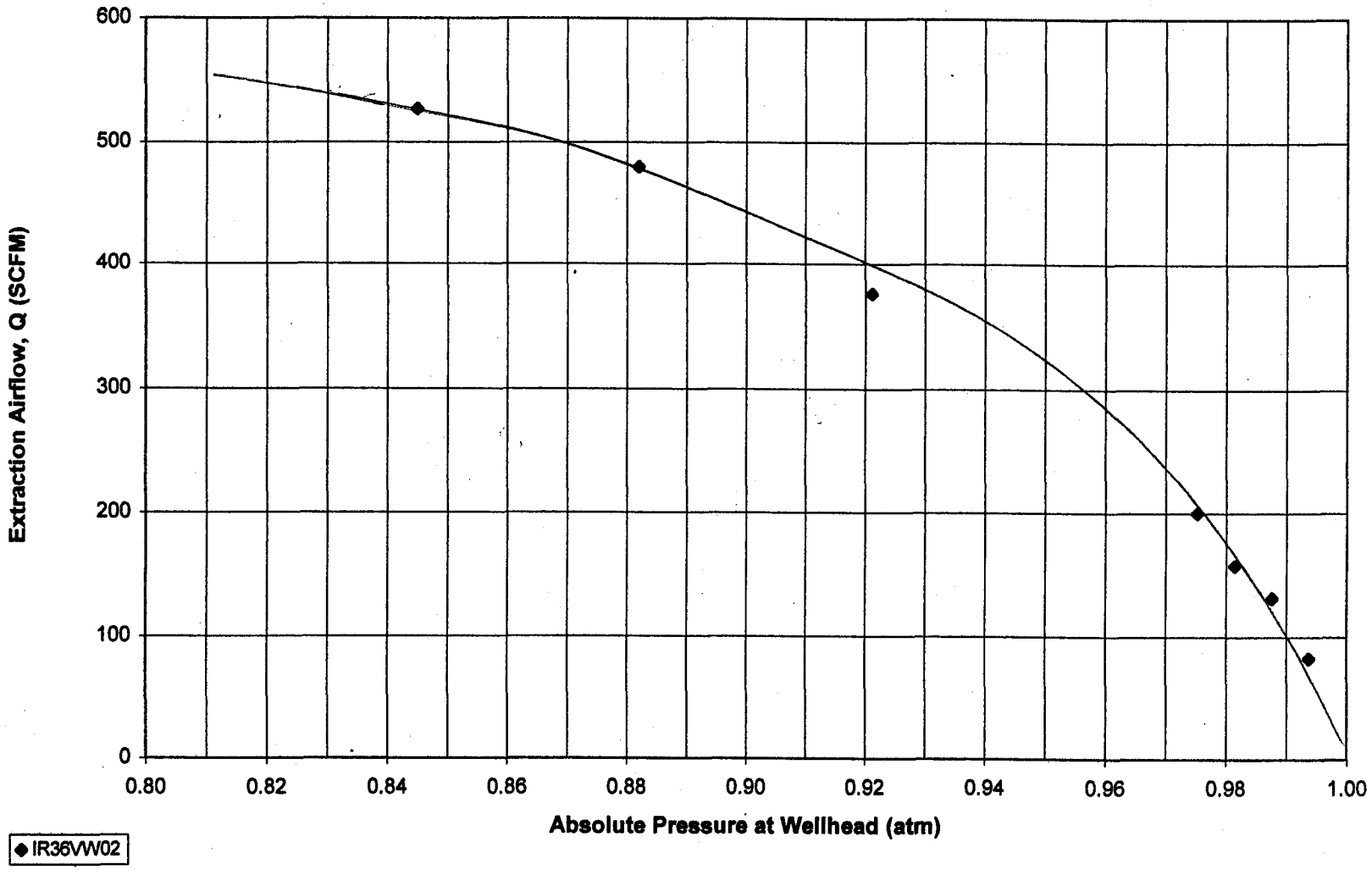

Figure 2 -- Plot of Influent Soil Vapor Concentration Over Hours of System Operation at IR36, Building 406, HPS, SF, CA

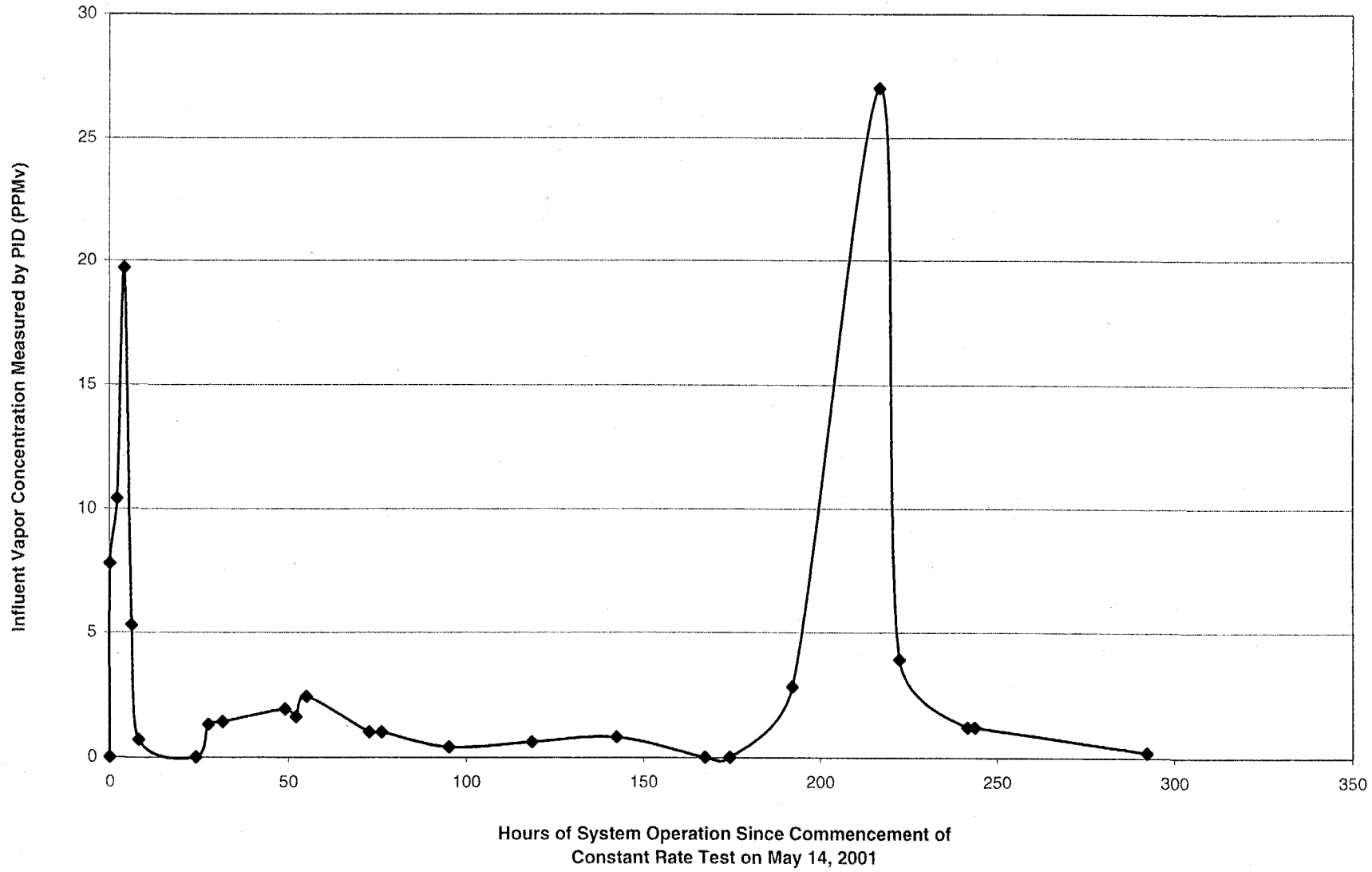

Figure 3 -- Plot of VOC Mass Extraction Rate Over Hours of System Operation at IR36, Building 406, HPS, SF, CA

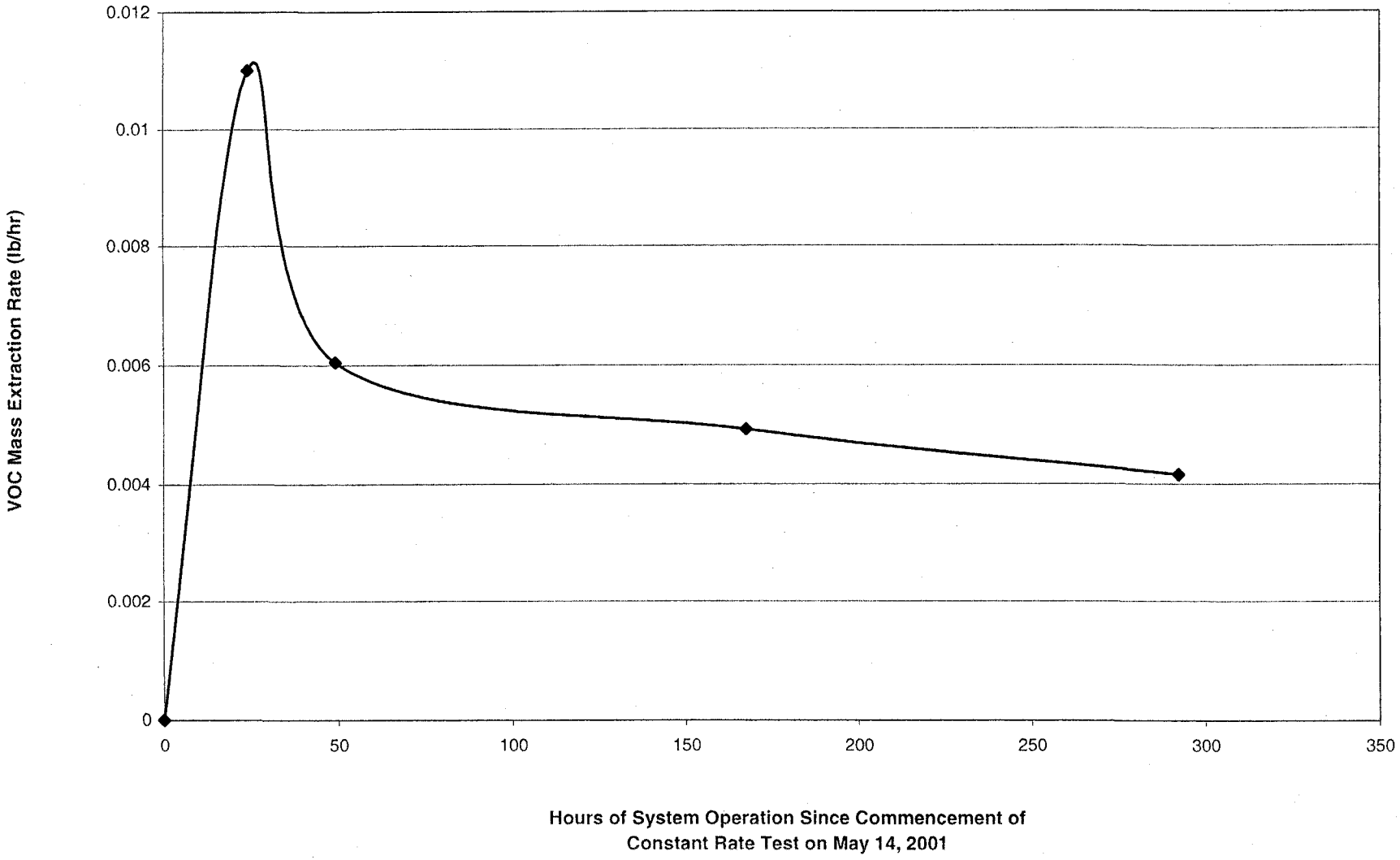

Figure 4 -- Plot of Cumulative VOC Mass Extraction Versus Hours of System Operation at IR36, Building 406, HPS, SF, CA

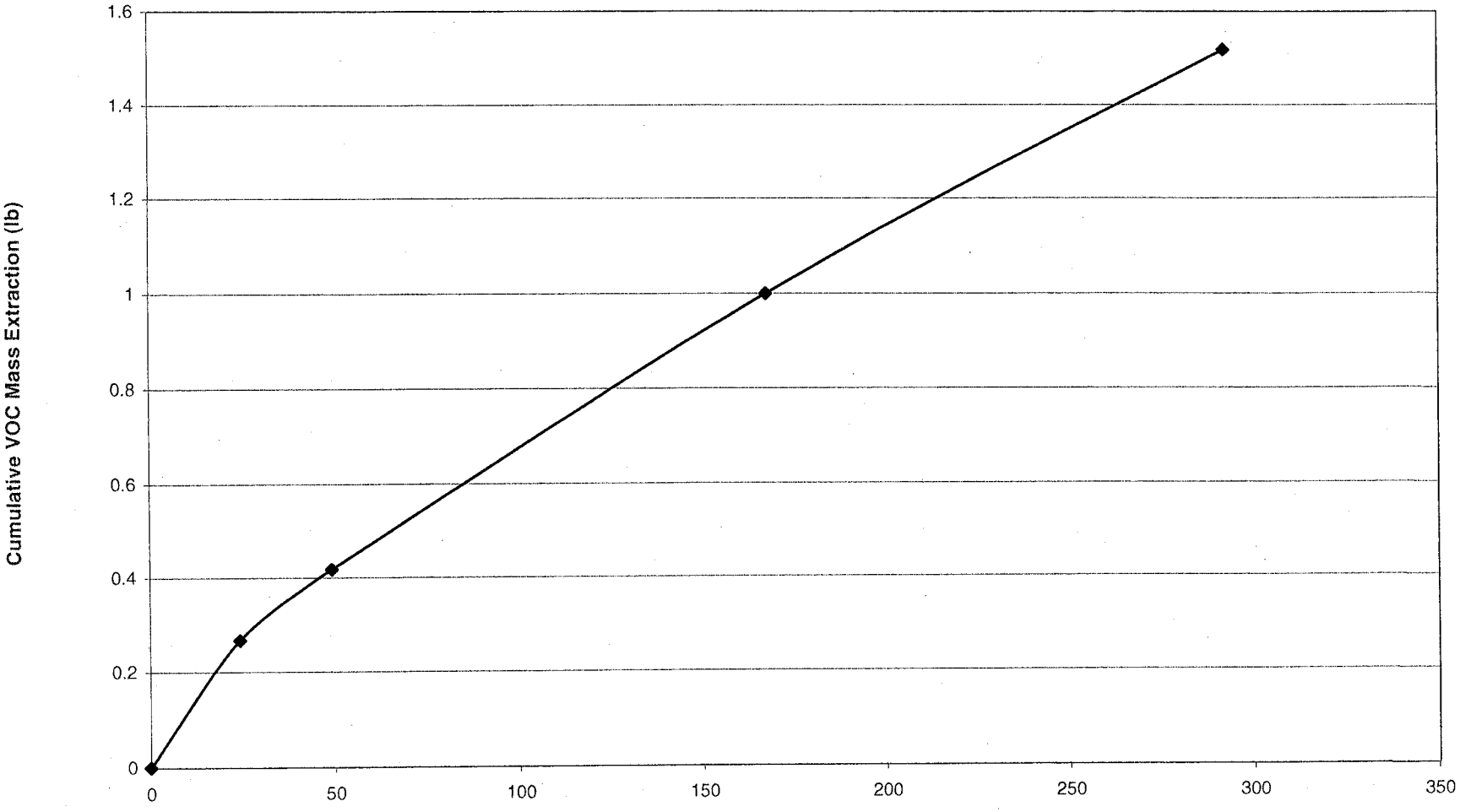

Figure 5 -- Plot of Carbon Treatment Unit Influent and Effluent Concentrations Versus Hours of System Operation at IR36, Building 406, HPS, SF, CA