LOAN DOCUMENT

PHOTOGRAPH THIS SHEET

LEVEL

INVENTORY (0)

DTIC ACCESSION NUMBER

Extended Bioventing Testing Results . . .

DOCUMENT IDENTIFICATION

17 Sep 96

DISTRIBUTION STATEMENT A
Approved for Public Release
Distribution Unlimited

DISTRIBUTION STATEMENT

HANDLE WITH CARE

ACCESSION FOR
NTIS GRA&I ☑
DTIC TRAC ☐
UNANNOUNCED ☐
JUSTIFICATION

BY

DISTRIBUTION/

AVAILABILITY CODES

DISTRIBUTION	AVAILABILITY AND/OR SPECIAL	
A-1		

DISTRIBUTION STAMP

DATE ACCESSIONED

DATE RETURNED

20001214 092

DATE RECEIVED IN DTIC

REGISTERED OR CERTIFIED NUMBER

PHOTOGRAPH THIS SHEET AND RETURN TO DTIC-FDAC

DTIC FORM 70A JUN 90

DOCUMENT PROCESSING SHEET

PREVIOUS EDITIONS MAY BE USED UNTIL STOCK IS EXHAUSTED.

LOAN DOCUMENT

PARSONS ENGINEERING SCIENCE, INC.

290 Elwood Davis Road, Suite 312 • Liverpool, New York 13088 • (315) 451-9560 • Fax (315) 451-9570

Telecon 25 Sep 96 w/ Jack M. & Paul K. @ WARB - Proceed w/ closure w/ confirmatory sampling. If samples indicate A-2 status - great. If not class A-3 is acceptable. Phoned John Ratz + asked to proceed. EBM

September 17, 1996

Capt. Ed Marchand
AFCEE/ERT
3207 North Road, Bldg. 532
Brooks AFB, Texas 78235-5363

Subject: Extended Bioventing Testing Results at the Medical Training Facility, Westover ARB (Contract No. F41624-95-R-8036, Order 17)

Dear Capt. Marchand:

Parsons Engineering Science, Inc. (Parsons ES) is pleased to submit the results of the extended bioventing testing at the Medical Training Facility (MTF) at Westover Air Reserve Base (ARB), located in Chicopee, Massachusetts. Soil gas samples were collected and *in situ* respiration testing was performed by Parsons ES from 29 July 1996 to 2 August 1996 to assess the extent of remediation completed during one year of air injection bioventing. The purpose of this letter is to summarize bioventing activities to date, present the results of the most recent respiration testing and soil gas sampling, and make recommendations based on site data. A site layout and three tables are attached. The as-built bioventing system and sampling/respiration testing locations are illustrated on Figure 1. Table 1 summarizes soil analytical results as compared to State of Massachusetts criteria. Tables 2 provides results of initial and 1-year soil gas sampling, and Table 3 provides results of initial and 1-year respiration testing.

SITE/PROJECT HISTORY

In October 1994 during construction of a new Medical Training Facility, the Army Corps of Engineers uncovered an abandoned 2,000 gallon underground #2 fuel oil storage tank. In November 1994 the Corps proceeded to remove the tank and some contaminated soil surrounding the tank. Environmental Compliance Services, Inc. (ECS) was contracted to conduct Initial Response Actions (IRA) including performing a soil gas survey at 12 locations near the construction site, collecting three groundwater samples from temporary monitoring wells upgradient and downgradient of the former under ground storage tank (UST), and performing a ground penetrating radar (GPR) survey in the area of the former UST to identify the possible presence of additional USTs in the area.

AQM01-03-0531

The ECS assessment activities revealed no evidence of groundwater contamination near the former UST area, and no evidence of soil gas contamination or additional USTs in the area outside of the former UST area.

In December 1994, Tighe and Bond, Inc. advanced four soil borings to the groundwater table within the new building footprint in order to further delineate the extent of contamination. These soil borings locations are shown on Figure 1. Soil samples were collected from each boring and analyzed for total petroleum hydrocarbons (TPH). Two soil samples, collected from soil borings B-1 and B-3 from between 15 and 25 feet below ground surface, contained TPH concentrations above 10,000 mg/kg, which exceeded the Massachusetts Department of Environmental Protection (DEP) risk-based soil clean-up standard of 5,000 ppm.

In April 1995, a pilot scale bioventing system was installed in the MTF area by Parsons Engineering Science, Inc. (Parsons ES) as part of the Air Force Center for Environmental Excellence (AFCEE) Extended Bioventing Project (Contract No. F41624-92-R-8036, Order 17). As shown in Figure 1, the installed bioventing system consisted of a single vent well (VW), three multi-depth vapor monitoring points (MPs), and a blower unit. During installation, respiration and air permeability testing and soil and soil gas sampling also were performed. A detailed description of bioventing system design and initial site activities are provided in the July 1995 Bioventing Interim Test Results report prepared by Parsons ES for this site. The project at the Medical Training Facility included 1 year of system operation followed by soil gas sampling and respiration testing.

Soil gas samples were collected and *in situ* respiration testing was performed in July and August 1996 following 1 year of system operation. The system was shut down 30 days prior to testing to allow soils and soil gas to come to equilibrium in order to compare 1-year and initial conditions.

EXISTING SOIL DATA AND MASSACHUSETTS DEP CRITERIA

Table 1 provides a summary of soil analytical results obtained during sampling by Tighe and Bond, Inc. in December 1994 and Parsons ES in April 1995, and compares these results to the Massachusetts DEP risked-based soil standards.

A comparison of the April 1995 sampling results with the DEP standards indicates that benzene, toluene, ethylbenzene, and xylene (BTEX) concentrations were below the DEP Class A-2 standards, and TPH concentrations exceeded both Class A-2 and Class A-3 standards prior to the operation of the bioventing system. Achieving Class A-2 standards allows for site closure with no activity use limitations (AUL). Achieving Class

A-3 standards allows for site closure with implementation of an AUL deed restriction. Based on these results and the following soil gas chemistry and respiration testing results, site soil and soil gas contaminants have been reduced significantly, as a result of one year of bioventing system operation, and are now likely to meet Class A-3 standards.

SOIL GAS CHEMISTRY RESULTS

Field screening and collection of soil gas samples for laboratory analysis were performed on 29 July 1996 following one month of system shutdown. The system was inactive for one month to allow soil gas conditions to reach equilibrium. Laboratory soil gas samples were collected from MPA-11-13, MPA-26-28, MPB-12-14, and MPB-19-21. Each MP was field-screened to assess soil gas concentrations of oxygen, carbon dioxide, and total volatile hydrocarbons (TVH). As can be seen from the results presented in Table 2, equilibrium oxygen concentrations in the soil gas have increased with continued bioventing at the site in all MPs except MPA-11-13, MPA-26-28, and MPC-8-10. MPA-11-13 and MPC-8-10 showed only a slight decrease in oxygen concentrations. However, MPA-26-28 showed a 12 percent decrease in equilibrium oxygen concentrations over the one year period. The overall increases in soil gas oxygen concentrations indicate that aerobic hydrocarbon biodegradation rates have decreased substantially, suggesting that very little degradable substrate (fuel hydrocarbons) remain in the soil at these locations. The decrease in soil gas oxygen concentrations at MPA-26-28 suggests that biodegradable petroleum constituents may still exist in the subsurface near this location, and suggest the possibility that petroleum impacted soil gas may have migrated from the center of the former UST excavation, at MPB toward MPA.

Initial and 1-year soil gas samples for laboratory analysis were collected at MPA-11-13, MPA-26-28, MPB-12-14 and MPB-19-21. Soil gas samples were sent to Air Toxics, Ltd. laboratory in Folsom, California and analyzed for TVH and BTEX using EPA Method TO-3. As can be seen from the results at each of the locations sampled, BTEX concentrations in soil gas were reduced to near non-detect levels during the first year of system operation. TVH concentrations were significantly reduced in each of the MPs sampled during the first year of system operation. Analytical soil gas results strongly suggest nearly complete remediation of hydrocarbon contaminants at the MTF, however, field screening data indicates the possible continued presence of biodegradable hydrocarbons.

RESPIRATION TEST RESULTS

After 1-year of system operation, an *in situ* respiration test was also performed at the Medical Training Facility from 27 July 1996 to 2 August 1996. The test was performed

according to procedures outlined in the July 1995 Interim Test Results report and followed one month of bioventing system shutdown and the completion of the soil gas sampling effort. Air was injected for 20 hours into three MPs (MPA-11-13, MPA-26-28 and MPB-26-28), using 1 cubic-foot-per-minute (cfm) pumps, to oxygenate site soils. Following air injection, changes in oxygen, carbon dioxide, and TVH soil gas concentrations were monitored over a 71-hour period. Observed rates of oxygen utilization were then used to estimate aerobic fuel biodegradation rates. Table 3 summarizes initial and 1-year respiration and fuel biodegradation rates at the site.

Observed oxygen utilization rates have increased significantly in MPA-26-28, decreased significantly in MPB-26-28 and renamed the same at MPA-11-13 as a result of bioventing system operation, as shown in Table 3. As a result, estimated fuel biodegradation rates following the first year of system operation increased in MPA-26-28, decreased in MPB-26-28, and remained approximately the same in MPA-11-13. Oxygen utilization and fuel biodegradation rates typically decrease with continued bioventing as the lighter, more readily biodegraded hydrocarbons are preferentially destroyed over more biologically recalcitrant, higher molecular weight hydrocarbons. This is demonstrated by the soil gas results, which show that BTEX compounds have been almost completely biodegraded. The observed increase in oxygen utilization and fuel biodegradation rates at MPA-26-28 was possibly caused by an increase in the microbial population in soils near this sampling point.

RECOMMENDATIONS

Based on initial soil sampling, soil gas and respiration results obtained following initial and extended bioventing system operation, it is recommended that site closure (Option 2) activities be initiated for the MTF site. Parsons ES recommends pursuing closure of the site based on existing data, and as a first deliverable, under Option 2, proposes to complete a Closure Sampling and Analysis Plan (SAP). This plan provides a document for regulatory review which clearly describes the methods of sampling and analysis intended to be used to confirm that site closure requirements are met and outlines the DEP's soil and soil gas sampling requirements necessary for site closure. Following AFCEE and Westover ARB review, the SAP will be forwarded to the Massachusetts DEP for review.

Following approval of the SAP, closure soil sampling will be performed and a Response Action Outcome (RAO) report will be filed with the DEP. If the DEP agrees with site closure based on the data collected, the MTF site will be closed and no further remediation will be required. While Parsons ES believes adequate remediation of the MTF site has occurred, air injection at the site should be continued until site closure is approved by the DEP.

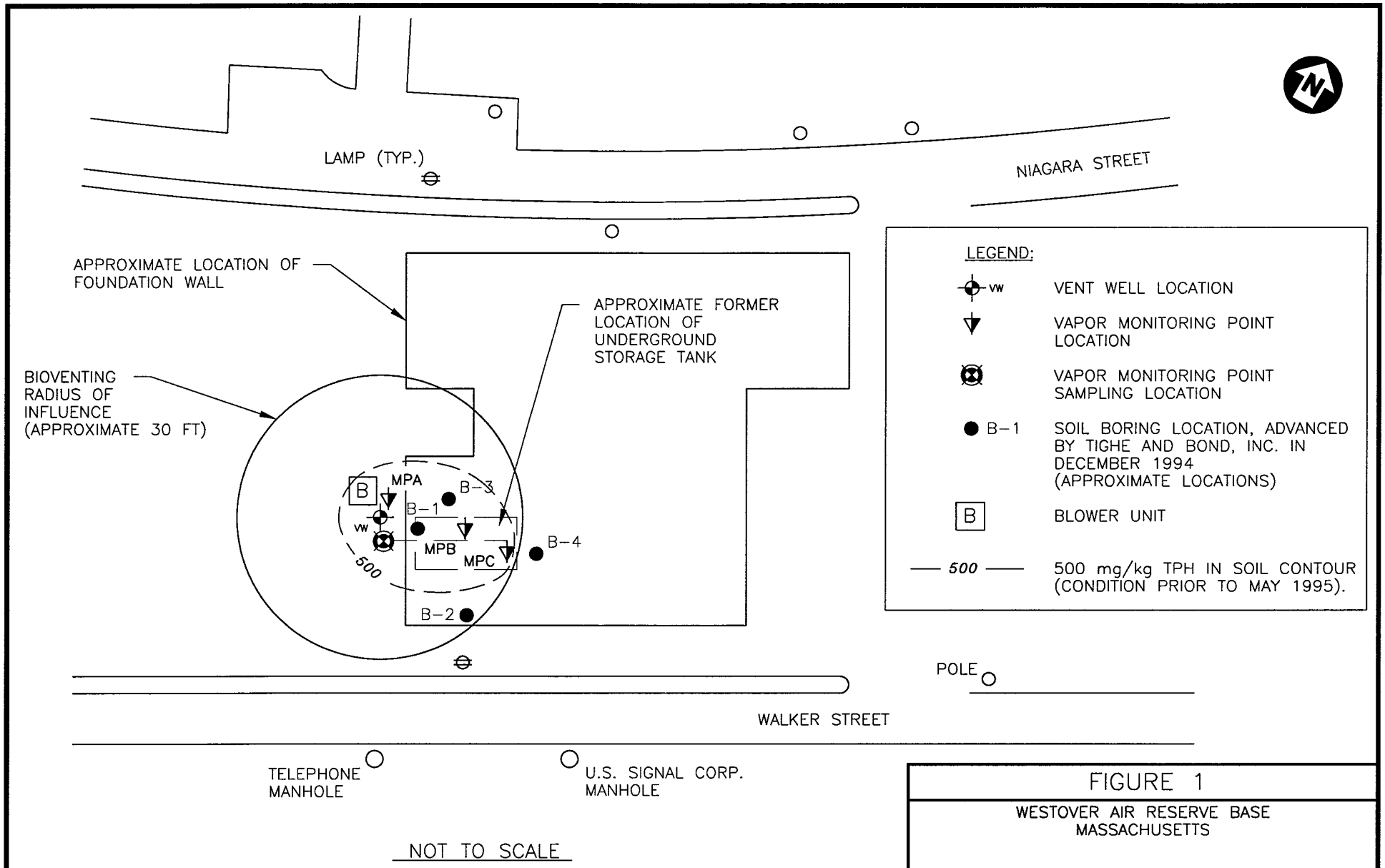
If you have any questions or require additional information, please contact either Mr. John Ratz at (303) 831-8100 or me at (315) 451-9560.

Sincerely,

PARSONS ENGINEERING SCIENCE, INC.

John M. Mastracchio
Environmental Engineer

cc: Mr. Jack Moriarty, Westover ARB
Mr. Paul Kwiatkowski, Westover ARB
Mr. John Ratz, Parsons ES, Denver
File 726876.37110 Letter Results Report



NOT TO SCALE

ORIGINAL DATE: 07/21/95 (SEH)
REVISED DATE: 09/12/96 (SEH)
H:\CAD\726876\26876G09.DWG (MODEL SPACE)

FIGURE 1

WESTOVER AIR RESERVE BASE
MASSACHUSETTS

AS-BUILT BIOVENTING SYSTEM LOCATION
MEDICAL TRAINING FACILITY

PARSONS ENGINEERING SCIENCE, INC.
DESIGN * RESEARCH * PLANNING
290 ELWOOD DAVIS ROAD * SUITE 312 * LIVERPOOL, N.Y. 13088 * 315/451-9560
OFFICES IN PRINCIPAL CITIES

Table 1
Soil Analytical Results Compared to Massachusetts DEP Criteria
Medical Training Facility Site
Westover Air Reserve Base, Massachusetts

	Analyte[a]				
	TPH (mg/kg)[b]	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Xylenes (mg/kg)
Massachusetts DEP Criteria					
Class A-2 Standard[c]	500	10	90	80	500
Class A-3 Standard[d]	5,000	10	90	80	500
Sample Location[e]					
Parsons ES[f]					
VW-14-16	8,650	0.052U[g]	0.052U	0.089	1.1
VW-30-32	405	0.053U	0.053U	0.053U	0.13U
MPA-20-22	4,860	0.053U	0.053U	0.053U	0.39
MPB-20-22	3,210	0.057U	0.057U	0.057U	0.14U
MPB-26-28	5,530	0.068U	0.21	0.068U	1.5
TBI[h]					
B-1	18,000	---[i]	---	---	---
B-2	55	---	---	---	---
B-3	14,000	---	---	---	---
B-4	54	---	---	---	---

[a] TPH=total petroleum hydrocarbons analyzed by EPA Method 418.1; BTEX analyzed by EPA Method SW8020.

[b] mg/kg=milligrams per kilogram.

[c] Class A-2 - Closure with no activity and use limitation (AUL), based on S-1 values.

[d] Class A-3 - Closure with implementation of an AUL deed restriction, based on S-3 values.

[e] Sample location gives location of boring and sample depth in feet below ground surface.

[f] Soil samples collected in April, 1995, by Parsons ES, prior to bioventing system startup.

[g] U=compound analyzed for, but not detected. Number shown represents the method detection limit.

[h] Soil samples collected on December, 1994, by Tighe and Bond, Inc.

[i] ---=not analyzed.

Table 2
Initial and 1-Year Soil Gas Field and Laboratory Analytical Results
Medical Training Facility
Westover Air Reserve Base, Massachusetts

		Field Screening Data			Analytical Data				
Sample Location[a/]	Sampling Event[b/]	Oxygen (percent)	Carbon Dioxide (percent)	Field TVH[c/] (ppmv)[d/]	Laboratory TVH (ppmv)	Benzene (ppmv)	Toluene (ppmv)	Ethylbenzene (ppmv)	Xylenes (ppmv)
VW	Initial	19.5	1	78	150	0.1	1.1	0.32	2.7
	1-Year	—	—	—	—[e/]	—	—	—	—
MPA-11-13	Initial	19.8	1.1	110	260	0.009	0.56	0.74	4.7
	1-Year	19.1	0.6	500	8.8	0.006	0.017	0.015	0.11
MPA-26-28	Initial	19.1	1.5	94	330	0.011U	0.011U	1	5.8
	1-Year	7.0	8.5	1100	45	0.002	0.006	0.014	0.2
MPB-12-14	Initial	19.8	0.8	42	48	0.005	0.15	0.054	0.25
	1-Year	20.0	0.2	100	9.9	0.002U	0.006	0.003	0.027
MPB-19-21	Initial	19.5	1.0	63	240	0.01U	0.26	0.21	0.84
	1-Year	19.9	0.3	600	8.7	0.002	0.004	0.003	0.022
MPB-26-28	Initial	18.9	1.5	150	430	0.0018U	0.0018U	0.53	3.6
	1-Year	20.0	0.0	80	—	—	—	—	—
MPC-8-10	Initial	20.0	0.5	34	—	—	—	—	—
	1-Year	19.2	0.7	300	—	—	—	—	—
MPC-15-17	Initial	20.0	0.5	63	—	—	—	—	—
	1-Year	—[g/]	—	—	—	—	—	—	—
MPC-22-24	Initial	20.0	0.5	32	—	—	—	—	—
	1-Year	20.2	0.0	70	—	—	—	—	—

[a/] Sample location identifies the monitoring point and depth in feet below ground surface.

[b/] Initial soil gas sampling was performed on 5 June 1995. 1-Year soil gas sampling was performed on 29 July 1996.

[c/] TVH=total volatile hydrocarbons.

[d/] ppmv=parts per million, volume per volume.

[e/] ---=not analyzed.

[f/] U=compound analyzed for , but not detected. Number shown represents the method detection limit.

[g/] ---=not analyzed due to flooded monitoring point screen.

Table 3
Medical Training Facility
Respiration and Degradation Rates
Westover Air Reserve Base, Massachusetts

Location-Depth (feet below ground surface)	Initial[a/]		1-Year[b/]	
	K_o (% O_2/min)	Degradation Rate (mg/kg/year)[c/]	K_o (% O_2/min)	Degradation Rate (mg/kg/year)[c,d/]
MPA-11-13	0.00024	71	0.00026	76
MPA-26-28	0.00021	62	0.0028	671
MPB-26-28	0.00028	43	0.000048	7

[a/] Initial respiration testing was performed in June 1995.

[b/] 1-Year respiration testing was performed in July and August 1996.

[c/] Milligrams of hydrocarbons per kilogram of soil per year.

[d/] Assumes moisture content of the soil following 1 year is the same as initial moistures.

DEFENSE TECHNICAL INFORMATION CENTER
REQUEST FOR SCIENTIFIC AND TECHNICAL REPORTS

Title: AFCEE Collection

1. Report Availability *(Please check one box)*

☒ This report is available. *Complete sections 2a - 2f.*

☐ This report is not available. *Complete section 3.*

2a. Number of Copies Forwarded: 1 each

2b. Forwarding Date: July/2000

2c. Distribution Statement *(Please check ONE box)*

DoD Directive 5230.24, "Distribution Statements on Technical Documents," 18 Mar 87, contains seven distribution statements, as described briefly below. Technical documents MUST be assigned a distribution statement.

☒ DISTRIBUTION STATEMENT A: Approved for public release. Distribution is unlimited.

☐ DISTRIBUTION STATEMENT B: Distribution authorized to U.S. Government Agencies only.

☐ DISTRIBUTION STATEMENT C: Distribution authorized to U.S. Government Agencies and their contractors.

☐ DISTRIBUTION STATEMENT D: Distribution authorized to U.S. Department of Defense (DoD) and U.S DoD contractors only.

☐ DISTRIBUTION STATEMENT E: Distribution authorized to U.S. Department of Defense (DoD) components only.

☐ DISTRIBUTION STATEMENT F: Further dissemination only as directed by the controlling DoD office indicated below or by higher authority.

☐ DISTRIBUTION STATEMENT X: Distribution authorized to U.S. Government agencies and private individuals or enterprises eligible to obtain export-controlled technical data in accordance with DoD Directive 5230.25, Withholding of Unclassified Technical Data from Public Disclosure, 6 Nov 84.

2d. Reason For the Above Distribution Statement *(in accordance with DoD Directive 5230.24)*

2e. Controlling Office: HQ AFCEE

2f. Date of Distribution Statement Determination: 15 Nov 2000

3. This report is NOT forwarded for the following reasons. *(Please check appropriate box)*

☐ It was previously forwarded to DTIC on ..... *(date)* and the AD number is .....

☐ It will be published at a later date. Enter approximate date if known. .....

☐ In accordance with the provisions of DoD Directive 3200.12, the requested document is not supplied because:

.....

.....

.....

Print or Type Name	Signature
Laura Peña	Laura Peña
Telephone	*(For DTIC Use Only)*
210-536-1431	AQ Number M01-03-0531