SPONSORING ORGANIZATIONS:

U.S. ARMY ENVIRONMENTAL CENTER
AEC
ABERDEEN PROVING GROUND, MD 21010-5401

NAVAL EXPLOSIVE ORDNANCE DISPOSAL TECHNOLOGY DIVISION
NAVEODTECHDIV
INDIAN HEAD, MD 20640-5070

PREPARED UNDER CONTRACT TO:

INDIAN HEAD DIVISION/NAVAL SURFACE WARFARE CENTER
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JEFFERSON PROVING GROUND PHASE IV TECHNOLOGY DEMONSTRATIONS

REPORT TITLE:

DEMONSTRATION WORK PLAN
Version 2

PREPARED BY:

TETRA TECH EM INC.

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FINAL DOCUMENT

Tetra Tech EM Inc.

FINAL REPORT

CONCEPT ENGINEERING GROUP, INC.

REMEDIATION DEMONSTRATION

AT

JEFFERSON PROVING GROUND

FOR

JPG IV

Submitted by:

Jerome Apt, Jr., P.E.
Project Manager
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NOVEMBER 2-5, 1998

1.0 INTRODUCTION

1.1 Company description.

Concept Engineering Group, Inc. (CEG) was incorporated in 1991 by four principals and is a small business engaged in the design, development and manufacture of safe excavation equipment. It occupies office and shop facilities in Verona, Pennsylvania, a Pittsburgh suburb. It has designed and built safe excavation systems as small as 80 pounds and measuring 2 feet by 4 feet for non-damaging horticultural purposes to a large trenching machine weighing 34,000 pounds and measuring 37 feet long by 9.5 feet wide by 11.5 feet high capable of excavating trenches 6 feet wide by 10 feet deep. The company's design team operates totally with CAD equipment and the shop space is capable of metal fabrication and assembly of both prototypes and production runs of small quantities of equipment for commercial sale.

1.2 Project Team and Roles

Jerome Apt, Jr., P.E. – Project Manager
Richard D. Nathenson, P.E. – Technical Oversight
Paul M. Brumbaugh – Equipment modification design
Kevin Kovalski – Field Technician

1.3 Subcontractors and Team Members

There were no subcontractors utilized on this project.

2.0 DEMONSTRATED TECHNOLOGIES

2.1 Remediation System and Transport Mode

CEG's premier technology is the company developed and patented supersonic air jet nozzle which uses compressed air from any standard commercial air compressor and converts the discharged air to a focused jet moving at mach 2, twice the speed of sound. This focused jetstream of supersonic air enters pores in the ground and expands as it loses velocity and explodes the surrounding soil. These jetstreams do not impact non-porous items buried in the excavation. The supersonic air jets will not damage pipe, conduit, fiber optic cable with which contact is made. CEG then utilizes its secondary technology, a high velocity vacuum system, to remove the disturbed soil from the excavation, permitting the supersonic nozzles to attack fresh soil.

CEG first tested this technology, supersonic air jets coupled with a high efficiency vacuum system at JPG II with the large 34,000 pound machine mentioned above. This equipment was designed as a trenching machine to operate in an urban environment on firm, level ground and not as an off-the-road, rugged terrain vehicle. However, the work done at JPG II performed sufficiently good enough to encourage the company to pursue the remediation of both UXO and AP and AT mines. In 1996 CEG constructed a system for the U.S. Air Force at Tyndall Air Force Base that was coupled to and mounted on a large bucket excavator (A John Deere 690C). This is a six-wheeled machine and the combined weight of the excavator and the CEG equipment trailer and separator (mounted on the dip stick of the 690C) exceeds 47,000 pounds. This unit is still at Tyndall Air Force Base awaiting testing and evaluation.

During this same period, 1996-1997, CEG under contract to the U.S. Army, CECOM at Ft. Belvoir, VA, developed a small, light weight portable gas-engine compressor unit (<290#) to supply compressed air to CEG's AIR-SPADE™ hand tool to safely expose anti-personnel mines of all types. This development was successfully tested at Ft. A.P. Hill, VA and currently there are AIR-SPADE™ units in Cambodia, Afghanistan and Angola. As part of this U.S. Army contract, CEG developed a small air jet/vacuum system to safely expose anti-tank mines. This unit was designed to be as compact as possible so that the entire system could be mounted on a small all-terrain vehicle. The result was the SAFEX™, Jr., which has been successfully tested at Ft. A.P. Hill, and with CECOM's permission was the unit demonstrated at JPG IV. A photograph of this system is shown below.

SAFEX™, Jr. at JPG IV 11/03/98

The SAFEX™, Jr. is self-contained and is powered by a 24HP air-cooled gasoline engine which drives a 300 scfm, 9"Hg positive displacement vacuum pump and a 70 scfm, 150 psig rotary screw air compressor. The vacuum pick up hose is 3" diameter vacuum hose capable of withstanding 12" Hg vacuum. The air compressor supplies compressed air to a CEG AIR-SPADE™ hand tool. The entire system is mounted on a John Deere 6X4 Gator all-terrain vehicle powered by an 18 HP water cooled gasoline engine. The flotation type tires give this unit a very low ground pressure, 6 psig.

2.2 Recommended Applications and Technology Limitations

The system demonstrated is a non-contacting excavation system, as such it can safely be used by trained personnel to totally expose UXO once the ordnance has been located by a reliable detection system. After exposure, the UXO can be deactivated and removed or destroyed in place. If desired, the entire system may be configured to be remotely controlled however, the CEG supersonic air jets do not exert sufficient force to trigger UXO.

The limitations of this system are that is slower than a larger backhoe machine but it is far safer. The contacting type excavators can easily trigger UXO and cause damage to the machine and endanger personnel and property.

2.3 Logistics Requirements

The entire system is transported on a single axle trailer having a gross vehicle weight of 3500 pounds and is easily towed by a 1 ton pick up truck. The Gator is not a licensable vehicle and connot be driven on a highway.

2.4 Data Acquisition

All data acquisition was performed manually using a stopwatch, measuring tape, a soil moisture measuring instrument and a soil strength measuring device.

2.5 Data Processing and Interpretation

All data was entered into two Excel spread sheets. The data required in accordance with the contract is detailed in section 4.2.

2.6 Quality Assurance

The operation of the system and the accuracy of the data acquisition were controlled by the CEG project manager.

3.0 DEMONSTRATION RESULTS

3.1 Assumptions

The only assumptions made were that the flags placed on the surface accurately designated the location of the suspected UXO.

3.2. Site-Specific Procedures

The system was driven to the flag designating the suspected target, and excavation was begun. Travel times were recorded for several locations, however since the Gator traveled at the same speed between all targets, not all travel times were logged. The stopwatch was started and then stopped when the target was encountered. When the ordnance or non-ordnance was uncovered the on-site ordnance specialist was summoned to identify the uncovered target.

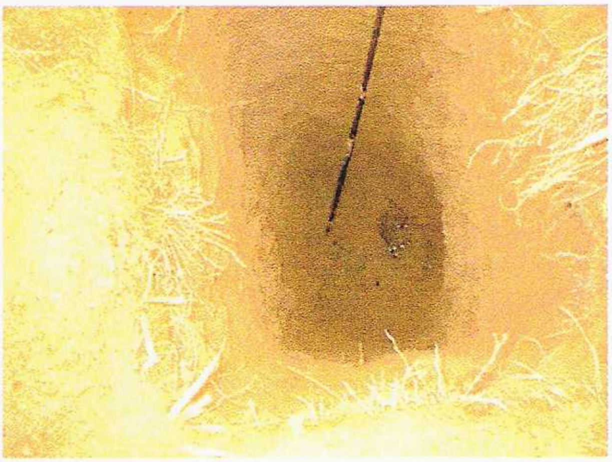
3.2 Problems Encountered

Three problems occurred. A spring shackle weld failed on the trailer on the way to the site on Monday morning, which delayed the start by approximately 3 hours. Wet soil clogged the vacuum hose on a few occasions requiring some minor lost time to clear. The third problem occurred on Thursday. The 24HP engine fuel filter became clogged causing the engine to stall. A trip to Madison was required to purchase a new filter, creating about 2 hours of down time.

3.3 Discussion of Results

CEG felt that the results of the demonstration were excellent. In all, 30 targets were uncovered and all targets were fully identified. The excavations were well defined with surgically cut vertical side walls.

Typical excavation at JPG IV



4.0 DATA

See attached spreadsheet.

5.0 Conclusions

The system worked successfully and will operate even more efficiently when the hand tool and vacuum hoses are attached to an overhead control mechanism, a modification to be made as a result of this JPG IV demonstration.

REMEDIATION DATA FOR CONCEPT ENGINEERING GROUP, INC. - JPG IV

demonstrator	Scenario	target	northing	easting	TetraTech	Type	Travel Rate	Dig Time
					depth-m		k/hr	min.
CEG	2	68	4309530.6987	641686.6266	0.367	152 mm proj.	16	34
CEG	2	57	4309478.6079	641677.0733	0.632	4.2" mortar	16	14
CEG	2	51	4309491.9892	641640.4295	1.498	57 mm proj.	16	120
CEG	2	88	4309739.7898	641623.5044	0.254	76 mm HEAT	16	10
CEG	2	89	4309739.3830	641631.7813	0.302	81 mm proj.	16	14
CEG	2	99	4609719.9596	641645.3574	0.325	4.2" mortar	16	3
CEG	2	118	4309681.4582	641638.2797	0.503	155 mm HEAT	16	9
CEG	2	114	4309699.4430	641657.9399	1.133	105 mm proj.	16	180
CEG	2	90	4309731.4799	641627.1256	0.785	152 mm proj.	16	5
CEG	2	105	4309736.6163	641672.7084	1.680	152 mm proj.	16	130
CEG	2	98	4309720.1761	641636.2995	0.589	57 mm proj.	16	25
CEG	2	141	4309583.9011	641441.6773	0.484	90 mm AP	16	22
CEG	2	11	4309711.9248	641524.5496	0.747	4.2" mortar	16	20
CEG	2	145	4309571.6988	641434.7353	0.406	non ordnance	16	18
CEG	2	100	4309724.7227	641654.0519	0.666	non ordnance	16	22
CEG	2	24	4309633.6994	641524.6555	1.261	non ordnance	16	89
CEG	2	25	4309647.9414	641494.9067	0.778	non ordnance	16	40
CEG	2	28	4309648.3457	641480.0782	1.646	non ordnance	16	68
CEG	2	92	4309721.1882	641626.8560	1.195	non ordnance	16	74
CEG	2	135	4309725.5767	641705.7480	1.000	non ordnance	16	43
CEG	2	134	4309719.0252	641703.2589	0.866	non ordnance	16	32
CEG	2	41	4309525.6634	641610.2988	0.704	non ordnance	16	22
CEG	2	36	4309531.0660	641627.8857	0.639	non ordnance	16	30
CEG	2	122	4309699.0424	641666.6680	0.582	non ordnance	16	25
CEG	2	109	4309737.3039	641680.2341	1.155	non ordnance	16	46
CEG	2	106	4309744.7036	641680.6079	1.166	non ordnance	16	41
CEG	2	128	4309706.0809	641696.8856	0.656	non ordnance	16	23
CEG	2	136	4309732.4228	641703.4278	0.975	non ordnance	16	76
CEG	2	140	4309588.1029	641447.8817	0.964	non ordnance	16	49
CEG	2	160	4309533.9374	641457.3376	0.678	non ordnance	16	25