FY 2000 - ANNUAL REPORT

U.S. ARMY ENVIRONMENTAL CENTER

U.S. ARMY ENVIRONMENTAL CENTER

Pollution Prevention & Environmental Technology Division

Innovative Technology Demonstration, Evaluation and Transfer Activities

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13. SUPPLEMENTARY NOTES

14. ABSTRACT

This report summarized projects carried out during Fiscal Year 2000 by the U.S. Army Environmental Center's Pollution Prevention and Environmental Technology Division. The report describes the projects, participants, results, requirements, milestones, and products. P2&ETD conducts demonstrations of new and innovative environmental technologies and transfers successful technologies to the field. The division's experienced scientists and engineers handle projects in program areas such as environmental clean-up, compliance, pollution prevention, and conservation.

15. SUBJECT TERMS

Annual Report, Demonstration, Technlolgy, Technology Transfer, Evaluation, Projects, Programs, Summary Range XXI, FY00, Pollution Prevention, Conservation, Compliance, Restoration.

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Introduction

This report describes current endeavors at the U.S. Army Environmental Center's (USAEC's) Pollution Prevention and Environmental Technology Division (P2&ETD) during fiscal year (FY) 2000. These project summaries will help readers to better understand the division's efforts and capabilities.

Technology is a major weapon in the Army's efforts to both defend the nation and sustain its environment. Through the programs described in this report, USAEC gives the Army access to the most effective and affordable environmental tools available.

P2&ETD has retained its focus on conservation, compliance and cleanup technologies, bolstering the Center's commitment to saving money and quickly putting innovative ideas to work for its Army and Defense Department customers.

What's Inside

The FY 2000 P2&ETD Annual Report is organized by the following categories:

- Pollution Prevention Programs
  - Pollution Prevention Team
  - HSMS Team
  - Acquisition Team
- Environmental Technology Programs
  - Cleanup Technology
  - Compliance Technology
  - Pollution Prevention Technology
  - Program Focus: Range XXI
  - Other Technology Programs
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Project descriptions are organized into several sections:

Purpose What problem does the project address?

Benefits How does the project help its users?

Technology Users Who will use the technology?

Description Why develop such a technology? How does it work? What is the development approach?

Accomplishments and Results So far, what results have been achieved?

Limitations What might affect the use of this technology?

Follow-On Program Requirements What additional requirements are anticipated?

Point of Contact Whom do I contact for more information?

Program Partners What organizations are participating in the project? (Appendix B contains a consolidated list of partners.)

Publications What publications relate to the project?

(Section headings that do not apply to the project are omitted.)

For More Information

Want to know more about USAEC pollution prevention and environmental technology projects?

Write to EnvironmentalHotline@aec.apgea.army.mil
Call the Army Environmental Hotline at (800) USA-3845.
Visit the USAEC Web site at http://aec.army.mil/

Pollution Prevention Programs

P2&ETD program teams support initiatives to merge pollution prevention into Army missions, such as aiding efforts to buy and use materials that don't pollute the environment; integrating pollution prevention practices into training; fielding systems and methods to manage hazardous materials and reduce generation of hazardous waste; helping major commands and installations prepare and pay for P2 plans; and partnering with state and federal regulatory officials.

EMERGENCY PLANNING AND COMMUNITY RIGHT-TO-KNOW ASSISTANCE

Department of Defense (DoD) installations began reporting toxic releases from munitions-demilitarization activities under the Emergency Planning and Community Right-to-Know Act (EPCRA) on 1 July 2000. DoD installations will begin reporting toxic releases from munitions-range activities under EPCRA- Toxic Release Inventory (TRI) on 1 July 2002. This project seeks to collect and place information on certain EPCRA toxic chemical releases from munitions use and demilitarization activities into a software package for installation use.

PURPOSE

To develop technical guidance for EPCRA reporting.

BENEFITS

Cost-effective and consistent EPCRA reporting. Compliance with EPCRA and DoD reporting requirements.

TECHNOLOGY USERS

Army and DoD installations.

DESCRIPTION

DoD required EPCRA reporting of munitions-demilitarization activities beginning 1 July 2000. Reporting of munitions-range activities will follow on 1 July 2002. This project seeks to identify EPCRA toxic chemicals in munitions, training activities, and those released by munitions-demilitarization activities and package this information in a software data-delivery system for installation use.

The Army, U.S. Army Environmental Center, Air Force, Navy, Marine Corps and Deputy Under Secretary of Defense jointly funded this effort for Environmental Security.

ACCOMPLISHMENTS AND RESULTS

The Range XXI program is developing accurate emissions data. Literature research and software evaluations are complete; designing and populating of the database are underway.

The software was beta-tested during summer 1999.

FOLLOW-ON PROGRAM REQUIREMENTS

- Revise the software according to beta-testing results; perform routine maintenance and update of the TRI-Data Delivery System (DDS) Web site.
- Field the software and begin training. Software estimate emission factors for reporting are now available on the TRI-DDS Web site (http://www.dod-tridds.org/tri-web.htm). Training for use of TRI-DDS software will be conducted spring 2001.

- *EPCRA Munitions Reporting Handbook* generated by GAIA Corp. for the U.S. Army February 2000. Updated September 2000. Latest update to be published fall-winter 2001. Handbook is available on DENIX with DoD user password: http://www.denix.osd.mil/denix/DOD/Library/Munitions/EPCRA/epcra.html.

Point of Contact

Craig Peters

Program Partners

U.S. Army
U.S. Navy
U.S. Air Force
U.S. Marine Corps
Deputy Under Secretary of Defense for Environmental Security
Science Applications International Corporation
URS – Radian International
GAIA Corp.

Publications

Emergency Planning and Community Right-to-Know Act (EPCRA) Munitions Reporting Handbook for the U.S. Army. September 2000. http://www.denix.osd.mil/denix/DOD/Library/Munitions/EPCRA/munireporting.pdf.

Updated Guidance on Applying EPCRA to Munitions to Meet Requirements for EO 12856. March 2000. http://www.denix.osd.mil/denix/Public/ESprograms/Pollution/EO12856/epcra2.html.

DoD EPCRA Data Source Evaluation Report. January 1998.

DoD Munitions EPCRA TRI Calculation Methods. December 1998.

Toxic Release Inventory Data Delivery System User's Guide. June 1999.

Estimates of TRI Releases from Army Training Activities. Science Applications International Corporation. December 2000.

Pollution Prevention Investment Fund

The Army Office of the Director of Environmental Programs (ODEP) initiated this five-year program in 1997. The Pollution Prevention Investment Fund (P2IF) is a component of the Army's strategy for reducing the overall cost of compliance with legally mandated environmental requirements on Army operations. The Fund emphasizes cost-effective pollution prevention (P2) initiatives that support the Department of Defense Measures of Merit, reduce hazardous or non-hazardous material use, and reduce or eliminate environmental requirements at Army installations and facilities.

Purpose

The centrally managed and resourced fund provides a mechanism to focus limited resources on high-return P2 investments that lead to permanent source reduction or material process change.

Benefits

The P2IF program:

- Provides actual cost-benefit data on P2 processes.
- Evaluates performance of P2 systems.
- Assesses Armywide applicability of P2 technologies.
- Distributes success stories and lessons learned.

- Enhances the opportunity to obtain Other Procurement Army funds for large equipment purchases.
- Funds projects that otherwise may not get funded.
- Saves money.

Technology Users

All Army activities (including Army Reserves and National Guard).

Description

The P2IF is directed by ODEP and administered by the U.S. Army Environmental Center (USAEC). The fund allows Armywide P2 projects to compete evenly for supplemental P2 resources based on economic payback, waste reduction and toxicity of the major pollutant.

Required performance reports are used to analyze actual cost benefit data and waste reduction data versus project estimates.

Accomplishments and Results

- Fiscal year (FY) 1997 – The P2IF disbursed $325,000 to eight projects with an estimated annual cost avoidance of $274,000 and an estimated payback of 1.2 years.

- FY 1999 – The P2IF disbursed $7.5 million to 80 projects with an estimated annual cost avoidance of $7 million and an estimated payback of 1.1 years.

- FY 2000 – The P2IF disbursed $4.7 million to 58 projects with an estimated annual cost avoidance of $8.8 million and an estimated payback of 0.5 years.

- FY 2001 – The P2IF disbursed $10 million directly to major Army Commands (MACOMs) to fund MACOM priority projects.

Limitations

This is a five-year program beginning in FY 1997 and ending in FY 2001. Funding was not available in FY 1998. Availability of funding limits the number of projects. All projects must be consistent with the P2IF Guidance and Procedures.

Follow-On Program Requirements

The five-year P2IF program ended with the disbursement of FY 2001 funds. Cost benefit data and success stories will continue to be collected and distributed.

Program Partners

Office of the Director of Environmental Programs
Major Army commands
U.S. Army Environmental Center

Point of Contact

Bill Nelson

Publications

P2IF guidance and information are provided on the USAEC Web site at http://aec.army.mil.

Field Assistance Support and Technology Transfer Team

The Field Assistance Support and Technology Transfer (FASTT) team is a pollution prevention (P2) and environmental field assistance team initiated by the Navy. FASTT can help operations and maintenance personnel meet environmental requirements while performing their missions on schedule yet at a lower cost. Since its inception, the team has grown in its membership and site evaluations. The FASTT team consists of members from the Navy, Army (including the U.S. Army Environmental Center), Air Force and Marines.

Purpose

The FASTT mission is to reduce the cost of environmental compliance and improve maintenance work processes utilizing the best technology and management practices available. P2 plans and updates are required of all Army installations by Army Regulation 200-1 and Executive Order 13148. Sound environmental planning involving pollution prevention has been deemed the most economical and practical means of addressing environmental compliance concerns. Identifying pollution prevention opportunities at installations will assist in efforts to comply with Army mandates as well as legal requirements. Since the site report contains cost benefit data, it can serve as an addendum to your P2 plan. Emphasis is placed on finding, developing and implementing only those material substitutions, work process changes and technology acquisitions that will decrease the burden on the serviceman.

Benefits

Army FASTT team members coordinate visits at participating Army installations. All site surveys are scheduled through the activity environmental offices. Once an installation is selected, a small team visits the activity to conduct a pre-survey. This enables the FASTT team to formulate a team best suited to meet the activity's needs. A few weeks later, a FASTT team will return to conduct the site survey. At the exit briefing with the activity commanding officer, the team presents a written report targeting opportunities for maintenance process improvement, waste reduction and cost avoidance. The ideas and suggestions in the report can be used to reduce business costs through reductions in waste streams, labor, and costs associated with environmental compliance.

Technology Users

Army installations and major Army commands as well as other service (Navy, Air Force and Marines) members.

Accomplishments and Results

To date, more than 48 sites have been visited, and recommendations have been made with an estimated cost savings approaching $200 million.

Limitations

All recommendations made during an Army site visit are left to installation personnel to initiate and prioritize based on available resources and need unless otherwise indicated in the report. Each service handles the recommendations somewhat differently. For instance, in the Navy, all

FASTT recommendations and equipment needs are implemented as priority.

Follow-On Program Requirements

A follow up/Return on Investment (ROI) visit is conducted two to three years after the initial survey. The return visit is used to assess the effectiveness of implemented technologies and make adjustments in the program to meet the customer need. The ROI visits also measure projected savings with actual results achieved.

Point of Contact

Doenee Moscato

Program Partners

U.S. Navy
U.S. Air Force
U.S. Marines

Environmental Program Requirements Support

The Environmental Program Requirements (EPR) is a reporting system and database that provides the primary means for identifying and documenting all current and projected environmental requirements and resources needed to execute the Army's environmental program. The EPR report satisfies the Army's reporting requirements as specified in executive orders, Office of Management and Budget (OMB) circulars and other federal directives. Support to this Headquarters, Department of the Army (HQDA) program includes technical guidance to major Army commands (MACOMs) and installations, comprehensive quality assurance/quality control (QA/QC) reviews of the submitted data, identification of program and budget shortfalls, and analysis of data to support the budget process.

Purpose

The EPR is used at all levels to manage the Army's environmental program. This program is used to plan, program, budget and forecast costs, and to attain and maintain compliance with environmental laws and regulations. The program documents past accomplishments and expenditures, tracks project execution, validates budget year requirements, supports the budget process, and allocates resources consistent with Army priorities. The U.S. Army Environmental Center (USAEC) provides technical support to all aspects of the program.

Benefits

- Ensures cost-effective environmental stewardship.
- Ensures resources are allocated consistent with congressional, Department of Defense (DoD) and Army priorities.
- Identifies program shortfalls and validates budget year requirements.
- Supports budget development process.
- Tracks project execution.

Technology Users

The EPR report is used by commanders and environmental managers at all levels, including congressional inquiries.

Accomplishments and Results The USAEC provides year-round continuous technical support to the program as well as comprehensive QA/QC reviews of all must-fund pollution prevention (P2) projects twice a year.

Follow-On Program Requirements Perform comprehensive QA/QC reviews of all must-fund P2 projects twice yearly.

Point of Contact Tom Guinivan

Program Partners
Installations
Major Army commands
Headquarters, Department of the Army
Department of Defense

Publications
Policy and Guidance for Identifying U.S. Army Environmental Program Requirements. HQDA, Office of the Director of Environmental Programs (ODEP). August 2000.

The U.S. Army Environmental Program Requirements Project Catalog. HQDA, ODEP and USAEC. August 2000.

Pollution Prevention Plans Review

In accordance with Executive Order (EO) 13148, Army installations and major commands (MACOMs) must update pollution prevention (P2) plans by March 2002. The U.S. Army Environmental Center reviewed existing P2 plans in July 1999 to ensure their compliance with several Army and federal government requirements.

Purpose To review Army installation and MACOM P2 plans as directed by Assistant Chief of Staff for Installation Management (ACSIM)/Office of the Director of Environmental Programs.

Benefits In addition to providing direction to installation and MACOM P2 and compliance efforts, effective P2 plans ensure compliance with EO 13148, Army Regulation 200-1, and ACSIM guidance.

Technology Users Installations and MACOMs.

Description USAEC continues to monitor compliance. Any P2 plans updated before April 2000 do not count against the new requirement mandated in EO 13148.

Accomplishments and Results USAEC staff reviewed plans from the Army MACOMs in 1998 and 1999. Logistics Management, Inc. reviewed installation plans in 1996.

Point of Contact Craig Peters

Environmental Quality Report Support

The Environmental Quality Report (EQR) is a Web-based data collection and reporting system that serves as the primary source of information for conveying the Army's environmental status. The EQR is used to track Army adherence to environmental laws for pollution prevention (P2), compliance, pest management, and cultural and natural resources. Tracking indicators include inspections, enforcement actions, permits, Conservation Management Plans, archeological and Native American resources, wetlands, and threatened and endangered species. Data are collected on a quarterly and annual basis. P2 Branch support to this Headquarters, Department of the Army (HQDA) program includes technical guidance to major Army commands (MACOMs) and installations, comprehensive quality assurance/quality control (QA/QC) reviews of the submitted data, identification of program shortfalls, data analysis, and support with status reports to Department of Defense (DoD) and congress.

Purpose

The EQR is used at all levels to provide the status of the Army's environmental program. This program is used to plan, program, and attain and maintain compliance with environmental laws and regulations. The P2 Branch provides technical P2 support to all aspects of the program.

Benefits

- Ensures sound environmental stewardship with accurate status reporting.
- Identifies program shortfalls and areas for improvement.
- Tracks progress towards achieving Measures of Merit goals.
- Generates data for the Environmental Quality Reports to DoD and Congress, as well as the Quarterly Army Performance Review to the Secretary of the Army.

Technology Users

The EPR report is used by commanders, environmental managers at all levels, DoD, other federal agencies, and Congress.

Accomplishments and Results

The P2 Branch provides year-round continuous technical P2 support to the program as well as comprehensive QA/QC reviews.

Follow-On Program Requirements

Perform comprehensive QA/QC reviews of all P2 information on a quarterly and annual basis.

Point of Contact

Tom Guinivan

Program Partners

Installations
Major Army commands
Headquarters, Department of the Army
Department of Defense

Publications

Environmental Quality Report QA Handbook. U.S. Army Environmental Center. September 1999.

THE ARMY HAZARDOUS SUBSTANCE MANAGEMENT SYSTEM PROGRAM

The Army Hazardous Substance Management System (HSMS) program is an integrated program that encompasses two separate but interrelated components (Hazardous material management business practices and HSMS software).

PURPOSE

To facilitate centralized hazardous material management and to assist with environmental reporting by tracking hazardous material from the time of request until its departure from an installation.

BENEFITS

Installations using HSMS software while centrally managing and controlling their hazardous materials (HM) have reduced their HM inventories and improved personnel safety. Better business practices have helped many installations reduce hazardous waste (HW) and its associated disposal costs. Most installations that use HSMS software have instituted stringent controls of HM along with shelf-life extension and material reuse programs. These initiatives have helped the Army avoid millions of dollars of HW disposal and HM procurement costs.

TECHNOLOGY USERS

Department of Defense (DoD) facilities that handle HM and HW, which would require centralized management and an automated tracking system.

DESCRIPTION

The HSMS program is an integrated program that encompasses two separate but interrelated components. The first component is evaluation, selection and implementation of a set of HM management business practices that best meet the needs of an Army installation and its organizations. The HSMS software tracks the hazardous materials and waste that are managed within the context of the Hazardous Material Management Program (HMMP). Both components are part of an installation's overall HMMP.

In the late 1980s, the early 1990s, and again in 2000, commanders faced new environmental management and tracking requirements mandated by Executive Order 13148, Executive Order 12856, and the Emergency Planning and Community Right-To-Know Act. They faced strict criminal liabilities under the Resource Conservation and Recovery Act. DoD installations also discovered that lack of adequate HM visibility and control led to excessive HM inventories, which, in turn, led to high waste-disposal costs, and unnecessary personnel exposures.

To address these problems, installations began developing nonstandard, *ad hoc* automated tools. The DoD had to eliminate redundancy and unnecessary costs stemming from these less-than-optimal business practices and overlapping tracking systems, while enhancing pollution prevention (P2) and environmental compliance.

Army policy letters in 1995 and 1996 directed that HSMS software would be the only authorized Army HM/HW/P2 tracking system. Army activities were to stop developing or buying commercially available software for tracking hazardous substances. As an interim measure, installations operating a system could use that system until HSMS was fully implemented. However, installations were to plan immediately for the transition to HSMS.

Early on, it was recognized that HSMS software alone did not save money or prevent pollution. Only when installations use HSMS software as part of the garrison commander's HMMP are benefits realized.

The management of hazardous materials can be accomplished in many different but equally effective ways. One method is centralized management and storage that includes a management cell and a supply support activity for receipt, storage and issue of HM. Setting up centralized management/decentralized storage is another method for managing HM that some Army installations have adopted. Additionally, some installations have implemented several HM storage locations throughout their installation.

This mission is not new; HMMP is an established regulatory requirement (Army Regulation 710-2). Centralization of hazardous material management functions is essential to an effective program and saves Army resources.

The HSMS program is, above all, an installation commander's program. The functional contractors, funded by the U.S. Army Environmental Center (USAEC) and managed by the U.S. Army Corps of Engineers, support the HSMS Program by helping installations develop and implement their programs. As an additional resource, Army Headquarters published a business practice guide that provides an overview of HMMP, describes eight potential business-practice initiatives and offers a model organizational approach for HM management.

Accomplishments and Results

The Army began fielding the HSMS Program to selected installations in early fiscal year (FY) 1996. By the end of FY 2000, 45 sites across the country had achieved initial operational capability. The current installation sequence list – developed by USAEC in consultation with the major Army commands – includes plans to field HSMS at 12 additional installations by the end of FY 2001.

Limitations

If small installations with limited industrial operations do not require automation to track HM and HW, the Army HSMS Program may not be a cost-effective option.

Follow-On Program Requirements

- Complete the HSMS Program implementation at all Army installations by the end of FY 2001.

Point of Contact Stan Childs

Program Partners U.S. Army Environmental Center
U.S. Army Corps of Engineers
Program Executive Office, Standard Army Management Information Systems, HSMS Project Office.

ARMY 500

The Department of Defense requires weapon system program managers (PMs) to implement hazardous materials management programs and pollution prevention programs. Army 500 is a management tool being developed to help PMs rank hazardous materials and make informed decisions regarding their use.

PURPOSE

To provide an automation tool that helps weapon system PMs and staff collect information on hazardous materials and rank the materials based on human toxicity and environmental hazards.

BENEFITS

Army 500 will help program offices analyze hazardous materials and identify opportunities to eliminate the use of these materials. Reducing requirements for hazardous materials will reduce lifecycle costs for weapon systems.

TECHNOLOGY USERS

Program, project and product managers throughout the acquisition community, and environmental staffs at major commands and installations.

DESCRIPTION

Use of hazardous materials increases costs associated with occupational health and safety, as well as environmental liability. Requirements to implement hazardous materials management and pollution prevention programs compel PMs to identify the hazardous materials required in the design, manufacture and support of their weapon systems. Where possible, PMs must eliminate the need for hazardous material use or mitigate the environmental, health and safety impacts when elimination is impossible. Army 500 is designed to assist in the evaluation of hazardous materials for elimination.

Army 500 consists of an Excel spreadsheet into which PM staffs can enter information on known hazardous materials and their applications. Once the data are entered for all materials under consideration, the spreadsheet ranks the materials according to human toxicity and environmental hazard. Inputs to the spreadsheet include factors for permissible exposure limits, threshold limit values, reportable quantities, legislative risk, and treatment and disposal methods. The spreadsheet also considers costs and produces a rank-ordered listing with values assigned for each factor. The spreadsheet will be made available to the acquisition community and other potential users on a World Wide Web site.

ACCOMPLISHMENTS AND RESULTS

The users (PM offices) are reviewing Army 500. The comments received will be incorporated into the document, and any appropriate changes will be made. The final release of the Army 500 is anticipated during March or April of 2001.

POINT OF CONTACT

Charles George

Program Partners

U.S. Army Environmental Center
PM-Blackhawk
PM-Apache
PM-Chinook
PM-Crusader
PM-Comanche

Comanche Helicopter Program Environmental Quality Lifecycle Cost Estimate

The Department of Defense (DoD) requires weapon system program managers (PMs) to integrate environmental considerations into their acquisition strategies and include environmental costs in their program cost estimates. The U.S. Army Environmental Center (USAEC) had been asked to assist the Comanche program office and the U.S. Army Cost and Economic Analysis Center (CEAC) in the development of lifecycle environmental costs for the Comanche helicopter system.

Purpose

To develop and verify the environmental lifecycle costs for the Comanche helicopter system.

Benefits

By identifying program environmental cost elements, weapon system PMs can make informed decisions on environmental issues by evaluating their impacts on long-term costs. Identification of environmental costs helps the Army develop more accurate and complete lifecycle cost estimates for weapon system acquisition programs.

Technology Users

Program Executive Officer (PEO)-Aviation, PM-Comanche and the U.S. Army CEAC.

Description

In a 1997 audit, the DoD Inspector General found that environmental costs were not fully included in the Comanche program's cost estimates. In fact, the Inspector General found the Comanche cost estimate might be understated. As a result of the audit, PM-Comanche and CEAC requested USAEC assistance in identifying and estimating lifecycle environmental costs.

This project required analysis of the entire acquisition plan for the Comanche helicopter program, identification of all activities with environmental impacts, and estimation of all associated environmental costs. Costs were correlated to a work-breakdown structure for the program and documented using CEAC-approved cost-documentation formats.

Accomplishments and Results

USAEC completed this estimate and published it during June 2000. USAEC continues to work with PM-Comanche and CEAC to provide support for future milestone reviews.

POINT OF CONTACT Charles George

PROGRAM PARTNERS
U.S. Army Environmental Center
U.S. Army Cost and Economic Analysis Center
PM-Comanche
Fort Campbell, Kentucky
Corpus Christi Army Depot, Texas

ENVIRONMENTAL COST HANDBOOK

The Department of Defense (DoD) requires program executive officers (PEOs) and program managers (PMs) to integrate environmental considerations into their acquisition strategies and include environmental costs in their lifecycle cost estimates. Environmental lifecycle costing is a relatively new requirement, and little guidance is available to assist PEOs and PMs. The *Environmental Cost Handbook* will describe how to identify and estimate lifecycle environmental costs for weapon systems.

PURPOSE To develop a handbook that describes how to identify and estimate lifecycle environmental costs for weapon systems.

BENEFITS Recognition of environmental costs will allow PEOs and PMs to evaluate impacts on lifecycle costs and make informed decisions on environmental issues.

TECHNOLOGY USERS PEOs, PMs, other acquisition officials and the U.S. Army Cost and Economic Analysis Center (CEAC).

DESCRIPTION The U.S. Army Environmental Center (USAEC) is supporting the CEAC Weapon System Cost and Economic Analysis Division in developing and verifying environmental lifecycle costs for Army weapon systems. This support has required close coordination with several weapon system program offices. USAEC confirmed there is no "how to" guidance available for identification and estimation of environmental costs.

The *Environmental Cost Handbook* is being developed to help PEOs and PMs figure environmental costs as independent values. The handbook will provide guidance in a way that allows PEOs and PMs to associate estimated costs with work-breakdown structure elements to support activity-based costing and performance monitoring.

The handbook will offer approaches for developing categories of environmental costs. For each environmental category or activity, potential sources of existing cost information will be identified along with guidance for developing cost-estimating relationships. The goal is to provide guidance flexible enough to support the estimation of environmental lifecycle costs for most weapon systems.

ACCOMPLISHMENTS AND RESULTS

USAEC is planning to publish this handbook and make it available to the PM and costing community by April/May 2001. This handbook will be updated on an on-going basis as more environmental costing information becomes available on different types of weapon systems.

POINT OF CONTACT

Charles George

PUBLICATIONS

U.S. Army Environmental Center
U.S. Army Cost and Economic Analysis Center
PM-Comanche
PM-Apache
PM-Chinook
PM-Bradley

LONGBOW APACHE ENVIRONMENTAL QUALITY LIFECYCLE COST ESTIMATE

Weapon system program managers (PMs) must integrate environmental considerations into their acquisition strategies and include environmental costs in their program lifecycle cost estimates. The Weapon System Cost and Economic Analysis Division of the U.S. Army Cost and Economic Analysis Center (CEAC) requested U.S. Army Environmental Center (USAEC) support in the development of environmental lifecycle cost estimates for the Longbow Apache upgrade program.

PURPOSE

To develop an environmental lifecycle cost estimate for inclusion in the Army cost position for the Longbow Apache system.

BENEFITS

Department of Defense regulations (DoD 5000.2-R) require PMs to identify the lifecycle costs for their systems, including environmental costs. This project will help the PM for the Apache helicopter comply with this acquisition requirement. Identification of environmental costs will also help PMs make informed decisions on environmental issues by allowing them to evaluate the long-term costs of alternative courses of action.

TECHNOLOGY USERS

PM-Apache, the CEAC and the Longbow Apache Cost Analysis Working-Level Integrated Product Team (CA-WIPT).

DESCRIPTION

A portion of the A-model Apache fleet will be modified to the Longbow configuration. The new configuration includes mast-mounted fire control radar, a modified airframe and a radio frequency autonomous seeker in an upgraded HELLFIRE missile system. The PM must develop a program office estimate (POE), which includes all lifecycle costs for the upgrade program. CEAC will develop an independent cost estimate (ICE) to evaluate the accuracy of the program estimate. Differences in the two estimates will be arbitrated to produce a final recommended Army Cost

Position (ACP). USAEC will participate in this process by developing a lifecycle estimate for environmental costs. Both the PM and CEAC will use USAEC's environmental cost estimate.

USAEC evaluated all phases of the acquisition strategy and identified activities with environmental impacts. Costs were attached to environmental impacts and requirements; the total of all environmental costs were used to develop the lifecycle environmental estimate. USAEC coordinated closely with representatives from the program office, manufacturers and system users to identify all environmental activities. Costs were documented using a work-breakdown structure developed specifically for the Longbow Apache program. Cost descriptions and methodologies were documented using CEAC-approved cost-documentation formats.

Accomplishments and Results

The Environmental Quality Lifecycle Cost Estimate (EQLCCE) for the Apache was completed and published during June 2000. This EQLCCE was used to help determine the Army's Cost Position during December 2000/January 2001.

Point of Contact

Charles George

Program Partners

U.S. Army Environmental Center
U.S. Army Cost and Economic Analysis Center
PM-Apache

NEPA Manual for Materiel Acquisition

Recent government audits of selected Defense Department acquisition programs revealed that compliance with the National Environmental Policy Act (NEPA) had not been properly factored into the acquisition management process. This manual will provide information to help program managers (PMs) consider NEPA during materiel acquisition.

Purpose

To provide advisory information for integrating the requirements of NEPA and Army Regulation (AR) 200-2, Environmental Analysis of Army Actions, into the materiel acquisition process.

Benefits

This manual will simplify the NEPA process so PMs understand when to use a Categorical Exclusion (CX) or Record of Environmental Consideration (REC), an Environmental Assessment (EA) or Environmental Impact Statement (EIS), and feel comfortable with each approach.

Technology Users

Department of Defense (DoD) PMs and program executive officers (PEOs).

Description

NEPA requires the identification and analysis of potential environmental impacts of certain federal actions and alternatives before those actions can be initiated. The law also contains specific requirements for informing and involving other federal and state agencies and the public. NEPA requires a systematic, interdisciplinary approach to analyzing and considering environmental factors when planning or conducting federal agency programs and projects. The process for implementing the law is codified in Council on Environmental Quality Regulations, 40 Code of Federal Regulations (CFR) Parts 1500-1508.

Recent government audits revealed that NEPA compliance had not been properly factored into several DoD acquisition programs. This was likely due, in part, to the false assumption that NEPA is primarily of concern only to installation and facility engineers.

This manual will provide advisory information for integrating the requirements of NEPA and AR 200-2 into the materiel acquisition process. The information will assist PEOs and PMs with the implementation of NEPA policies and procedures as they pertain to Army materiel acquisition.

There is a significant effort within DoD to reduce the number of mandatory policies, procedures and practices for the acquisition of weapon systems and other Army materiel. This manual will offer PEOs and PMs flexibility in satisfying the goals of NEPA.

This manual is one of a set of four instructional manuals covering the integration of NEPA into Army activities. Previously published manuals cover base realignment and closure, installation operations, and on- and off-post training NEPA considerations. The manual represents a "living document" that will change as future improvements to the acquisition process occur.

Accomplishments and Results

The U.S. Army Environmental Center recently completed and is preparing for publication the final *NEPA Manual for Materiel Acquisition*. This edition, dated November 2000, updates the July 1999 *Final Draft NEPA Manual for Materiel Acquisition*. It incorporates the most current information contained in AR 70-1 (Army Acquisition Policy) and the most recent drafts of DoD 5000.2-R (Mandatory Procedures for Major Defense Acquisition Programs and Major Automated Information System Acquisition Programs) and AR 200-2 (Environmental Effects of Army Actions).

Follow-On Program Requirements

Forward a memorandum from the Assistant Secretary of the Army (ASA) for Installation and Environment with Mr. Ray Fatz's signature to ASA for Acquisition, Logistics, and Technology with a fact sheet for the *NEPA Manual for Materiel Acquisition* for distribution to the acquisition community. The fact sheet will describe the *NEPA Manual for Materiel Acquisition* and inform acquisition community members on how they can

access the manual on the World Wide Web (DoD Acquisition Deskbook under Reference Library/Army Documents/Discretionary Documents and on the USAEC Web page).

Point of Contact

Louis Kanaras

Program Partners

U.S. Army Environmental Center
U.S. Army Space and Missile Defense Command
Teledyne Solutions Incorporated

Programmatic Environmental, Safety and Health Evaluation Guide

Department of Defense (DoD) Regulation 5000.2-R requires that all programs, regardless of acquisition category, include a programmatic environmental, safety and health (ESH) evaluation in their acquisition strategy. The regulation does not set a format for this evaluation but requires it to describe a program/project/product manager's (PM's) strategy for meeting ESH requirements, establishing responsibilities and tracking progress. Developing a guide for such evaluations will help PMs plan, execute and document actions that fulfill the ESH requirements of DoD 5000.2-R.

Purpose

To develop a guide for analyzing five specific ESH areas: National Environmental Policy Act, Environmental Compliance, System Safety and Health, Hazardous Materials and Pollution Prevention.

Benefits

The development of an ESH evaluation helps ensure those actions that fulfill the ESH requirements of DoD Regulation 5000.2-R are planned, executed and documented.

Technology Users

DoD PMs and program executive officers (PEOs).

Description

DoD 5000.2-R requires that all programs, regardless of acquisition category, include a programmatic ESH evaluation in their acquisition strategy. The PM must initiate the ESH evaluation at the earliest possible time in support of a program initiation decision (usually Milestone I) and update the evaluation throughout the program's lifecycle.

The *Programmatic Environmental, Safety and Health Evaluation (PESHE) Guide* can assist PMs in meeting ESH integration requirements by providing a description of techniques, practices, and processes for integrating ESH-related activities into the systems engineering program design process. It can help to document a program's current ESH status, establish a process for monitoring changing compliance requirements, integrate ESH requirements into the program's acquisition strategy and other program documentation, and establish a plan of action to meet

future ESH requirements. The guide is intended to provide information that will help make the ESH evaluation a useful tool for PMs in carrying out their responsibilities to consider ESH requirements and issues early in the design process and will make sure potential program "showstoppers" are identified and resolved early in the acquisition process.

ACCOMPLISHMENTS AND RESULTS

- Received and incorporated comments on the draft *PESHE Guide.*
- Developed the coordinating draft of the *PESHE Guide* and distributed it for comments.
- Obtained PEO comments.
- Developed an updated guide (July 1999) based upon PEO comments.
- Because of recent changes to the DoD 5000 Series, and concurrent changes to the DoD Acquisition Deskbook, initiated updates to the *PESHE Guide.*

FOLLOW-ON PROGRAM REQUIREMENTS

- Current plans are to complete updating and improving the guide in spring 2001, following the anticipated completion and approval of the revised DoD 5000.2-R.
- Distribute a memorandum from the Assistant Secretary of the Army (ASA) for Installation and Environment with Mr. Ray Fatz's signature to ASA for Acquisition, Logistics, and Technology with a fact sheet for the *PESHE Guide* for distribution to the acquisition community. The fact sheet will describe the guide and inform acquisition community members on how they can access the guide on the World Wide Web (DoD Acquisition Deskbook under Reference Library/ Army Documents/Discretionary Documents and on the USAEC Web page).

POINT OF CONTACT

Louis Kanaras

PROGRAM PARTNERS

U.S. Army Environmental Center
U.S. Army Space and Missile Defense Command
Teledyne Brown Engineering

BRADLEY A3 UPGRADE PROGRAM ENVIRONMENTAL QUALITY LIFECYCLE COST ESTIMATE

The Department of Defense (DoD) requires weapon system program managers (PMs) to integrate environmental considerations into their acquisition strategies and include environmental costs in their program cost estimates. The U.S. Army Environmental Center (USAEC) has been asked to assist the Bradley A3 Upgrade program office and the U.S. Army Cost and Economic Analysis Center (CEAC) in the development of lifecycle environmental costs for the Bradley A3 Upgrade ground combat system.

PURPOSE

To develop and verify the environmental lifecycle costs for the Bradley A3 Upgrade ground combat system.

BENEFITS

By identifying program environmental cost elements, weapon system PMs can make informed decisions on environmental issues by evaluating their impacts on long-term costs. Identification of environmental costs helps the Army develop more accurate and complete lifecycle cost estimates for weapon system acquisition programs.

TECHNOLOGY USERS

Program Executive Officer (PEO)-Ground Combat Support Systems, PM-Bradley A3 Upgrade and the U.S. Army CEAC.

DESCRIPTION

In a 1997 audit, the DoD Inspector General found that environmental costs were not fully included in the Comanche program's cost estimates. In fact, the Inspector General found the Comanche helicopter cost estimate might be understated. As a result of the audit, PM-Comanche and CEAC requested USAEC assistance in identifying and estimating lifecycle environmental costs.

After completing the environmental lifecycle cost estimate for the PM-Comanche, USAEC provided similar data collection and coordination efforts with PM-Apache (AH-64D) and with PM-Chinook (CH-47F/ Improved Cargo Helicopter) to develop environmental lifecycle cost estimates for these programs. USAEC is also developing an environmental lifecycle cost estimate handbook for rotary wing aircraft.

USAEC's next step was to gather environmental lifecycle cost estimates for ground combat systems with the Bradley A3 Upgrade program selected as the first system and Crusader selected as the second. There are two versions of the Bradley Fighting Vehicle Systems (BFVS): an M2 Infantry Fighting Vehicle (IFV) and an M3 Cavalry Fighting Vehicle (CFV). A total of 1109 Bradleys will be modified to the A3 configuration. On 17 March 2000, a meeting was conducted at the PM-Bradley to coordinate the preparation of the Bradley A3 modification environmental lifecycle cost estimate. This project required analysis of the entire acquisition plan for the Bradley A3 Upgrade ground combat program, identification of all activities with environmental impacts, and estimation of all associated environmental costs. Costs were correlated to a work-breakdown structure for the program and documented using CEAC-approved cost-documentation formats.

Lessons learned from this and other projects on ground combat systems will be included in a ground combat system environmental cost handbook. The handbook will serve as a guide for PEOs and PMs to estimate their programs' environmental lifecycle costs.

ACCOMPLISHMENTS AND RESULTS

USAEC has conducted data collection efforts at United Defense Limited Partnership (UDLP) Lemont Furnace, Pennsylvania, and UDLP-York Pennsylvania, at PM Bradley A3 (Warren, Michigan), at Fort Hood,

Texas, and in Germany, Korea, and Alaska. The environmental lifecycle cost estimate for the Bradley A3 Upgrade program was completed in early February 2001 in preparation for the Cost Review Board and the Acquisition Review meetings scheduled for March 2001.

Point of Contact

Louis Kanaras

Program Partners

U.S. Army Environmental Center
U.S. Army Cost and Economic Analysis Center
PM-Bradley A3 Upgrade
United Defense Limited Partnership
Fort Hood
U.S. Army Europe
U.S. Army Pacific

Chinook Helicopter Program Environmental Quality Lifecycle Cost Estimate

The 1995 Defense Appropriations Act, Public Law 103-337 (5 October 1994), SEC 815, requires the analysis of the environmental costs of major defense acquisitions as an integral part of the program's lifecycle costs analysis. Responsibility for performing cost analysis of Major Defense Acquisition Programs (MDAPs) in the Army is borne by the appropriate Program Manager Office (PMO), the U.S. Army Cost and Economic Analysis Center (CEAC), and various Department of Defense (DoD) agencies.

Purpose

To develop and verify the environmental lifecycle costs for the Chinook (CH-47F) helicopter system.

Benefits

By identifying program environmental cost elements, weapon system PMs can make informed decisions on environmental issues by evaluating their impacts on long-term costs. Identification of environmental costs helps the Army develop more accurate and complete lifecycle cost estimates for weapon system acquisition programs.

Technology Users

Program Executive Officer (PEO)-Aviation, PM-Chinook (CH-47F) and the U.S. Army CEAC.

Description

In January 2000, USAEC met with CH-47F environmental personnel and cost analysts in Huntsville, Alabama, to further identify the environmental cost elements and discuss algorithms and formulas for determining their cost. Finally, a process was developed that permitted communication, participation, review and validation of the cost elements, algorithms and assumptions between subject matter experts, cost analysts, U.S. Army Environmental Center (USAEC) personnel and other knowledgeable organizations.

ACCOMPLISHMENTS AND RESULTS

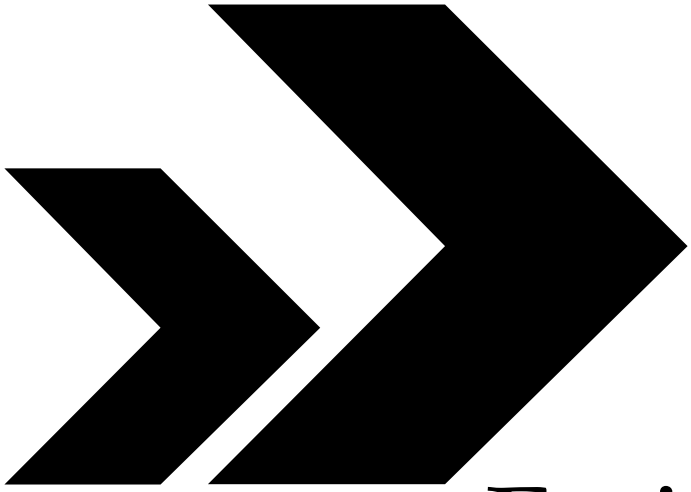
USAEC completed and published the Environmental Quality Lifecycle Cost Estimate (EQLCCE) during August 2000. USAEC continues to work with PM Chinook (CH-47F) and CEAC to provide support for future milestone reviews.

POINT OF CONTACT

Charles George

PROGRAM PARTNERS

U.S. Army Environmental Center
U.S. Army Cost and Economic Analysis Center
PM-Chinook (CH-47F)



Environmental Technology Programs

P2&ETD technology development and transfer programs enable the Army to test and implement cost-effective technologies in cleanup, compliance, pollution prevention and conservation.

Cleanup

Many Army sites hold remnants from past training, testing and industrial operations. P2&ETD supports Army efforts to clean up these areas by providing cost-effective technologies to remove pollutants from soil, surface water and groundwater.

Compliance

Army installations must comply with laws and regulations governing wastewater discharge, noise abatement, air quality, and management of solid and hazardous waste. P2&ETD initiatives help the Army stay ready to meet constant changes in environmental laws.

Pollution Prevention

P2&ETD demonstrates and transfers cost-effective industrial process changes and technologies designed to help installations prevent pollution, use fewer hazardous materials and generate less hazardous waste.

Conservation

The Army manages 12 million public acres, which include a variety of natural and cultural resources. P2&ETD supports Army efforts to protect these irreplaceable resources while providing realistic backdrops for military training.

C-SPARGE TREATMENT SYSTEM AT LETTERKENNY ARMY DEPOT

The C-Sparge treatment system promises to be an effective way to remove volatile compounds from water. Installation of this system at Letterkenny Army Depot, Pennsylvania, will help treat contamination at the source in a challenging hydrogeologic setting.

PURPOSE To prepare and implement a final design of the C-Sparge treatment system for Letterkenny Army Depot, an installation on the National Priorities List.

BENEFITS If installed successfully, this system will help remove volatile organic compound (VOC) contamination at the source and reduce long-term treatment requirements.

TECHNOLOGY USERS Letterkenny Army Depot.

DESCRIPTION The U.S. Army Environmental Center (USAEC) awarded a contract to conduct bench-scale and pilot tests of the system, complete the design and construct the treatment system. Effluent testing will begin after system construction. A basic C-Sparge treatment system uses a fine-bubble diffuser to facilitate the removal of contaminants from the affected media.

ACCOMPLISHMENTS AND RESULTS A pilot test was completed at Rocky Spring, proving system effectiveness in treating spring water. A concept paper was developed for piloting the treatment system at the source area to create an *in-situ* treatment.

FOLLOW-ON PROGRAM REQUIREMENTS

- Approve and conduct C-Sparge system pilot test at source area.
- Issue draft version of the final design.
- Complete system construction.
- Start treatment system and initiate monitoring program.

POINT OF CONTACT Scott Hill

FIELD ANALYTICAL TECHNOLOGY

The major source of error associated with an analytical result is derived from sampling, yet little has been done to improve the process. A cost-effective method to accurately determine the distribution of contaminants will benefit Army site-remediation efforts.

PURPOSE To create a procedure whereby the error associated with collecting soil samples can be applied correctly to the analytical results; to develop a strategy and procedure to determine explosives contamination at impact ranges; and to adapt it to other analytes when appropriate.

Benefits

A cost-effective method to determine the distribution of contaminants will benefit the site-remediation process. Because they contain unexploded ordnance (UXO), impact ranges present a unique cleanup challenge. Some Records of Decision require the Army to deal with explosives before addressing UXO. The developed strategy will allow installations to handle this scenario.

Technology Users

Army installations with explosives-contaminated soils.

Description

The major source of error associated with an analytical result is derived from sampling, but little has been accomplished to improve the process. Previous sampling was based on a specified grid approach, which resulted in extreme sampling error for nonhomogenous distributed contaminants such as explosives. True and cost-effective determination of the distribution of contaminants is essential to the site-remediation process.

A site contaminated with cyclotetramethylene (HMX) and trinitrotoluene (TNT) will be assessed. A final report will document the sampling and analytical errors associated with short-range and longer-range analyte distributions for this site. The report also will document improvements in site characterization that result from the use of a composite-based sampling procedure and on-site analysis, and address whether this approach reduced sampling error to acceptable levels for this site.

Additional sampling and analysis studies will be conducted to demonstrate the effectiveness of the combination of on-site analytical methods and simple composite sampling procedures. Sites contaminated with Royal Demolition Explosive (RDX) and nitroguanidine (NG) will be sampled (if available), as well as a non-explosives-contaminated site, to assess whether levels of heterogeneity at these sites are similar to those observed for sites contaminated with TNT, dinitroluene (DNT), ammonium picrate and HMX. An evaluation will be performed between field analytical results and laboratory analytical results.

Accomplishments and Results

In Phase 1 of this project, several explosives-contaminated sites were intensely sampled to obtain information on the short-range heterogeneity of analyte distribution as a function of the specific contaminant, mode of contamination and soil type. The samples were analyzed both on- and off-site.

These results were used to compute overall analytical error. The on-site analytical methods for TNT, DNT and picric acid provided adequate data for site assessment at much lower costs. Based on these results, various strategies to minimize sampling error were considered, and a larger-scale sampling strategy was proposed.

This approach was evaluated in Phase 2 at a site contaminated with HMX and TNT. Analysis of larger-scale sampling and analytical results indicated that an approach based on discrete grab sample collection and analysis

could not adequately describe analyte concentrations. A rapid compositing approach was assessed, and the analysis of these results showed this was the best approach for sampling nonhomogenous distributed contamination. This approach was further validated at a site contaminated with RDX and TNT. It also underwent preliminary testing at an impact range.

In the next phase, a pilot study on applying the sampling strategy learned from the previous effort was performed at an inland impact range at Fort Ord, California. Because of the UXO issue, the strategy was modified to include actual sampling being performed by Explosive Ordnance Disposal (EOD) personnel. Sampling was also modified to address the effects of long-range heterogeneity. Experiments were conducted to assess the utility of a Gas Chromatograph-Nitrogen/Phosphorous Detector method for on-site analysis of explosives in soil. Results were promising in that they allowed measurement of RDX in the presence of large amounts of HMX, a contaminant situation often encountered at anti-tank firing ranges.

The field analysis using the gas chromatographic (GC) method was further tested with both a nitrogen/phosphorus detector and an electron capture detector. Various archived samples were checked by the GC technique, with good results when compared to standard explosives analyses. To field test the technology, participation was sought and received from the Environmental Protection Agency (EPA) for their Environmental Technology Program for the Evaluation of Explosive Field Analytical Techniques at the Oak Ridge National Laboratory. A new version of the GC was tested at this time. The chromatograph was configured so that air could be used as the carrier gas, which allowed for extreme portability of the system. At the same time, a thermionic ionization detector, a new detector more sensitive to explosives, was tested. Preliminary results show very good correlation for the TNT analyses. However, some breakdown in the RDX analysis occurs when using air as the carrier gas.

In fiscal year 2000, modifications to the gas/injector system were made. The performance of the chromatograph was much improved when using nitrogen as the carrier gas, while continuing to use air for the detector. The instrument was used in two field trials (at Fort Leonard Wood and at the Umatilla Army Depot) and was able to demonstrate the ability to differentiate between 2,4–DNT, TNB, TNT, RDX and HMX. Some of the breakdown products of TNT, not usually detectable by existing field tests (aminodinitrotoluenes and diaminonitrotoluenes) were determined by this technique. Participation in a second EPA Environmental Technology Validation demonstration has shown the much-improved performance of the gas chromatographic system. There was good correlation between the results from the field gas chromatographic system with the results from a reference laboratory.

Follow-On Program Requirements

Methodology will be submitted for acceptance as standard field method. A guide will be written that will be usable for sampling and analysis of explosives at any site by field personnel. It will be designed to marry the

previously developed sampling strategy with the field analysis that has been proven to result in accurate analyses for explosives.

POINT OF CONTACT

Martin Stutz

PROGRAM PARTNERS

U.S. Army Environmental Center
U.S. Army Engineer Research and Development Center-Cold Regions Research and Engineering Laboratory (CRREL)

PUBLICATIONS

Assessment of Sampling Error Associated with Collection and Analysis of Soil Samples at Explosives-Contaminated Sites. CRREL Special Report 96-15.

EPA ORD/OSWER. *Field Sampling and Selecting On-Site Analytical Methods for Explosives in Soil – EPA Federal Facilities Forum Issue*. Report EPA/540/R97/501. November 1996.

Assessment of Sampling Error Associated with Collection and Analysis of Soil Samples at a Firing Range Contaminated with HMX. CRREL Special Report 97-22.

Site Characterization of the Inland Firing Range Impact Area at Fort Ord. CRREL Special Report 98-9.

Determination of Nitroaromatic, Nitramine, and Nitrate Ester Explosives in Water Using Solid-Phase Extraction and GC-ECD: Comparison with HPLC. CRREL Special Report 98-2.

Determination of Nitroaromatic, Nitramine, and Nitrate Ester Explosives in Soils by Gas Chromatography-Electron Capture Detection. CRREL Special Report 99-12.

On-Site Method for Nitroaromatic and Nitramine Explosives in Soil and Groundwater Using GC-NPD. CRREL Special Report 99-9.

Field Gas Chromatography Thermionic Detector System for the Analysis of Explosives in Soils. ERDC-CRREL Special Report (In Press).

FIELDING BIOTREATMENT TECHNOLOGIES UNDER THE AGRICULTURE-BASED BIOREMEDIATION PROGRAM

The Agriculture-Based Bioremediation Program (ABRP) is a Congressionally sponsored partnership between the Army and the U.S. Department of Agriculture to demonstrate agronomic remediation processes to restore contaminated military and civilian sites – with emphasis on sites in the Pacific region.

PURPOSE

To demonstrate agronomic remediation processes to restore contaminated military and civilian sites, emphasizing sites in fragile Pacific island ecosystems.

BENEFITS

Besides proving out dual-use agriculturally based technologies, the program actively supports capability building and education, and provides economic opportunities and environmental security to island communities.

TECHNOLOGY USERS

Department of Defense (DoD) installations.

DESCRIPTION

Various field demonstrations are being conducted under the ABRP.

Green waste composting was demonstrated in 1998 at Schofield Barracks, Hawaii. This project evaluated the performance and cost of alternative composting methods for reducing green waste to useful horticulture products. Both aerated static pile and commercial in-vessel aerated static pile processes produced quality, finished compost in 55 days. The Army's cost/benefit analysis anticipates the economic return on green waste composting will pay for the process within two years of operation, while reducing the installation's nonhazardous waste stream.

The U.S. Army Corps of Engineers is performing pilot-scale tests of multiple methods of composting green waste and sewage sludge from the Schofield Barracks wastewater treatment plant. The performance and cost of aerated static pile and windrow composting will be compared to a commercial in-vessel aerated static pile process. The potential cost avoidance is significant, since Schofield Barracks alone pays $10,000 a month to dispose of its sewage sludge and about $130,000 a month in tipping fees for green-waste disposal.

Del Monte Fresh Produce, Inc. has completed a field demonstration of phytoremediation to treat groundwater contaminated with volatile organic compounds (VOCs), including ethylene dibromide, 1,2 dibromo-3-chloropropane and 1,2 dichloropropane. Pilot-scale tests have shown the *Luecaena leucophala* (or Koa Haole) plant can effectively remove the contaminants for half the cost of carbon treatment. After test results permit authorities to assess the long-term effectiveness of the process, the phytotreatment units can be scaled up to remediate a site on the Environmental Protection Agency's National Priorities List.

The Dole Food Company, in partnership with the Navy in Hawaii, initiated a field-test of a 1.3-acre phytotreatment wetland to biotreat municipal wastewater for use in aboveground irrigation. Recovery of wastewater has important commercial and municipal applications across the islands, where fresh water can be scarce.

ACCOMPLISHMENTS AND RESULTS

A Broad Agency Announcement (BAA) was initiated in October 1998 to open the program to more government, commercial and academic participants.

The ABRP has initiated several new projects through its BAA. The program has additional field demonstrations ongoing in the following areas:

- Bioremediation of slaughterhouse wastewater using the "Living Machines" process
- Bioremediation of petroleum, oil and lubricant (POL)-contaminated soils
- Phytotreatment of contaminated sediments using manufactured soils
- Phytoremediation of explosives-contaminated soils

The University of Hawaii has added summaries of ABRP projects under its Bioremediation Web site, at http://www2.ctahr.hawaii.edu/biosystems/bioremediation/.

Follow-On Program Requirements

Program management of the ABRP transitioned to the U.S. Department of Agriculture in September 2000.

Point of Contact

Mark Hampton

Program Partners

U.S. Army Environmental Center
U.S. Department of Agriculture
U.S. Army Engineer Research and Development Center-Waterways Experiment Station
Tennessee Valley Authority

Publications

U.S. Army, Pacific. *Pilot Compost Facility, U.S. Army Garrison, Hawaii, Schofield Barracks, Final Report.* May 1998.

Groundwater Extraction and Treatment Effectiveness Reviews

The U.S. Army spends millions of dollars each year to operate and maintain major groundwater pump-and-treat systems, but most of the systems have no defined measures of effectiveness. The Groundwater Extraction and Treatment Effectiveness Reviews (GWETER) will help installations determine how well a system is performing, when the system has reached the end of its usefulness, or whether another method could meet remediation goals at lower costs.

Purpose

To institute an Armywide program for developing clear remediation objectives and measures of effectiveness for planned and installed groundwater pump-and-treat systems. For systems where remedial objectives cannot yet be obtained, the program will reevaluate and renegotiate the objectives using risk-based approaches and reasonable land-use scenarios.

Benefits

Optimization of existing systems and the proper setting of objectives could help the Army avoid costs of $100 million in the next 10 years.

Technology Users

Major Army commands and installations with operating or proposed pump-and-treat systems.

Description

The U.S. Army operates major groundwater pump-and-treat systems at 35 installations, with a yearly operations and maintenance cost of approximately $25 million. Each major system costs about $3 million to build and is expected to last at least 30 years, with some lasting up to 100 years. Of the systems with a definable objective, more than half were designed to contain plumes, not restore aquifers. Most of the systems have no defined measures of effectiveness; the Army, therefore, has little or no ability to determine how well a system is performing or when a system has reached the end of its usefulness. In addition, approximately 70 major pump-and-treat systems are in the planning stages within the Installation Restoration, Base Realignment and Closure (BRAC) and Formerly Used Defense Sites (FUDS) programs.

An Army Science Board study on the effectiveness of groundwater and soil treatments recommended that a team of independent experts review the Army's largest groundwater pump-and-treat remediation programs (according to cost-to-complete estimates). The study also recommended implementing a groundwater cleanup strategy to reduce the number of pump-and-treat systems being proposed in the Army's environmental program.

The GWETER will:

- Validate the objectives of remediation systems
- Determine measures of effectiveness
- Collect the data necessary to measure system effectiveness
- Examine the remediation objectives and compare these goals to appropriate human and ecological risk levels for the current and future site use
- Create a process for acquiring the resources to implement system modification and/or replacement where significant long-term cost savings are identified
- Provide "lessons learned" to the field and Army Headquarters
- Produce cost savings of 10 to 20 percent and make systems more cost-effective

An effectiveness review team is made up of individuals experienced in the design, operation and optimization of pump-and-treat systems, as well as in the regulatory aspects of Record of Decision (ROD) development and modification. Depending on the installation's technical and regulatory situations, the team uses different mixes of in-house and outside experts. The disciplines that might be required include:

- Groundwater modeling and hydraulic optimization
- Hydrogeology

- Environmental law and ROD development
- Process and chemical engineering
- Innovative technology
- Risk assessment
- Natural attenuation processes
- Community relations

A contractor handles the team's administrative requirements, such as collecting data, preparing the site for the visit and preparing reports. Team members could be drawn from the U.S. Army Environmental Center; the Army Center for Health Promotion and Preventive Medicine; the Groundwater Modeling Support Program at the U.S. Army Engineer Research and Development Center-Waterways Experiment Station; the U.S. Geological Survey; Environmental Protection Agency laboratories; the Department of Energy; and nongovernmental entities. Local regulatory agencies and community representatives may be involved in the later stages of a site visit.

ACCOMPLISHMENTS AND RESULTS

Teams examined 13 active and proposed pump-and-treat systems during the past year. These included Fort Wainwright, Arkansas; Sacramento Army Depot (AD), California; Picatinny Arsenal, New Jersey; Tacony Warehouse, Pennsylvania; Aberdeen Proving Ground, Maryland; Camp Staley Storage Activity, Texas; Umatilla Chemical Depot (CD), Oregon; Milan Army Ammunition Plant, Tennessee; Fort Devans, Massachusetts; Cameron Station, Virginia; Livingston Housing, New Jersey; Tooele AD, Utah; and Pueblo CD, Colorado. The teams identified approximately $69 million in potential lifecycle cost avoidances.

LIMITATIONS

Reviews are labor intensive; only a few can be accomplished each year.

POINT OF CONTACT

Ira May

PROGRAM PARTNERS

U.S. Army Environmental Center
Major Army commands
Installations with operating or proposed pump-and-treat systems

PUBLICATIONS

Evaluation of the Effectiveness of Existing Groundwater and Soil Treatments. Army Science Board. 1998.

GROUNDWATER MODELING SYSTEM AND SUPPORT CENTER

When it comes to groundwater treatment, state-of-the-art tools and techniques can save installations vast amounts of money. The Groundwater Modeling System (GMS) and Support Center provides

technical expertise to installations and other users of groundwater modeling technologies.

PURPOSE

To provide groundwater modeling technical expertise to installations and other users of groundwater modeling technologies.

BENEFITS

State-of-the-art modeling can save vast amounts of money, as can a system to help ensure that proper remedial actions are carried out.

TECHNOLOGY USERS

Army installations and U.S. Army Corps of Engineers districts.

DESCRIPTION

The Groundwater Modeling Technical Support Program, sustained jointly by the U.S. Army Environmental Center (USAEC) and the U.S. Army Corps of Engineers Military Programs Office (CE-MP), has been assisting agencies and Army installations for several years. The program is administered by the Groundwater Modeling Technical Support Center at the U.S. Army Engineer Research and Development Center-Waterways Experiment Station (WES) and is overseen by a technical advisory group from the funding agencies. The program has provided technical expertise and products to a rapidly expanding group of users, evidenced by over 3,000 support calls during the last three years. The technical expertise made available through the program has led to more efficient remediation projects.

Many of the calls have come from Army installations looking for Department of Defense GMS support. The GMS was developed specifically to address groundwater remediation projects in the U.S. Army. Although USAEC has been the largest supporter of the system, other agencies, including the Environmental Protection Agency (EPA) and the Department of Energy (DOE), have recently followed the Army lead by supporting GMS technology.

Consequently, several federal and local government agencies have accepted GMS as their standard modeling system for addressing groundwater remediation. The GMS has over 800 users in the United States and is accepted by the EPA's Superfund and Wellhead Protection programs. The EPA also uses GMS in all 10 of its regional offices.

The rapid increase in technical support requests demonstrates widespread acceptance of GMS technology. The acceptance is largely based on the system's advanced technology, and its development by government institutions such as USAEC, CE-MP, WES and the EPA. Equally significant are the high quality-control standards and technical support programs that ensure the maintenance and improvements necessary for software longevity – an important consideration for installations where cleanup actions can take many years.

ACCOMPLISHMENTS AND RESULTS

- Continued providing groundwater modeling technology transfer assistance to Army users. This support included distributing GMS software and manuals, and providing training as needed.

- Provided groundwater-modeling assistance to the Army's independent technical reviews (ITR) and Groundwater Extraction and Treatment Effectiveness Reviews (GWETER) programs.
- Provided telephone support and on-site technical assistance, as necessary, to installations conducting groundwater remediation activities. Site assistance was typically limited to less than one man-week of labor (per site) and travel costs.
- Demonstrated the capability and cost-effectiveness of natural attenuation modeling in reducing remediation costs. This was accomplished by reducing the number of years required for active remediation systems such as pump-and-treat.
- Distributed results from the demonstration projects to installation personnel to ensure technology transfer within the Army.
- Provided groundwater-modeling services to Milan Army Ammunition Plant (AAP), Tennessee; Longhorn AAP, Texas; Pueblo Chemical Depot (CD), Colorado; the former Sacramento Army Depot, California; Umatilla CD, Oregon; Stratford Army Engine Plant, Connecticut; and Aberdeen Proving Ground, Maryland.

LIMITATIONS

Due to resource limitations, users can only receive support for less than one person-week without providing their own additional resources.

FOLLOW-ON PROGRAM REQUIREMENTS

USAEC's institutional support is necessary for the continued success of the program.

POINT OF CONTACT

Ira May

PROGRAM PARTNERS

U.S. Army Environmental Center
U.S. Army Engineer Research and Development Center-Waterways Experiment Station
U.S. Army Engineer Research and Development Center-Cold Regions Research and Engineering Laboratory Headquarters, U.S. Army Corps of Engineers

PUBLICATIONS

Groundwater Modeling System, Version 3.1.

http://chl.wes.army.mil/software/gms/. (Web site for the modeling system.)

OPTIMIZATION OF *IN-SITU* VOLATILIZATION DEVICES

Many Army installations use soil vapor extraction (SVE) to remove volatile compounds from soil, mainly because they can leave the soil in place during the cleanup operation and save money. This project is developing a model that installations can use to improve the design and operations of such *in-situ* remediation systems.

Purpose

To develop a three-dimensional vadose-zone model to assist in the optimization of *in-situ* volatilization systems.

Benefits

This model will be useful at both the design stage (to determine optimal vent spacing, depths and flow rates) and the operational phase (to determine optimal time of system operation and to balance the systems) of *in-situ* volatilization systems.

Technology Users

Installations with operating or proposed *in-situ* volatilization systems.

Description

Many Army sites have subsurface contamination problems stemming from disposal of volatile organic compounds (VOCs). SVE has often been used to remediate the unsaturated zone, mainly because it leaves the soils in place during the cleanup process and results in large cost savings. Field implementation of SVE systems has often proceeded without the benefit of numerical modeling to provide an optimal engineering design and estimate the time required for cleanup.

The U.S. Army Environmental Center (USAEC) is conducting characterization and cleanup activities at Twin Cities Army Ammunition Plant (TCAAP), Minnesota, to remediate contaminated soils, sediments and groundwater. These remediation efforts include SVE systems at two sites to remove VOCs from soils and reduce contaminant migration to groundwater. The SVE systems have operated since 1987 and, according to sampling data, have removed large volumes of VOCs. They provide a platform to calibrate a new vadose-zone model and test proposed optimization concepts.

This study used site-specific data collected at TCAAP to develop a multidimensional, unsaturated numerical model for analyzing the effectiveness of SVE. The model was calibrated and validated, and used to assess the efficiency of the remediation systems, evaluate alternative designs and determine possible improvements. As part of the study, sensitivity and importance analyses were conducted to identify the critical input parameters needed to simulate the SVE process. The results of this study will be used to bridge the gap between using empirical correlation and field experience for system design and using numerical modeling for evaluating system performance and design.

Accomplishments and Results

Based on the modeling results, it appears that the SVEs at TCAAP removed within the first three years the VOCs in the vadose zone that are available for transport to the groundwater. Since that time, the SVEs have been removing VOCs from the surface of the groundwater table and VOCs adsorbed in the vadose zone. The adsorbed VOCs present in the vadose zone are only marginally able to reach the groundwater; therefore, there is no longer an active source of VOCs in the soils adding to groundwater contamination. While the original objective of the remedial action has been reached, it is considered worthwhile to use the SVE to aid in the direct remediation of the groundwater due to the low cost of the annual operations and maintenance.

A paper on study results was presented at the 1999 American Society of Civil Engineers, Water Resources Division meeting in Phoenix, Arizona.

LIMITATIONS

The model will need to be extended to handle the uncertainties involved in sites that do not have all the data necessary to take advantage of the optimization concept.

POINT OF CONTACT

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PROGRAM PARTNERS

U.S. Army Environmental Center
Argonne National Laboratory
Twin Cities Army Ammunition Plant, Minnesota

PUBLICATIONS

May, I.P., Z. Jiang, and L.A. Durham. "Evaluation of the Soil Vapor Extraction System at the Twin Cities Army Ammunition Plant: A Post-Audit Assessment." ASCE presentation. June 1999.

Williams, G.P., D. Tomasko, and Z. Jiang. 2000. *Twin Cities Army Ammunition Plant Soil Vapor Extraction System: A Post-Audit Modeling Study, Argonne National Laboratory ANL/EAD/TM-97.*

PHYTOREMEDIATION OF EXPLOSIVES IN GROUNDWATER USING CONSTRUCTED WETLANDS

Many Department of Defense (DoD) sites contain explosives-contaminated groundwater. Demonstrating cost-effective methods to treat this contamination will allow installations to conduct restoration using reliable, accepted and effective processes. Phytoremediation, the use of plants and microbes to degrade explosives, provides an opportunity to treat large volumes of groundwater at lower costs.

PURPOSE

To demonstrate the use of phytoremediation as an alternative technology.

BENEFITS

Phytoremediation destroys organic contaminants in groundwater at lower costs; the savings can be applied to other installation operations or restoration efforts.

TECHNOLOGY USERS

Army and DoD installations with explosives-contaminated groundwater.

DESCRIPTION

Current groundwater cleanup technologies, such as granular activated carbon (GAC) and advanced oxidation, are labor-intensive and costly. GAC requires additional disposal. Ultraviolet oxidation systems require significant capital investment, labor and utilities expenses for the life of the project.

An alternative such as phytoremediation can provide lower maintenance and capital costs. Typically, a GAC system costs $2 million to $8 million

for construction and $1.5 million annually (for 30 years) per site. Cost-performance data indicates that for surface water discharge, a gravel-based wetland yields capital costs of $330,000 per acre and $6,000 an acre (per year) to operate and maintain. For a site treating 500,000 gallons per week, the potential cost savings are $2 million.

Milan Army Ammunition Plant (MAAP) in Milan, Tennessee, was the site of the field demonstration. Prior efforts by the Environmental Protection Agency (EPA) identified the plant enzyme nitroreductase as able to degrade trinitrotoluene (TNT).

In the initial phase of the project, plants native to Tennessee that contain the enzyme were challenged with explosives-contaminated water from the site. The three submergent and three emergent species that best reduced TNT and Royal Demolition Explosive (RDX), along with parrotfeather, were selected for the second phase.

Two distinct systems were constructed in the second phase: lagoon and gravel-based. The lagoon system, consisting of two cells in a series, was planted with submergent species in 2 feet of groundwater. The groundwater was treated by the plants, naturally occurring microbes and sunlight. The gravel-based wetland contained emergent plant species in both cells. The first cell was operated anaerobically (to degrade RDX) and the second cell was aerobic. This aerobic cell was a reciprocating wetland. Reciprocation, the movement of water between cell compartments, further enhances water quality.

Phytoremediation can be used as a pretreatment for other technologies or as a final "polishing" technology.

Accomplishments and Results

Both wetland systems operated from June 1996 to September 1997. The lagoon system was not effective in degrading RDX under the demonstration parameters. Initially, the lagoon system degraded TNT, but as plant growth suffered, photodegradation was a major factor in TNT degradation. The system, requiring more attention in coaxing submergent species to grow in the contaminated groundwater, did not rebound and was taken out of operation in September 1997.

The gravel bed system was more effective in degrading TNT and RDX. On average, the gravel bed system reduced explosives residues with 95 percent or greater efficiency. TNT contaminants were reduced from 4,000 parts per billion (ppb) to less than 2 ppb, and total explosives were reduced from 10,000 ppb to less than 50 ppb. From October 1997 to July 1998, the gravel bed system operated under parameters that would allow for the design of a 200 gallon-per-minute (gpm) facility at the installation. The design and cost analysis for such a facility are included in the final report.

This demonstration has shown an approximate 56 percent cost avoidance in using constructed wetlands over granular media filter (GMF)/GAC.

Amortized over 30 years, wetlands yield $1.82 per kgal of water, of which $1.52 is for operation and maintenance. GMF/GAC yields $3.97 per kgal, of which $3.39 is operation and maintenance.

A final report was completed and approved by the Environmental Security Technology Certification Program (ESTCP). A cost-and-performance report was also approved by the ESTCP and is available through the ESTCP Web site, www.estcp.org.

Limitations

Cool weather, time constraints and space requirements may limit the use of phytoremediation using constructed wetlands.

Follow-On Program Requirements

Technology transfer efforts must continue. Another location should be found to implement phytoremediation using gravel-based constructed wetlands.

Point of Contact

Darlene F. Bader-Lohn

Program Partners

U.S. Army Environmental Center
Tennessee Valley Authority
U.S. Army Engineer Research and Development Center-Waterways Experiment Station

Publications

Demonstration Results of Phytoremediation of Explosives-Contaminated Groundwater Using Constructed Wetlands at the Milan Army Ammunition Plant, Milan, Tennessee. SFIM-AEC-ET-CR-97059.

Phytoremediation of Explosives-Contaminated Groundwater in Constructed Wetlands: II-Flow Through Study. SFIM-AEC-ET-CR-96167.

Phytoremediation of Explosives-Contaminated Groundwater in Constructed Wetlands: I-Batch Study. SFIM-AEC-ET-CR-96166.

Demonstration Plan for Phytoremediation of Explosives-Contaminated Groundwater in Constructed Wetlands at Milan Army Ammunition Plant, Milan, Tennessee: Volume I and II. SFIM-AEC-ET-CR-95090.

Evaluation of Various Organic Fertilizer Substrates and Hydraulic Retention Times for Enhancing Anaerobic Degradation of Explosives-Contaminated Groundwater While Using Constructed Wetlands at the Milan Army Ammunition Plant, Milan, Tennessee. SFIM-AEC-ET-CR-98031.

Cost and Performance for the Use of Constructed Wetlands to Phytoremediate Explosives-Contaminated Groundwater at the Milan Army Ammunition Plant, Milan, Tennessee. Available at www.estcp.org.

Phytoremediation of Lead in Soil

Because it can leach into groundwater or surface water, lead in soil can jeopardize the continued operation of training ranges. Phytoremediation, the use of plants to remove or degrade contaminants from various environmental media, offers a potentially reliable method for removing lead from soil.

Purpose

To demonstrate the effectiveness of phytoremediation – specifically *in-situ* phytoextraction – in removing lead from soil.

Benefits

Potential benefits from successful phytoremediation of lead-contaminated sites are lead removal from the soil and lead recovery for off-site disposal or potential recycling, which allows for nonrestrictive site use. Future costs of monitoring and maintaining a hazardous site or landfilled hazardous waste would be eliminated, as would the long-term liability associated with hazardous waste. *In-situ* phytoextraction minimizes site disturbance and potentially limits dispersal of contaminants, in contrast to excavating and landfilling soil.

In-situ phytoextraction would potentially cost much less than conventional methods. *In-situ* phytoextraction of 1 acre to a depth of 50 centimeters is estimated to cost $60,000 to $100,000 under optimal conditions. Excavating and landfilling the same amount of soil are estimated to cost $400,000 to $1.7 million.

Technology Users

Army and Department of Defense (DoD) installations with lead-contaminated soil.

Description

Disposal and burning of scrap ammunition and powder, firing range use and similar activities have resulted in lead-contaminated soils at many DoD installations. Current treatments include excavation and landfilling, soil washing, or immobilization through chemical treatment. As a result, the metals are neither destroyed nor reclaimed. Liability, long-term monitoring and restricted land use all contribute to high costs.

Phytoremediation, specifically the technique of *in-situ* phytoextraction, is an alternative technology. Phytoextraction is the use of plants to pull metals out of the soil solution and into the plant structure. Process optimization and treatability studies conducted by the Tennessee Valley Authority (TVA) have determined the most efficient plant species, leachate concerns, levels of soil amendments, amendment application and fertilization effects on lead accumulation and extraction for *in-situ* phytoextraction.

This project demonstrated the use of *in-situ* phytoextraction at Twin Cities Army Ammunition Plant (TCAAP) in Arden Hills, Minnesota. TVA conducted optimization and treatability efforts before designing the

field demonstration. Two 0.2-acre sites were selected for the demonstration. One site contained low concentrations of lead (740 parts per million [ppm]); the other had moderate lead concentrations (3,500 ppm). Two crops were planted on each site: corn in May 1998 and white mustard in August 1998. At the appropriate time in the growth cycle of each crop, soil amendments were applied to encourage uptake of lead. The crops were harvested and transported to a smelter. In 1999, a single crop of silage corn was planted at each site, harvested and smelted.

The U.S. Army Environmental Center (USAEC) and the DoD Environmental Security Technology Certification Program provided funding for this demonstration.

Accomplishments and Results

The interim guidance document reported 1998 results with an average lead concentration in corn of 0.65 percent and 0.13 percent for the two sites. Lead concentrations in the white mustard averaged 0.083 percent and 0.034 percent for the two sites. In 1999, a silage corn variety was planted for its greater biomass. Due to extreme wet conditions in the mid-West, the corn production was not optimal, resulting in a reduced plot area for phytoextraction. In general, the 1999 lead concentrations in corn were tenfold less than 1998. Surface water, groundwater, and additional soil sampling in 2000 indicated that there had been an impact to the shallow groundwater at one location. There were no additional phytoremediation activities conducted at either location after the 1999 season.

Limitations

Time constraints, as well as the depth and degree of contamination, are one limitation. Another limitation may be the length of the growing season and the availability of soil amendments in large quantities. Extreme weather conditions, resulting in poor crop growth, will impact the effectiveness of this technology.

A severe limitation to *in-situ* phytoextraction is the potential impact to groundwater and other surrounding areas. Under certain circumstances, it may be acceptable to conduct *in-situ* phytoextraction. However, excavating the soil and placing it either in a lined pit or cell prior to conducting the technology would remove the concern for any potential groundwater impact. The cost to do so would be somewhat prohibitive to conducting phytoextraction cheaply.

Point of Contact

Darlene F. Bader-Lohn

Program Partners

U.S. Army Environmental Center
Twin Cities Army Ammunition Plant, Minnesota
Tennessee Valley Authority
Alliant TechSystems

Publications

Final Report on the Demonstration Results for the Phytoextraction of Lead-Contaminated Soil at the Twin Cities Army Ammunition Plant, Arden Hills, Minnesota. SFIM-AEC-ET-CR-200045.

Results of the 1998 Field Demonstration and Preliminary Implementation Guidance for Phytoremediation of Lead-Contaminated Soil at the Twin Cities Army Ammunition Plant, Arden Hills, Minnesota. SFIM-AEC-ET-CR-99001.

Technology Demonstration Plan for Phytoremediation of Lead-Contaminated Soil at the Twin Cities Army Ammunition Plant, Arden Hills, Minnesota. SFIM-AEC-ET-CR-98008.

Test Plan for the Phytoremediation Studies of Lead-Contaminated Soil from the Sunflower Army Ammunition Plant, DeSoto, Kansas. SFIM-AEC-ET-CR-96198.

Results of a Greenhouse Study Investigating the Phytoextraction of Lead from Contaminated Soils from the Sunflower Army Ammunition Plant, DeSoto, Kansas. SFIM-AEC-ET-CR-98036.

RANGE RULE RISK METHODOLOGY

The Department of Defense (DoD) has been developing a directive that identifies a process for evaluating appropriate response actions on closed, transferred and transferring ranges. The U.S. Army Environmental Center (USAEC) is developing a methodology – known as the Range Rule Risk Methodology (R3M) – that will help the DoD assess health and environmental risks posed by these ranges.

PURPOSE

To develop a risk management and assessment methodology for use in implementing the new directive.

BENEFITS

The R3M will serve as the DoD method for evaluating ranges under DoD's Range Response program framed by the new directive. It also may be used to evaluate unexploded ordnance (UXO) on ranges not covered specifically by the Range Rule and as a framework in parallel evaluations of human health risks stemming from physiologic and physical injuries.

TECHNOLOGY USERS

Range Response program and project managers conducting response programs under the new DoD directive.

DESCRIPTION

DoD had previously drafted a Range Rule that identified a process for evaluating appropriate response actions on closed, transferred and transferring ranges. Response actions will address safety, human health and the environment. The Range Rule contained a process that is consistent with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and tailored to the special risks posed by military munitions and ranges. This process includes range identification, range assessment, range evaluation, recurring reviews and range closeout. In late 2000, DoD withdrew the Range Rule from the rulemaking process and

began developing a DoD directive as an interim measure. The Range Rule and the directive rely on a risk-based approach to site management.

To satisfy this process, USAEC is developing a multicomponent risk evaluation methodology – R3M – that includes a risk management strategy, risk management framework, risk assessment methods and risk communication tools.

Many R3M components come directly from other methods used in range evaluation and response actions. The R3M effort serves to combine – or improve and develop – the necessary elements into a cohesive process that will be fully reviewed and approved by all DoD components and the Environmental Protection Agency (EPA).

The project includes several steps:

- Develop an interim method consisting of qualitative and semi-quantitative tools to reduce risks while meeting Range Rule requirements;
- Coordinate development with DoD, the EPA, states, tribes and other stakeholders;
- Support partnering initiatives and Public Information Forums;
- Further develop, test, and validate R3M elements during the early years of implementation;
- Revise the R3M based on testing and validation and prepare methods to evaluate sites relative to closeout criteria.

Accomplishments and Results

- Conduct Interim R3M Preliminary Validation effort.
- Approve release of draft R3M for public availability.

Follow-On Program Requirements

- Continue development of interim R3M through input from validation results and DoD, EPA, partnering initiative team and public input.
- Conduct final R3M development program.

Point of Contact

Scott Hill

Program Partners

U.S. Army Environmental Center
Department of Defense
Environmental Protection Agency
Range Rule Partnering Initiative

Publications

Public Information Forum fact sheets on the Range Rule.

Remediation Technologies Screening Matrix and Reference Guide

Many government agencies produced documents to help their environmental project managers make intelligent decisions on cleanup technologies, but a lack of coordination led to duplication of effort among these agencies. The Federal Remediation Technologies Roundtable (FRTR) developed a guide to serve as a neutral platform from which to evaluate technologies.

Purpose

To monitor and update the *FRTR Remediation Technologies Screening Matrix and Reference Guide, Version III*. Distribute full-size screening matrix posters as a quick guide to technology groups' ability to handle contaminants.

Benefits

The guide is an unbiased medium in which users can find information to save them time and effort. The guide is also recognized as a comprehensive source for environmental restoration technology information.

Technology Users

Remediation project managers, government agencies, private organizations and academia.

Description

In the past, numerous government agencies, divisions and branches produced documents as tools for their environmental project managers. The FRTR sponsored production of the *FRTR Remediation Technologies Screening Matrix and Reference Guide, Version III* to eliminate the duplication of effort among its member agencies.

The document is electronic, allowing for quick and easy updating. The update effort committed Roundtable members to work together, leverage funds and resources and prevent duplication of effort.

The committee representatives, who had the option to serve as a review entity for each technology, selected technologies included in the guide. After the document was written and reviewed, the information was formatted in HTML, integrated with all necessary hyperlinks and placed on the Internet for universal use.

The current World Wide Web version of the *FRTR Remediation Technologies Screening Matrix and Reference Guide,* located on the FRTR home page, replaced Version II. Web technology affords the Roundtable the opportunity to update and modify this "living" document. Each week, the guide is reviewed for broken links and outdated or incorrect information. New information is reviewed and evaluated for validity. This regular maintenance ensures the document's integrity.

Accomplishments and Results

This project helps to demonstrate and foster cooperation among many federal agencies. Committee members established the personal

relationships necessary to coordinate the update effort. There was a successful leveraging of funds from the Army, Navy and Air Force. The Environmental Protection Agency donated significant support. Other agencies dedicated numerous in-house personnel hours toward the effort.

The document was released on the Web at www.frtr.gov/matrix2/top_page.html in November 1997. A poster version of the Screening Matrix became available in June 1998.

Limitations

The document is an electronic Web file, so there is no conveniently accessed paper version. Links and information must be continually monitored.

Follow-On Program Requirements

It has been three years since a major overhaul of the guide has taken place. There are a variety of new technologies, innovations and contaminants of concern that must be accounted for in the document. An effort will be kicked off in fiscal year 2001 to drastically update and refine the data and format of the guide.

Point of Contact

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Program Partners

U.S. Army Environmental Center
Federal Remediation Technologies Roundtable
Naval Facilities Engineering Service Center
Air Force Center for Environmental Excellence
Environmental Protection Agency
U.S. Geological Survey
Department of Energy

Publications

Federal Remediation Technologies Screening Matrix and Reference Guide, Version III. November 1997.

Federal Remediation Technologies Screening Matrix poster. June 1998.

PINK WATER TREATMENT TECHNOLOGY RESEARCH TASK

Army ammunition plants produce explosives-contaminated water known as pink water. The plants meet discharge requirements by using granular activated carbon (GAC) to remove contaminants from pink water. The explosives-laden GAC – classified as a hazardous waste – is either regenerated or incinerated. Other treatment technologies are being sought to avoid the generation of this hazardous waste.

PURPOSE

To evaluate alternatives to GAC treatment of pink water.

BENEFITS

A cost-effective alternative to GAC absorption that does not generate hazardous waste when treating pink water will help Army installations meet stringent regulations pertaining to water effluent quality.

TECHNOLOGY USERS

Army ammunition plants.

DESCRIPTION

Army ammunition plants perform two functions that generate a waste stream known as pink water. These functions are (1) load, assemble and pack (LAP), and (2) demilitarization of munitions. Associated housekeeping and processing operations create the wastewater stream. Typical sources are wash down and wash out of munitions and laundering workers' clothing. Pink water typically contains photochemically active trinitrotoluene (TNT). The photoreactive products color the water. Besides TNT, pink water usually contains Royal Demolition Explosive (RDX) and cyclotetramethylene (HMX). The composition of pink water varies, depending on process materials and operations. The reference value established in this work is 200 parts per million (ppm) dissolved energetic-related materials.

Army ammunition plants meet discharge requirements by using GAC to remove contaminants from pink water. The explosives-laden GAC, classified as a K045 hazardous waste, is either regenerated for reuse or incinerated for disposal. Technologies are being sought to avoid the generation of this hazardous waste, which is difficult to handle and expensive to dispose of.

Concurrent Technologies Corporation (CTC), the operating contractor of the National Defense Center for Environmental Excellence (NDCEE), under the initial Statement of Work (SOW) from the U.S. Army Environmental Center (USAEC), was tasked to identify and evaluate the technologies as Phase I. This entailed surveying literature, assessing regulatory issues related to pink water, identifying candidate technologies, developing performance criteria and evaluation methods, selecting candidates for detailed evaluation, selecting the five best technologies based on the performance criteria, and issuing a Phase I final report. The five technologies selected were Large Aquatic Plants (Biological) Treatment,

GAC Thermophilic (Biological) Process, Fenton's Chemistry Process (Advanced Oxidation Process), Electrolytic Process (Mixed Oxidants) and Fluidized Bed Bioreactor Process.

Under Phase II, CTC was tasked to perform bench-scale tests on the five technologies using pink water generated from LAP operations at McAlester Army Ammunition Plant (MCAAP), Oklahoma, and pink water generated from demilitarization activities at Milan Army Ammunition Plant (MAAP), Tennessee. This entailed identifying vendors for the selected technologies, requesting test plans and safety plans from the vendors, determining critical process parameters and evaluation criteria, demonstrating and validating the bench-scale technologies, evaluating the technologies against the performance criteria, recommending the three best technologies for the pilot-scale demonstration and issuing a Phase II final report. The three best technologies identified were the Fluidized Bed Bioreactor Process, the GAC Thermophilic (Biological) Process and the Large Aquatic Plants (Biological) Treatment (Phytoremediation)

Under Phase III, CTC was tasked to plan for operation of up to three technologies at 2 gallons per minute (gpm). This entailed developing detailed engineering specifications, submitting an outline of a test and implementation plan, submitting an outline of a demonstration and validation proposal, and issuing a Phase III final report. Due to a limitation in funding, the U.S. Army selected the granular activated carbon (GAC) Thermophilic (Biological) Process (TBP) as the pink water treatment technology that would be evaluated during the pilot scale demonstration. This technology had the best efficacy and estimated treatment cost.

USAEC wrote an SOW to direct CTC to perform Phases IV through VI. Phase IV included the design, installation and debugging of the GAC TBP demonstration plant. Activities included selecting an engineering design subcontractor, preparing a detailed design estimate, finishing the detailed design, selecting an ammunition plant demonstration location, fabricating the TBP demonstration plant, and issuing a Phase IV final report. Phase V consisted of operating and evaluating the TBP demonstration plant. Activities included operating the TBP plant for 180 days, evaluating the TBP according to the test plan and issuing a Phase V final report. Phase VI consisted of finalization and follow-through. Activities included revising operating documentation based on lessons learned in the pilot-scale demonstration(s), providing follow-on training, and providing follow-through support.

Accomplishments and Results

The TBP has undergone testing of loading and regenerating energetics-laden from 24 August 1998 through 15 March 2000 in accordance with the Pink Water Treatment Technology Test Plan for the TBP Pilot Scale Equipment (17 August 1998). The TBP was evaluated in accordance with the evaluation criteria specified in the test plan. As a result of these

qualification tests completed at MLAAP, the following conclusions were reached:

- The TBP is technically sound, economically viable and environmentally safe.
- Under the optimized conditions, the TBP technology degraded over 90 percent of the nitrobodies from the loaded GAC. During loading, the discharge of nitrobodies from the regenerated GAC in the column gave slightly higher (better) percent removals of nitrobodies compared to that of loading with virgin GAC.
- The water discharged is nontoxic, according to the toxicity testing.
- The TBP's estimated cost is lower than current treatment costs for GAC, allows for the reuse of GAC from 5 to 23 times, and has an estimated 1½ to 6 year payback period.

Researchers successfully negotiated the transfer of the TBP technology to Iowa Army Ammunition Plant (IAAP) for loading and regenerant testing with IAAP pink water. Hawthorne and Crane AAPs have also expressed potential interest in the transfer of this technology.

Point of Contact

Louis Kanaras

Program Partners

U.S. Army Environmental Center
Concurrent Technologies Corporation
National Defense Center for Environmental Excellence
McAlester Army Ammunition Plant, Oklahoma
Milan Army Ammunition Plant, Tennessee

Publications

Pink Water Treatment Options (May 1995). SFIM-AEC-ETD-CR-95036.

Pink Water Treatment Options Technical Report (November 3, 1997). SFIM-AEC-ET-CR-99064.

Safety/Health Plans to Build Thermophilic (Biological) Process Pilot Scale Equipment (June 22, 1998).

Test Plan for Thermophilic (Biological) Pilot-Scale Equipment (August 17, 1998).

Pilot-Scale Thermophilic (Biological) Process, Interim Test Results (December 22, 1998).

Pilot-Scale Thermophilic (Biological) Process, Results from 6th though 11th Loadings and Regeneration (May 21, 1999).

Pilot-Scale Thermophilic (Biological) Process, Results from 12th and 13th Loadings and Regeneration (July 21, 1999).

Pilot-Scale Thermophilic (Biological) Process, Results from 14th, 15th, and 16th Loadings and Regeneration, Draft (October 12, 1999).

Thermophilic (Biological) Process System Procurement and Fabrication Guide, and Cost and Performance Report (April 30, 2000).

Pilot-Scale Thermophilic (Biological) Process Final Technical Report (June 15, 2000).

Plasma Energy Pyrolysis System

The Army has identified various complex military waste streams that have significant costs associated with their disposal. Plasma arc technology can handle most of these waste streams in an efficient and cost-effective manner. The Plasma Energy Pyrolysis System (PEPS) project aims to build and improve on traditional plasma thermal technology.

Purpose

To build a continuously operating pre-production unit of a transportable PEPS.

Benefits

The PEPS program has focused on improvements to traditional plasma thermal technology and has realized a simple-to-control, automated operating system.

Technology Users

Department of Defense (DoD).

Description

Two extended demonstrations were conducted under the Transportable PEPS Program to assess technology maturity and facilitate its full-scale implementation to destroy problem DoD waste streams. The waste steams selected for the two demonstrations were Agricultural Blast Media (ABM) and Regulated Medical Waste (RMW), respectively, and the objectives of the program were: 1) to demonstrate that a PEPS could destroy problematic waste streams and have all products of the destruction process meet or improve upon Environmental Protection Agency (EPA) requirements; 2) to operate the PEPS for a minimum of 200 hours on a 24-hour basis during each of two demonstrations, with a target downtime not to exceed 30 percent; and 3) to establish the performance and cost-effectiveness of the PEPS, from data gathered during the demonstrations. The PEPS was approved and permitted by the Virginia Department of Environmental Quality (DEQ) as an alternative to incineration for the destruction of Regulated Medical Wastes (RMW). The independent sampling and analysis conducted by Arcadis, Geraghty & Miller, Inc. validated the performance of PEPS in full compliance with applicable EPA and DEQ environmental regulations.

Accomplishments and Results

- All the program's technical objectives were met or exceeded.
- Destruction and Removal Efficiency (DRE) of >99.99999 percent proved the ability of the PEPS to safely and completely destroy large quantities of typical problem DoD wastes and drastically reduce waste volumes.

- The PEPS successfully destroyed ABM and RMW waste streams. Because of the widely different compositions of these wastes, it can be safely said that the system is capable of destroying a wide variety of military wastes.
- EPA requirements for air emissions and slag were greatly improved upon as verified by independent analyses.
- The transportable PEPS operated continuously for more than 200 hours on a 24-hour basis in each demonstration with an equipment downtime of less than 30 percent and established the viability of the commercial-scale operation of the system.
- The success of the program is also reflected in lessons learned from operating the system. A total of 73,000 pounds of contaminated Agricultural Blast Media (ABM) and RMW were processed during the two demonstrations. RMW was processed as received with minimal manual handling and without presorting. Significant design changes were made to the system during the program that served to make it safe and reliable to operate.
- The cost and operations data collected during the demonstration operations confirmed the cost effectiveness of a commercial scale PEPS, making it a preferred alternative to current disposal methods for "hard to treat" wastes.

Limitations

This technology costs more than conventional technologies and should find its niche in the "hard to treat" wastes.

Follow-On Program Requirements

Decide the best course of action/location/property control and ownership for future utilization of the Transportable PEPS.

Point of Contact

Louis Kanaras

Program Partners

U.S. Army Environmental Center
Tennessee Valley Authority
Vanguard Research Inc.
Plasma Energy Applied Technology
U.S. Army Engineer Research and Development Center-Construction Engineering Research Laboratories.

Publications

Transportable Plasma Energy Pyrolysis System (PEPS) Cost and Performance Report (March 15, 2000).

Transportable Plasma Energy Pyrolysis System (PEPS) Operations and Maintenance Manual (March 20, 2000).

Plasma Energy Pyrolysis System (PEPS) Final Technical Report (March 20, 2000).

ALTERNATIVE CLEANER COMPATIBILITY AND PERFORMANCE EVALUATION PROGRAM

The U.S. Army Environmental Center (USAEC) and the U.S. Army Aberdeen Test Center (ATC) have established the Alternative Cleaner Compatibility and Performance Evaluation Program to facilitate test and evaluation of alternative cleaners proposed as substitutes for hazardous, toxic and flammable solvents.

PURPOSE

The purpose of the Alternative Cleaner Compatibility and Performance Evaluation Program is to provide a mechanism to evaluate and validate alternative cleaner applicability in U.S. Army/Department of Defense (DoD) maintenance, cleaning and repair activities.

Associated goals include quantifying and qualifying user needs; maintaining a protocol for test and evaluation; conducting and providing defensible data through test and evaluation; documenting results and lessons learned; facilitating the development and use of a usage decision tool; targeting proven results to meet user specific needs; and promoting participation within public, private and academic sectors.

BENEFITS

The most striking benefit derived from the Alternative Cleaner Compatibility and Performance Evaluation Program has been the development of the program's test and evaluation protocol. The development, endorsement and use of a uniform protocol by the various Army commodity commands prevents the need to test products several times under differing methods and criteria and thus reduces the possibility for duplication of effort. This benefit reduces the needless expenditure of time, resources and manpower that could otherwise be used for acquisition, infrastructure, or training.

Better understanding of user needs and dissemination of knowledge of the approval process throughout the Department of the Army are a critical component and major benefit of the Alternative Cleaner Compatibility and Performance Evaluation Program. To realize ultimate success, it is vitally important that purchasing organizations and field activities be made aware of the detrimental effects the use of unproven and unauthorized solvent substitutes can have on their mission, material and readiness.

The Army will be better able to preserve readiness, save money and avoid bad decisions by knowing which alternative cleaning products meet its stringent requirements for performance, soldier safety and environmental compliance. Participation will help vendors and manufacturers maximize marketing resources and will alleviate the need to do product-specific evaluations at the direction of each potential user or customer, thus saving significant time, money and resources. In addition, vendors and manufacturers will have an accepted process for validating their products for possible defense procurement.

Technology Users

Results, products and efforts originating from this program will benefit project and product managers throughout the acquisition community, environmental staffs at major U.S. Army commands and installations, other DoD services and government agencies, and Original Equipment Manufacturers (OEMs).

Description

A couple decades ago, no one expected the use of solvents in general maintenance, cleaning and repair operations to come under the scrutiny it did. The long-term effects of solvent use on worker health and the environment and the impact that regulations would have on procurement, storage, use and disposal were unknown. Many federal, state and local laws and regulations limit the use, storage and disposal of hydrocarbon-based cleaning solvents due to their classification as hazardous, flammable, and toxic substances. Unfortunately, the Army and other defense agencies rely on these solvents to maintain unique, mission-critical systems and materiel.

The transition from the use of solvents to more environmentally friendly alternatives is a relatively recent phenomenon. Alternative cleaners have the potential to reduce solvent use and provide significant economic benefits. Unfortunately, an environmentally friendly designation is in no way associated with a product's ability to perform a particular task (e.g., cleaning, stripping or polishing). Nor is it an indication of whether it is compatible with the object to be cleaned, polished or stripped.

Alternative cleaners have the potential to reduce solvent use and provide significant economic benefits. An inherent problem in selecting and using alternative cleaners, however, is that selection mistakes are often made because many products marketed are listed in Defense Logistics Agency (DLA) catalogs as "environmentally friendlier" or have a General Services Administration (GSA) contract number. Although an alternative cleaner may have an environmentally friendlier designation, that designation does not mean that the product's performance has been verified or that it is authorized for military use. In many instances, assumptions based on these designations have led purchasing organizations to procure alternative cleaners without realizing the potential impact to soldiers who use them, the materiel items they are used on, and ultimately, readiness.

Another problem is that many purchasing organizations are unaware of the approval process or that validation is needed before making any changes to maintenance procedures or cleaning regimens. As a result, the uncontrolled replacement of solvents with environmentally friendly products has resulted in a number of use, approval and material compatibility problems. Problems such as these have driven the need to better understand performance requirements, establish validation standards, prevent duplication of effort, and facilitate expeditious review and approval of alternative cleaner use where appropriate.

The performance and compatibility of alternative cleaners proposed as substitutes for solvents currently used must be determined and demonstrated and their use approved by the respective commodity

managers of weapon systems. The Alternative Cleaner Compatibility and Performance Evaluation Program has put in place mechanisms to achieve this objective.

Building on past experience and lessons learned, the Army has launched a project that will allow manufacturers to validate the performance of alternative cleaning solvents on military equipment. Using the protocol developed recently in partnership with commodity managers, the USAEC and the U.S. Army ATC led a multi-agency initiative to comprehensively test several cleaning products and gather data the Army and other DoD services can use to make procurement and usage decisions.

The protocol was developed with the help and at the direction of commodity command approval authorities. The protocol is the key element for the collective performance validation and evaluation effort and, because of tri-service involvement, it will be established as a joint test protocol. In addition, the protocol is being promoted as the basis for an alternative cleaner performance specification and as a compendium document for the next iteration of American Society for Testing and Materials (ASTM). The current program test protocol can be found on the USAEC Web page at http://aec.army.mil. It should be noted that the protocol performance requirements and test methods may change at any time as directed by commodity command approval authorities. However, if any changes are made to the protocol before, during or after testing, due notice of those changes shall be given.

The Alternative Cleaner Compatibility and Performance Evaluation Program requires that potential technologies submitted for evaluation satisfy certain selection criteria. Alternative cleaners submitted for evaluation must be environmentally beneficial compared to hydrocarbon solvents currently being used, have obvious economic benefit, and have pollution prevention qualities that can be tested and presented as valuable evaluation factors to the commodity approval authorities. Cleaners to be tested should also be commercially ready for implementation. This means that they should be beyond the conceptual stage, and logistically available, maintainable, supportable and reliable. The concept of commercially ready will be evaluated on a case-by-case basis and will be dependent on availability for the target user and volume of delivery required by the user. An attractive aspect of the program is that a pre-screening regimen has been developed that will assist private industry participants in determining if it is economically beneficial to proceed with full-scale performance evaluation.

Each product submitted for testing will be reviewed to determine if the submission meets the above criteria. Candidates for evaluation testing will be selected based on several factors, including passing a pre-screening, having demonstrated and documented success in private or private sectors in the past, having virtually nonexistent environmental impact, low economic risks for implementation, realistic potential to meet performance requirements, and practicality of implementation.

Meetings with potential private industry participants are scheduled to begin in February 2001. The meetings will ensure understanding of program objectives, private industry roles and the test and evaluation scope, including environmental evaluation factors, performance and quality evaluation factors required for approval, user implementation decisions, data valuable to technology providers to promote products, and data valuable to end users of the product. For evaluation testing, the USAEC and ATC will include all interested private industry participants whose products meet the defined requirements and who are willing to provide the fee determined after all responses have been received.

Testing is being jointly funded; solvent manufacturers will pay for the tests on their specific products, while the Army will maintain overall test capabilities and purchase materials needed to conduct the test. Private industry participants will be required to contribute funds towards completion of testing. Under the terms of the program, private industry participants will be required to pay for compatibility and performance testing of their specific products while government funds will be used to qualify manufacturer/vendor furnished data, to perform test set-up, to purchase military-unique materials required for testing, and to conduct performance validation test. Alternative solvent manufacturers will realize significant cost savings under this program due to economies-of-scale and cost sharing. The minimum private industry contribution for evaluation will be determined by the amount of funds available to support testing, the cost to perform the testing per product, and the number of technology providers participating.

Participants involved in the evaluation process will go through a thorough screening process to decide which products to put through the full range of performance tests. The ATC will conduct compatibility and performance evaluation allowing technology providers to participate as observers on designated occasions. Performance parameters evaluated will focus on constituent evaluation, material compatibility, and environmental quality benefits reflective of the alternative cleaner. The result of compatibility and performance evaluation testing will be a final report that shall be prepared by ATC for private industry participant consumption and the commodity manager approval process.

Government evaluation testing by ATC will be performed pursuant to a Test Support Agreement executed by ATC with each participating private party. Evaluation testing will be executed by ATC staff at ATC's facilities unless ATC does not have the existing capabilities to do so. In this case, another laboratory having the desired expertise will be used. Confidential or proprietary information may be required to be released for government consumption only as necessary to evaluate constituents or to determine a cleaner's potential impact on the environment, safety and occupational health. It is recommended that this type of information be kept to a minimum until as required to permit, begin and perform testing.

The ATC is responsible for maintaining the validation protocol (i.e., making changes and tracking review and comment); evaluating and verifying data; conducting the evaluation testing; preparing a draft evaluation report for review and comment by commodity approval authorities and private industry participants; and preparing and disseminating the final report and any other related information. Final reports provided to private industry participants shall contain the industry participant's data and results only. The version of the final report provided to the commodity commands shall be used to identify solvent substitutes that meet stringent military maintenance, cleaning, service and repair performance requirements and to update or prepare Qualified Products Lists (QPLs).

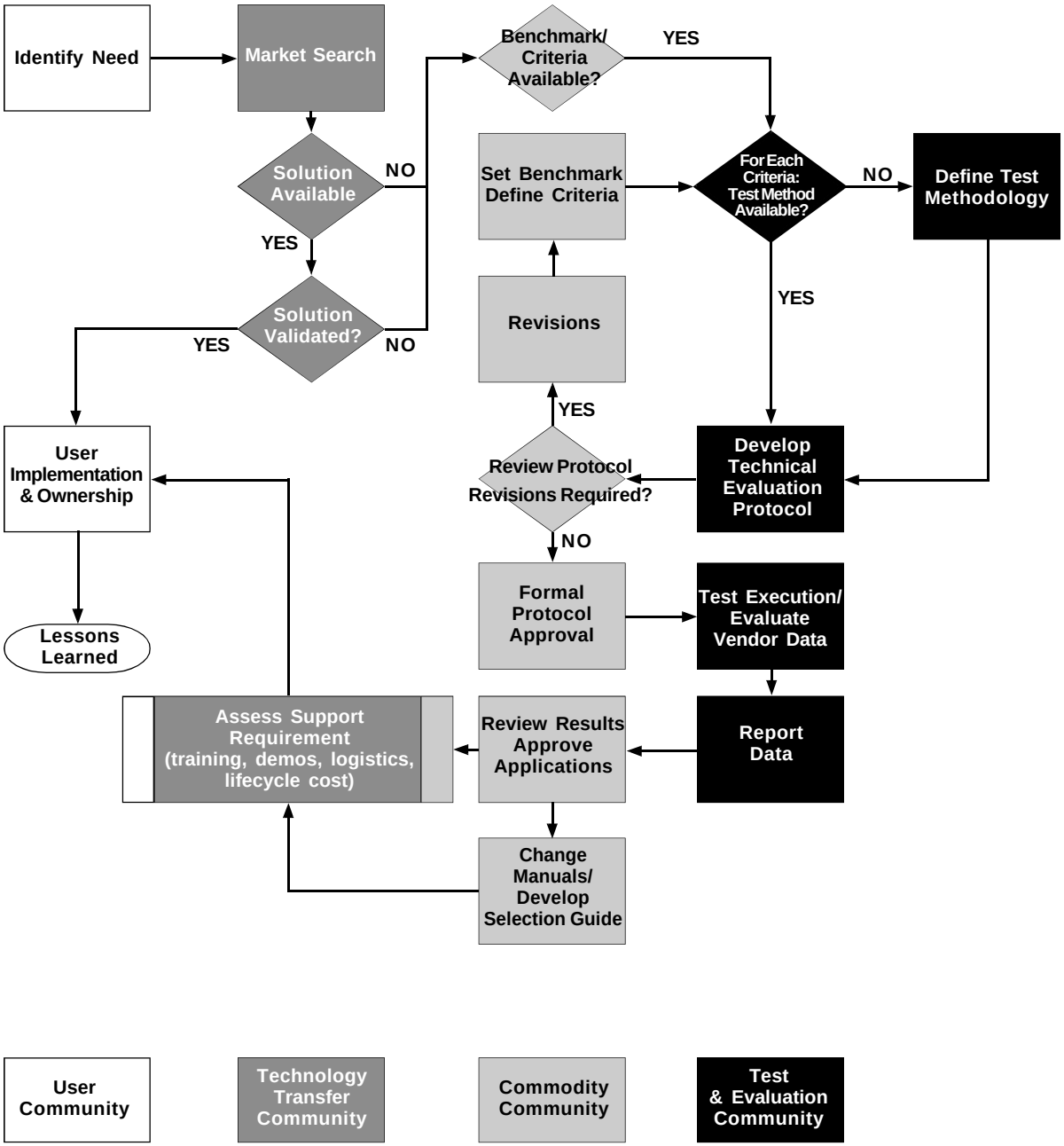
The test and evaluation process is considered complete when the final report has been provided to commodity approval authorities. Follow-on requirements after testing include facilitating the decision process regarding acceptable alternative cleaner usage. A workgroup has been established that includes representatives from the user, approval authority and private industry communities. Private industry participants will have the opportunity to provide input to future program direction and protocol development. The public/private partnership seeks to prevent duplication of effort, encourages the acceptance of alternative cleaners where appropriate and helps to identify the most viable markets for technology insertion.

The program has an aggressive strategy for information dissemination. Results of the evaluation will be distributed to all applicable users as deemed appropriate by commodity command approval authorities to increase awareness of technically and commercially viable alternative cleaners (this assures the maximum exposure and visibility of the results of the evaluation). Although the U.S. government can endorse no verified product, the DoD or its agencies completing performance evaluation testing will enhance the acceptance and use of validated alternative cleaners. This program promotes pollution prevention by providing a viable mechanism to facilitate performance validation of solvent substitutes through active participation from users, private industry and approval authorities.

Manufacturers and vendors of solvent substitutes will derive major benefit through the program's partnering and coordination with the Environmental Technology Evaluation (ETV) Program. The ETV program is an EPA-sponsored program designed to verify the environmental worthiness of environmental technologies. The ETV program, however, does not verify product performance or compatibility with military unique materiel. Coordination with the ETV Program will, therefore, also earn additional assistance in facilitating technology transfer and acceptance through EPA technology evaluation statements for manufacturers and vendors that meet environmental worthiness criteria.

Alternative Cleaner Compatibility and Performance Evaluation Program

Process Flow Diagram



Applicability

Many federal, state and local regulations limit the use, storage and disposal of hydrocarbon-based cleaning solvents. This program supports initiatives in response to the 1990 Pollution Prevention Act and Executive Order 12856 that mandate federal agencies implement measures to address waste reduction and pollution prevention at the source.

Limitations

Unfortunately, it is unlikely that an alternative cleaner drop-in replacement will be found for hydrocarbon solvents currently used in U.S. Army/DoD maintenance, cleaning and repair activities. Although manufacturers and vendors will realize substantial benefits participating in the Alternative Cleaner Compatibility and Performance Evaluation Program, they may still have to be actively involved in optimizing potential solutions to meet specific user requirements. This may involve tasks such as performing on-site demonstrations, training installation staff, or reconfiguring and refining equipment and processes.

Point of Contact

A.J. Walker

Program Partners

U.S. Army Environmental Center
U.S. Army Aberdeen Test Center
U.S. Army Forces Command
U.S. Army Research Laboratory
U.S. Army Petroleum Center
U.S. Army Aviation and Missile Command
U.S. Army Armament, Development and Engineering Center
U.S. Army Center for Health Promotion and Preventive Medicine
U.S. Army Tank Automotive and Armament Command
U.S. Army Tank-Automotive Research and Development Center
U.S. Army Pollution Prevention Support Office
U.S. Army Integrated Product Teams
National Defense Center for Environmental Excellence
Naval Facilities Engineering Service Center
Naval Cognizant Field Activities
Naval Air Warfare Centers
Marine Corps Systems Command
U.S. Air Force Center for Environmental Excellence
U.S. Air Force Corrosion Prevention & Control Office
U.S. Air Force Petroleum Office

Conclusion

Environmental laws, regulations, practices, initiatives and lessons learned during the last century have permanently changed today's military-industrial complex and how it deploys troops, maintains bases and adheres to laws. Today more than ever, we understand the tremendous financial cost and know the unfortunate environmental, health and safety risk associated with the routine use of hazardous, toxic and flammable solvents.

Those lessons having been learned, the USAEC and ATC have established the Alternative Cleaner Compatibility and Performance Evaluation Program to promote and enable evaluation, approval and routine use of

environmentally acceptable solvent substitutes where their use can be technically and physically proven to not adversely affect military readiness, soldiers or materiel.

This program promotes pollution prevention by providing a viable mechanism to facilitate performance validation of solvent substitutes through active participation from approval authorities, users, private industry and academia. The program is quickly gaining wide acceptance among the tri-services as well as throughout private industry

Accomplishments and Results

Success in the program to date includes the establishment of a test protocol developed in cooperation with and endorsed by major commodity commands responsible for approving solvent substitute use on Army materiel items.

Milestones: Calendar Year 2000

Information and coordination meeting with APG-DHSE and Green Seal (APG-AA, Maryland)	Jan 2000
Program IPR	Feb 2000
Protocol coordination meeting with TACOM (APG, Maryland)	Mar 2000
Protocol coordination meeting with AMCOM (Huntsville, Maryland)	Mar 2000
Coordination meeting with AAPPSO (Alexandria, Virginia)	Mar 2000
Protocol coordination meeting with NFESC, NAVAIR, and USMC MALS (Pt. Hueneme, California)	Mar 2000
Brief to Program IPR	May 2000
Coordination meeting with NDCEE (Johnstown, Pennsylvania)	May 2000
Information and coordination meeting at CleanTech 2000	Jun 2000
Information and coordination meeting with P2 Tech Team (Atlanta, Georgia)	Jun 2000
Paper Presentation P2 and HW Conference (San Antonio, Texas)	Aug 2000
Program IPR	Aug 2000
Began Navy Protocol Validation Testing	Oct 2000
Poster Presentation SERDP/ESTCP Envir. Tech. Symp. (Crystal City, Virginia)	Nov 2000
Presentation and Exhibit at 11th Annual Solvent Substitution Conference (Scottsdale, Arizona)	Dec 2000

Publications

Technical Protocol. *Alternative Cleaner Compatibility and Performance Evaluation Test Protocol.* July 2000. SFIM-AEC-ET-TR-99062.

Technical Report. *Abbreviated Test Plan of the ChemFree Enzyme-Based Aqueous Solvent Performance Test.* January 1998. SFIM-AEC-ET-CR-98041.

Technical Report. *Evaluation of Automatic Aqueous Parts Washers*. December 1997. USACERL Technical Report 98/16.

Technical Report. *Evaluation of Effects and Environmental Compliance of Cleaning Compounds on Air Force Corrosion Prevention Phase I Final Report Aqueous Parts Washer Survey*. 10 December 1999. AFRL/MLS-OLR Report, Kaldon, Looper, Clark, et al.

Technical Report. *Field Demonstration for P-D-680 Solvent Replacement*. October 1996. TARDEC Technical Report No. TR-13730.

Technical Report. *Field Demonstration for P-D-680 Solvent Replacement (Part II)*. May 1998. TARDEC Technical Report No. TR-13751.

Technical Report. *Replacement of P-D-680 For Army General Maintenance of DoD Equipment*. September 1995. TARDEC Technical Interim Report No. 13643.

Technical Report. *Replacement of P-D-680 For Army Ground Vehicle and Equipment Applications*. October 1993. BRDEC Letter Report Number 94-1.

Technical Report. *Review of Candidate Replacements for Mil-C-372C, (Cleaning Compound, Solvent for Bore of Small Arms and Automatic Aircraft Weapons*. August 1997. TARDEC Interim Report TFLRF No. 314.

Technical Paper. *Corrosion Testing for Alternative Solvent Substitution Performance Validation*. November 1999. Newton, Ziegler and Walker.

Technical Paper. *A Study of the Applicability of an Aqueous Cleaning Agent as a Drop in Replacement for P-D-680 at Fort Campbell*. November 1996.

Technical Paper. *1,1,1 Trichloroethane Replacement Study*. March 1996. ARDEC Report. Brescia, DePiero and Meyler.

FLASHJET® Coatings Removal Process

The Defense Department is looking for coating removal alternatives to chemical stripping and media blasting. The FLASHJET® coatings removal process, a xenon-flashlamp and frozen carbon dioxide combination patented by The Boeing Company, is a cost-effective and timesaving technology with proven military application.

Purpose

To demonstrate the FLASHJET® coatings removal process for military use.

Benefits

The FLASHJET® process offers low lifecycle costs, saves time and reduces the amount of hazardous waste generated during depainting.

Technology Users

Department of Defense (DoD) depots and depot-level maintenance shops.

Description

Efforts have been underway within DoD to find alternatives to chemical paint removal and media blasting for several years. In the *U.S. Army Environmental Requirements and Needs Report*, requirements for finding alternatives to chemical paint removal and media blasting include Contaminated Blast Media (2.3.n); Hazardous Air Pollutant (HAP) Emission Control (2.1.g); and Alternate Paint Stripping Chemicals of Military Interest (3.2.h). The U.S. Navy requirements relating to depainting activities include Control/Reduce Emissions from Coating, Stripping and Cleaning Operations (2.I.1.g); Control of Volatile Organic Compound and HAP Emissions (2.I.1.q); and Non-hazardous Coating System Removal (3.I.5.a). U.S. Air Force depainting requirements include Substitute for Methylene Chloride Paint Strippers (449); Decreased Waste Generation from Plastic Media, Sand, Walnut Hull and Other Blasting Depaint Operations (808); and New Paint-Stripping Methods Have to Be Identified to Reduce Hazardous Waste and Cost (814). All these requirements are considered high-ranking needs within their respective service.

As an environmentally preferred coatings-removal process, FLASHJET® eliminates the use of HAP chemicals and blasting media. The FLASHJET® process does not use any hazardous materials during the coating-removal stage, thus minimizing the potential for hazardous airborne dust and cutting the cost of paint removal.

FLASHJET® combines two depainting technologies in one process: a xenon-flashlamp and a continuous stream of carbon dioxide pellets. The process also includes an effluent capture system that collects effluent ash and organic vapors. Effluent ash is captured by a series of high efficiency particulate air (HEPA) filters; organic vapors are processed through an activated charcoal tank. The process is fully automated and requires limited worker involvement.

The FLASHJET® system includes six components: the flashlamp and stripping head; the manipulator robotic arm; the computer processed cell controller; the effluent capture system; the carbon dioxide pelletizer; and the flashlamp power supply. The xenon-flashlamp is the primary coatings-removal step. The xenon-flashlamp emits low-pressure xenon gas and creates a high-intensity flash that ablates the coating from the surface. Light energy generated from the xenon-flashlamp pulses four to six times per second. The amount of coating ablated is directly proportional to the amount of energy put into the system. The process can be controlled to remove as little as .001 inches of coating and as much as .004 inches of coating. This control factor can be an asset when topcoat removal is required, but the underlying primer must remain on the substrate.

The carbon dioxide pellet-blasting technology is not a direct form of pellet blasting. The continuous stream of carbon dioxide pellets has two purposes. First, it cools and cleans the substrate, keeping the substrate at an acceptable temperature while the xenon-flashlamp ablates the coating. Second, the stream keeps the flashlamp clear of any coating by "pushing" the coating away from the flashlamp and toward the effluent capture system. All carbon dioxide emitted during the process is captured from other industrial type sources, converted into liquid carbon dioxide and reused.

The effluent capture system collects all effluent ash and organic vapors generated during ablation. Effluent ash is vacuumed into the capture system, separated by size in a particle separator, and captured in a series of HEPA filters. Organic vapors are captured and processed through an activated charcoal scrub and emitted to the atmosphere with less than 5 parts per million light hydrocarbon emission.

The FLASHJET® process has several advantages over other commonly used depainting technologies. The only wastes generated are coating ash and spent HEPA filters. Compared to common media blasting and chemical paint-removal operations used at military depots, the FLASHJET® process has the potential to substantially reduce the amount of waste a facility generates.

The former McDonnell Douglas Corporation conducted lifecycle cost comparisons for the F/A-18A fighter aircraft. The estimated lifecycle cost for FLASHJET® was $2.89 per square foot. Plastic media blasting was calculated at $15.40 per square foot, and chemical depainting was calculated at $33.61 per square foot. Although the FLASHJET® process has a high acquisition cost, it is offset by an attractive lifecycle cost. These costs are calculated over a 15-year period.

This process has gained acceptance within DoD. The Air Force installed a system at the Warner-Robins Air Logistics Center in Georgia for stripping off-aircraft components. Corpus Christi Army Depot in Texas installed a system for stripping the Army UH-60 Black Hawk and the Navy SH-60 Seahawk rotary wing aircraft, which is operational. The FLASHJET® system installed at the Naval Air Station-Kingsville, Texas, for the Navy's T-45 program has operated since summer 1999. One Naval Aviation Depot (Jacksonville) has a FLASHJET® system in their facility equipment plans.

Accomplishments and Results

FLASHJET® has undergone over ten years of extensive metallic and composite substrate panel testing for qualification purposes. The Navy approved the process for use on metallic and composite fixed-wing aircraft. After all the high-cycle fatigue tests are successfully completed for aluminum substrates, approval is expected from the services for metallic substrates on rotary-wing aircraft.

Limitations

The main limitation of the FLASHJET® process is its high acquisition cost. One system now costs $3.2 million, not including the expense of retrofitting an existing structure or constructing a new building. The system cannot access angles and tight corners due to the configuration of the stripping head; this could result in using more than one pass and increasing the xenon-flashlamp energy input, which could reduce the coating removal rate. The stripping head is approximately 15 inches wide, including the xenon-flashlamp, the carbon dioxide pellet stream nozzles, the containment shroud and the bump sensors. A secondary depainting process is needed for areas inaccessible to the stripping head. This problem, however, is commonly found with other depainting technologies. Currently, the ESTCP is funding a demonstration/validation on a series of handheld laser systems for spot coating removal. One other limitation is that lighter colored paint is harder to strip than darker pigmented paint. Although not a large problem, it does require that the operation pay closer attention to the process, especially during the initial setup of the equipment.

Follow-On Program Requirements

Requirements for fiscal year (FY) 2001 will concentrate on completing remaining high-cycle fatigue qualification testing. The military vehicle and equipment demonstrations were completed in FY 2000. The vehicle and equipment demonstration included stripping of the hull of M113 Armored Personnel Carrier. The FLASHJET® SH-60 Aircraft demonstration began on 13 October 1999, and finished 16 December 1999.

Point of Contact

Dean Hutchins

Program Partners

U.S. Army Environmental Center
Department of Defense Environmental Security Technology Certification Program
Department of Defense Program Managers
Anniston Army Depot, Alabama
Aberdeen Test Center, Maryland
Corpus Christi Army Depot, Texas
Patuxent River Naval Air Station, Maryland
Naval Aviation Depot – Cherry Point, North Carolina
Warner-Robins Air Logistics Center, Georgia
Fort Hood, Texas
National Defense Center for Environmental Excellence
The Boeing Company

Publications

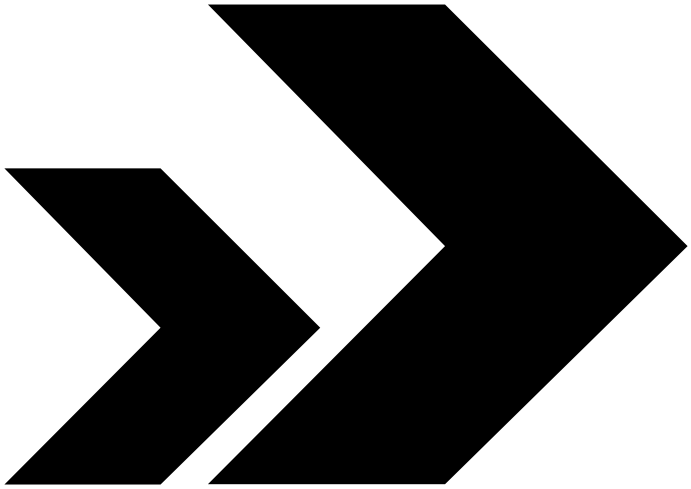
Conducting Force Controlled Constant Amplitude Axial Fatigue Tests of Metallic Materials. ASTM E466. 1997.

Briehan, David W., *Xenon Flashlamp and Carbon Dioxide Advanced Coatings Removal Prototype Development and Evaluation Program.* MDC 92B0479. McDonnell Douglas Corp. for Warner-Robins Air Logistics Center. 1992.

Bonnar, G.R. and J.R. Hollinger. *Qualification of Xenon-Flashlamp/CO2 Paint Removal Procedures for Use on Douglas Commercial Aircraft Components.* 93K0296. McDonnell Douglas Corp. for Douglas Aircraft Co. 1993.

Briehan, David W., and James Reilly. *Xenon-Flashlamp and Carbon Dioxide Coatings Removal Development and Evaluation – U.S. Navy Add-on Program Final Report.* MDC 93B0341. McDonnell Douglas Corp. for NADEP Jacksonville. 1993.

Berkel, Tom R. *Xenon Flashlamp & Carbon Dioxide Advanced Coatings Removal Development and Evaluation Program – U.S. Navy Follow-On Program.* MDA 96X0019. McDonnell Douglas Corp. for the Naval Air Warfare Center. 1996.



Program Focus: Range XXI

GREEN AMMUNITION

Millions of small arms rounds are fired annually on military ranges during training and testing activities. These projectiles contain lead, a federally listed toxic material, and may pose an environmental risk to soil, sediments, surface water and groundwater. Replacing lead in conventional projectiles with a tungsten core will minimize environmental compliance impacts on training and help avoid costly cleanup efforts.

PURPOSE

To provide the Department of Defense (DoD) with small-caliber service ammunition that will meet U.S. and NATO performance standards while eliminating lead in the projectile core.

BENEFITS

This program will revolutionize small-caliber ammunition. The next generation of ammunition, while benign to the environment, potentially offers enhanced lethality and functionality. Environmental restrictions on training U.S. military personnel will be minimized. Training realism and effectiveness will be greatly enhanced, while future cleanup costs may be eliminated. Furthermore, DoD will be the international leader in these technologies, and the environmental stewardship shown will enhance both public image and trust.

TECHNOLOGY USERS

U.S. Army Armament Research, Development and Engineering Center (ARDEC), Small Caliber Ammo Branch
U.S. Army Infantry Center (USAIC)
U.S. Army Research Laboratory (ARL)
Naval Surface Warfare Center-Crane (NSWC)
Department of Energy (DOE) Oak Ridge National Laboratory (ORNL)

DESCRIPTION

Lead in soil, sediment, surface water and groundwater has been confirmed through investigations at Army, Navy, Marine Corps and Air Force small arms ranges throughout the United States and Europe. Lead uptake studies in vegetation at a Marine Corps range in Quantico, Virginia, showed lead levels as high as 23,200 parts per million. Remediation has proven to be extremely expensive. Furthermore, inspections of National Guard indoor ranges from 1986 to 1988 resulted in 812 ranges being shut down due to high levels of lead contamination, both surface and airborne. Those ranges will require costly renovations to meet Environmental Protection Agency and Occupational Safety and Health Administration standards.

About 689 million rounds of small arms ammunition (.22-caliber through .50-caliber) are fired annually during DoD training, with an additional 10 million rounds fired annually by DOE. The annual amount of heavy metal introduced into the environment from this training is approximately 3 million pounds.

The lead projectile cores and compounds used in primers create dust and fumes when fired, exposing shooters and range operators to dangerously

high levels of airborne lead. Studies from the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) show that projectiles account for 80 percent of airborne lead released on firing ranges, while the remaining 20 percent comes from primer combustion. The studies also indicate that 40 percent of inhaled lead is dissolved in the bloodstream, and 10 percent is absorbed directly by the body. Once in the body, lead is very difficult to remove.

The Joint Service Non-Toxic Ammunition Working Group was established in 1995 by ARDEC as a multi-service cooperative forum of DoD, DOE, private industry and academia experts to investigate alternate projectiles and propellants. Other programs followed and eventually the Green Ammunition Project was created to provide "greening" of small caliber ammunition through re-design of ammunition components and production processes. The Small Caliber Ammunition Group within ARDEC partnered with the U.S. Army Environmental Center (USAEC) and other Joint Working Group agencies to replace lead and is responsible for program execution.

USAEC has worked to secure funding and is responsible for overall program management for efforts to eliminate lead from the projectile core. This focus is due to the lead buildup from rounds in small arms range impact areas, which could result in noncompliance with environmental laws and regulations.

The next generation of small arms projectiles will rely on innovative materials to reproduce and improve upon the physical, ballistic and mechanical properties of lead. Composite materials, such as metal powders in nylon or high-density metal particulates bonded with light metals, are being examined as nontoxic replacements for lead.

Concurrent with the USAEC-funded demonstration of an alternative 5.56-millimeter (mm) projectile, other efforts will target the toxic components in the cartridge primer and manufacturing process.

Of primary concern at outdoor ranges is the introduction and dispersion of tungsten throughout the environment. Development of the toxicity and environmental recovery information to support recycling or closed-loop use of the materials, and data on environmental effects has been determined. Leaching, environmental corrosion and biological uptake tests have been performed to fully define stability and mobility characteristics. Study results are being used to provide guidance for projectile formulation such that all materials will be stable and recoverable. Projectile design, constituent materials and processing will be optimized to support the maximum recovery and assure this next generation of projectile materials can be recycled. USAEC will specify recovery and recycle methods and provide for the pilot-scale demonstration. Adequate information regarding the use, release and mobility of the high-density constituents under consideration, specifically tungsten, is considered crucial for acceptance.

Demonstrating the producibility of the lead-free projectile is as critical as the performance demonstrations. If the items cannot be produced in a cost-effective, environmentally compliant fashion, the technology will fail. Lake City Army Ammunition Plant (LCAAP) in Missouri is the Army's principal supplier of small-caliber ammunition. The producibility testing of the proposed nontoxic projectile will be performed at LCAAP. Additionally, other environmental issues regarding production methods, machinery and support materials for small-caliber ammunition manufacture will be addressed.

Producibility testing will be used to minimize production costs and provide feedback to the projectile and primer designers. Production rates of 1,200 items per minute require special consideration in item design and manufacture. Performing producibility tests will assure that item unit-costs stay within 10 percent of current ammunition production costs.

USAEC provided funding for qualification tests and type classification of the new 5.56-mm cartridge for Armywide implementation. At the start of Phase II, the composite materials identified in Phase I were refined. Approximately 100,000 rounds of the successful candidates from Phase I (i.e., tungsten/nylon and tungsten/tin) were purchased from Texas Research Institute and Powell River Laboratories. A task order contract was prepared for LCAAP to assemble and load M855 cartridges using the composite projectiles. Cartridges from each lot were subjected to standard production verification testing to ensure their safety and performance. All cartridges were then shipped to the NSWC in Crane, Indiana, for qualification testing.

Qualification test requirements and ammunition quantities were finalized. Tests not conducted during Phase I that had the highest likelihood of revealing projectile-related deficiencies were conducted first. Some of these tests included environmental conditioning (hot and cold temperature cycling), rough handling and barrel erosion. The remainder of the testing included, but was not limited to, electronic pressure, velocity and action time, dispersion and penetration. Two candidates meet all requirements, and both were determined to be qualified alternate materials.

During Phase III, the technology will be transitioned to the 7.62-mm and the 9-mm projectiles, and demonstration/testing of those configurations will be performed. Concurrent with the manufacture and testing activities, a corrosion and lifecycle cost analysis will be performed for all three calibers. This effort will examine product cost from raw material processing through manufacture, use and eventual disposal or recycling.

Accomplishments and Results

During Phase I, USAEC and ARDEC demonstrated the viability of seven nondevelopmental item formulations to replace lead in the 5.56-mm projectiles. Composite materials tested during Phase I consisted of tungsten bonded with light metals (i.e., tin and zinc) or synthetics (i.e., nylon). Composites were subjected to a high-speed assembly and loading process to produce net shape cores with physical properties similar to lead.

Projectiles underwent ballistics performance testing for dispersion, penetration, electronic pressure and velocity and action time. Phase I isolated two candidates suitable for replacing the current 5.56-mm service round. Toxicity studies on tungsten were completed and analyzed at ORNL and USACHPPM.

The final report of the demonstration of lead-free alternatives for 5.56-mm ammunition was submitted to USAEC in February 1997. Both configurations advanced through Phase II to production. A 3-million-round tungsten-nylon core production lot is currently being manufactured, and the tungsten-tin core has recently been qualified for limited production.

Follow-On Program Requirements

- Complete Phase III (transition the technology to other calibers).
- Evaluate tungsten recycle

Point of Contact

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Program Partners

U.S. Army Environmental Center
U.S. Army Armament Research, Development and Engineering Center
Lake City Army Ammunition Plant, Missouri
Oak Ridge National Laboratory
Naval Surface Warfare Center, Crane, Indiana
Naval Surface Warfare Center, Indian Head, Maryland

Changing Dyes in Smokes

Regulatory enforcement of environmental laws and regulations continues to expand with regard to munitions production and military range operations. Particularly, a rapid trend has developed towards the increased accountability of the Department of Defense (DoD) for the emissions from the use of munitions items during training and testing operations.

Purpose

In 1997, the need to quantify the emissions resulting from munitions use, and to assess the risk to human health and the environment from these emissions, was identified as a critical issue for the U.S. Army and the other services. Environmental Protection Agency (EPA) Region I requested information on the emissions and residues from the use of munitions at the Massachusetts Military Reservation (MMR). DoD was unable to provide the requested data and thus could not present any valid assessment of the impacts from the use of munitions there. Since that time, additional data requirements, such as Emergency Planning and Community Right-to-Know Act-Toxic Release Inventory (EPCRA-TRI) reporting have evolved.

In September 1997, the Chief of Staff of the Army directed the Assistant Chief of Staff for Installation Management (ACSIM) to establish a General Officer Steering committee to address the implications of the restrictions

on operations at Mmr. The ACSIM directed and funded the U.S. Army Environmental Center (USAEC) to gather emissions data. The USAEC has developed a comprehensive program to identify the emissions resulting from range operations that involve weapons firing, smoke and pyrotechnic devices, and exploding ordnance, and to assess the environmental and health hazard impacts resulting from their use. In the execution of that program, it was identified that two of the colored signal smoke grenades and one of the smoke pots contain and emit toxic and carcinogenic dyes in significant quantities. These signaling items are critical to training operations and provide a method to immediately cease operations in the event that safety issues are identified. These dyes/smokes may present a risk to the soldier, any nearby receptors, and to the production and test personnel as well. It is in the best interest of the Army and DoD to demonstrate and implement a material substitution for the dyes/ smokes in these specific munitions items.

Benefits

The substitution of dyes in the smoke grenades and the hexachloroethane (HC) smoke pots will complete efforts for the elimination of carcinogenic materials from the signaling and smoke devices. This will provide reduced risk to soldiers, the environment and surrounding communities. In addition, this will reduce the potential for restricted operations and for fines and penalties associated with the impacts of these items. Training realism will be enhanced and maintained due to the lessening of restrictions. This next generation of colored smokes, while impacting less on the environment, will also provide an enhanced operational capability to the soldier.

Technology Users

Soldiers
Installations
Police
Department of Transportation

Description

Several alternative materials have been identified, but funding is required to validate the functional and operational capabilities of these items with the alternative (less toxic) dye materials prior to their implementation.

Accomplishments and Results

As of yet, the project is in the planning stage. It is anticipated that the new grenades will be manufactured in fiscal year 2001.

Limitations

The new smoke grenades must meet military standard criteria. To complete the transition, the new smoke formulations must meet Soldiers Observer and Maintainer Test and Evaluation requirements. This requirement includes a color comparison, part of the Production Validation Test (PVT). The color comparison includes soldiers testing the items on the ground as well as helicopters flying over to ensure the color is accurate from the sky. The actual PVT is a testing of the item that was produced outside the normal line type production. After completion of the PVT, an Environmental Fate Assessment will occur. Upon completion of the environmental testing, an Inhalation and Toxicology testing or

assessment occurs. After all of these have been completed, the Material Change Approval is issued. Upon the change in formulation, a phased-in production occurs. The first article states a large sample of the items is to be tested to ensure they can be made by line operators and function as intended. After this final testing, the material is released for full-scale production and use.

Point of Contact

Tamera L. Clark-Rush

Program Partners

Environmental Security Technology Certification Program
West Deseret Test Center, Dugway Proving Ground
Pine Bluff Arsenal
Edgewood Chemical and Biological Center
Environmental Protection Agency

Publications

Plan publications are for Production Quality Testing and Environmental Design Tests.

RANGE XXI: IMPACT AREA EVALUATION

UNEXPLODED ORDNANCE CORROSION

Testing and training operations using exploding ordnance continue to play a key role in maintaining the readiness of the warfighter. Roughly 3.5 percent of the rounds used in these operations malfunctions, resulting in unexploded ordnance (UXO). Many of these UXO contain high explosives (HE). UXO exists at impact areas on the surface and buried in soil, in wetlands sediment and in water, under both aerobic and anaerobic conditions. Data on the condition of existing UXO and its impacts on the environment has not been collected or evaluated. Additionally, factors that may affect the condition of UXO (such as munition type, soil type, aqueous conditions and pH) have not been evaluated. This study evaluates the rate and mode of UXO corrosion.

PURPOSE

Provide the U.S. Army with a tool to assess the site-specific years to perforation for unexploded ordnance (UXO).

BENEFITS

This project will enable installation range managers to evaluate the potential risk from UXO corrosion and release of munitions-related compounds on their installations. We are developing a user-friendly computer tool that provides the number of years to perforation for a user-specified thickness of metal. This computer tool can be used as a program management aid, giving the range manager information to manage the need and timing for range maintenance. Environmental restrictions on training U.S. military personnel will be minimized. Future cleanup costs may be reduced. Furthermore, the environmental stewardship observed will enhance both public image and trust.

TECHNOLOGY USERS

U.S. Army Installations
U.S. Aberdeen Test Center (ATC)
U.S. Army Corps of Engineers
Risk Assessment Community

DESCRIPTION

The Army has a growing need to respond to regulatory questions about the environmental impact of UXO in and around firing ranges. As a result, the U.S. Army Aberdeen Test Center (ATC), under the direction of the U.S. Army Environmental Center, has established a program to address these issues. The data to be gathered for this program provide information on the likelihood of UXO to degrade to the point of perforation. This work addresses if and how conventional UXO on military test ranges corrodes over time and provides the parameters, assumptions and constraints of the modeling techniques being used in the development of this UXO Corrosion Model. The Personal Computer tool has three models that estimate the time to failure (or perforation) for UXO. Two of these are existing models (off-the-shelf), originally intended not for UXO, but for other steel structures in soil. The third model was developed based upon empirical data from pit depths from soil-borne UXO. Future efforts will involve using first principles and literature-reported rates of steel corrosion in soils, and UXO pit depths from a

variety of soil and climate types to revamp the 1999 UXO version of the UXO corrosion empirical algorithm (built-in Phase 2). Corrosion modeling based on soil type, and any corrosion by-products, will be performed using techniques under development at the University of Louisiana at Lafayette. The results of this modeling effort will provide input (time to perforation) in future range risk assessments.

A phased approach has been developed. Phase I encompassed an extensive data search, data evaluation, development of test methodology, objectives and data quality standards. The focus of this effort was to perform an extensive data search, evaluate the available data for adequacy, quantitatively analyze the data, and document findings. Phase 2 placed together the two existing steel corrosion tools and the empirical algorithm in a personal computer format. Ongoing work (Phase 3) will gather additional UXO corrosion data from sites where the UXO age is well constrained and over a variety of soil/environmental conditions that may influence corrosion rates. The data generated will support the U.S. Army and Army installations in assessing the environmental impact of weapons firing as a part of testing and training operations.

Accomplishments and Results

During Phase I, USAEC and ATC developed a low fidelity model. Phase II produced a model with real-world data. Approximately seven samples were collected to refine the model. The final report for Phases I and II will be finalized in February 2001. Along with the report will be a Corrosion Model and user's manual. This tool may be used by installation range managers to assess the time to perforation on their ranges.

Follow-On Program Requirements

- Complete Phase II: write reports.
- Begin Phase III:
  1. Write program plan.
  2. Write Sampling Protocol for UXO on ranges.
  3. Collect data from a variety of ranges.
  4. Revise model and write final report with basis for revised model.

Point of Contact

Bonnie Packer

Program Partners

U.S. Army Environmental Center
U.S. Army Aberdeen Test Center
Louisiana State University-Lafayette
U.S. Army Corp of Engineers

UXO Technology Demonstration Program

The Department of Defense needs advanced methods to detect, locate, identify, neutralize, recover and dispose of unexploded ordnance (UXO). The UXO Technology Demonstration Program, conducted at Jefferson Proving Ground, Indiana, has established a framework to better understand and assess UXO technologies. In addition, the experience gained during these endeavors will be applied at the Environmental Security Technology Certification Program-funded UXO standardized demonstration sites.

Purpose

To evaluate, establish and advance UXO technology performance.

Benefits

This program has created a framework for the evaluation of UXO technology. Baseline technology performance has been established, and technology capabilities and limitations have been assessed. Technology users are better able to select the optimum technology or system for their needs. Private industry has benefited from program feedback, and participants are better able to improve their systems.

Technology Users

Military installations with sites that contain UXO.

Description

Congress mandated the UXO Technology Demonstration Program. More than 60 technology demonstrations of UXO characterization and remediation technologies were conducted. Phase I, Phase II and Phase III were conducted in 1994, 1995 and 1996 at Jefferson Proving Ground in Madison, Indiana. The demonstrations were performed on a controlled test site containing a known baseline of emplaced, inert ordnance. Additional technology demonstrations were conducted during 1995 at five U.S. sites that contained live ordnance.

For each phase of the demonstration program, companies and government agencies were given the opportunity to demonstrate their system capabilities. Details of the multiphase demonstration programs were published in reports.

Overall technology detection rates have improved since the initial Phase I demonstration program in 1994. Phase III results show that state-of-the-art technology can detect a substantial portion of emplaced ordnance (five vendors were capable of detecting over 90 percent of the emplaced targets). However, significant technology limitations exist. Along with the improved ability to detect ordnance, there has been a significant increase in the number of false alarms.

The Phase IV effort capitalized on previous UXO technological investments by focusing on target discrimination and the reduction of false-alarm rates. This effort provided the government with state-of-the-art technology for target discrimination capabilities.

ACCOMPLISHMENTS AND RESULTS

Results from this program have been used across the U.S. to aid in the selection and use of companies, systems and sensors for UXO characterization and restoration efforts.

FOLLOW-ON PROGRAM REQUIREMENTS

- Technology enhancements
- Technology demonstrations
- Evaluation and reporting
- Technology transfer
- Identification of support to continue demonstration activities

POINT OF CONTACT

George Robitaille

PROGRAM PARTNERS

U.S. Army Environmental Center
Naval Explosive Ordnance Disposal Technology Division
U.S. Army Corps of Engineers-ERDC

PUBLICATIONS

Unexploded Ordnance Advanced Technology Demonstration Program at Jefferson Proving Ground (Phase I). December 1994.

Evaluation of Individual Demonstrator Performance at the Unexploded Ordnance Advanced Technology Demonstration Program at Jefferson Proving Ground (Phase I). March 1995.

Unexploded Ordnance Advanced Technology Demonstration Program at Jefferson Proving Ground (Phase II). June 1996.

Live Site Unexploded Ordnance Advanced Technology Demonstration Program. June 1996.

Unexploded Ordnance Technology Demonstration Program at Jefferson Proving Ground (Phase III). April 1997.

The Phase IV Report is available on the U.S. Army Environmental Center Web site: http://aec.army.mil.

LOW-COST HOT GAS DECONTAMINATION OF EXPLOSIVES-CONTAMINATED FIRING RANGE SCRAP

The Department of Defense (DoD) has numerous training, target, bombing, and firing ranges at active installations, Formerly Used Defense Sites (FUDS) and Base Realignment and Closure (BRAC) sites that have accumulated a substantial amount of contaminated scrap metal. Range sweeps generate piles of high-value recyclable scrap metal. Contrary to popular belief, many of these items still contain explosives residues after detonation. Explosive incidents involving scrap metal from training and firing ranges have occurred over the years.

PURPOSE

Use hot gas technology to achieve an analytically clean level (5X) for explosives-contaminated material by thermally desorbing and destroying the explosives.

BENEFITS

Hot gas technology has been demonstrated in the past as an effective technology for decontaminating explosives-contaminated materials. Application of this technology was limited to fixed facilities that were effective but expensive to operate. This application of the technology takes the decontamination process to the field where the scrap is located and decontaminates the scrap in place at a much cheaper price than a fixed facility.

TECHNOLOGY USERS

All DoD installations, BRAC sites and FUDS sites can use this technology. The technology can be applied by installation personnel or can be contracted out.

DESCRIPTION

Hot gas technology is a proven technology that will achieve an analytically clean level (5X) for explosives-contaminated material by thermally desorbing and destroying the explosives. All materials and equipment used in this process are off-the-shelf and readily available. Application of this process to piles of contaminated range scrap involves placing thermocouples in the pile, covering the pile with an insulating blanket, connecting a gas burner to the pile, heating the pile until all of the thermocouples reach the set temperature, and holding the temperature for a set period of time, usually four to six hours.

ACCOMPLISHMENTS AND RESULTS

The demonstration site has been selected, regulatory approval has been received, the demonstration plan has been prepared, equipment has been ordered, and the scrap has been selected. Field demonstrations are scheduled to start in March 2001.

LIMITATIONS

This process cannot be used on unexploded ordnance or other items that are still explosively configured in any way. It is not intended for use on combustible materials.

FOLLOW-ON PROGRAM REQUIREMENTS

A visitors' day will be held during the demonstrations for all the military services. All reports and manuals are scheduled for completion in December 2001. Technology transfer to the services and interested users will be accomplished during the following year.

POINT OF CONTACT

Wayne E. Sisk

PROGRAM PARTNERS

U.S. Army Environmental Center
Naval Ordnance Center, Indian Head
Aberdeen Test Center
Parsons Engineering Science

PUBLICATIONS

Design Guidance Manual for Low-Cost Disposable Hot Gas Decontamination System for Explosives-Contaminated Equipment and Facilities. November 1998. Parsons Engineering Science. SFIM-AEC-ET-CR-98046.

Demonstration Results of Hot Gas Decontamination for Explosives at Hawthorne Army Depot, Nevada. September 1995. Tennessee Valley Authority Environmental Research Center. SFIM-AEC-ET-CR-95031.

Hot Gas Decontamination of Explosives-Contaminated Items Process and Facility Conceptual Design. January 1995. Tennessee Valley Authority Environmental Research Center.SFIM-AEC-ET-CR-94118.

SHOCK-ABSORBING CONCRETE PERFORMANCE AND RECYCLING DEMONSTRATION

Recovering lead and other bullet fragments from conventional soil berms is often difficult. As a result, lead and other heavy metals may leach into groundwater, potentially resulting in a remediation effort. Bullet traps constructed from shock-absorbing concrete (SACON) will retain bullets and reduce leaching while providing an easy-to-recycle berm material.

PURPOSE

To assess the use of SACON to reduce the potential of off-site migration of lead and other heavy metals.

BENEFITS

SACON may provide a means to recycle projectiles and prevent buildup of heavy metals in range soils. SACON could also mitigate the excessive soil erosion experienced on outdoor ranges caused by bullet impacts. Erosion control and soil stabilization would help prevent migration of heavy metals off the range, and alleviate the recurring costs of land rehabilitation on the ranges. In addition, SACON may reduce or eliminate safety problems caused by ricochets off natural or other materials.

TECHNOLOGY USERS

The Army – primarily Forces Command and Training and Doctrine Command installations – as well as the National Guard, Navy, Marine Corps, Air Force and Coast Guard.

DESCRIPTION

Numerous Department of Defense small arms ranges contain lead and other metals in soils. In some cases, those inorganic materials may "migrate" to surface water or groundwater. The Army operates approximately 1,400 outdoor small arms ranges in the continental United States while the Navy (including Marine Ranges) and the Air Force run approximately 270 and 200 outdoor small arms ranges, respectively. The U.S. Army Environmental Center (USAEC), U.S. Army Training Support Center and U.S. Army Engineer Research and Development Center-Waterways Experiment Station seek ways to reduce the potential of off-site migration of lead and other heavy metals.

SACON has been used as a bullet-stopping material since the 1980s. It has been extensively field tested with a variety of small arms, including military and civilian automatic and semi-automatic weapons. The Army and other federal and state agencies have fabricated "training villages" from SACON. However, SACON has not been demonstrated as a berm material on conventional small arms ranges.

SACON can be used to build safe, durable, low-maintenance barriers that can hold spent bullets in a low-permeability, alkaline matrix that will minimize escape of potentially harmful metals into surrounding soil or groundwater. After use, the SACON bullet traps can be recycled. The SACON is crushed and the bullet fragments separated from the crushed

material. The aggregate developed from the crushed SACON can be used to recast blocks in a new foamed concrete mixture. The bullet fragments can be recycled.

Demonstration objectives focused on identifying and validating the performance, cost, safety, logistics, training realism and recycling aspects of the SACON bullet trap material. Field demonstration of SACON was conducted at the United States Military Academy in West Point, New York, from April through November 1997 and at Fort Knox, Kentucky, from March 1997 through January 1998. SACON recycling was demonstrated at Engineer Research and Development Center, Vicksburg Pvt, in October 1997. Accelerated durability and ricochet testing was conducted at U.S. Army Aberdeen Test Center in March 1998.

Accomplishments and Results

Field demonstrations were completed in March 1998. A final technical report was issued in August 1999, and a Cost and Performance Report was completed. A summary of performance results follows:

SACON does provide range managers with a means of effectively capturing and containing lead on small arms ranges. SACON offers significant benefits in comparison to current commercial off-the-shelf (COTS) technologies. It exhibits an ability to inhibit the leaching of lead corrosion products. Other COTS bullet traps and soil berms lack this lead stabilization capability. The waste generated from the use of SACON is not classified as a hazardous waste and can be disposed of as a solid waste. SACON is not flammable and can be formed in any shape, making it adaptable to more range applications than standard COTS technologies. However, like all bullet traps, SACON is an expensive means of mitigating the risk of lead transport from ranges and should be considered only as a last resort for keeping ranges environmentally compliant. Other methods of reducing lead transport risk should be investigated prior to installing any bullet trap technology. New methods of stabilizing the lead on the range and mitigating physical lead transport in storm water runoff are being developed and may provide more cost-effective means of reducing lead transport risk and bioavailability.

Limitations

Use of SACON to capture rounds may result in:

- Increased maintenance costs for ranges;
- Increased construction costs for new or refurbished ranges;
- Reduced range use flexibility (SACON must be designed for specific calibers of ammunition).

Follow-On Program Requirements

Disseminate the demonstration results through articles.

Point of Contact

John Buck

Program Partners

U.S. Army Environmental Center
Combat Training Support Directorate, Deputy Chief of Staff-Training, Training and Doctrine Command

U.S. Army Engineer Research and Development Center-Waterways Experiment Station
U.S. Military Academy, New York
Fort Knox, Kentucky
Environmental Security Technology Certification Program
U.S. Army Aberdeen Test Center

PUBLICATIONS

"Management of Spent Bullets and Bullet Debris on Training Ranges." Presentation for the American Defense Preparedness Association (ADPA) 1997 Waste Management Conference.

"Chemical Containment of Heavy Metals from Bullet Debris in Shock-Absorbing Concrete (SACON) Bullet Barriers." Paper presented at the 23rd ADPA Environmental Symposium.

"Design of Modular Bullet Trapping Units Using Shock-Absorbing Concrete (SACON)." Paper presented at the 1997 Tri-Service Environmental Workshop.

Final Report, Demonstration of Shock-Absorbing Concrete (SACON) Bullet Trap Technology. August 1999. SFIM-AEC-ET-CR-99017.

SMALL ARMS RANGE BULLET TRAP DEMONSTRATIONS

Lead from bullets fired on small arms ranges may contaminate groundwater and soil. Such lead contamination could lead to range closure and long-term cleanup costs. Capturing the bullets will prevent the lead from entering the environment. The use of bullet traps on small arms ranges may prevent pollution and result in greater range availability for training and environmental protection.

PURPOSE

To reduce the potential of off-site migration of lead and other heavy metals, to reduce the impacts on the environment, and to promote training readiness through pollution prevention methods that reduce environmental compliance impacts.

BENEFITS

Bullet traps may provide a means to recycle projectiles and prevent contamination of ranges and the surrounding environment. Bullet traps would also mitigate excessive soil erosion on outdoor ranges caused by the impact of the projectiles. Erosion control and soil stabilization on the ranges would help prevent the off-range migration of heavy-metal contaminants.

TECHNOLOGY USERS

Army and Department of Defense installations with small arms ranges. There may also be civilian applications.

Description

The Army operates approximately 1,400 outdoor small arms ranges in the continental United States; the Navy runs approximately 270 outdoor small arms ranges (including Marine ranges), and the Air Force operates approximately 200 outdoor small arms ranges.

Future regulatory focus may restrict testing and training activities and force the closure of valuable small arms range facilities unless methods are implemented to capture and recycle projectile material and prevent contamination of the range and the surrounding environment. Bullets from small arms are primarily lead, listed as a toxic material under the federal Resource Conservation and Recovery Act (RCRA). Once in soil, bullets may corrode, and the lead may enter groundwater or surface water, resulting in a potential violation of RCRA or other laws. Cleanup of water contaminated with lead is costly, and contamination may result in range closures or restricted use.

Bullet traps can reduce the amount of lead and other metal compounds that end up in soil. Use of bullet traps is presently limited to only a handful of military installations and primarily confined to indoor ranges. This project assesses the performance capabilities of three commercially available bullet traps for use at outdoor military ranges.

Techniques that limit the volume of soil containing heavy metals at small arms ranges also will limit cleanup costs and prevent regulatory restrictions of testing and training activities at active sites. Bullet traps that capture and contain projectiles for recycling will limit or possibly prevent soil contamination on training sites.

Accomplishments and Results

Accelerated testing was completed on three commercially available bullet traps. The following types of traps were tested in a 25-meter range backstop scenario: composite rubber block trap; granular (or shredded) rubber trap; and steel decelerator-type trap.

The consensus is that the bullet traps do not meet their manufacturers' performance claims. Problems ranged from ill-defined usage limitations to lead-dust containment and exposure concerns. A report documenting the traps' performance, environmental benefits and cost analyses is available.

Limitations

Use of bullet traps to capture lead may result in:

- Increased maintenance costs for ranges;
- Increased construction costs for new or refurbished ranges;
- Reduced training realism (in some cases);
- Reduced range use flexibility (some bullets or weapons might damage the traps);
- Increased environmental and personnel exposure risks (if the selected trap is not suited for the type of ammunition used on the range).

Follow-On Program Requirements

Publicize the demonstration results through articles.

POINT OF CONTACT John Buck

PROGRAM PARTNERS U.S. Army Environmental Center
U.S. Army Training Support Center
U.S. Army Aberdeen Test Center

PUBLICATIONS *Final Report, Bullet Trap Feasibility Assessment and Implementation Plan, Technology Identification Report.* March 1996. SFIM-AEC-ET-CR-96005.

Final Report, Bullet Trap Feasibility Assessment and Implementation Plan, Evaluation Criteria Report. April 1996. SFIM-AEC-ET-CR-96142.

Final Report, Bullet Trap Feasibility Assessment. December 1996. SFIM-AEC-ET-CR-96195.

Final Report, Bullet Trap User's Guide. December 1996. SFIM-AEC-ET-CR-96201.

RANGE AND MUNITIONS USE WORKGROUP

Limited technical information is available on the impact of munitions and their residues on the environment. Data gaps are particularly apparent with regard to (1) the types and quantities of chemicals released during the functioning of munitions; and (2) the environmental fate and effects of those chemicals. Although the military services have conducted limited individual studies regarding the impacts of unexploded ordnance (UXO), constituents and residues on specific ranges, a consistent Department of Defense (DoD) approach to assessing ranges is necessary to ensure DoD's critical operational mission requirements are sustained while minimizing or eliminating environmental risks to human health or the environment.

PURPOSE Develop a coordinated DoD plan to assess current range conditions and estimate the environmental impacts of munitions' use on active and inactive ranges.

BENEFITS A DoD-wide plan for assessing ranges will focus resources, avoid duplication of effort, and allow all DoD branches to prioritize their respective range assessment efforts. The approach developed by the team will be peer reviewed and will lend credibility to any assessments conducted. A consistent approach for assessment of ranges could reduce costs and increase confidence in the assessment. The tools developed by the team should reduce installations' costs during the design and execution of range assessments.

TECHNOLOGY USERS Army, Navy, Air Force and Marine major commands and installations with active/inactive training and testing ranges.

Description

The development of a coordinated DoD plan will be accomplished through the execution of an approach that encompasses three core elements or sub-objectives. The information obtained will provide the DoD with the capability to rapidly assess range conditions and show that the ranges are being conscientiously managed in an environmentally sound manner. This will be accomplished through the development of a phased or tiered approach of assessment that factors in prioritization of ranges with respect to mission and regulatory impact, public and local interest, as well as other factors. The core elements are as follows:

- Identify requirements and standards for assessing ranges and related data for active/inactive ranges.
- Identify technical approaches, protocols and methods for assessing ranges and identify data gaps and issues.
- Develop a framework approach for use by the services in prioritizing specific data needs for assessing ranges.

Accomplishments and Results

The Range and Munitions Use (RMUS) workgroup has met for approximately one year, meeting regularly since August 2000. The most significant accomplishment is the development of a Program Plan Outline that will guide all subsequent efforts. Progress has been hampered somewhat by the changing makeup of the team. It is anticipated that the Program Plan will be finalized by second quarter fiscal year 2001.

Limitations

The development of the plan will not ensure execution of all aspects of the plan. It will be up to the individual services to establish their own program and implement all aspects of the plan. Although regulatory input and concurrence will be sought, complete acceptance by the regulators of range assessments conducted per the plan cannot be guaranteed.

Follow-On Program Requirements

The services will need to identify resources and executors for each subobjective identified in the Program Plan Outline and finalized Program Plan. Each service will then be responsible to execute the plan per its individual needs.

Point of Contact

John P. Buck

Program Partners

U.S. Navy
U.S. Marine Corps
U.S. Air Force
Department of Defense

Publications

DoD 4715.11 & 12, RMUS Objective Use #1.

Advanced Small Arms Range Guidance Document

Metals such as zinc, copper and lead that exist on small arms ranges can migrate from the range to adjacent water sources and pose a human health risk. Lead is of most concern because of the high quantities that accumulate on the range and its ability to persist in the environment. To continue operations of these ranges, the Army must obtain information on containing metals on the range and making this information accessible to range managers.

Purpose

To develop a range guidance document that will allow range managers the ability to accurately determine if there is a risk potential of lead migration on the installation's ranges and a step-by-step solution process for containing lead on the range.

Benefits

Continue for the operation, integrity, safety and serviceability of small arms ranges while protecting human health and the environment.

Technology Users

Installation range managers.

Description

A draft guidance manual will be developed that will include a discussion of lead mobility on small-arms ranges; regulatory and logistical drivers for improved range management practices; lead mobility and erosion assessment methodology, technology identification and selection methodology; technology performance assessment methods; technology economic cost analysis guidance; potential funding sources for range environmental improvements; and technology vendor/source information.

An installation will be selected to conduct the demonstration, and a suitable range site will be chosen for validation of the manual contents based on range environmental and use criteria. The methods identified in the draft *Guidance Manual and Demonstration Plan* will be used to characterize the lead migration and soil erosion from the site, and an assessment will be made on the potential environmental impact resulting from the lead migration.

A modification of the range site will be conducted with appropriate lead migration and soil erosion methods based on the results of the site characterization and the guidance provided in the draft guidance manual. Post range modification monitoring will continue for a minimum of one year. Monitoring is expected to consist of monthly field inspections to gather information from automated monitoring equipment and semi-annual sampling to monitor lead distribution on the range.

The draft guidance manual will be revised as determined necessary following the field demonstration. The final methodology will be formatted into tools that are useful to the range manager, such as a field

worksheet and guidance key. These tools will be incorporated into the design *Guidance and Maintenance Methods Manual.*

The Aberdeen Test Center is conducting this project.

Accomplishments and Results

The program plan was completed and the assessment portion of the document was developed. Fort Jackson, South Carolina, was selected as the installation on which to conduct the demonstration.

Follow-On Program Requirements

- Collect data from Fort Jackson.
- Review data and select range sites for the demonstration.
- Determine positions to monitor for sediment movement and lead deposits.
- Determine locations and methods of ground water sampling.
- Revise and correct Draft Guidance Manual as deemed necessary.

Point of Contact

David Lorenz

Program Partners

U.S. Army Environmental Center
Aberdeen Test Center
Fort Jackson, South Carolina

VEGETATION WEAR TOLERANCE

Erosion can affect the quality of training sites and the environment on Army installations. Revegetating eroded areas with species able to tolerate heavy vehicle and troop traffic will reduce erosion, keep lands open for training and maneuvers and save time and money.

PURPOSE

To determine which vegetative species are the most tolerant to wear from troop and vehicle traffic on individual installations within a climatic region.

BENEFITS

Revegetating eroded areas with species able to tolerate heavy vehicle and troop traffic will reduce erosion, keep lands open to training and maneuvers and save time and funds.

TECHNOLOGY USERS

Installation range and natural resource managers.

DESCRIPTION

Demonstrations using vegetation thought to best reclaim eroding land and withstand wear from troops and vehicles will be conducted at three installations within a regional climatic area, on two or three dominant soil types.

After selecting the region and installation for the initial demonstration, researchers will select best-known species for use by installation and climatic region (including soils). They will design a test and demonstration project that can be used at all sites for statistical analysis and evaluation. They will then select specific sites on the installations and begin the demonstration.

Researchers will monitor the demonstrations for three to four years. The demonstrations will involve controlled troop and vehicle traffic, submitting the plants to diverse levels of wear. Based on the test results, certain species will be recommended for installation and regional use. The species may be installation-specific to one or more soils, or may be adaptable to all installations and soils within the climatic region. Information on these species will be available on the VegSpec computer program, so natural resource and range managers can easily identify and select the plants best suited for their revegetation needs.

Researchers are conducting this demonstration in cooperation with the Natural Resources Conservation Service (NRCS).

ACCOMPLISHMENTS AND RESULTS

Poor initial stands of selected vegetation and an unmanageable stand of weeds caused the bottomland site to be dropped from evaluation. Decision-makers maintained that the time involved in reestablishing the site would leave no time for evaluating it.

Controlled traffic or access was begun on the remaining sites at a low rate because of the extended drought.

The disturbed upland lawn (barracks area with extensive foot traffic) experienced generally good establishment after some replanting. Three varieties show promise despite the drought.

The disturbed upland lawn (with tire and track traffic) had some difficulty establishing because of the drought and poor soil conditions. Researchers halved planned traffic on this area to maintain the vegetation. A number of accessions thrived despite the dry weather and vehicle traffic.

The wooded upland area (bivouac area) was the best established site; it was shady and little used.

The disturbed upland area (small arms range), though harsh and poorly established, had three accessions that show promise. Adding to the stress of the site, parts of it were bladed to smooth out the bullet furrows. This unplanned blading defeated the purpose of the trial. Sufficient plots may remain to continue evaluations.

The project has been completed in the field. Data are being summarized, and a technical report is being formalized for publication in 2001. Early tabulations indicate that there is a wide tolerance to wear by various species with native selections in some cases out competing introduced selections in the barracks, disturbed upland and small arms range.

Follow-On Program Requirements

- Review installations and select demonstration sites.
- Initiate project on all sites by preparing them for planting.
- Plant projects on all installations.
- Review all sites for stands and replant if necessary.
- Monitor project; make sure vehicle and foot traffic is applied according to the project plan.
- Record results, summarize data, prepare technical report and publish results.

Point of Contact

David Lorenz

Program Partners

U.S. Army Environmental Center
Natural Resources Conservation Service
Fort Leonard Wood, Missouri

ORDNANCE EMISSIONS CHARACTERIZATION PROGRAM

Military installations need to characterize the emissions generated by munitions during training and testing activities. The Ordnance Emissions Characterization Program will provide the Army and Defense Department with data to help them assess the environmental impacts from munitions use, as well as build various models and health and risk assessments.

PURPOSE

- To obtain data and identify models that quantify the emissions generated from munition items.
- To provide the U.S. Army with data to assess the potential air emissions.
- To create defensible data to be used for fate, transport and effect work.

BENEFITS

The data generated from this effort will help the Army and Army installations assess the environmental impacts of using munitions during training and testing operations. The emissions data can be used to feed various models (such as air, fate and transport) and support the generation of health and risk assessments. Installations can also use the data to meet Emergency Planning and Community Right-to-Know Act or the Toxic Release Inventory reporting requirements. Environmental restrictions on training U.S. military personnel will be minimized, due to more scientific data. Future cleanup costs may be reduced. Furthermore, environmental stewardship shown will enhance both public image and trust.

TECHNOLOGY USERS

Army and Department of Defense Installations
U.S. Army Installations
U.S. Army Research Laboratory
U.S. Army Corps of Engineers – Waterways Experiment Station

DESCRIPTION

The U.S. Army Environmental Center (USAEC) has developed a test program to identify and quantify the emissions that result from weapons firing and from the use of pyrotechnic devices. The data to be gathered will provide information on the concentrations of the emission products. The requirement for this information was identified as a result of the Administrative Orders (AOs) issued by the Environmental Protection Agency (EPA) Region I, which severely restricted training operations at the Massachusetts Military Reservation. The Army questioned the validity of the claims made by the EPA Region I, but was unable to provide data regarding training range emissions and the fate and transport of those emissions in the environment. This test program is focused on obtaining and developing data such that the Army will be able a present an incontrovertible case for the continuation of operations or at least limit the breadth of restrictions to those activities that are in fact causing peril.

The three distinct but related project areas to quantify emissions have been developed as follows:

1) Firing Point Emission Study

This effort will develop data on the emissions resulting from weapons firing at the firing position and associated emissions factors. The focus of the effort will be to quantify the emissions, develop emissions factors and evaluate the fate of emissions from representative U.S. Army weapon system ammunition classes. The data generated will support the U.S. Army and U.S. Army installations in assessing the environmental impact of weapons firing as a part of training and testing operations. Limited data exist on the emissions associated with weapons firing. Research efforts such as those conducted by IIT Research Institute on small caliber (5.56 millimeter [mm]) and large caliber (105 mm) were very limited in scope. A phased approach has been developed. Phase I will encompass a data search and analysis, test matrix and methodology development, model development, and an interim report. An important objective of Phase I will be to establish item similarities and data crossover so that the item test matrix and costs are minimized. Phase I was completed in October 1998. Phase II involves actual weapons firing at the Aberdeen Test Center, Aberdeen Proving Ground, Maryland, with sampling and analysis results used to develop emission factors for specific weapons systems and ammunition types.

2) Characterization of Smoke and Pyrotechnic Emissions

This effort will develop data on the emissions resulting from smoke grenades and flare use during training and testing. A phased approach will be used to accomplish this task. Phase I encompasses a comprehensive data search followed by actual testing to develop data on the emissions resulting from smoke grenade and flare use. The emissions will be characterized in the Bang Box at the Dugway Proving Ground, Utah, for various smoke grenades (colored and uncolored) and flare devices (colored and uncolored). Results of these characterization efforts will then be used to generate emission factors for the various items. The emission factors can then be used in conjunction with standard dispersion models to estimate downwind concentrations and rates of deposition.

3) Exploding Ordnance Emissions

This effort identifies and evaluates the fate of explosive compounds in projectiles that have properly functioned during training and testing operations. Efforts will be focused to assess and document the completeness of reaction, and to quantify the emission residuals and byproducts from explosive detonation of military projectiles. The dispersal of the residuals and byproducts in air, soil and water will be evaluated, as well as factors affecting their environmental degradation and transport. A phased approach is planned. Phase I efforts will consist of a

significant data search and review, test matrix and methodology development, and model identification. One aspect of test methodology will be to assess the potential of using small-scale detonations that mimic much larger sized ordnance. It is envisioned that at least one full-scale detonation will be required, and those results will be used for verification of the test methodology. Phase II will provide for the actual testing and for the development of emission factors.

Phase III for all studies in this effort involves a comprehensive study on the environmental fate and transport of the emission products in the environment.

For all of the emissions studies, it is known that in perfect combustion of an organic (carbon-containing) substance, only carbon dioxide and water are created. However, because explosions and other types of combustion do not always take place under optimum conditions, and because there are other substances included in these items, researchers look for many other substances in addition to carbon dioxide and water. During testing, the item being evaluated is placed in the testing chamber, and the system used to collect the emissions from the ignition of the item is activated. Upon detonation, the emission products are collected through a vacuum system. The samples collected are then processed by chemists to determine amounts of any substances present. Chemists analyze the samples collected for over 300 different substances that can be byproducts of any combustion. The airborne compounds sampled for during these tests included total suspended particulate (TSP), particulate matter that was smaller than 10 microns, metals, volatile organic compounds, dioxins and furans, carbon monoxide, and similar compounds that might lead to public health concerns.

The tests were also meticulously videotaped with high-speed film, enabling researchers to play back the video and measure the fire plumes and smoke patterns from the detonations. The temperature and velocity of the firing are also being measured. The information obtained can be used by modelers to determine what is ultimately happening to the emissions and their effects, if any.

Accomplishments and Results

Testing of 42 items for smoke and pyrotechnic and firing point emissions was completed. Reports are being generated recording emission factors, actual concentrations and analysis of emissions.

The EPA-Research Triangle Park (EPA-RTP) has been reviewing Detailed Test Plans (DTPs) prior to the firing or detonating of the ordnance. EPA-RTP's comments and approval of the plans has added great validity to the testing.

Follow-On Program Requirements

- Complete 50 various tests in fiscal year 2001 at Dugway Proving Ground and the U.S. Army Aberdeen Test Center.
- Complete documents publishing emission factor results.

- Publish emission factors in the EPA's standard document (AP-42)
- Publish fact sheets and technical documents for each item tested (with descriptions of the item, its emissions and a generic health risk assessment).

POINT OF CONTACT

Tamera Clark-Rush

PROGRAM PARTNERS

U.S. Army Environmental Center
U.S. Army Aberdeen Test Center
U.S. Army West Deseret Test Center, Dugway Proving Ground, Utah
Environmental Protection Agency
U.S. Army Center for Health Promotion and Preventive Medicine

DUD AND LOW ORDER RATE STUDY

Environmental regulators, citizens and the Department of Defense (DoD) are concerned about the potential that range activities pose threats to the environment. Some believe that unexploded ordnance (UXO) can release explosives into the soil, with possible subsequent transport to groundwater. The Army, particularly the U.S. Army Environmental Center (USAEC), is conducting various studies to determine the validity of this concern. If this concern is valid, then the amount of UXO on a range is an important parameter in estimating the amount of explosives available for release. The amount of UXO on a range is a function of the number of rounds fired, the dud rate, and, to a lesser degree, the low order detonation rate. Many have expressed the belief that ammunition dud rates are 10 to 20 percent. To obtain hard data on both dud and low order detonation rates, USAEC funded the Defense Ammunition Center (DAC) to compile rates from existing firing records.

PURPOSE

To more accurately determine the dud and low order rates of ammunition versus conventional estimation.

BENEFITS

Better determines the dud and low order rates of ammunition versus conventional estimation.

TECHNOLOGY USERS

Range assessors
Installation personnel
Materiel developers

DESCRIPTION

DAC compiled dud and low order rates using test firing records from Ammunition Stockpile Reliability Program (ASRP). The purpose of the ASRP is to determine the reliability of ammunition in storage. The ASRP tests samples of ammunition drawn from Army storage locations all over the world. Since the 1950s, the ASRP has conducted thousands of tests on a wide variety of ammunition items. Each test consists of firing many samples of a specific type of ammunition. The ASRP has tested hundreds of different types of ammunition. In total, the ASRP has tested hundreds

of thousands rounds of ammunition. It has tested ammunition that the Army has used since the early 1940s to the present day. Each ASRP test report provides performance data, such as dud and low order rates. DAC retrieved these ASRP test reports from their records repositories and loaded the test data into a database. The database provides dud and low order detonation rates by individual item (e.g., cartridge, 105-millimeter [mm] high explosives [HE], or M1), by size (105-mm, 155-mm, etc.), by family (gun, howitzer, mortar, etc.), or by type of filler (HE, white phosphorus [WP], submunition, etc). The data clearly show that dud rates for gun, howitzer, mortar and rocket ammunition are much lower than the 10 to 20 percent quoted in some circles. As for low order detonation rates, they are an order of magnitude less than dud rates. This fiscal year, USAEC is funding DAC to look into rates for other types of ammunition, such as pyrotechnics and hand grenades.

Accomplishments and Results

So far, over 100 Department of Defense Information Codes (DODIC) have been assessed based on testing data.

Limitations

Not all items have an obtainable dud/low order rate due to unique use, recovery of items, expense of items, etc.

Point of Contact

Tamera L. Clark-Rush

Program Partners

Defense Ammunition Center

Publications

Dud/Low Order Rate Study

Emission Source Modeling and Health Risk Assessment

When conducting site-specific evaluations of munitions emissions, installations may request guidance in gathering pertinent data. A handbook that details the types of modeling information necessary to perform site-specific assessments would be helpful. USAEC has been characterizing ordnance emissions; these emission can be used to feed air dispersion models. After modeling is completed, those numbers can be compared with health risk assessment toxicity levels to determine if there is a potential health risk from the use of those munition items at the installation.

Purpose

Develop a handbook to be used by an installation to collect pertinent data for performing site-specific evaluations and health risk assessments. This handbook is not intended to be used as a guide for conducting site-specific modeling; instead, it identifies the information that would be needed if such an analysis were desired. Specifically, the handbook includes a general overview of the selected model; identifies parameters (e.g., wind speed) that are needed to perform a site-specific evaluation; and provides sources

where information may be obtained, if applicable. Recommendations on possible modifications to make the model more applicable for Army use may also be included as appropriate (e.g., ability to use item-specific emissions data).

Benefits

Installation-specific health risk assessment for the use of munitions.

Technology Users

Installation personnel
Air modelers

Description

Identifies needs and provides estimated hours and costs to perform site-specific assessments of munitions emissions and associated risks, if any.

Accomplishments and Results

A draft handbook was produced.

Limitations

Air models are not capable of modeling different point sources.

Follow-On Program Requirements

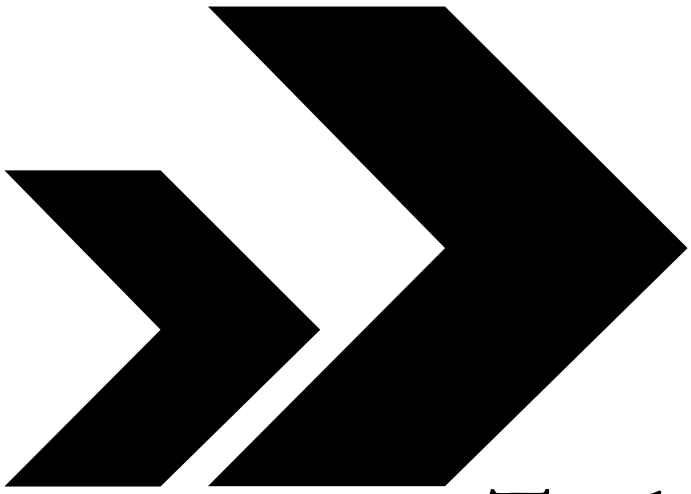
Final handbook to be used and validated at the installation level.

Point of Contact

Tamera L. Clark-Rush

Program Partners

U.S. Army Center for Health Promotion and Preventive Medicine
Environmental Protection Agency



Technology Transfer

TRI-SERVICE ENVIRONMENTAL TECHNOLOGY SYMPOSIUM

In this age of decreasing funds, it is important for military services to leverage available resources and information. The Tri-Service Environmental Technology Symposium provides such an opportunity. The symposium is a forum for technical exchange and interaction on environmental technology strategies, initiatives, demonstrations and products.

PURPOSE

To provide a forum for technical exchange and interaction on environmental technology strategies, initiatives, demonstrations and products.

BENEFITS

By combining efforts with the Navy and Air Force, the Army reduces its funding needs to one-third of the symposium's total cost. The symposium also helps disseminate information across the services, reducing the "reinventing the wheel" syndrome. Combining what could be three conferences into one also reduces personnel travel expenses and time away from the office.

TECHNOLOGY USERS

Department of Defense (DoD) installations.

DESCRIPTION

In 1995, the U.S. Army Environmental Center (USAEC) hosted the DoD Environmental Technology Workshop. Bringing together the three military environmental support centers, this venue offered the opportunity for a unified position on environmental technology. The services recognize the need to share information. Since then, the services have supported and USAEC has hosted the prior Tri-Service Environmental Technology Workshops and the upcoming 2001 Tri-Service Environmental Technology Symposium.

USAEC remains the host agency for the symposium and chair of the organizational committee. The committee's main role is to review and select abstracts for platform presentation; it performs other functions as necessary. The balance of the effort is handled by USAEC and the support contractor, TMC Design Corporation.

Symposium presentations focus on mature technologies of timely interest to participants. Emphasis is placed on technologies that are "field ready," are currently being demonstrated, or have been demonstrated. This workshop is supported by the Tri-Service Environmental Support Centers Coordinating Committee.

ACCOMPLISHMENTS AND RESULTS

The 2001 Tri-Service Environmental Technology Symposium will be held 18-20 June 2001 in San Diego, California. Efforts are underway to solicit platform presentations, posters and exhibits. It is anticipated that a tour will be offered as well. A Web site detailing the conference is located at www.ets-2001.com.

Follow-On Program Requirements

Members of the organization committee will continue to develop the program for the 2001 Tri-Service Environmental Technology Symposium. Preliminary efforts will be initiated to solicit support for a follow-on symposium and to secure a location.

Point of Contact

Darlene F. Bader-Lohn

Program Partners

U.S. Army Environmental Center
Office of the Director of Environmental Programs
Office of the Assistant Secretary of the Navy for Installations and Environment
Headquarters, Air Force
Naval Facilities Engineering Service Center
Air Force Center for Environmental Excellence

Publications

Proceedings from 1996 workshop. SFIM-AEC-ET-CR-96187.

Proceedings from 1997 workshop. SFIM-AEC-ET-CR-9705.

Proceedings from 1998 workshop available at www.aec.army.mil/.

U.S. Army Environmental (User) Requirements and Technology Assessments

During the first 15 years of Army environmental research, most Research, Development, Test and Evaluation (RDT&E) goals and objectives were established through informal coordination within the Army development community. Given greater emphasis on relevance to Army users, a more rigorous, requirements-based approach was developed in the early 1990s. Since 1993, the environmental user requirements process has been formalized into a two-year cycle aligned with the Program Objective Memorandum process.

Purpose

To serve as the Army Headquarters' central repository for environmental user requirements and related information in support of the Army's Environmental Quality Technology (EQT) Program. U.S. Army Environmental (User) Requirements and Technology Assessments (AERTA) facilitates Army's validated and prioritized environmental user requirements to help the RDT&E community identify opportunities for developing and demonstrating improved environmental systems and identify applicable off-the-shelf technologies to help Army users make informed decisions on technologies that are better, faster and more cost-effective.

Benefits

In addition to satisfying the annual Department of Defense (DoD) tri-service reporting requirement to the Environmental Security Technology Requirements Group (ESTRG), the AERTA process enhances

communication between the "users" of environmental technologies and the Army's environmental RDT&E community. It gives the RDT&E community a better understanding of users' environmental technology requirements with associated performance metrics, their priorities, and the Army's cost of living with the problem, all of which provide the basis for developing RDT&E environmental technology management plans. AERTA provides Army installations with information on the development and availability of faster and more cost-effective environmental technologies. Organizations with technology requirements can use AERTA to identify and share "lessons learned" in a time of shrinking resources.

Technology Users

Army and DoD major commands and installations use technologies to satisfy their environmental requirements. The AERTA Web site documents technology needs from four user communities: (1) users responsible for installation infrastructure; (2) users responsible for weapons systems acquisition; (3) major commands that use these weapons systems; and (4) agencies responsible for collecting and tracking needs related to infrastructure and weapons systems.

Description

The initial database contained approximately 200 environmentally related operational problems throughout the Army. These were screened to focus on those requiring long-term research and development. These were then prioritized based on six ranking criteria: (1) environmental impact; (2) impact on readiness; (3) annual cost of operating with the unresolved requirement; (4) extent of the problem throughout the Army; (5) impact on quality of life; and (6) regulatory time limits.

The Office of the Assistant Chief of Staff for Installation Management (ACSIM), through the U.S. Army Environmental Center (USAEC), refined and updated these requirements from 1995 through 1997, expanding the scope of the effort into the Technology (User) Needs Survey (TNS). The Army's environmental databases were analyzed to maximize existing user environmental reporting, and several site visits were conducted across Army installations and major commands. These actions refined the qualitative and quantitative data on user needs and allowed requirements to be compiled in a common format that supports the DoD Tri-Service Environmental Quality Requirements Strategy (prepared by ESTRG). The updated requirements were presented at technology team meetings in 1996 and 1997 for review and validation. The list was narrowed to 142 requirements in 1997 and further focused to 44 requirements in 1999, which were prioritized within each program area (i.e., pillar) by the user community.

The TNS was retailored as a database, tailored to Internet access and was renamed AERTA. AERTA is a database that is kept current through the Army's EQT and ACSIM's user-requirements process and schedule. As the technology teams develop and execute RDT&E programs in response to these needs, the user representatives and stakeholders will adjust the need statements and related performance metrics (i.e., measurements for

determining when the need is considered completely satisfied). On a biennial basis, the user representatives assess each program area to determine if a readjustment of the need statements, performance metrics and supporting documentation is warranted. Completion of the first cycle for user-requirement development, under the formal AERTA process, was accomplished in April 1999.

The AERTA database can be accessed and reviewed on the Defense Environmental Network and Information eXchange (DENIX) at www.denix.osd.mil/denix/DOD/Policy/Army/Aerta. The advantage of storing information on the DENIX Web site is that access is restricted to DoD employees and contractors with approved accounts and passwords. To address problems of data management, two versions of the Army's environmental technology requirements are maintained. The first version contains unfiltered information and is maintained on the DENIX Web site. A second version, from which "sensitive" information not readily needed by the public has been deleted, is on the ESTRG Web site at xre22.brooks.af.mil/estrg/estrgtop.htm. The ESTRG site will also identify primary points of contact (one to two per program area, per service) as a gateway for interested parties outside DoD.

Accomplishments and Results

The AERTA process focused the requirements into 41 validated mission-critical environmental needs. The AERTA data was validated in fiscal year 2000 with cooperation of numerous user and RDT&E community representatives across the four program areas. The requirements portion of AERTA is updated biennially in the even fiscal years, with the technology assessments portion updated quarterly.

Limitations

The technology teams are responsible for screening out needs for which the solutions clearly do not involve technology.

Point of Contact

Scott Hill

Program Partners

U.S. Army Environmental Center
Members of the Army RDT&E Community
Army Technology Users

Publications

Army Technology Needs Survey.

Army Environmental Requirements and Technology Assessments. (www.denix.osd.mil/denix/DoD/Policy/Army/Aerta).

Fiscal Year 2000 Army Environmental Requirements and Technology Assessments, Final Report. November 2000.

U.S./Germany Environmental Technology Data Exchange Agreement

Through Data Exchange Agreements (DEAs), the United States and other countries can share technical expertise and data to tackle common challenges and improve quality of life. The Department of Defense (DoD) has administered an environmental technology exchange agreement with Germany for more than a decade.

Purpose

To promote sharing of environmental research and development (R&D) information among engineers and scientists of the U.S. and Germany. The agreement's focus was expanded in 1994 to include joint field demonstrations.

Benefits

Sharing information and expertise will benefit technology research and development efforts, and save R&D costs.

Description

Through DEAs, the United States and other countries can share technical expertise and data to tackle common challenges and improve quality of life. The DoD has administered an environmental technology DEA with Germany since 1986. Under the agreement, the U.S. and Germany may share environmental information directly. In addition to this regular activity, the technical project officers of each DEA participate in periodic progress reviews, and general exchange meetings are held every 18 months. Meeting locations alternate between U.S. and German hosts.

The U.S./Germany environmental technology DEA consists of four individual agreements:

- DEA 1311, Hazardous Materials/Pollution Prevention/Air;
- DEA 1520, Soil Remediation;
- DEA 1521, Water Remediation;
- DEA 1522, Demilitarization and Disposal of Conventional Munitions.

Since the inception of the Agreement, the U.S. Army Environmental Center (USAEC) has taken a leadership role as the Soils DEA technical project officer, or representative of all U.S. military agencies doing environmental research or development work on soils characterization and remediation.

Accomplishments and Results

In addition to sharing valuable scientific data and lessons learned, USAEC has sponsored a cooperative U.S./Germany field demonstration of Site Characterization and Analysis Penetrometer System (SCAPS) technology at Rhein Main Air Base, Germany.

Follow-On Program Requirements

In fiscal year (FY) 2000, leadership of the Soils DEA transitioned to the U.S. Army Engineer Research and Development Center, Waterways Experiment Station. As a charter member of the DEA, USAEC continues to support international environmental technology transfer.

POINT OF CONTACT Mark Hampton

PROGRAM PARTNERS Deputy Assistant Secretary of the Army for Environment, Safety and Occupational Health (U.S. general officer for the DEA)
U.S. Army Edgewood Chemical and Biological Center (U.S. DEA project officer)
U.S. Army Environmental Center, Pollution Prevention and Environmental Technology Division (DEA 1520)
U.S. Army Armament Research, Development and Engineering Center (DEAs 1311 and 1522)
U.S. Air Force Research Lab (DEA 1521)
Federal Office for Defense Technology and Procurement (German DEA project officer)
German Federal Armed Forces Scientific Institute for Protection Technologies (German technical project officer for DEA 1520)

PUBLICATIONS *Proceedings of the 1997 Environmental Technology Data Exchange Meeting.* April 1998.

UNEXPLODED ORDNANCE/COUNTERMINE FORUM 2000

In a concerted effort to bring together the best minds from all corners of the world, the annual Unexploded Ordnance (UXO)/Countermine Forum 2000 addressed technology, policy and regulatory issues related to countermine and UXO. Participants acquired a greater understanding of UXO issues, how they affect our world today, and the implications for the 21st century.

PURPOSE To produce, manage and host a conference that addresses countermine and UXO technology, policy and regulatory issues.

BENEFITS The conference brings together a diverse audience to exchange ideas and information on countermine and UXO.

DESCRIPTION The UXO/Countermine Forum 2000 addressed technology, policy and regulatory issues related to UXO.

UXO/Countermine Forum 2000 was sponsored by the U.S. Department of Defense Explosives Safety Board (DDESB) and hosted by the U.S. Army Environmental Center (USAEC), in cooperation with the Office of the Project Manager for Mines, Countermine and Demolitions, the Unexploded Ordnance Center of Excellence, Night Vision Electronic Sensors Directorate, CECOM, the Environmental Security Technology Certification Program, the Strategic Environmental R&D Program Office, the U.S. Army Product Manager for Non-Stockpile Chemical Materiel, the Headquarters U.S. Army Corps of Engineers R&D, the

Naval Explosive Ordnance Disposal Technology Division, the U.S. Air Force Research Laboratory, and the National Association of Ordnance and Explosive Waste Contractors. The DDESB will also sponsor the UXO/Countermine Forum 2001.

Accomplishments and Results

USAEC produced and hosted UXO/Countermine Forum 2000 in Anaheim, California, from 2 to 4 May 2000. Approximately 700 individuals attended.

Follow-On Program Requirements

Include the five Joint UXO Coordination Office mission areas into the UXO/Countermine Forum 2000. Plan and conduct the UXO/ Countermine Forum 2001 in New Orleans, Louisiana, from 9 to 12 April 2001.

Point of Contact

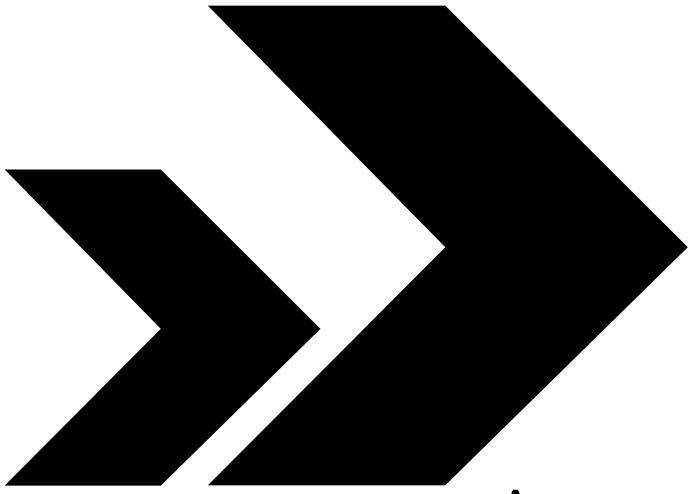
Darlene Edwards

Program Partners

U.S. Army Environmental Center
U.S. Department of Defense Explosives Safety Board
Office of the Project Manager for Mines, Countermines, and Demolitions
Unexploded Ordnance Center of Excellence
U.S. Army Product Manager for Non-Stockpile Chemical Materiel
Naval Explosive Ordnance Disposal Technology Division
U.S. Air Force Wright Laboratory
Headquarters, U.S. Army Corps of Engineers Research and Development (R&D)
National Association of Ordnance and Explosive Waste Contractors
Night Vision Electronic Sensors Directorate, CECOM
Environmental Security Technology Certification Program Office
Strategic Environmental R&D Program Office

Publications

UXO Forum 1997, 1998, 1999 and 2000 conference proceedings.



Appendices

APPENDIX A

ACRONYMS

AAP	Army Ammunition Plant
AAPPSO	Army Acquisition Pollution Prevention Support Office
ABM	Agricultural Blast Media
ABRP	Agriculture-Based Bioremediation Program
ACP	Army Cost Position
ACSIM	Assistant Chief of Staff for Installation Management
ACSIM	Assistant Chief of Staff for Installation Management (Army)
ADPA	American Defense Preparedness Association
AERTA	Army Environmental (User) Requirements and Technology Assessments
AMCOM	Aviation and Missile Command
AO	Administrative Orders
APG	Aberdeen Proving Ground, Maryland
APG-AA	Aberdeen Proving Ground, Aberdeen Area
APG-DSHE	Aberdeen Proving Ground Directorate of Safety, Health and Environment
AR	Army Regulation
ARDEC	U.S. Army Armament Research Development and Engineering Center
ARL	U.S. Army Research Laboratory
ASA	Assistant Secretary of the Army
ASRP	Ammunition Stockpile Reliability Program
ASTM	American Society for Testing and Materials
ATC	Aberdeen Test Center
BAA	Broad Agency Announcement
BFVS	Bradley Fighting Vehicle System
BRAC	Base Realignment and Closure
CEAC	U.S. Army Cost and Economic Analysis Center
CECOM	Communications Electronics Command
CE-MP	U.S. Army Corps of Engineers Military Programs Office
CFV	Cavalry Fighting Vehicle
COTS	Commercial off-the-shelf technologies
CRREL	U.S. Army Engineer Research and Development Center-Cold Regions Research and Engineering Laboratory
CTC	Concurrent Technologies Corporation
DAC	Defense Ammunition Center
DDESB	Department of Defense Explosives Safety Board
DDS	Data Delivery System
DEA	Data Exchange Agreement
DENIX	Defense Environmental Network and Information eXchange
DEQ	Department of Environmental Quality
DLA	Defense Logistics Agency
DNT	Dinitroluene
DoD	Department of Defense
DODIC	Department of Defense Information Codes

DOE	Department of Energy
DRE	Destruction and Removal Efficiency
DTP	Detailed Test Plans
EO	Executive Order
EOD	Explosive Ordnance Disposal
EPA	Environmental Protection Agency
EPA-RTP	Environmental Protection Agency Research Triangle Park
EPCRA	Emergency Planning and Community Right-to-Know Act
EPR	Environmental Program Requirements
EQLCCE	Environmental Quality Lifecycle Cost Estimate
EQR	Environmental Quality Report
EQT	Environmental Quality Technology
ESH	Environmental, safety and health (evaluations)
ESTCP	Environmental Security Technology Certification Program
ESTRG	Environmental Security Technology Requirements Group
ETV	Environmental Technology Evaluation
FASTT	Field Assistance Support and Technology Transfer
FRTR	Federal Remediation Technologies Roundtable
FUDS	Formerly Used Defense Sites
FY	fiscal year
GAC	Granular activated carbon
GC	Gas Chromatographic
GMF	Granular media filter
GMS	Groundwater Modeling System
gpm	gallons per minute
GSA	General Services Administration
GWETER	Groundwater Extraction and Treatment Effectiveness Reviews
HAP	Hazardous air pollutant
HC	Hexachloroethane
HE	High explosives
HEPA	High efficiency particulate air
HM	Hazardous materials
HMMP	Hazardous Material Management Program
HMX	Cyclotetramethylene
HQDA	Headquarters, Department of the Army
HSMS	Hazardous Substance Management System
HW	Hazardous waste
IAAP	Iowa Army Ammunition Plant
ICE	Independent Cost Estimate
IFV	Infantry Fighting Vehicle
IL&E	Installations, Logistics and Environment
IPR	In-Process Review
ITAM	Integrated Training Area Management
ITR	Independent technical reviews

LAP	Load, assemble and pack
LCAAP	Lake City Army Ammunition Plant, Missouri
MAAP	Milan Army Ammunition Plant, Tennessee
MACOM	Major Army command
MDAPs	Major Defense Acquisition Programs
MCAAP	McAlester Army Ammunition Plant, Oklahoma
MMR	Massachusetts Military Reservation
NATO	North Atlantic Treaty Organization
NAVAIR	Naval Air Systems Command
NDCEE	National Defense Center for Environmental Excellence
NEPA	National Environmental Policy Act
NFESC	Naval Facilities Engineering Service Center
NSWC	Naval Surface Warfare Center
ODEP	Office of the Director of Environmental Programs (Army)
OMB	Office of Management and Budget
ORNL	Oak Ridge National Laboratory
P2	Pollution prevention
P2&ETD	Pollution Prevention and Environmental Technology Division
P2IF	Pollution Prevention Investment Fund
PEO	Program executive officer
PEPS	Plasma Energy Pyrolysis System
PESHE	Programmatic Environmental, Safety and Health Evaluation guide
PM	Program manager
PMO	Program Manager Office
POE	Program Office Estimate
ppb	Parts per billion
ppm	Parts per million
PVT	Production Validation Test
QA/QL	Quality assurance/quality control
QPL	Qualified Products Lists
R&D	Research and Development
R3M	Range Rule Risk Model
RCRA	Resource Conservation and Recovery Act
RDT&E	Research, Development, Test and Evaluation
RDX	Royal Demolition Explosive
RMUS	Range and Munitions Use
RMW	Regulated Medical Waste
ROD	Record of Decision
ROI	Return on investment
SACON	Shock Absorbing Concrete
SCAPS	Site Characterization and Analysis Penetrometer System
SERDP	Strategic Environmental Research and Development Program

SOW	Statement of Work
SVE	Soil vapor extraction
TACOM	Tank and Automotive Command
TBP	Thermophilic (Biological) Process
TCAAP	Twin Cities Army Ammunition Plant, Minnesota
TNS	Technology (User) Needs Survey
TNT	Trinitrotoluene
TRI	Toxic Release Inventory
TSP	Total suspended particulate
TVA	Tennessee Valley Authority
USAEC	U.S. Army Environmental Center
USAIC	U.S. Army Infantry Center
USMC-MALS	U.S. Marine Corps—Marine Aviation Logistics Squadron
UXO	Unexploded ordnance
VOC	Volatile organic compound
WES	U.S. Army Engineer Research and Development Center-Waterways Experiment Station
WP	White phosphorus

APPENDIX B

PROGRAM PARTNERS

P2&ETD specialists often team with experts from across the Army, Navy, Air Force, Department of Defense, other federal and state government agencies, private industry and academia. Our partners include:

Aberdeen Test Center
Air Force Center for Environmental Excellence
Alliant TechSystems
Anniston Army Depot, Alabama
Argonne National Laboratory

Combat Training Support Directorate, Deputy Chief of Staff-Training, Training and Doctrine Command
Concurrent Technologies Corporation
Corpus Christi Army Depot, Texas

Defense Ammunition Center
Department of Defense
Department of Defense Environmental Security Technology Certification Program
Department of Defense Program Managers
Department of Energy
Deputy Assistant Secretary of the Army for Environmental, Safety, and Occupational Health (U.S. General Officer for the DEA)
Deputy Under Secretary of Defense for Environmental Security

Edgewood Chemical and Biological Center
Environmental Security Technology Certification Program

Federal Office for Defense Technology and Procurement (German Data Exchange Agreement Project Officer)
Federal Remediation Technologies Roundtable
Fort Campbell, Kentucky
Fort Hood, Texas
Fort Jackson, South Carolina
Fort Knox, Kentucky
Fort Leonard Wood, Missouri

GAIA Corporation
German Federal Armed Forces Scientific Institute for Protection Technologies

Headquarters, Air Force
Headquarters, Department of the Army
Headquarters, U.S. Army Corps of Engineers Research and Development

Iowa Army Ammunition Plant, Iowa

Joliet Army Ammunition Plant, Illinois

Lake City Army Ammunition Plant, Missouri
Louisiana State University—Lafayette

Major Army Commands
Marine Corps Systems Command
McAlester Army Ammunition Plant, Oklahoma
Milan Army Ammunition Plant, Tennessee

National Association of Ordnance and Explosive Waste Contractors
National Defense Center for Environmental Excellence
Natural Resources Conservation Service
Naval Air Warfare Centers
Naval Aviation Depot – Cherry Point, North Carolina
Naval Cognizant Field Activities
Naval Explosive Ordnance Disposal Technology Division
Naval Facilities Engineering Service Center
Naval Facilities Engineering Service Center
Naval Surface Warfare Center, Crane, Indiana
Naval Surface Warfare Center, Indian Head, Maryland
Night Vision Electronic Sensors Directorate, Communications Electronics Command

Oak Ridge National Laboratory
Office of the Assistant Secretary of the Navy for Installations and Environment
Office of the Director of Environmental Programs (Army)
Office of the Project Manager for Mines, Countermines and Demolitions

Parson's Engineering Science
Patuxent River Naval Air Station, Maryland
Pine Bluff Arsenal
Plasma Energy Applied Technology
PM—Apache
PM—Blackhawk
PM—Bradley A3 Upgrade
PM—Chinook
PM—Comanche
PM—Crusader
Program Executive Office-Standard Army Management Information Systems, HSMS Project Office

Range Rule Partnering Initiative

Science Applications International Corporation
Strategic Environmental R&D Program Office

Teledyne Brown Engineering
Teledyne Solutions Incorporated

Tennessee Valley Authority
The Boeing Company
Twin Cities Army Ammunition Plant, Minnesota

U.S. Air Force
U.S. Air Force Wright Laboratory
U.S. Army
U.S. Army Aberdeen Test Center
U.S. Army Armament Research, Development and Engineering Center
U.S. Army Corps of Engineers
U.S. Army Cost and Economic Analysis Center
U.S. Army Edgewood Chemical and Biological Center (U.S. DEA project officer)
U.S. Army Engineer Research and Development Center-Cold Regions Research and Engineering Laboratory
U.S. Army Engineer Research and Development Center-Construction Engineering Research Laboratories
U.S. Army Engineer Research and Development Center-Waterways Experiment Station
U.S. Army Environmental Center
U.S. Army Environmental Center, Pollution Prevention and Environmental Technology Division
U.S. Army Europe
U.S. Army Forces Command
U.S. Army Infantry Center
U.S. Army Integrated Product Teams
U.S. Army Military Academy, New York
U.S. Army Pacific
U.S. Army Petroleum Center
U.S. Army Pollution Prevention Support Office
U.S. Army Project Manager for Non-Stockpile Chemical Materiel
U.S. Army Research Laboratory
U.S. Army Research, Development, Test, and Evaluation
U.S. Army Space and Missile Defense Command
U.S. Army Tank-Automotive and Armaments Command
U.S. Army Training Support Center
U.S. Army West Deseret Test Center, Dugway Proving Ground, Utah
U.S. Department of Agriculture
U.S. Department of Defense
U.S. Department of Defense Explosives Safety Board
U.S. Environmental Protection Agency
U.S. Geological Survey
U.S. Marine Corps
U.S. Navy
Unexploded Ordnance Center of Excellence
USR – Radian International

Vanguard Research Inc.

Warner-Robins Air Logistics Center, Georgia