Evaluation of Alternative Technologies for Disposal of Liquid Wastes from the Explosive Destruction System

BOARD ON ARMY SCIENCE AND TECHNOLOGY
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Evaluation of Alternative Technologies for Disposal of Liquid Wastes from the Explosive Destruction System

Committee on Review and Evaluation of the Army
Non-Stockpile Chemical Materiel Disposal Program

Board on Army Science and Technology
Division on Engineering and Physical Sciences
National Research Council

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Preface

The Committee on Review and Evaluation of the Army Non-Stockpile Chemical Materiel Disposal Program (see Appendix A for biographies of committee members) was appointed by the National Research Council (NRC) to conduct studies on technical aspects of the U.S. Army Non-Stockpile Chemical Materiel Disposal Program. During its first year, the committee evaluated the Army's plans to dispose of chemical agent identification sets (CAIS)—test kits used for soldier training (NRC, 1999d). During the second year, the committee recommended nonincineration technologies that might be used for the posttreatment of neutralization wastes from Army nonstockpile materiel disposal systems. For this third year, the Army asked the committee to supplement its report on neutralent wastes to include wastes produced by the Army's newest mobile system, the explosive destruction system (EDS) (NRC, 2001a). In addition, in a report to be published in the spring of 2002, the committee is assessing the operational concepts for mobile and semi-permanent facilities being developed by the product manager.

At its meetings, the committee was given a number of briefings (see Appendix B) and held subsequent deliberations. The committee is grateful to the many individuals, particularly Lt. Col. Christopher Ross, Product Manager for Non-Stockpile Chemical Materiel, and his staff, who provided technical information and insights during these briefings. This information provided a sound foundation for the committee's deliberations.

This study was conducted under the auspices of the NRC's Board on Army Science and Technology. The committee acknowledges the continued superb support of the director, Bruce A. Braun, associate director Michael A. Clarke, NRC staff, committee members, the study director, support staff, and the publication staff, who all worked diligently on a demanding schedule to produce this report. In addition, I would like to particularly recognize the extra leadership and effort by committee member Douglas Medville in the preparation of this specific report.

John B. Carberry, *Chair*
Committee on Review and Evaluation of the
Non-Stockpile Chemical Materiel Disposal Program

Acknowledgments

This report has been reviewed by individuals chosen for their diverse perspectives and technical expertise, in accordance with procedures approved by the NRC's Report Review Committee. The purpose of this independent review is to provide candid and critical comments that will assist the authors and the NRC in making the published report as sound as possible and to ensure that the report meets institutional standards for objectivity, evidence, and responsiveness to the study charge. The content of the review comments and the draft manuscript remain confidential to protect the integrity of the deliberative process. We wish to thank the following individuals for their participation in the review of this report:

Joseph Bozelli, New Jersey Institute of Technology,
Elisabeth M. Drake, Massachusetts Institute of Technology,
Gene Dyer, consultant,
Gary Lage, ToxiLogics, Inc.,
Alvin Mushkatel, Arizona State University,
Carmo Pereira, DuPont Engineering,
William R. Rhyne, consultant,
Chandra M. Roy, ABS Consulting, and
William Tumas, Los Alamos National Laboratory.

Although the reviewers listed above have provided many constructive comments and suggestions, they were not asked to endorse the conclusions or recommendations nor did they see the final draft of the report before its release. The review of this report was overseen by John Bailar. Appointed by the NRC's Report Review Committee, he was responsible for making certain that an independent examination of this report was carried out in accordance with institutional procedures and that all review comments were carefully considered. Responsibility for the final content of this report rests entirely with the authoring committee and the institution.

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Acronyms and Abbreviations

ACWA	Assembled Chemical Weapons Assessment (Program)
ATAP	Alternative Technology Approach Program
BAA	broad agency announcement
CAIS	chemical agent identification sets
CAMDS	chemical agent munitions disposal system
CDU	capacitor discharge unit
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	U.S. Code of Federal Regulations
CG	phosgene
CSC	conical shaped charge
CSDP	Chemical Stockpile Disposal Program
CWA	Clean Water Act
CWC	Chemical Weapons Convention
CWM	chemical warfare materiel
DA	diphenylchloroarsine
DM	adamsite
DOT	U.S. Department of Transportation
DPG	Dugway Proving Ground
EBW	exploding bridge-wire
EDS	explosive destruction system
EPA	Environmental Protection Agency
FOTW	federally owned treatment works
FSS	fragment suppression system
GA	tabun (nerve agent)
GB	sarin (nerve agent)
GPCR	gas-phase chemical reduction
H	sulfur mustard
HD	sulfur mustard (distilled)
HL	mustard-lewisite mixture
HN-1, H-3	nitrogen mustard
HT	mustard agent T mixture
L	lewisite
LDR	land disposal restrictions
LSC	linear shaped charge
MEA	monoethanolamine
MEK	methyl ethyl ketone
MMD	munitions management device
NATO	North Atlantic Treaty Organization
NPL	national priorities list
NRC	National Research Council
NSCMP	Non-Stockpile Chemical Materiel Product
NSCWCC	Non-Stockpile Chemical Weapons Citizens Coalition
NSCWM	Non-Stockpile Chemical Warfare Materiel
O/SS	oxidant/solvent system
PCB	polychlorinated biphenyl
PD	Porton Down (United Kingdom)
PINS	portable isotopic neutron spectroscopy
PMCD	Program Manager for Chemical Demilitarization
PMNSCM	Product Manager for Non-Stockpile Chemical Materiel
POP	persistent organic pollutants
POTW	publicly owned treatment works
ppb	parts per billion (μg/L)
ppm	parts per million (mg/L)
RAP	regulatory approval/permitting
RCRA	Resource Conservation and Recovery Act
RD&D	research, development, and demonstration

RDX	cyclotrimethylenetrinitramine
RMA	Rocky Mountain Arsenal
RRS	rapid response system
SCWO	supercritical water oxidation
SET	solvated-electron technology
SVOC	semivolatile organic compound
TCLP	toxicity characteristic leaching procedure
TNT	trinitrotoluene
TSDF	treatment, storage, and disposal facility
UXO	unexploded ordnance
VOC	volatile organic compound
VX	a nerve agent
WAO	wet-air oxidation

Executive Summary

Chemical warfare materiel (CWM) encompasses diverse items that were used during 60 years of efforts by the United States to develop a capability for conducting chemical warfare. Non-Stockpile CWM (NSCWM) is materiel not included in the current U.S. inventory of chemical munitions and includes buried materiel, recovered materiel, components of binary chemical weapons, former production facilities, and miscellaneous materiel. NSCWM that had been buried on former military sites is increasingly being dug up as the land is developed for other purposes. Other NSCWM may be found on or near the surface at former research facilities or test and firing ranges.

Through its Chemical Stockpile Disposal Program (CSDP), the U.S. Army is the designated executive agent for destroying CWM under the terms of the 1997 international Chemical Weapons Convention (CWC).[1] Disposal of nonstockpile CWM is being handled by the Non-Stockpile Chemical Materiel Product (NSCMP), under the Program Manager for Chemical Demilitarization (PMCD). Because NSCWM is stored or buried at many locations, the Army is developing transportable treatment systems that can be moved from site to site as needed. Originally, the Army planned to develop three transportable treatment systems for nonstockpile chemical materiel: the rapid response system (RRS), the munitions management device (MMD), and the explosive destruction system (EDS).

The RRS was designed to treat recovered chemical agent identification sets (CAIS), which contain small amounts of chemical agents and a variety of toxic industrial chemicals. These sets were developed as training aids, and, unlike chemical munitions, they were not designed with lethal intent. The MMD systems were conceived to dispose of nonstockpile chemical munitions and sample containers deemed stable enough for transport and long-term storage. The EDS was originally developed to destroy nonstockpile items that were deemed to be too unstable for transport or long-term storage; however, it can also be used to treat limited numbers of stable chemical munitions, with or without explosive components. The MMD systems proved to be complex, expensive, and difficult to permit, so their development was discontinued. The EDS, which is smaller and less complex than the MMD, is now considered the Army's primary transportable system for treatment of small quantities of nonstockpile items.[2]

This report is a supplement to an earlier report (NRC, 2001a), which evaluated eight alternative technologies[3] for destruction of the liquid waste streams from the RRS and the MMD. This report evaluates the same technologies for the

[1]Formally known as the Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on Their Destruction, the CWC requires the destruction of the chemical weapons in the stockpile by 2007 and any nonstockpile weapons in storage at the time of the treaty ratification (1997) within 2, 5, or 10 years of the ratification date, depending on the type of chemical weapon or on the type of chemical with which an item is filled. Any chemical weapons "discovered . . . after the initial declaration of chemical weapons shall be reported, secured and destroyed in accordance with Part IV (A) of the Verification Annex" (CWC Article IV, Paragraph 9). Thus, NSCWM buried before January 1, 1997, is excluded from the treaty requirements as long as it remains buried. However, once this CWM is dug up and removed from the ground, the recovered CWM must be identified, declared under the CWC, inspected, and destroyed as soon as possible (U.S. Army Final Programmatic Environmental Impact Statement, 2001, volume 1, pp. 1-3).

[2]The EDS Phase 1 (EDS-1) can treat munitions containing up to one pound equivalent TNT; the larger EDS Phase 2 (EDS-2), under design and development, will treat munitions containing up to three pounds equivalent TNT. All EDS testing to date has been with the EDS-1. The EDS-1 is intended for use with World War I and World War II vintage chemical warfare materiel produced prior to 1945. Post-World-War II projectiles have larger bursters that exceed the capacity of the system.

[3]The technologies were chemical oxidation, wet-air oxidation, electrochemical oxidation using Ag(II) or Ce(IV), supercritical water oxidation, solvated electrons, biodegradation, gas-phase chemical reduction, and plasma arc.

destruction of liquid waste streams produced by the EDS. Although it focuses on the destruction of EDS neutralent, it also takes into consideration the ability of posttreatment technologies to process the more dilute water rinses that are used in the EDS following treatment with a reagent.

Between November 1999 and November 2000, the EDS Phase 1 (EDS-1) was tested at a military installation at Porton Down in the United Kingdom. In early 2001, it was used in an emergency action to dispose of six bomblets containing the nerve agent sarin at Rocky Mountain Arsenal (RMA) in Colorado. Subsequently, four more bomblets were discovered during remediation of the same area at RMA. At this writing, the EDS-1 had been dispatched to dispose of these also. As a result of the success of these operations, the decision was made to discontinue development of the MMD,[4] another mobile system that used the same process chemistry as the EDS to destroy chemical agent but that was both more complex and less versatile than the EDS.

The EDS produces four types of liquid waste streams for which treatment options are being evaluated: (1) a neutralent resulting from treatment of the chemical agent with an alkaline chemical reagent, (2) rinsates resulting from washing the EDS vessel with clean water to remove any residues of reagent and reaction products remaining after treatment, (3) cleaning solution consisting of washes (water and detergent) that are made between processing of each munition, and (4) final washes (using, for example, water and acetic acid) carried out after completing a munitions campaign.

Neutralent wastes from the EDS are expected to be classified as hazardous wastes under the Resource Conservation and Recovery Act (RCRA)[5] (U.S. Army, 2001g). The Army's current plan is to send them to a permitted hazardous waste incinerator for final disposal. Rinsates and cleaning solution from the EDS generally have much lower concentrations of hazardous chemicals and are more likely to be classified as nonhazardous wastes.[6] Assuming rinsates and cleaning solution meet the pretreatment standards specified by the Clean Water Act, these waste streams may be eligible for discharge to a publicly owned treatment works (POTW) or an equivalent federally owned treatment works (FOTW).

The incineration of chemical agents has generated opposition among some public interest groups, and this opposition may be extended to the incineration of EDS neutralents, even though the concentration of any remaining agent in the neutralents will be miniscule, ranging from undetectable to a few parts per million (ppm). As a result of this public concern, the Army is investigating alternative (nonincineration) technologies for disposing of EDS neutralents and has asked the National Research Council (NRC) for advice.

The committee wishes to stress that this report is a supplemental evaluation that is focused on the destruction of EDS liquid waste streams. Nothing discussed here should be interpreted as the committee's evaluation of the EDS as a complete operating system. Such an evaluation would examine issues such as the structural integrity of the EDS with repeated use, operational procedures, the process chemistry, and whether a secondary vapor containment structure is needed. A summary of NSCWM that has been destroyed to date by the EDS, as well as the main constituents of the liquid waste streams, is given in Table ES-1. The principal agent fills of nonstockpile munitions encountered are expected to be phosgene (CG), sulfur mustard (H, HD), and sarin (GB). In addition to these fills, it is possible that some nonstockpile items containing VX[7] as well as arsenic-derived chemical agents such as lewisite, an organoarsenic

TABLE ES-1 EDS-1 Liquid Waste Streams Considered in This Study

Agent Fill	Items Destroyed to Date	Key Constituents of Liquid Waste Streams
Phosgene (CG)	4 cylinders, 7 mortar rounds	Water, NaOH, NaCl, metals
Sulfur mustard (HD)	2 cylinders, 12 mortar rounds or projectiles	Water, MEA, volatile and semivolatile organics, metals, HD degradation products
Sarin (GB)	1 cylinder, 10 bomblets	Water, MEA, GB degradation products, volatile and semivolatile organics, metals

SOURCE: Compiled by the NRC from Army sources.

[4]Lt. Col. Chistopher Ross, Product Manager, Non-Stockpile Chemical Materiel Project, "U.S. Army Non-Stockpile Chemical Materiel Product (NSCMP) Project Overview/Status," presentation to the committee, March 15, 2001.

[5]Under RCRA, a substance is determined to be a hazardous waste either because it is listed as such in the federal or state regulation (a listed hazardous waste) or because it exhibits one or more characteristics of hazardous waste, as defined in the hazardous waste regulations (e.g., corrosivity), or because it is derived from a listed waste.

[6]High levels of chloroform—a listed hazardous waste under RCRA—were observed in EDS cleaning solutions from the RMA tests (Appendix C, Table C-1). The source appears to be the particular type of lubricant/sealant used to seal joints. The chloroform is therefore not a necessary constituent of the waste stream and could be eliminated by using a different formulation of sealant/lubricant.

[7]Although there are no known nonstockpile munitions containing the nerve agent VX, there are about 100 VX-filled containers in the nonstockpile inventory. Some of these—for example, glass bottles and vials—can be disposed of in the RRS, while others—for example, steel Department of Transportation (DOT) bottles and cylinders—are potential candidates for disposal in the EDS should the Army decide to do so.

blister agent, may also be processed in the EDS. If this processing does take place, arsenic compounds such as sodium arsenite (from treatment with sodium hydroxide) will be produced, and these compounds will require conversion to relatively insoluble arsenate salts as part of the posttreatment of the EDS neutralent.

STATEMENT OF TASK

On March 16, 2001, the Army Product Manager for the NSCMP requested that the NRC undertake a supplemental assessment of alternative technologies for destruction of EDS liquid waste streams. The statement of task is as follows:

The NRC will:

- Examine alternative destruction technologies for liquid waste streams generated from the Explosive Destruction System (EDS).
- Discuss the regulatory approval issues and obstacles for the combined use of the EDS and the alternative technologies that treat the EDS secondary waste streams.

COMMITTEE APPROACH

As in the previous study (NRC, 2001a), the committee began by establishing some boundary conditions. Only liquid neutralent wastes from the EDS were considered, in accordance with the statement of task. Treatment of solid wastes, such as metal munition bodies, packing materials, and carbon air filters, was not considered. Waste solids from the EDS include metal fragments (from the munition bodies and the fragmentation suppression system), dunnage, used carbon filters, and disposable personnel protective equipment. These solids will be bagged, placed in waste containers, and disposed of in a hazardous waste landfill. The treatment goals for the neutralent destruction technologies considered were taken to be solids that could be disposed of in an approved (i.e., permitted) landfill and liquids that could be released to a POTW or FOTW.[8] Air discharges from the neutralent treatment technologies should contain primarily carbon dioxide, water vapor, and nitrogen.

The primary analytical approach in this report was to evaluate the ability of alternative technologies to process EDS liquid waste streams, taking note of any differences between these waste streams and those generated by the MMD considered previously (NRC, 2001a). The committee then examined the extent to which any differences between the EDS and MMD liquid waste streams might alter its earlier recommendations on alternative technologies for destruction of these wastes. However, the committee notes that several important developments have occurred since the publication of the earlier report, *Disposal of Neutralent Wastes* (NRC, 2001a):

- The MMD program has been suspended; this means that the liquid waste streams generated by nonstockpile mobile treatment systems will be primarily from the EDS, with a small volume from the RRS.
- New data have become available regarding the performance of several of the alternative technologies, both from the Army's Technology Testing Program (see Chapter 3) and from its Assembled Chemical Weapons Assessment (ACWA) program, which was reviewed by another NRC committee (NRC, 1999a, 2000).

The committee's earlier recommendations are also reconsidered in light of recent test results from both the Army's Technology Testing Program and its ACWA program.

The committee also considered the criteria for public and regulatory acceptability that are likely to affect the selection of alternative destruction technologies. It identified several regulatory approval/permitting (RAP) issues associated with EDS liquid waste disposal, discussed the regulatory status of these wastes, and developed several findings and recommendations on regulatory and public acceptability issues.

FINDINGS AND RECOMMENDATIONS

Technical Issues

Finding: Neutralents from the EDS are similar to those from the MMD owing to similar treatment chemistries. However, there could be three differences:

- The potential presence of residual explosives or explosive-derived organic compounds in the EDS neutralents and rinsates. The MMD and the EDS produce different liquid wastes because of the different ways that munitions are processed. The MMD does not process items containing explosives, while the EDS can handle munitions containing bursters and/or fuzes. The EDS also uses explosives to open the munition and detonate any explosives contained therein.
- Potentially higher concentrations of dissolved or suspended metals (e.g., Hg, Pb, Cu, and Al) in EDS neutralents and rinsates owing to explosive accessing of the munition and/or the presence of fuzes or bursters. The fragmentation of the munition bodies may expose more metal surface to the

[8]The committee felt that, on the one hand, a technology need not be excluded if it did not completely mineralize the neutralents, as long as the resulting liquids could be sent for final treatment at a POTW/FOTW. On the other hand, it felt that multiple treatment technologies should not be necessary; the selected technology should be able to destroy neutralent such that the residuals could be either released to a POTW/FOTW or sent to a permitted landfill.

monoethanolamine (MEA) reagent,[9] which is a good extractant for some of these metal ions. In addition, the detonator materials in fuzes, such as lead azide and mercury fulminate, may introduce some highly toxic metal ions.

• The potential presence of arsenic compounds in the EDS neutralent from a small number of munition fills (the MMD was not intended to treat agents containing arsenic).

Finding: The fills expected to be processed most frequently in the EDS are sulfur mustard (H, HD), phosgene (CG), and—to a lesser extent—sarin (GB). Items filled with other agents—such as lewisite (L), which contains arsenic, or the nerve agent VX—are expected to be encountered much less often, but they do exist in the nonstockpile inventory.

The Army has conducted operational testing of the EDS only for munitions containing H, CG, and GB. Thus, the committee's analysis focused mainly on liquid waste streams resulting from EDS treatment of these three types of agent. However, because lewisite munitions are known to exist in the inventory and may be treated in the EDS, the committee also considered in its analysis the effect of high concentrations of arsenic compounds.

Finding: If agents containing arsenic (such as lewisite) are processed in the EDS, additional treatment steps will be needed to remove the arsenic from the EDS neutralent or reduce its mobility in treated solids. In these rare cases, however, suitable treatment chemistries are known and have been demonstrated to be effective.

Finding: The EDS neutralization process and subsequent water rinses produce four liquid waste streams in two categories: (1) organic-rich liquids consisting of the neutralent and a reagent-based rinse and (2) cleaning solutions and final washes containing relatively low concentrations of organics.

Recommendation: The committee recommends that the Army consider separate treatment strategies for organic-rich liquids and these other aqueous liquids, since their chemical properties and regulatory status are different.

Finding: Chemical analyses of EDS neutralents and rinsates obtained from testing of HD, CG, and GB in the EDS may not have accounted for some species, such as energetic compound decomposition products, that may be encountered during operations.

Recommendation: The Army should review the sampling and analytical techniques employed at Porton Down and at RMA to ensure they are sufficiently sensitive and complete to detect any species of agent, energetics, and other components that could be in concentrations high enough to be of concern to human health or the environment.

Finding: The two-track approach[10] recommended for selecting treatment technologies for RRS and MMD neutralents in the committee's previous report (NRC, 2001a) remains valid for EDS liquid waste streams. However, based on new and preliminary results from NSCMP's Technology Test Program, as well as test results on some of the technologies obtained in the Army's Assembled Chemical Weapons Assessment (ACWA) Program, the preferential ranking of technologies in the resource investment track has changed, as described in the following recommendation.

Recommendation: The NSCMP should pursue a two-track strategy to identify a suitable treatment technology for EDS liquid waste streams. As part of the first track, the NSCMP should take advantage of available equipment that would require little or no investment (that is, it should piggyback on alternative technologies from the ACWA Program or on existing commercial technologies, such as chemical oxidation, wet-air/O_2 oxidation, or plasma arc[11] technology). The committee judged that if any of these existing and available technologies can accomplish the task safely, this would be a relatively rapid and inexpensive course of action.

If, on the other hand, none of the existing and available technologies can be used as is—for example, if substantial research and development resources would be needed to adapt them to the destruction of nonstockpile neutralents—the committee recommends that NSCMP, as part of track two, should invest first in chemical oxidation and wet-air/O_2 oxidation. Only if these technologies cannot be adapted eas-

[9]The choice of MEA as a reagent was based on extensive previous experience with it in other CWM programs, its ability to dissolve the agents, miscibility with water, low corrosivity with stainless steel, and low flammability.

[10]In the report on disposal of neutralent wastes (NRC, 2001a), the first track of the two-track approach contained technologies that did not need any Army development investment. The second track consisted of alternative technologies requiring investment. The earlier report recommended investigating the track one technologies before turning to track two.

[11]One commercial plasma arc technology (the PLASMOX process) has treated a chemical warfare agent in Switzerland. Although it has not yet been permitted for use on any hazardous waste in the United States, it has also been used for the commercial treatment of hazardous waste in Switzerland. The Army has represented to the committee that there are a number of plasma arc facilities permitted in the United States, primarily for treatment of medical wastes, and that it intends to test some of these plasma arc designs. The committee has not reviewed the emissions data from the PLASMOX treatment of chemical agent or from these commercial facilities. Plasma arc technologies may emit low levels of polychlorinated dibenzodioxins. Since PLASMOX uses oxygen, it may be considered by some regulators and some members of the public as a more sophisticated incinerator.

ily does the committee recommend that the Army consider investing R&D resources in supercritical water oxidation (batch mode).[12]

The committee recommends that no further resources be spent on development of electrochemical oxidation, supercritical water oxidation (continuous mode), gas-phase chemical reduction, biotreatment (by itself), or solvated electron technology for this purpose.

Finding: The Army has an ongoing program to test several alternative technologies for their ability to destroy EDS neutralents. Based on information provided to it regarding this test program, the committee has several concerns:

- The tests are often being conducted with simulated EDS neutralents mixed from laboratory chemicals rather than with actual EDS neutralents.
- The Army does not appear to have identified key tracking compounds[13] that are the most difficult to destroy and whose disposition can serve as indicators for the performance of the treatment technologies.
- The test program does not appear to be designed to provide basic data on the kinetics and thermodynamics of the oxidation of key waste stream components under process conditions.

Recommendation: The test program could be improved if the following steps are taken:

- To the extent feasible, the Army should use a representative range[14] of actual EDS neutralents obtained from munition destruction in its tests of alternative treatment technologies.
- A limited number of tracking compounds chosen for their ability to gauge process performance and issues of regulatory concern should be identified and analyzed for in the treatment effluent.
- To supplement tests on EDS neutralents, the Army should collect information about the kinetics and thermodynamics of the destruction of these tracking compounds by the preferred destruction technology.
- Physical properties of neutralents such as phase behavior (including suspended solids) and flash point should be determined on neutralent samples obtained from EDS-1 and EDS-2 treatment of actual chemical munitions.

[12]If any of the technologies in track one can be demonstrated to work and be cost effective, then the committee recommends that research and development on track two technologies be terminated. However, the strict time constraints imposed by the CWC—i.e., that all NSCWM recovered prior to 1997 must be destroyed by 2007—in effect require that the two tracks be pursued at the same time.

[13]One example of a tracking compound for destruction of nerve agents might be methylphosphonic acid, which is very stable and difficult to destroy. Further discussion of tracking compounds may be found in Appendix D.

[14]As noted in Chapter 2, the compositions of EDS neutralents from destruction of separate NSCWM will not necessarily be consistent, even for munitions of the same type.

Regulatory Issues

Finding: EDS neutralent may be treated off-site or on-site. If the EDS liquid waste is treated off-site, the Army must obtain a permit for a new facility or find a permitted hazardous waste treatment facility or a FOTW or POTW that can treat the EDS liquid wastes. If a facility with an existing permit is used for treatment, that existing permit may require modification.

Finding: Based on available data and the experience of the members of the committee, the chemical constituents most likely to be of concern in the RAP process for EDS liquid wastes are chlorinated organics, possible degradation products of energetic compounds, metals, suspended solids,[15] and monoethanolamine (MEA). These constituents were chosen based on their abundance in the neutralent, their inherent toxicity, their resistance to treatment, or overall regulatory and public concern.

Recommendation: The Army's RAP strategy should ensure that sufficient information is obtained about the chemical constituents of greatest concern in the RAP process for the EDS liquid wastes: chlorinated organics, degradation products of energetic compounds, metals, suspended solids, and MEA.

Finding: RAP options associated with treatment of EDS neutralents, rinsates, and cleaning solutions depend on whether the waste is regulated as hazardous within the state where it is generated and, if it is, whether it is a "listed" hazardous waste, a "characteristic" hazardous waste, or both.

If EDS liquid wastes are determined to be hazardous under the federal RCRA program (via the RCRA characteristics), RCRA's land disposal restrictions (LDRs) apply, and the wastes must be treated to meet specific requirements.

Note that the remainder of the findings and recommendations in this section are based on the premise that neutralent (but not necessarily rinsate or residue) will be defined as hazardous waste. This may not always be the case, although the Army's policy to date has been to treat the neutralent as hazardous waste.

[15]Suspended solids are a concern only if they are determined to contain residual chemical agent in microscopic cracks and crevices. See discussion in Chapter 2.