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CHEMICAL
RESEARCH,
DEVELOPMENT &
ENGINEERING
CENTER

CRDEC-CR-88092

OPERATIONAL ENVIRONMENTAL ASSESSMENT

Kenneth J. Salamon, Ph.D.
Richard T. Williams, Ph.D.
Korah T. Mani
Donald M. MacGregor
John S. Howell
Walter J. Wujack, Ph.D.
Patrick J. Rafferty

ROY F. WESTON, INC.
West Chester, PA 19380

Kathleen M. Buchi, Ph.D.

RESEARCH, DEVELOPMENT & ENGINEERING
SUPPORT DIRECTORATE

September 1988

U.S. ARMY
ARMAMENT
MUNITIONS
CHEMICAL COMMAND

Aberdeen Proving Ground, Maryland 21010-5423

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UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION
UNCLASSIFIED

1b. RESTRICTIVE MARKINGS

2a. SECURITY CLASSIFICATION AUTHORITY

2b. DECLASSIFICATION / DOWNGRADING SCHEDULE

3. DISTRIBUTION / AVAILABILITY OF REPORT
Approved for public release; distribution is unlimited.

4. PERFORMING ORGANIZATION REPORT NUMBER(S)
CRDEC-CR-88092

5. MONITORING ORGANIZATION REPORT NUMBER(S)

6a. NAME OF PERFORMING ORGANIZATION
Roy F. Weston, Inc.

6b. OFFICE SYMBOL *(If applicable)*

7a. NAME OF MONITORING ORGANIZATION

6c. ADDRESS *(City, State, and ZIP Code)*
Weston Way
West Chester, PA 19380

7b. ADDRESS *(City, State, and ZIP Code)*

8a. NAME OF FUNDING / SPONSORING ORGANIZATION
CRDEC

8b. OFFICE SYMBOL *(If applicable)*
SMCCR-SPS-E

9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
DAAA15-85-D-0020, Task 5

8c. ADDRESS *(City, State, and ZIP Code)*
Aberdeen Proving Ground, MD 21010-5423

10. SOURCE OF FUNDING NUMBERS

PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.	WORK UNIT ACCESSION NO.

11. TITLE *(Include Security Classification)*
Operational Environmental Assessment

12. PERSONAL AUTHOR(S) Salamon, Kenneth J., Ph.D.; Williams, Richard T., Ph.D.; Mani, Korah T.; MacGregor, Donald M.; Howell, John S.; Wujack, Walter J., Ph.D.; (Continued on reverse)

13a. TYPE OF REPORT
Contractor

13b. TIME COVERED
FROM 87 Sep TO 88 Aug

14. DATE OF REPORT *(Year, Month, Day)*
1988 September

15. PAGE COUNT
148

16. SUPPLEMENTARY NOTATION
COR: Kathleen M. Buchi, Ph.D., SMCCR-SPS-E, (301) 671-2063

17. COSATI CODES

FIELD	GROUP	SUB-GROUP
07	03	

18. SUBJECT TERMS *(Continue on reverse if necessary and identify by block number)*
Environmental
Assessment
Operations.

19. ABSTRACT *(Continue on reverse if necessary and identify by block number)*

The U.S. Army Chemical Research, Development and Engineering Center (CRDEC) manages and conducts the research, development and engineering activities to provide defense against chemical and biological attack and to provide deterrent and retaliatory capability against chemical attack. In accordance with the requirements of the National Environmental Policy Act, CRDEC has prepared this environmental assessment of the operations occurring at its facilities. This environmental assessment addresses the environmental impacts of the operations at CRDEC. All operations were evaluated for possible air and water quality impacts. Each organization within CRDEC has a specialized mission, however, the same material is often used. Therefore, the environmental assessment defines the mission, then discusses the operations in terms of categories: chemical, biological, radionuclides, electromagnetic radiation, laboratory animals, munitions, explosives, and other materiel, other military chemicals, and nonmilitary/commercial chemicals. All were evaluated in terms of handling, storage and proper disposal. Sources to discharge to the environment were highlighted as a separate subject. The good management practices employed by
(Continued on reverse)

20. DISTRIBUTION / AVAILABILITY OF ABSTRACT
☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS

21. ABSTRACT SECURITY CLASSIFICATION
UNCLASSIFIED

22a. NAME OF RESPONSIBLE INDIVIDUAL
SANDRA J. JOHNSON

22b. TELEPHONE *(Include Area Code)*
(301) 671-2914

22c. OFFICE SYMBOL
SMCCR-SPS-T

DD FORM 1473, 84 MAR — 83 APR edition may be used until exhausted. All other editions are obsolete.

SECURITY CLASSIFICATION OF THIS PAGE
UNCLASSIFIED

12. PERSONAL AUTHOR(S) (Continued)

Rafferty, Patrick J. (Roy F. Weston, Inc.); and Buchi, Kathleen M., Ph.D., (CRDEC).

19. ABSTRACT (Continued)

CRDEC, such as following regulatory and Army storage requirements, monitoring, testing, inspections, and prompt response by CRDEC to spill or emergency events, minimize the chances for environmental impacts.

PREFACE

The work described in this report is one of the programmatic environmental analyses authorized by the U.S. Army Materiel Command. The report was prepared under Contract No. DAAA15-85-D-0020. This work was started in September 1987 and completed in August 1988. The report reflects the status of the U.S. Army Chemical Research, Development and Engineering Center (CRDEC) as of February 1988. This report is incorporated by reference in the "Draft Programmatic Environmental Impact Statement, Biolcgical Defense Research Program," and will be incorporated by reference in the new edition of Aberdeen Proving Ground's "Installation Environmental Impact Assessment, 4th Edition, March 1978." The finding of no significant impact for the operations at CRDEC will be incorporated in the latter document.

The use of trade names or manufacturers' names in this report does not constitute an official endorsement of any commercial products. This report may not be cited for purposes of advertisement.

ACKNOWLEDGMENTS

The authors thank the following individuals for their technical contributions: T. Mann and D. Gross of CRDEC.

AGENCY RESPONSIBILITY

In accordance with the requirements of the National Environmental Policy Act, the CRDEC is required to prepare and keep current an Environmental Assessment of operations taking place at its facilities. This Operational Environmental Assessment is based on the latest APG Regulation No. 200-1 and other related guidelines prepared by the Army for implementing NEPA guidelines due to the expanded role of CRDEC in Army research, development, and engineering activities. It is an update on the April 1983 Environmental Assessment for Operations at U.S. Army Chemical Systems Laboratory.

This Operational EA was prepared by personnel of Roy F. Weston, Inc., West Chester, Pennsylvania. The work was performed under Contract DAAA 15-85-D-0020, Task 05. The contractor, an environmental consulting firm, has no financial or other interest in the information provided here, or any other outcome from the publication of this document.

The material contained within this document is based primarily on material supplied by the CRDEC and from extensive interviews with related personnel of the Directorates and Offices of CRDEC and other support elements located at APG during September-October 1987.

This Operational EA has been reviewed for content, applicability, NEPA compliance, and objectivity by the CRDEC Contract Officer Representative and by personnel of the Directorates, Offices, and other support elements.

DEPARTMENT OF THE ARMY
U.S. Army Materiel Command
U.S. Army Armament, Munitions and Chemical Command
U.S. Army Chemical Research, Development and Engineering Center
Research, Development and Engineering Support Directorate
Aberdeen Proving Ground, MD 21010-5423

OPERATIONAL ENVIRONMENTAL ASSESSMENT

August 1988

Prepared by:

KENNETH J. SALAMON, Ph.D.
Project Director
Roy F. Weston, Inc.

Prepared by:

KATHLEEN M. BUCHI, Ph.D.
Chemist
Research, Development and Engineering Support Directorate
CRDEC

Reviewed by:

DONALD GROSS
Chemical Engineer
Research, Development and Engineering Support Directorate
CRDEC

Recommend Approval:

31 May 88
TERESA M. MANN
Environmental Coordinator
CRDEC

Reviewed by:

for ROBERT C. SCRANTON
Director
Research, Development and Engineering Support
CRDEC

OPSEC Reviewed by:

for GARY J. SAWYER - 10 Jun 88
MAJ, MP
Provost Marshal
CRDEC

Approved by:

JOHN S. PLUMMER
LTC, CM
Acting Deputy Commander
CRDEC

Reviewed by:

KENNETH P. STACHIW
Environmental Quality Coordinator
USAAPGSA

Approved by:

ROBERT W. HAUBRICH
COL, AR
Deputy Installation Commander
USAAPG

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TABLE OF CONTENTS

TABLE OF CONTENTS
(continued)

TABLE OF CONTENTS
(continued)

TABLE OF CONTENTS
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LIST OF FIGURES

LIST OF TABLES

1. PURPOSE AND NEED FOR CRDEC

The mission of the U.S. Army Chemical Research, Development, and Engineering Center (CRDEC) is "to manage and conduct the research, development, and engineering activities to provide defense against chemical and biological attack and to provide deterrent and retaliatory capability against chemical attack."(1) CRDEC acts as the Executive Agent of the U.S. Army Armament, Munitions, and Chemical Command (AMCCOM) "for all research, exploratory, advanced, and engineering development and to provide life cycle engineering for chemical weapons and chemical and biological defense."(1)

From an environmental standpoint, CRDEC is to "direct and conduct the Environmental Technology Program to assure CRDEC life cycle operations do not adversely impact the environment."(1)

Additionally, CRDEC's mission is to: "develop an AMCCOM chemical safety program policy, procedures, standards, and objectives for issuance by Chief, AMCCOM Safety Office; develop procedures to perform and to manage the Department of the Army (DA) Chemical Accident and Incident Investigation Program; act as worldwide focal point for investigation of chemical accidents/incidents; and establish safety requirements for all privately owned and operated contractor facilities possessing chemical surety materiel for which AMCCOM is accountable."(1)

2. NEED FOR THE OPERATIONAL EA

CRDEC is required, under the National Environmental Policy Act (NEPA), to prepare and keep current an Environmental Assessment (EA) of operations taking place at its facilities. NEPA requires that all Federal agencies plan such action to prevent, eliminate, or minimize damage to the environment. The current EA was prepared in 1975[2] with partial updates through April 1983.[3]

The most-recent guidelines for implementing NEPA[4] were promulgated by the Council on Environmental Quality (CEQ).[5] The Department of Defense (DOD) established procedural regulations[6] for implementing NEPA into Department of the Army planning and decision making. These guidelines provide procedures for preparing environmental documents that analyze the environmental impact of proposed actions and programs. Environmental Assessments are prepared to determine the significance of an action's impact on the environment. If a Finding of No Significant Impact (FONSI) is concluded from an EA, then no further environmental documentation is required. Those actions or programs with significant environmental impacts require an Environmental Impact Statement (EIS). Certain actions, which are clearly insignificant and are similar to actions previously examined, are called Categorical Exclusions (CXs) and normally do not require either an EA or EIS.

The original EA was prepared in 1975 to cover the activities of Edgewood Arsenal. In 1977, Edgewood Arsenal was disestablished and portions of its mission were acquired by the newly-created Chemical System Laboratory (CSL) under the U.S. Army Armament Research and Development Command (ARRADCOM), a subordinate command of the U.S. Army Materiel Development and Readiness Command (DARCOM). CSL was a tenant facility in the Edgewood Area of the Aberdeen Proving Ground. The mission changes that resulted from this reorganization, technological developments in chemical warfare, and the requirements under the NEPA guidelines necessitated revisions to the 1975 EA.[7]

In 1978, U.S. Army Aberdeen Proving Ground (APG) prepared an EA[8] that included information on the environmental setting of the Edgewood Area and site-specific impacts associated with support activities provided to tenants including CSL.

On 1 July 1983, the old CSL became the new Chemical Research and Development Center (CRDC); on 26 March 1986, the name of the Center was changed to the Chemical Research, Development, and Engineering Center (CRDEC) to better reflect its actual mission. The component organizations under CRDEC have been expanding or revising their responsibilities, and new activities have been added to CRDEC's mission since its reorganization from CSL.

Based on the latest[9] APG Regulation No. 200-1 and other related guidelines prepared by the Army for implementing NEPA guidelines and due to the expanded role of CRDEC[1] in Army research, development, and engineering activities, it is determined that the current EA should be updated; hence the need for this Operational Environmental Assessment, CRDEC, as prepared in February 1988.

3. DESCRIPTION OF CRDEC

3.1 LOCATION OF CRDEC ACTIVITIES

CRDEC is one of the tenant activities in the Edgewood Area of Aberdeen Proving Ground (APG) (see Figure 3-1). Formerly the Edgewood Arsenal, the Edgewood Area is situated adjacent to the Town of Edgewood in the southwestern part of Harford County, Maryland, approximately 21 miles northeast of Baltimore.

CRDEC activities occupy a number of buildings and areas within the Edgewood Area, which is situated on a peninsula on the Chesapeake Bay, known locally as Gunpowder Neck (see Figure 3-2). Gunpowder Neck extends nine miles south into Chesapeake Bay between the Bush River and the Gunpowder River. CRDEC uses two areas on Gunpowder Neck: a northern portion for confined operations, such as laboratories, offices and storage facilities, and a southern portion for limited open air operations testing.

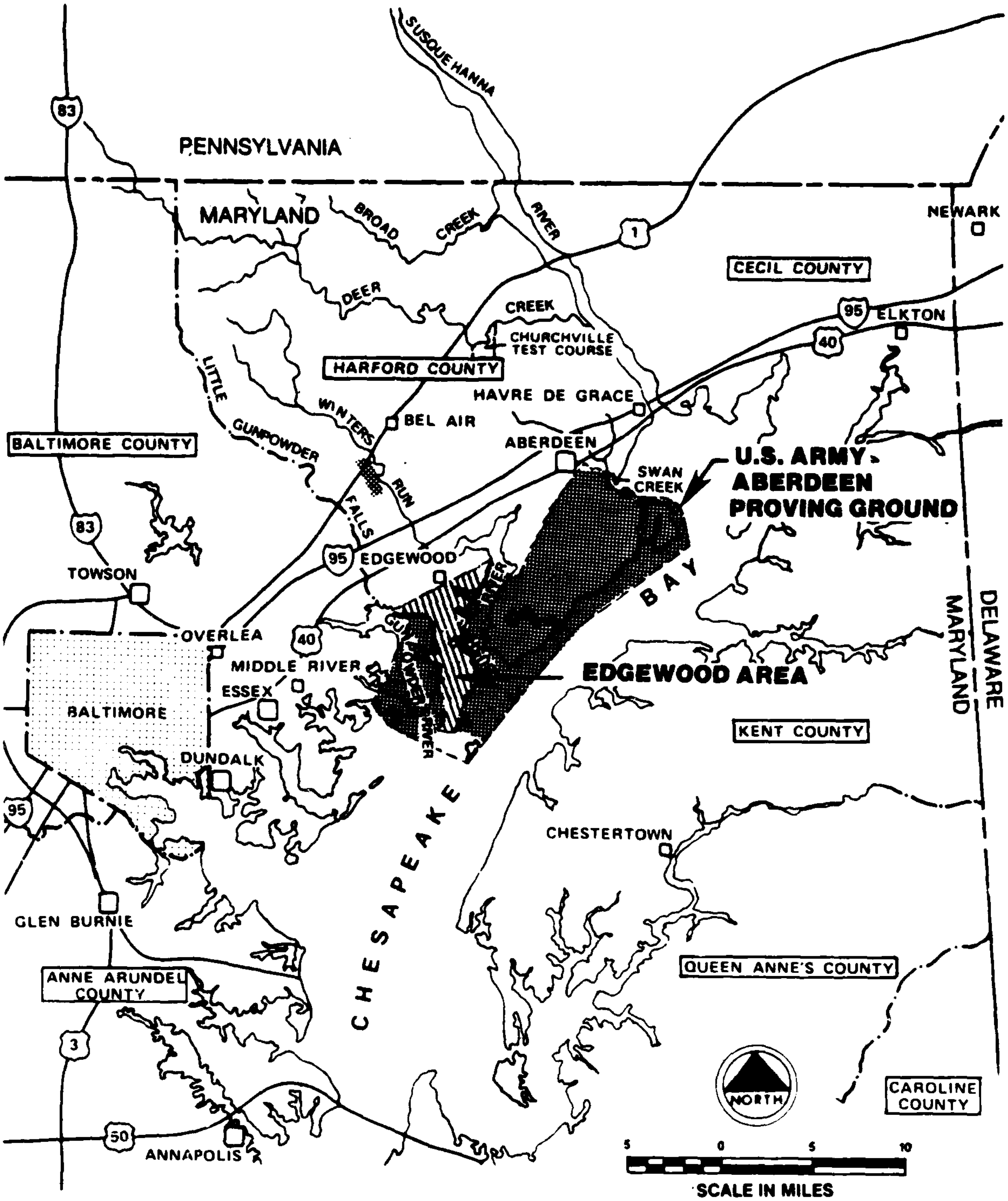
3.2 RELATIONSHIP WITH ABERDEEN PROVING GROUND

CRDEC is a tenant of APG; hence, CRDEC must comply with APG regulations and guidelines, as well as state, Federal, and Army regulations while carrying out its mission within the Edgewood Area. APG is responsible for the maintenance of the sites occupied by CRDEC. Additions or alterations to any of the buildings or structures occupied by CRDEC require application to and approval by APG. APG files all required applications to appropriate agencies at local, state, or Federal levels for environmental permits or licenses required by CRDEC for executing its missions.

APG is responsible for energy utilities, water supply, waste-water collection and treatment, and disposal of solid and hazardous wastes generated within the area occupied by CRDEC. Most land uses, vegetation, and utilities systems are handled by APG.

3.3 DIRECTORATES AND OFFICES WITHIN CRDEC

Figure 3-3 presents the various directorates and offices currently in operation under the Office of the Commander, CRDEC. There are a number of other Army organizations working closely with CRDEC in its mission "to manage and conduct the research, development, and engineering activities" related to the Nation's defense; some of these organizations are identified in Figure 3-3 as dotted line relationships.



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CHEMICAL RESEARCH DEVELOPMENT AND ENGINEERING CENTER
ABERDEEN PROVING GROUND, MARYLAND

FIGURE 3-1

LOCATION OF THE EDGEWOOD AREA OF ABERDEEN PROVING GROUND

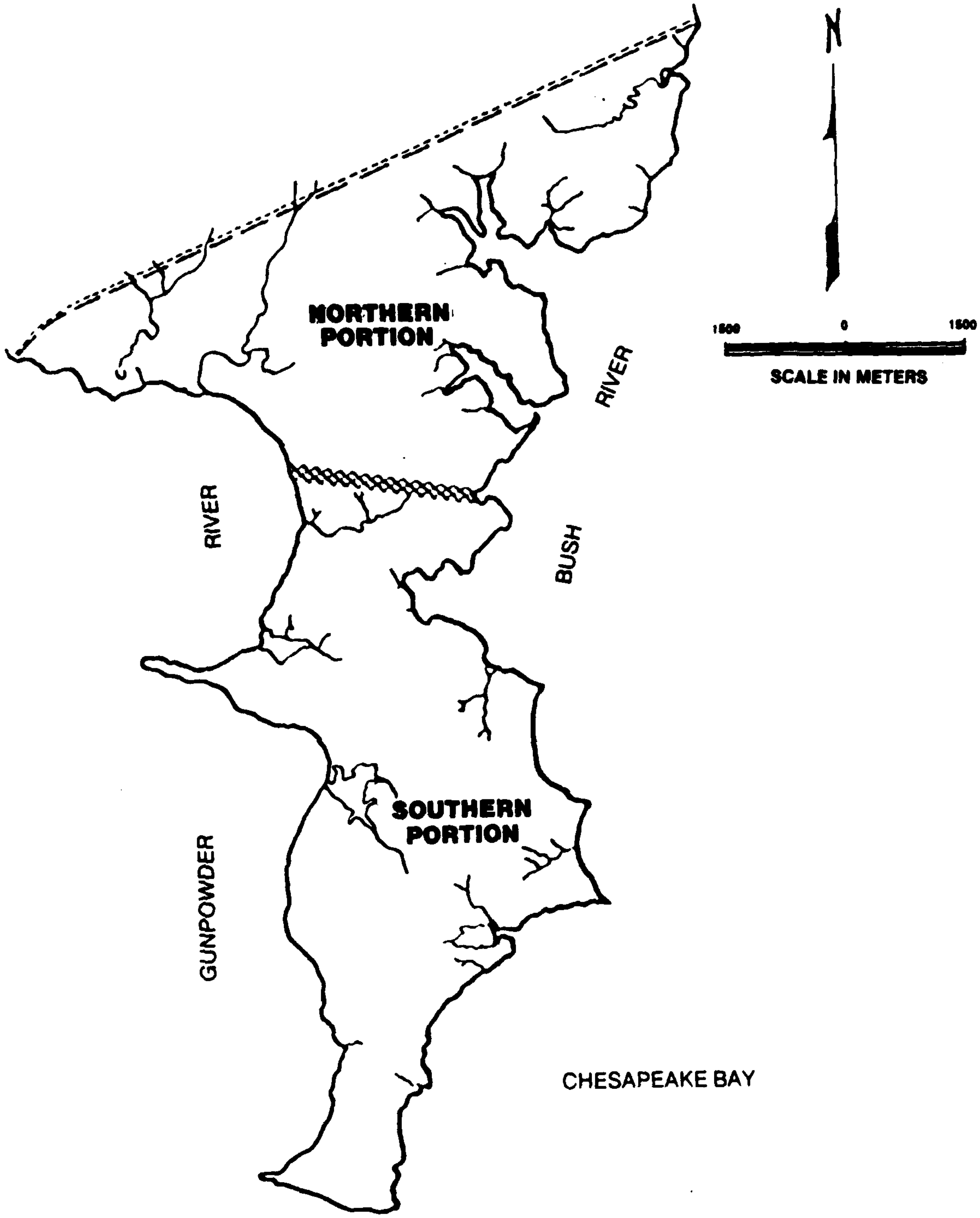

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FIGURE 3-2
EDGEWOOD AREA USED BY CRDEC
ABERDEEN PROVING GROUND

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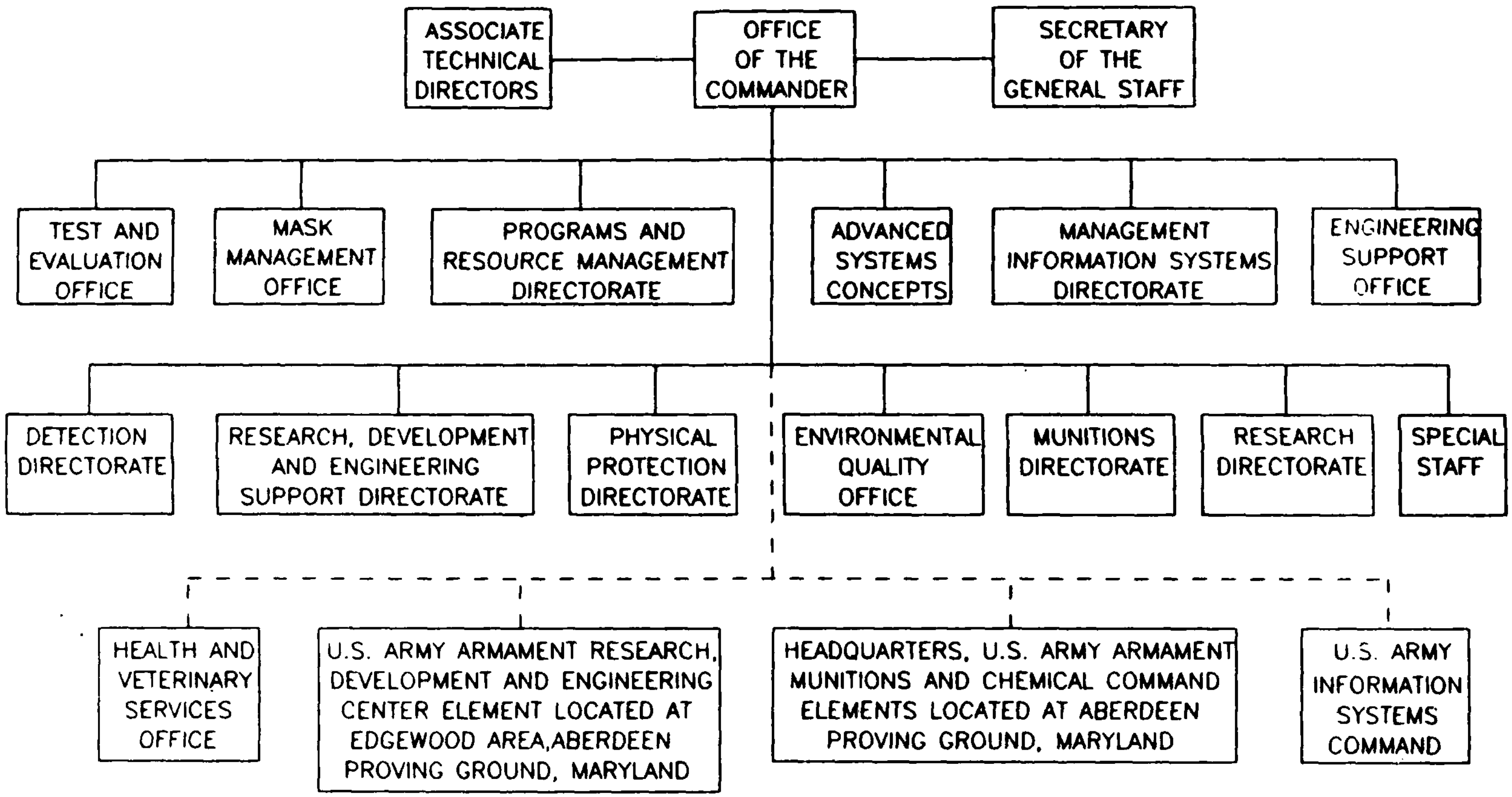

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ABERDEEN PROVING GROUND, MARYLAND

FIGURE 3-3
ORGANIZATION CHART OF THE
CHEMICAL RESEARCH, DEVELOPMENT AND ENGINEERING CENTER

3.4 MISSION RESPONSIBILITIES

This subsection outlines the responsibilities and functions of CRDEC and the various directorates and offices under CRDEC as presented in CRDEC Regulation[1] No. 10-1, of 5 August 1987.

3.4.1 Overview of CRDEC

The U.S. Army Chemical Research, Development, and Engineering Center (CRDEC) is a major subordinate activity of the U.S. Army Armament, Munitions, and Chemical Command (AMCCOM). CRDEC traces its lineage back to 1917 when the first chemical-related facility was constructed in Gunpowder Neck, Maryland.

The mission and major functions of CRDEC are the following:

- To manage and conduct the research, development, and engineering activities to provide defense against chemical and biological attack and to provide deterrent and retaliatory capability against chemical attack. To act as the AMCCOM Executive Agent for all research, exploratory, advanced, and engineering development, and to provide life cycle engineering for chemical weapons and chemical and biological defense.

- To plan and conduct the Technology Base Program for Chemical Materiel for Joint Service Applications.

- To participate in the international research, development, and standardization programs as the primary U.S. laboratory for chemical and biological defense materiel and chemical weapons materiel.

- To plan and conduct the Army research, exploratory development, advanced development, and engineering development for obscuring smoke/aerosol systems.

- To direct, manage, and/or execute a comprehensive engineering program as it pertains to configuration management support to full-scale production, product improvements, Replenishment Parts Breakout Program, engineering studies, and other related engineering activities on assigned chemical systems.

- To plan, coordinate, manage, and conduct the producibility engineering effort of all materiel development for items/systems under CRDEC management responsibility. This includes manufacturing technology, producibility engineering, production planning, process technology disposal engineering, hazards evaluation, and preparation of technical data packages. To coordinate and manage planning and execution of maintainability engineering, logistics support, and technical manual control, new equipment training, and design and acquisition of training devices.

- To plan, direct, and accomplish product improvement efforts as a viable alternative to development of new replacement items. To determine whether adoption of commercial items will fulfill military requirements.

- To provide support to U.S. Navy, U.S. Marine Corps, U.S. Air Force, and other government DOD agencies in the development of chemical materiel/munitions and devices.

- To direct and conduct the Environmental Technology Program to assure CRDEC life cycle operations do not adversely impact the environment.

- To develop AMCCOM chemical safety program policy, procedures, standards, and objectives for issuance by Chief, AMCCOM Safety Office. To develop procedures to perform and manage the DA Chemical Accident and Incident Investigation Program. To act as worldwide focal point for investigation of chemical accidents/incidents. To establish safety requirements for all privately owned and operated contractor facilities possessing chemical surety materiel for which AMCCOM is accountable.

- To ensure that integrated logistic support (ILS) requirements are integrated into item/system development. To ensure that an approved acquisition strategy is established at the start of advanced engineering and is maintained as a viable plan during the life cycle of an item.

- To plan and conduct item/system tests and evaluations in support of assigned functions.

- To manage the CRDEC's overall security program to include developing procedures for security of assigned chemical agents and munitions.

Special functions of CRDEC include:

- Staff supervision of the AMCCOM resident office at the National Space Technology Laboratories (NSTL).

- Manage the development, testing, and first production of the XM40 protective mask and related programs.

3.4.2 Directorates and Offices

Table 3-1 lists the divisions and branches within the directorates and offices within CRDEC.

The organization chart (see Figure 3-3) and the mission responsibilities provided here are effective as of 1 November 1987.

The mission/functions of the following Directorates/Offices have been identified as having no potential for environmental impact on the Edgewood Area of APG:

- Mask Management Office
- Programs and Resource Management Directorate
- Advanced Systems Concepts Directorate
- Engineering Support Office
- Alcohol and Drug Control/Employee Assistance Office
- Chemical Materiel Integration Office
- Headquarters and Headquarters Company
- NBC Survivability Office
- Office of the Provost Marshal
- Organizational Development Office
- Public Affairs Office
- Special Project Office for Binary Munitions
- Studies and Analysis Office
- Value Engineering Office

The mission of each Directorate/Office and identification of the Divisions that may potentially affect human health or the environment are presented following Table 3-1. For specific mission/functions of the Divisions and Branches within the Divisions, refer to CRDEC Regulation No. 10-1, dated 5 August 1987.

Table 3-1

Divisions/Branches Within
Directorates/Offices of CRDEC

Test and Evaluation Office

- Test Engineering Division
- Test Operations Division

Programs and Resource Management Directorate

- Acquisition Planning Division
- Industrial Engineering Division
- Management Review and Analysis Division
- Program Development Division
- Resources Management Division

Advanced Systems Concepts Directorate

- Current Operations Division
- Foreign Intelligence Office
- Plans Division
- Requirements Division

Management Information Systems Directorate

- Visual Information Division
- Management Systems Division
- Information Services Division
- Operations Division
- Techniques Division

Engineering Support Office

- Alarms and Munitions Support Division

Table 3-1
(continued)

- Physical Protection Support Division

SPECIAL STAFF

Alcohol and Drug Control/Employee Assistance Office

Chemical Materiel Integration Office

Chemical Surety Office

Environmental Quality Office

Headquarters and Headquarters Company

NBC Survivability Office

Office of the Provost Marshal

Organizational Development Office

Public Affairs Office

Safety Office

- Operations Division
- Engineering and Programs Division

Special Project Office for Binary Munitions

Studies and Analysis Office

Value Engineering Office

Research, Development and Engineering Support Directorate

- AMCCOM Resident Operations Office (at Bay St. Louis, MS)
- Scientific and Engineering Computer Applications Division
- Technical Data Division
  - Design and Packaging Branch
  - Verification Branch

Table 3-1
(continued)

- Systems and Operations Branch
- Standardization and Specification Branch

• Engineering Services Division

  - MCA/Facilities Branch
  - Equipment Management Branch
  - Technical Releases Branch

• Experimental Fabrication Division

  - Pattern and Plastics Branch
  - Electronics Branch
  - Manufacturing Engineering Support Branch
  - Metal Processing Branch

• Demil/Environmental Engineering Division

  - Demil/Environmental Documentation Branch
  - Monitoring Branch
  - Hazardous Materials Branch

Physical Protection Directorate

• Collective Protection Division

• Decontamination System Division

• Individual Protection Division

• Producibility Engineering Division

Munitions Directorate

• Chemical Munitions Development Division

  - Advanced Technology Branch
  - New Retaliatory Branch
  - Applications Branch
  - Special Munitions Branch

• Producibility Division

  - Near/Mid-Range Munitions Producibility Branch
  - Obscuration and Non-Tactical Branch
  - Long-Range Munitions Producibility Branch
  - Screening and Pyrotechnic Producibility Branch

Table 3-1
(continued)

- Smoke Development Division
  - Pyrotechnics Branch
  - Screening Smoke Branch
  - Tactical Obscuration Branch
  - Smoke Technology Branch
- Technical Integration Division

Research Directorate

- Biotechnology Division
- Chemical Division
  - Air Purification Branch
  - Applied Chemistry Branch
  - Organic Chemistry Branch
  - Physical Chemistry Branch
- Analytical Research Division
  - Analytical Systems Branch
  - Methodology Research Branch
  - Spectroscopy Branch
- Physics Division
  - Aerodynamic Risk and Concepts Assistance Branch
  - Obscuration Sciences Branch
  - Chemometric and Biometric Modeling Branch
  - Operational Services Branch
- Toxicology Division
  - Biosciences Branch
  - Environmental Toxicology Branch
  - Veterinary Services Branch

Detection Directorate

- Detection Development Division
- Detection Applications Division
- Detection Producibility Engineering Division
- Detection Technology Division

TEST AND EVALUATION OFFICE

To plan, manage, direct and conduct test and evaluation programs for CB materiel.

- Test Engineering Division
- Test Operations Divisions

MANAGEMENT INFORMATION SYSTEMS DIRECTORATE

To manage the total information area at CRDEC; to serve as the focal point and basic resource of ADP computer technology for CRDEC; and to provide audiovisual services through the management of a visual information facility.

- Visual Information Division
- Operations Division

SPECIAL STAFF

This group covers a number of offices with involvement in safety, security, chemical surety, and other issues. These offices are identified as having specific missions with the potential for environmental effects from their activities.

- CHEMICAL SURETY OFFICE

To develop, manage, and execute the Army Chemical Surety Program (CSP) for CRDEC and other tenants at the Edgewood Area of APG; to formulate CRDEC plans, procedures, and policies for the CSP; to ensure CRDEC compliance with all chemical surety reporting requirements; to establish regulatory requirements and act as the Office of Record for accountability of Chemical Surety Materiel (CSM) at Edgewood Area of APG; to plan and implement the Chemical Accident/Incident Control (CAIC) Plan at Edgewood Area of APG; to coordinate all CSM shipments to and from CRDEC; and to monitor military construction activities (MCAs) at Edgewood Area of APG related to the CSP at Edgewood Area.

- SAFETY OFFICE

To develop, establish, and maintain the CRDEC Safety Program with respect to chemical, industrial, and explosive safety; to provide safety management and engineering support to the Commander, CRDEC; to direct, technically supervise, and manage the CRDEC Safety Office; to serve as the CRDEC Occupational Safety and Health Area Workplace Designee; to develop policy, procedures, standards, and objectives for and implement the Occupational Safety and Health Program for CRDEC and AMCCOM Support Elements; and to develop, staff, and apply for necessary licenses for the procurement and use of radioactive materials.

To establish, manage, and execute the chemical contract safety program for privately-owned and operated contractor facilities that are allowed to perform research with government-furnished chemical surety materiel under AMCCOM-sponsored contracts.

To assign interim hazard classification for material developed by CRDEC and recommend final hazard classifications to AMC Field Safety Activity. To determine proper Department of Transportation (DOT) hazard classifications.

To prepare and approve Hazardous Component Safety Data Sheets for materiel developed by CRDEC. To prepare and coordinate Material Safety Data Sheets for military-unique chemicals developed by CRDEC.

- Engineering and Programs Division.
- Operations Division.

RESEARCH, DEVELOPMENT, AND ENGINEERING SUPPORT DIRECTORATE

To provide a full range of engineering and demilitarization/ environmental support and logistical services to CRDEC and applicable AMCCOM elements including design, fabrication, scientific and computer applications, equipment management, facilities/MCA, and hazardous material handling/storage support; to prepare the technical data packages (TDP) from conception through the life cycle of the item; to supervise the AMCCOM resident office at NSTL; to provide professional technical editing and publishing of CRDEC reports; to direct and conduct the monitoring/analysis programs and ensure that water, soiled toxicological agent protective (TAP) clothing, and other materials are free of hazardous levels of toxic agents; to maintain the protective mask control point; and to collect, package, and control radiological waste from the Edgewood Area.

- Engineering Services Division
- Experimental Fabrication Division
- Demil/Environmental Engineering Division
- Technical Data Division

PHYSICAL PROTECTION DIRECTORATE

To develop equipment for the protection of personnel in toxic environments; to decontaminate materiel and personnel exposed to toxic materials; and to manage the development and first production of new and assigned improved materiel for protection against and decontamination of toxic chemical and biological agents.

- Decontamination Systems Division
- Individual Protection Division
- Collective Protection Division
- Productibility Engineering Division

MUNITIONS DIRECTORATE

To maintain life cycle engineering and design responsibilities of Retaliatory Chemical Materiel, Antimateriel Chemical Systems, and Smoke/Obscurants from concept definitions through proof-of-principle, full-scale development, type classification, and transitioning to production; to provide engineering support, as required, for transferred items; and to provide Program Management for Antiterrorism/Counterterrorism, Special Munitions Programs, and Special Operating Forces Programs.

- Chemical Munitions Development Division
- Smoke Development Division
- Technical Integration Division
- Producibility Division

RESEARCH DIRECTORATE

To conduct basic and applied research in defense against chemical and biological attack (including toxins) in chemicals for deterent and retaliatory capability against such attack, and in smokes and obscurants.

To conduct the physical and biological sciences portion of the Department of Defense research program in the synthesis, properties, chemical analysis, modification, storage stability, and handling of antipersonnel, lethal, and incapacitating chemical agents, and riot control and training agents for military use and the basic aspects of defense against them.

To conduct the physical sciences program in synthesis, properties, and behavior of aerosal materiel used as smoke and obscuration agents.

To develop a toxicological data base in animal models/alternatives that will aid in defining the health hazards of military chemicals to the soldier in the field and developmental personnel who will address the environmental effects of these chemicals.

To conduct the Department of the Army research programs in physical protection, warning, and decontamination against chemical agents, smoke and obscuration agents, biological agents and toxins, and dissemination and dispersion of chemical agents.

- Chemical Division
- Biotechnology Division
- Toxicology Division
- Analytical Research Division
- Physics Division

DETECTION DIRECTORATE

To manage exploratory, advanced, and engineering development for NBC reconnaissance and detector application systems and CB agent detection/alarm/identification materiel, as well as the responsibility for life-cycle engineering for this materiel.

- Detection Development Division
- Detection Applications Division
- Detection Technology Division
- Detection Producibility Engineering Division

ENVIRONMENTAL QUALITY OFFICE

To develop, implement, and manage the CRDEC Environmental Management Program; to ensure that all CRDEC operations are in compliance with all Federal, state, local, and high headquarters environmental regulations and policies; and to ensure that all items under development by CRDEC are assessed for minimizing environmental impacts and addressed by the appropriate environmental document.

To establish and direct a program of chemical accountability to ensure that regulated chemicals are being controlled from procurement to ultimate disposal.

To establish and conduct a program to identify facilities and operations that do not meet environmental regulations and standards, provide guidance for improving such facilities and/or modifying operations to minimize environmental impacts, and maintain a listing of required actions. Initiate and conduct surveys, assessments, and studies necessary to identify and correct environmental problems.

To oversee the CRDEC Hazardous Waste Minimization Program.

To ensure that the CRDEC work force is informed of environmental policy and compliance requirements; and to develop policies, procedures, standards, and objectives for an adequate training program.

3.4.3 Support Elements

Several other Army organizations are located at APG that directly support or have routine involvement in CRDEC activities; these include:

- Headquarters, AMCCOM
  - Product Assurance Directorate
  - Technical Escort Unit
- Health and Veterinary Services Office

PRODUCT ASSURANCE DIRECTORATE

To manage the life cycle product assurance functions.

To provide the AMCCOM Command's product assurance interface for materiel assigned to CRDEC and designated program managers, including the quality engineering aspects of system safety, quality engineering, acquisition quality assurance, and chemical surety.

To plan, develop, staff supervise, and direct life-cycle product assurance programs for all AMCCOM-managed materiel.

To perform research and develop the technology and methodology for improving the effectiveness of product assurance for AMCCOM mission materiel.

To provide product assurance engineering and technical support in the areas of system safety, reliability, availability, maintainability, inspectability, treatability, quality engineering, acquisition quality assurance, and product quality management.(10)

- Chemical Systems Division
- Chemical Operations Division
- Technology and Assessment Division

TECHNICAL ESCORT UNIT

Technical escort of chemical agents and munitions, Department of Transportation (DOT) waivered radiological material and other hazardous materiel as directed.

Respond to and neutralize hazards resulting from a chemical accident/incident situation.

Planned or emergency neutralization and subsequent disposal of minor quantities of chemical agents and munitions or other hazardous materiel for the Department of Defense.

HEALTH AND VETERINARY SERVICES OFFICE

To provide direct technical support and consultation to the Commander, CRDEC, in the areas of occupational and environmental health, laboratory animal care use, and health hazards assessment of mission-related equipment within the research, development, test, and evaluation process.

To provide consultation concerning human physiological compatibility of and protection afforded by chemical/biological protective materials or procedures. Serve as advisor and liaison between CRDEC and the Army Medical Department (AMEDD) concerning human subjects research.

To serve as liaison with AMEDD elements to facilitate the flow of information and consultation services.

3.4.4 Mission and Facility Oversight

There are several groups at CRDEC that provide oversight functions to ensure the safety of the staff and activities of CRDEC and protection of the environment. They include the Health and Veterinary Services Office, the Environmental Quality Office, Safety Office, Chemical Surety Office, and the Office of the Provost Marshal. This subsection highlights the "oversight" functions of these offices and the training program/certification process required to be undertaken by CRDEC staff to ensure their safety, the security of the post, and the overall protection of environmental quality in the Edgewood Area of APG.

3.4.4.1 Health and Veterinary Services Office

As mentioned in Subsection 3.4.3, the HVSO is to provide direct support services to CRDEC in the areas of occupational health and industrial hygiene, environmental health, physiology, and human use testing; to coordinate delivery of installation medical support services; and to serve as liaison between medical and chemical RDTE communities to facilitate timely exchange of scientific data and information on new mission requirements.

3.4.4.2 Environmental Quality Office

As mentioned in Subsection 3.4.2, the Environmental Quality Office (EQO) is responsible for environmental monitoring and compliance. EQO ensures compliance with environmental laws and regulations by routine inspection of CRDEC facilities and laboratories, and associated monitoring of records, management practices, permits, etc. In addition, EQO reviews and recommends approval to the Deputy Commander, CRDEC, for environmental documentation support. Since CRDEC is a tenant in the Edgewood Area of APG, all information, permits, and other environmental reporting/compliance pertaining to APG facilities, resources, or real estate must flow through the Environmental Management Division (EMD) of the Directorate of Safety, Health, and Environment of APG. The APG EMD has the authority and responsibility for environmental compliance for the installation.

EQO has developed a checklist inspection form that it uses during site inspections to ensure that the operation of any facility, building, or laboratory is in compliance with related environmental regulations. EQO identifies the applicable regulations to the operating (research and testing) groups within CRDEC, and is authorized to shut down an operation, if required, when the environment is adversely impacted. EQO often acts in concert with other oversight groups, namely the Chemical Surety Office, Safety Office, and the Office of the Provost Marshal.

3.4.4.3 Surety, Safety, and Security Offices

The Chemical Surety Office is responsible for the formulation and execution of CRDEC plans, procedures, and policies for the Chemical Surety Program. In this capacity, the Chemical Surety Office is responsible for coordinating all CSM shipments to and from CRDEC, and for approving all CSM shipments for AMCCOM. The use of CSM is authorized by the Chemical Surety Office only after the issuance of a chemical surety permit, which is granted after a thorough review of the intended use of CSM by the Safety, Surety, and Security Offices. The office conducts its review by preoperational inspection and preoperational review of operations involving agents. It is also responsible for the implementation of the Personnel Reliability Program (PRP) described below.

The Chemical Surety Office monitors the handling of CSM by periodic inspections of both in-house and contractor laboratories. In the event of an accidental release of CSM, the Chemical Surety Office coordinates the activities of the Chemical Accident/Incident Control Center (CAIC). CAIC serves as the focal point for emergency response to accidental releases of CSM and coordinates the activities of the offices of Surety, Safety, Security, and Public Affairs.

The Chemical Personnel Reliability Program (CPRP) is administered by the Surety Office under Army Regulation 50-6[11], Chapter 3. The object of CPRP is to ensure that only qualified, secure personnel are provided access to CSM, which is essential to the completion of the appropriate mission. The essential elements of the CPRP include:

- Initial background investigations of employees prior to access to CSM.
- Procedures to ensure that only CPRP personnel have access to agents.
- Monitoring and working to reduce the number of personnel in the CPRP.
- Training of personnel in CPRP.
- Removal of personnel in the CPRP because of changes in security classification, administration of prescription drugs, or any other factor that may potentially influence the suitability of the personnel.

The Safety Office is responsible for the development and implementation of policy, procedures, standards, and objectives for the Occupational Safety and Health Program at CRDEC. The Safety Office's responsibilities include those of surety materiel, non-surety materials, and radioactive materials. The office serves as the safety and health consultation arm of the Commander in ensuring safe working conditions for all CRDEC employees. The Safety Office conducts periodic inspections of personnel, equipment, and systems designed to protect the health and safety of employees and the public at large.

Security is the responsibility of the Office of the Provost Marshal. Security functions include control of restricted areas including agent handling areas, and access to agents within the laboratories and storage areas.

3.4.4.4 Training

The Safety Office develops and presents training programs for both managers and professional/technical employees. These programs are designed to familiarize employees with the nature of the hazards of the chemicals used in all directorates throughout CRDEC and AMCCOM elements located at the Edgewood Area of APG, and to instruct employees in the safe handling of these chemicals.

Training includes a Hazardous Communication Program and a presentation of MSDS on chemicals actually encountered during specific activities. MSDSs are used as a basis for instruction on specific chemicals, environmental and human toxicity, and safe handling and disposal procedures.

CRDEC Regulation No. 385-10, 1 June 1986, and its revision C1, dated 10 March 1987, establish the minimum requirements necessary for the qualification and certification of military and civilian personnel who perform hazardous operations. The purpose of this regulation is to ensure that each operating element establishes and maintains a certification program that assures that only trained and knowledgeable personnel are permitted to work in hazardous operations. This program provides a positive means of maintaining safety and operational proficiency. Personnel who are not trained, certified, or otherwise qualified as authorized by this regulation will not be used (or allowed) in hazardous operations.

All employees involved in hazardous operations are provided local training regarding job orientation, safety rules, and basic work principles to be followed. All employees in positions covered by CRDEC Regulation 385-10 must be certified within twelve months of assignment to that position (see Figure 3-4, Sample Hazardous Operations Certification, SMCCR Form 1010) by the director/office chief, the certifying official. CRDEC 385-10 applies to positions requiring the preparation of Standing Operating Procedures (SOPs) due to potential hazards associated with the performance of assigned tasks. The responsibility for effective execution of safety, security, and surety management procedures is a critical job element for all applicable employees, supervisors, and managers. The certifying official will evaluate employees to determine if additional training is required prior to certification.

Certification will be suspended by the certifying official when any individual is suspected of performing hazardous acts or violating SOPs and/or regulations. The individual will be reassigned to nonhazardous operations pending investigation by the certifying official.

The training plan for certification of laboratory workers who work with toxic chemical material includes annual instruction in good worksite practices, such as: use, compatibility, and storage of chemicals; two-person concept, glove discipline, hazardous waste handling procedures, and waste disposal; emergency evacuation; detection equipment/monitoring requirements; and use and maintenance of first-aid equipment to include showers and eyewashes. Also, employees receive annual training in first-aid/self-aid including toxic aid, CPR, and lethality awareness training.

Employees receive biennial training through in-house and contract courses. A sample certification program for a chemist is shown in Figure 3-5.

Additionally, employees are required to demonstrate knowledge and/or proficiency in: hazard recognition; SOPs; use and care of personal protective clothing and equipment; decontamination procedures; laboratory requirements checks for hood ventilation, CRDECR 385-10

HAZARDOUS OPERATIONS CERTIFICATION
(For use of this form, see CRDECR 385-10; proponent is Safety Ofc.)

NAME: Joe Jones

JOB SERIES: GS-1320

DIVISION: Chemical Operations, PAD

TRAINING RECEIVED

TYPE	DATES
Toxic Aid	10 April 1986
CPR	9 May 1986
Supervisory (Semi-Annual)	
Other (List)	
~~Lethality~~	
Chemical Lab Safety	

The above named individual has received the required training and instruction contained in CRDECR 385-10, subject: Certification Program for Personnel Involved in Hazardous Operations, and fully meets the standards for hazardous operations certification.

Submitted by: Pete Smith ______ date

Verified by: Karen Boggs ______ date

Certification Approved/Disapproved:

Jim Jones
Director/Office Chief ______ date

SMCCR Form 1010, 1 Jun 86 replaces SMCCR Form 1010, 1 Jun 85 which is obsolete.

DEPARTMENT OF THE ARMY
CHEMICAL RESEARCH DEVELOPMENT AND ENGINEERING CENTER
ABERDEEN PROVING GROUND, MARYLAND

FIGURE 3-4
SAMPLE HAZARDOUS OPERATIONS CERTIFICATION
(SMCCR FORM 1010)

FIGURE 3-5

SAMPLE

TRAINING PLAN FOR CERTIFICATION

CHEMIST, GS-1320-12

(1 October - 30 September)

I. On-the-Job Training:

A. Individual will thoroughly trained and be required to demonstrate proficiency in the following:

1. Emergency procedures for casualties in laboratories.

2. Emergency evacuation plans of all buildings in which individual will be required to work.

TIME: 20 hours

B. Individual will be required to have hands-on experience in the following:

1. Handling, storage, and preparation of standards from:

a. G-agents.

b. V-agents.

c. H-agents.

Experience required - 20 hours

2. Decontamination and disposal of hazardous waste - 4 hours.

3. Handling and use of compressed gas cylinders - 3 hours.

a. Hydrogen.

b. Nitrogen.

c. Air.

d. Helium.

FIGURE 3-5

(CONTINUED)

e. Oxygen.

4. First Aid - 4 hours.

C. Mandatory attendance of annual training:

1. Toxic aid briefing.

2. CPR training and certification.

3. Lethality awareness.

II. Formal Training:

A. Individual will attend the following training:

1. On-site agent training - AMCCOM Field Safety Activity, "Hazardous Agents Chemical Munitions Class" - 40 hours.

2. Slides/cassettes - "Safety and You."

3. Film - "Storage and Handling of Chemical Agents and Munitions."

4. Slides/cassettes - "An Orientation in Occupational Safety and Health for Federal Employees."

5. Slides/cassettes - "Handling Flammable Liquids."

6. Slides/cassettes - "Research Laboratory Safety."

7. Slides/cassettes - "Compressed Gases Can Be Dangerous."

8. Film - "Compressed Gases."

B. Individual will receive biennial training through contract effort:

1. Civilian Personnel Office, as courses become known.

2. Safety Office, CRDEC, as courses become known.

FIGURE 3-5

(CONTINUED)

3. Safety Office, APG, as courses become known.

4. Chemical courses at NIOSH, as courses become known.

III. Responsibilities:

A. Individual will be required to read and be thoroughly aware of:

1. CRDEC SOP 385-1, "Safety."

2. FM 3-9, "Military Chemistry and Chemical Compounds."

3. Interim Guidance, Chemical Waste Management at CRDEC, April 1987.

4. AMC-R 385-131, "Safety Regulation for Chemical Agents H, HD, HT, GB, and VX," 9 October 1987.

5. AMC COM Reg 385-31, "Safety Regulations for Chemical Agent HD."

6. CRDEC Reg 50-2, "Chemical Surety Permits."

Time Required - 16 hours.

B. Following training, employee will be required to demonstrate knowledge and/or efficiency in the following areas:

1. Hazards recognition.

2. Self-aid/first aid.

3. Two person concept.

4. Applicable SOPs.

5. Use and care of personal protective clothing equipment.

6. Decontamination procedures.

FIGURE 3-5

(CONTINUED)

7. Daily laboratory requirements checks for hood ventilation, first aid equipment, decontamination materials, detection equipment, monitoring equipment, and documentation procedures for operations when hazardous operations are being conducted.

8. Proper accident reporting procedures.

9. Provisions of CRDEC SOP 385-1.

Submitted:

Supervisor

Recommend Approval:

Division Chief

Approved:

Director

first-aid equipment, decontamination materials, detection equipment/monitoring, and documentation procedures for operations when hazardous operations are being conducted; and proper accident reporting procedures.

Employees are instructed annually in the following surety requirements: chemical surety permits; chemical surety materiel accountability; and provisions of the chemical personnel reliability program.

The ultimate responsibility of providing proper training to the employees rests with the supervisory personnel, while the certification is provided by the director or the office chief.

CRDEC Regulation No. 385-12, dated 15 July 1987, establishes policy and procedures for implementation of the Hazardous Communication Standard (Title 29, CFR 1910-1200) to include hazardous chemical information and training. This mandatory program (Hazard Communication Program) includes the following requirements to be followed by all CRDEC personnel:

- Develop a hazardous chemical inventory listing all chemicals at CRDEC, and prepare a hazard assessment of all items in the inventory.

- Material Safety Data Sheets to be obtained or developed for all hazardous chemicals in the inventory except for chemicals undergoing development in R & D laboratories. An MSDS will be developed for newly-developed chemicals prior to shipment.

- Hazardous warning labels will be affixed and maintained on all hazardous chemical containers.

- Develop an employee training program to ensure all CRDEC employees are aware of their rights under the OSHA Hazard Communication Standard, and are instructed in the use of, and information contained on, hazardous labels and MSDSs, and know how and where to gain access to this information.

The CRDEC places a high priority on all environmental training, and, in particular, the formal training which has been determined mandatory before an employee can be considered adequately trained. As mentioned earlier, it is the responsibility of the managers and supervisors to see that the required training is accomplished. EQO periodically sponsors local environmental training courses in addition to informing the employees of upcoming environmental courses and events.

An employee is determined to be adequately trained for routine laboratory operations when that employee has successfully completed the following:

- Read the RCRA Orientation Manual, EPA 530-SW-86-001, January 1986.
- Read APGR 200-2, Solid and Hazardous Waste Management at APG, May 1982.
- Read APG Spill Contingency Plan, Appendix III to Annex G of APG Disaster Control Plan.
- Read Interim Guidance, Chemical Waste Management, CRDEC, April 1987.
- Read Command Policy Statements and EQO Guidance (example: SMCCR-CO, Management of Chemicals and Hazardous Waste, May 1986, Interim Guidance on HW).
- Attended at least 16 hours of formal training in the area of hazardous materials/waste handling or laboratory chemical management.
- Received on-the-job training in handling hazardous materiels and/or hazardous wastes.

The training requirements for an employee with duties requiring handling, storing, and transporting large quantities of hazardous materials and/or hazardous wastes could be the same as those listed above, except that they are required to have a minimum of 40 hours training in the area of handling hazardous materials and hazardous waste management procedures. The ALMC course on "Defense Hazardous Material Handling" is recommended for these employees, which is available through on-site and correspondence enrollments.

Additionally, EQO has developed Environmental Performance Standards (See Reference DF, SMCCR-DC, 10 November 1986, Subject: Environmental Performance Standards) to be added to the performance standards of all employees who have duty assignments with a potential for environmental impacts and environmental regulatory noncompliance. Other employees may have a requirement for the standards as determined by their supervisors. The standards are designed to satisfy various Federal and state environmental regulatory requirements such as training and hazardous waste generator/storage requirements. The intent of the standards is to increase employee attentiveness to environmental matters and to ensure environmental compliance.

The standards were developed in consideration with the grades, duty assignments, and the level of responsibility the individual has within the organization. However, when found not appropriate in any individual's case, some flexibility will be allowed in developing appropriate standards. The prevailing

Environmental Protection and Regulatory Compliance Standards for employees within Grades 07 to 11, and those for Branch/ Division/Office supervisors under Grades 13 and 14 are listed below as examples to illustrate their respective responsibilities in meeting the environmental regulatory requirements.

Grades 07 to 11 Employees

(a) Assures that operations he/she conducts are in compliances with applicable Federal, state, local, and Army environmental regulations with no more than three instances of failure to be in compliance identified within the appraisal period.

(b) Reads quarterly a file of current APG and CRDEC regulations dealing with handling chemicals and disposal of chemical waste and maintains reference materials needed to apply Federal, state, and local environmental regulations.

(c) Develops and follows internal procedures in accordance with APG regulations for collecting, storing, and disposing of hazardous waste produced by operations under his control. In no more than three instances in the reporting period are procedures found to be undeveloped when need is indicated or not followed when developed.

(d) Maintains an inventory of chemicals in his/her possession and updates the inventory when chemicals are disposed of or purchased which upon inspection is found to be 90 percent accurate and compiled within five working days of receipt or disposal of the chemical.

Grades 13 to 14 Supervisors (Branch/Division/Office)

(a) Assures that operations under his/her control are conducted in accordance with applicable Federal, state, local, and Army environmental regulations. In no more that three instances during the reporting period are minor violations within the operation verified. In no more than one case in the reporting period is a serious violation verified.

(b) Ninety percent of all assigned personnel handling hazardous waste will be adequately trained within 60 working days of entry into a position requiring such training. Ninety-five percent will be trained within 120 working days, and all personnel will be trained within 150 working days. Employees currently incumbering such positions will be trained on the same schedule as if entry into the position coincided with the effective date of this standard. Training records will be maintained and available for inspection.

(c) Inspects areas where violations or pollution incidents were reported within at least three days to assure that corrective action has been initiated or accomplished depending on the scope of the actions. When willful or serious violations occur on the part of subordinates who were aware of the proper procedures, takes steps to initiate proper disciplinary action to correct the situation within five days.

4. ITEMS, SUBSTANCES, FORCES, AND ACTIONS WITH POTENTIAL FOR IMPACT

4.1 MILITARY CHEMICAL SURETY MATERIEL

4.1.1 Definition and Identification

Military chemical surety materiel (CSM) is central to many CRDEC activities. CSM comprises all lethal and incapacitating chemical warfare agents that either have been adopted or are being considered for military use. Smokes, flames, incendiaries, defoliants, riot control agents, and other military chemicals are excluded (see Subsection 4.2).

Military CSM are categorized according to physical action:

- Blister agents (vesicants) - Blister agents are readily absorbed by both exterior and interior parts of the body, causing inflammation, blisters, and general destruction of tissues. The vapors, in addition to affecting the skin, attack the respiratory tract; the effects are usually more severe in the upper respiratory tract. Eyes are very susceptible to blister agents.

- Nerve agents - When inhaled, ingested, or absorbed through the skin, nerve agents react irreversibly to permit excessive concentrations of acetylcholine at the endings of the parasympathetic nerves, the motor nerves to voluntary muscles, nerves to autonomic ganglia, sympathetic nerves to sweat glands, and the central nervous system. The passage of nerve impulses is interrupted, and essential body functions, such as breathing, vision, and muscular control, are disturbed.

- Incapacitating agents - Incapacitating agents produce physiological or mental effects that may persist for hours or days after the exposure. Their effects range from stumbling or staggering, vomiting, and hallucinating, to loss of memory, inability to concentrate or comprehend, and delirium or coma.

Table 4-1 further identifies CSM used at CRDEC.[12]

Table 4-1

Military Chemical Surety Materiel Used at CRDEC

Type	Code Name	Common Name	Hazard Rating*
Blister	H		
	Q		
	HQ	Sulfur mustard	5
	T		
	HT		
	HD	Distilled sulfur mustard	5
	HL	Mixture of H and L	5
	L	Lewisite	5
Nerve	GA	Tabun	6
	GB	Sarin	6
	GD	Soman	6
	GF	G-type	6
	VX	V-type	6
Incapacitating	BZ	Glycolate	4
	EA 3834	Glycolate	4

* Approximate hazard rating according to M.N. Gleason, et al., Clinical Toxicology of Commercial Products, Williams and Wilkins, Co., Baltimore, Maryland, 1969. Ratings are based on oral dosage; because agents act primarily through contact or inhalation, ratings are only relative indicators of toxicity.

Table 4-1
(continued)

Ratings:

6 - Less than 5 milligrams (mg)/kg is lethal to man; common compounds in this class include atropine, heroin, LSD, nitroglycerine, and parathion (an organophosphorus insecticide).
5 - From 5 to 50 mg/kg is lethal to man; common compounds in this class include amphetamine, arsenic, codeine, iodine, and opium.
4 - From 51 to 500 mg/kg is lethal to man; common compounds in this class include sodium fluoride, DDT, menthol, oil of wintergreen, and tobacco.
3 - From 501 to 5,000 mg/kg is lethal to man; common compounds in this class include borax, ether, methyl alcohol, sodium chloride, and vanillan.
2 - From 5,001 to 15,000 mg/kg is lethal to man; common compounds in this class include castor oil, ethyl alcohol, lysol, milk of magnesia, and soaps.
1 - More than 15,000 mg/kg is lethal to man; common compounds in this class include graphite, lanolin, linseed oil, paraffin wax, and black pepper.

4.1.2 Use and Control

All application and use of CSM at CRDEC is for research and development (R&D), primarily for defensive measures and protection. Operational handling and storage of CSM, including bulk (i.e., small quantities of less than 4 liters) decontamination, is the responsibility of the Hazardous Materials Branch (HMB) of Demil/Environmental Engineering Division, Research, Development and Engineering Support (RDES) Directorate. The HMB, in operation since 1983, has four primary responsibilities:

- Bulk chemical agent storage.
- Production of calibration grade CSM.
- Detoxification/decontamination of CSM.
- Thermal treatment of decontaminated CSM.

A detailed description of these four missions of HMB is provided in Subsection 4.1.3, Handling and Storage.

The HMB distributes research quantities of CSM to individual laboratories and users through a formal permit and certification process. The following elements use and/or are accountable for surety materiel:

- Product Assurance Directorate
- Research Directorate
- Detection Directorate
- Munitions Directorate
- Research, Development, and Engineering Support Directorate
- Physical Protection Directorate
- Test and Evaluation Office
- Technical Escort Unit

Each of these primary organizational elements is required to submit a permit application for each area/person under its jurisdiction where agents are intended for use or storage. The permit (Figure 4-1) must be approved before handling, storing, or using any CSM to ensure that its conditions of use are safe and secure. Key elements of the permit include the following:

- Use of CSM only in limited exclusion areas and meeting all applicable physical security requirements.

10 June 1986

CHEMICAL SURETY PERMIT
(See CRDECR 50-2; proponent is Cml Surety Ofc)

PERMIT NUMBER: 4,893,893.2 EXPIRATION DATE: 1 Jan 2001

THE FOLLOWING PERSONNEL ARE AUTHORIZED TO PERFORM CSM OPERATIONS IN

BLDG E99,999 RM 2E5

Igor Frank
(TYPED & SIGNED) CUSTODIAN

ALTN (1) Frank I. Nstein
(TYPED & SIGNED)

ALTN (2) P. B. Shelley
(TYPED & SIGNED)

John B. Smith
CHIEF, CML SURETY OFFICE

Richard A. Jones
BRIGADIER GENERAL, USA
COMMANDING

SMCCR Form 1019, 1 Jan 86, which replaces DRDAR-CL 694, 1 Aug 81

CRDECR 50-2

DEPARTMENT OF THE ARMY
CHEMICAL RESEARCH DEVELOPMENT AND ENGINEERING CENTER
ABERDEEN PROVING GROUND, MARYLAND

FIGURE 4-1
SAMPLE OF CHEMICAL SURETY PERMIT

- Submission of standing operating procedures (SOP's) test protocols, and evidence of successful experimental "dry-runs."

- Verification that employees are fully trained and certified prior to working with CSM.

To further ensure safe and secure CSM use, a Personnel Reliability Program (previously known as the Surety and Reliability Program) was instituted to verify to CRDEC and the public that handlers of CSM are mentally and ethically fit. The PRP includes a background security check, psychological examinations, and random drug testing. Individuals are removed/ excluded from the program and prohibited from using or handling CSM if they are found to be unsatisfactory. Also, personnel can be removed from the list of individuals having access to CSM if access to CSM is no longer required.

Approval of the CSM permit requires the concurrence of the Chiefs of the Chemical Surety Office, Security Office and the Safety Office. In addition, periodic inspections are made by personnel of the Chemical Surety Office (CSO) to ensure that the element is working within the conditions of the chemical surety permit.

Security of CSM in the laboratories is tightly controlled. Agents are provided in research quantities by HMB and strictly secured in the laboratory when not in use. Neat (undiluted) chemicals are stored in locked steel cabinets that are further locked in special steel hoods. Dilute solutions are locked in small refrigeration units that are also locked within the hood. Thus, all active agent is always double-contained. Binary agents made within the test chamber or hood are destroyed the same day. Highly-dilute (drinking water level) agent is stored in a locked refrigerator.

Each building where surety chemicals are stored has a custodian who is responsible for maintaining the chemical and agent logbooks for each laboratory. All laboratories are required to maintain accurate inventories that are updated as the agents are used. Periodic inspections of quantities on hand and records of amounts consumed in testing or neutralized and disposed by the laboratory and HMB are conducted by the CSO.

4.1.3 Handling and Storage

4.1.3.1 Chemical Agent Storage

All tasks involving military CSM are conducted in laboratories under chemical fume hoods. Every location where CSM is used or stored is operated as a chemical exclusion area where rigorous security, surety, and safety precautions govern access and handling.

As noted in Subsection 4.1.2, laboratory quantities of CSM are stored in permitted buildings. Larger quantities are stored in the chemical agent storage yard (CASY), N-Field, and Chemical Transfer Facility (CTF), which are maintained and/or monitored by HMB.

Three types of bulk/non-laboratory CSM are stored:

- Wartime stockpiles of mustard are stored in ton containers at the CASY under high security and monitoring conditions. The containers are policed 24 hours/day and are monitored for leaks daily. The stockpile is part of a nationwide destruct program to be implemented beginning in 1988. A risk assessment performed by Oak Ridge National Laboratories has reported that "under normal operations of storage, no releases of active agent would occur ... and no impacts on human health ... or the environment are anticipated." Risks from accidents are reported to range from low to extremely low.(13)

- Research and development quantities of CSM are stored and maintained by HMB. Bulk volumes, typically stored in ton containers, are transferred to smaller containers (less than 4 liters) for purification and for use by R&D facilities. Storage and monitoring are maintained under very high security.

- Range recovered agent munitions from open air testing (terminated in 1973) and suspect CSM from various other sources are stored awaiting final destruction. The method of destruction will be determined through an EIS process. The materiel is stored in high-security bunkers at N-Field and is policed daily and monitored monthly.

All CSM storage areas and operations are subject to routine air monitoring by the Monitoring Branch, Demilitarization/Environmental Engineering Division, Research, Development and Engineering Support Directorate, to ensure all engineering controls are maintained. The areas are monitored, at a minimum, during the first five days of a new operation, and once every subsequent quarter. The areas include, but are not limited to, laboratories, test chambers, CASY, sheds, and facilities. Periodically, clothing, ductwork, filters, drums, pallets, and the like materials are also monitored for residual agents. The methods of analysis used are capable of detecting the Surgeon

General's time-weighted average agent concentration limits within the sampling period.

4.1.3.2 Chemical Agent Standard Analytical Reference Material (CASARM)

Purification (by a process of distillation) and synthesis of calibration-grade chemical surety materiel are performed at the CTF for production and use of CSM as instrumentation and analytical standards. Approximately 100 liters/year of agents are distilled from munitions-grade stock to 99-percent purity. Most of the distilled agent produced is GB because of its more widespread research and development use.

The reagent-grade materiel is certified under the CASARM program for use in research laboratories. Those stored are surveiled every 6 months by wet chemistry, gas chromatography (GC-FID), and nuclear magnetic resonance (NMR) analytical methods to ensure quality. The entire operation, with the exception of the laboratory analysis performed by the Research Directorate, is maintained by the HMB.

4.1.3.3 Decontamination of Chemical Surety Materiel

Decontamination of bulk (4 liters or less), unknown (e.g., aged materiel stored at other facilities), or other agents not decontaminated after testing in individual laboratories and in other facilities approved for their use is conducted at the CTF. Decontamination is accomplished through chemical neutralization specific to the individual agent, typically via caustics. In the case of "unknown" agents, sample testing is performed to determine the proper decontaminant to be used. (Table 4-6 in Subsection 4.2.1.4 presents typical decontaminants used for the agents maintained by CRDEC.) There are similar decontamination processes used by the Product Assurance Directorate and at the two test chambers used by the Test and Evaluation Office as an end result of R&D efforts. A Controlled Hazardous Substance (CHS) permit application is being prepared to address treatment at the CTF.

Agent detoxification is generally accomplished in 4-liter batches in a reactor vessel contained under negative pressure and accessed through a glove box. The decontaminated end-products, which are then neutralized using sulfuric acid, no longer exhibit military-specific properties or hazardous waste characteristics. They are subsequently stored awaiting treatment by incineration.

4.1.3.4 Thermal Treatment of Decontaminated Chemical Surety Materiel

According to the classification system in place, when the CSM in accessible form (i.e., undiluted agent) has been demilitarized, detoxified, transferred, or utilized in experimentation, its surety status is designated as, or equivalent to, "X." Once decontaminated by chemical neutralization, the previously-contaminated material is given "3X" status. Agent-free status, equivalent to "5X," is attained by subjecting the decontaminated ("3X" status) materiel to thermal treatment at a minimum of 1,000°F for 15 minutes(11) (see Table 4-2). Agent free ("5X") status is necessary before such materiel is permitted to leave government control (typically as residual ash and noncombustibles, e.g., metal).

Currently, CRDEC is permitted to thermally treat any decontaminated solid wastes from agent operations (e.g., towels, equipment, laboratory coats, etc.) and other conventional solid wastes. The current CHS permit for the CRDEC incinerator allows the burning of spent decontamination solution as a corrosive or reactive waste.

In January 1987, the State of Maryland Office of the Environmental Programs, Department of the Environment, listed waste military chemical warfare agents and residues from the treatment of such waste as CHS. Thus, with the present permit, spent decontamination solution from bulk operations cannot be burned in the Detox/Decon incinerator.

CRDEC has requested the State to delist residues from the treatment of agent waste since CRDEC believes these wastes to be nontoxic and nonhazardous. In the interim, these wastes are being stored. The State and APG are negotiating a consent order for the storage of the liquid 3X waste (MD02) at CRDEC for over 90 days. If the State responds positively to CRDEC's request for delisting, the spent solutions will be disposed.

The current CHS permit allows thermal treatment of up to 144 tons/year of hazardous wastes including "3X" solids and phossy water. (No agents are incinerated without first being decontaminated/neutralized to "3X" status.) There is no limit on conventional nonhazardous wastes. (See Subsection 4.9.2 for details on the CRDEC incinerator.)

4.1.4 Transport

Transport of all military CSM is accomplished by the Technical Escort Unit (TEU) of AMCCOM. TEU personnel are specially trained concerning the hazards, safety precautions, and security aspects of the shipments and have security clearances equal to or greater than the classification required for the CSM they are assigned to accompany. TEU assistance is required anytime CSM is transported between buildings or to off-post locations, including contractor surety-certified laboratories.

Table 4-2

Definitions of Levels of Decontamination

'X'	A single X indicates an item has been partially decontaminated. Further decontamination processes are required before an item is moved or any maintenance, repair, etc., is performed. This degree would generally be applied to an item as it stands in place after being used and subjected only to routine cleaning after use.
'XXX'	Three Xs indicate that an item has been examined and cleaned by approved procedures and no contamination can be detected by appropriate instrumentation, test solutions, or by visual inspection on easily accessible surfaces in concealed housings, etc., and is considered safe for intended use only.
'XXXXX'	Five Xs indicate equipment has been completely decontaminated and may be released for general use <u>or</u> sold to the general public.

TEU is also responsible for transport of decontaminated material and equipment to the on-post point of incineration. Routine off-post transport is limited to 1.0 liter per vehicle (RDT&E quantities); transport of larger quantities requires prior Congressional and DOT notification. TEU has custody of a shipment from the time it is accepted until custody of the shipment is relinquished to the authorized recipient. Once relinquished, transport along feeder routes within buildings or laboratory complexes is accomplished by certified CRDEC personnel, working in teams and using SOP's. On-post transportation can also be performed by personnel in the HMB using SOP guidelines.

Prior to shipment on-post, each container of CSM is packaged and overpacked. Prior to off-post shipment, containers of CSM are packaged in a DOT cyclinder, and then packaged in a wooden crate. At all times, CSM is at least double over packed.

CSM transport is conducted via heavily-armed escorted convoys authorized to employ deadly force, if necessary, to prevent the release or theft of CSM. Convoys consist of multiple unmarked vehicles, and routes are randomly selected a few hours before actual transport. CSM is transported only in government-owned vehicles. A limited number of vehicles, which are exclusively used by TEU, are used for the actual transport of agent. Escort units are manned by personnel trained: in NBC decontamination and emergency response at Fort McClellan, Alabama for eight to twelve weeks; in technical escort procedures at Redstone Arsenal for four weeks; and in post-specific procedures by AMCCOM at the Edgewood Area of APG.

4.1.5 Chemical Accident/Incident Control (CAIC)

Chemical Accident/Incident Control (CAIC) is directed by the Chemical Surety Office (CSO), and is conducted in accordance with the APG Disaster Control Plan. The purpose of CAIC is to prevent or control situations in which military CSM and other hazardous chemicals could threaten life or property. CAIC exercises are conducted on an unannounced/irregular schedule to ensure all involved are familiar with applicable procedures. The exercises simulate the spill, loss, theft, or seizure of military CSM and other military chemicals.

The CSO is responsible for directing such training as well as taking control of the CAIC Operations Center in case of an actual emergency involving a spill or exposure of agent. In case of an actual emergency, the person having the accident dials "17." This activates CAIC. Simultaneously, a conference call is established with the APG Fire Department, the Office of the Provost Marshal, the CSO, TEU, and the EQO. Security guards are called to the scene to secure the area from unauthorized personnel. The Fire Department would determine the level of response.

Once activated, the CAIC assumes control of all aspects of an emergency including: data collection via downwind air monitoring stations and mobile units from the Monitoring Branch of Demil/Environmental Engineering Division, RDES Directorate; planning and implementation of decontamination/cleanup; transportation by TEU personnel; and military security/evacuation.

Managers, military officers, and experts in applicable disciplines are brought in under the command of the CSO Chief to operate as a cohesive emergency unit functioning primarily out of the operations center.

4.2 OTHER MILITARY CHEMICALS INCLUDING SIMULANTS AND DECONTAMINANTS

4.2.1 Definition and Identification

Other military chemicals besides CSM are also used by CRDEC. These include chemical agent simulants, riot control agents, smokes, anti-terrorism compounds, and other military chemicals, all of which fulfill an important role at CRDEC.

4.2.1.1 Chemical Agent Simulants

As their name implies, chemical agent simulants possess essential chemical and physical properties of agents, but without the severe physiological effects. Therefore, they are an indispensable adjunct to the CRDEC research effort. They are used to test devices so that modifications can be made before they are challenged with military chemical agents. They are also used for all open-air tests (see Subsection 4.9.3) since public laws[14,15] prohibit open-air tests with lethal chemical agents without congressional approval. Table 4-3 identifies many chemical agent simulants used at CRDEC.

4.2.1.2 Riot Control Materiel

These materiel are used in situations where lethality and long-term incapacitation are not desired. Their main action is to cause flow of tears (hence their common name: tear gas), irritation of the skin, and vomiting. When released into open air they are extremely effective, but when released in closed spaces, where extreme concentrations could occur, they can cause serious illness or death. Table 4-4 further identifies riot control materiel used at CRDEC.

Table 4-3

Chemical Agent Simulants Used at CRDEC

Simulant	Identifier
Bis(2-ethylhexyl) 2-ethylhexyl phosphonate	N/A
Bis(2-ethylhexyl)phosphonate	BIS
n-Butyl mercaptan	BUSH
2-chloroethyl ethyl sulfide (CEES)	N/A
Diethyl adipate	N/A
Di(2-ethylhexyl)phthalate	DOP
Diethyl hydrogen phosphonate	DEHP
Diethyl malonate	DEM
Diethyl phthalate	DEP
Diethyl pimelate	N/A
Diethyl sebacate	DES
Diisopropyl fluorophosphate	DFP
Diisopropyl methylphosphonate	DIMP
Dimethyl adipate	DMA
Dimethyl hydrogen phosphonate	DMHP
Dimethyl methylphosphonate	DMMP
Dipropylene glycol monomethyl ether	DPGME
Ethanol	N/A
Ethyl chloroacetate	ECA

N/A - not available

Table 4-3
(continued)

Simulant	Identifier
Diethyl mercaptosuccinate, O,O-dimethyl phosphorodithioate	Malathion
Methyl salicylate	N/A
Diethyl p-nitrophenyl phosphate	Paraoxon
Diethyl p-nitrophenyl thiophosphate	Parathion
Polyethylene glycol 200	PEG 200
Triethyl phosphate	TEP
Trimethyl phosphate	TMP

N/A - not available

Table 4-4

Riot Control Materiel Used at CRDEC

Acronym[a]	Chemical Name	Hazard Rating
CA(BBC)	Bromobenzylcyanide	4
CNB	CN in benzene and carbon tetrachloride	4
CNC	CN and chloroform	4
CNS	CNC and chloropicrin	4
CR	Dibenz(b,f)-1,4-oxazepine	3
CS	O-chlorobenzylidene malononitrile	3
CS1	CS and silica aerogel	3
CS2	CS and cab-o-sil	3
DA[b]	Diphenolchloroarsine	4
DC[b]	Diphenolcyanoarsine	4
DM[b]	10-chloro-5,10-dihydrophenarsine	5
-	Mixture of DM and CN	
Foam	Firefighting concentrate in water	1

[a]Refer to Table 4-1 for definition of hazard rating.
[b]Vomiting agents.

4.2.1.3 Smokes

Smokes are dispersed as fine droplets or particles that scatter or absorb light or other electromagnetic radiation. Screening smokes are used to obscure military activities from the enemy. Signaling smokes are used to visually relay information on the battlefield. Signaling smokes are mixtures of appropriate dyes, sodium bicarbonate, sulfur and potassium chlorate. Table 4-5 further identifies smokes used at CRDEC.[16]

4.2.1.4 Decontaminants

Table 4-6 presents typical decontaminants used to neutralize the agents maintained by CRDEC. Since a single decontaminant would not be effective for all chemical agents or battlefield conditions, a number of decontaminants and delivery systems have been or are being developed at CRDEC. Failure to employ effective decontaminants would hinder military operations. Because some of the decontaminants decontaminate terrain, other vehicles, and some (i.e., kits) personnel, the Army's thrust is to develop a single decontaminant that would be effective against all chemical and biological agents.

4.2.1.5 Other Military Chemicals

Table 4-7 lists some of the other military chemicals used at CRDEC. Most of these chemicals are no longer stored in any quantity at CRDEC. These chemicals include toxic, blister, and incapacitating compounds.

Most of the Directorates within CRDEC use or handle non-CSM chemicals and chemical agent simulants as part of their operations. There is a formal chain-of-custody system for these chemicals. Currently, many Directorates have, or are implementing, a computerized inventory system of the chemicals to be updated monthly. Each laboratory/building has a custodian who is responsible for maintaining the chemical and CSM log books for each laboratory. All staff conducting experiments must submit standard operating procedures for review and dry test runs before experiments can be performed.

4.2.2 Handling and Storage

Handling of other military chemicals (including simulants and decontaminants) is accomplished under an integrated program of training, SOP's, and inspections. Each Directorate has the direct responsibility for the safe handling of these materials. Oversight is provided by the Safety Office, Environmental Quality Office (EQO), and the Health and Veterinary Services Office (HVSO).

Table 4-5

Smokes Used at CRDEC

Type of Smoke[(a)]	Trial Duration (min)	Airborne Hazard Range (m)
Phosphorus	5 - 20	2,647
Fog Oil	10 - 60	502
Diesel Fuel	10 - 60	332
HC	5 - 20	900
Colored Smoke	2	400
EA 5752	10 - 60	353
EA 5763	10 - 60	631
EA 5755	5	421
Carbon	10 - 60	411
Chaff	2 - 10	411
Iron Oxide	2 - 5	196
Fly Ash	10 - 60	411
Kaolin	10 - 20	411
Portland Cement	10 - 20	411
Amorphous Silica	10 - 20	411
Ground Limestone	10 - 20	411
Diatomaceous Earth	10 - 20	411
Terephthalic Acid	2 - 10	385

(a)Smoke material used at M Field, including alternate smoke materials namely Fly Ash, Kaolin, Portland Cement, Amorphous Silica, Ground Limestone and Diatomaceous Earth used as less toxic substitutes for EA 5763; and Terephthalic Acid, a less toxic alternate material in place of HC and Colored Smokes.

Table 4-6

Decontaminants

Name	Components
STB	Bleach Chlorinated lime Calcium lime Citric acid (anhydrous) Sodium tripolyphosphate Citric acid monohydrate
DS-2	Diethylenetriamine Ethylene glycol monomethyl ether Sodium hydroxide
HTH	Calcium hypochlorite
Alcoholic caustic	Sodium hydroxide Ethanol
Sodium carbonate	
Sodium hypochlorite	
Sodium hydroxide	
M258A1 Personal Decontamination Kit	Ethanol Phenol Sodium hydroxide Ammonium hydroxide Sodium benzesulfonchloramine Zinc chloride
C-8 Emulsion	Perchloroethylene Calcium hypochlorite Calcium dodecylbenzene sulfonate Polyoxyethylenated tetradecyl alcohol Isopropanol Water

Table 4-7

Other Military Chemicals Used at CRDEC

Type	Code Name	Common Name	Hazard Rating[a,b]
Blister	CX	Phosgene oxime	5
	HS		
	HN1	Nitrogen mustard	5
	HN2		
	HN3		
Blood	AC	Hydrogen cyanide	6
	CK	Cyanogen chloride	5
Choking	CG	Phosgene	5
	DP	Diphosgene	5
Binary Precursor	DF	Methylphosphonic difluoride	5
	QL	2-diisopropylamino-ethyl methylphosphonite	2
Nerve	VM	V-type	6

[a]Approximate hazard rating according to M.N. Gleason, et al, Clinical Toxicology of Commercial Products, Williams and Wilkins, Company, Baltimore, Maryland, 1969. Ratings are based on oral dosage of the formulated product; because agents act primarily through contact or inhalation, ratings are only relative indicators of toxicity.
[b]See notes in Table 4-1 for hazard ratings.

The Safety Office maintains a complete file of material safety data sheets (MSDS) used in all directorates throughout CRDEC and provides them on request to individuals responsible for the safe handling cf particular chemicals. Subsection 3.4.4.3 presents the training program provided to CRDEC personnel.

The Safety Office, EQO, and HVSO are responsible for reviewing SOP's prior to the implementation of any hazardous activity.

The SOP review includes a detailed analysis of physical, chemical, and toxicological compatibilities and ensures that handling, storage, and disposal practices are designed to be consistent with these properties. The Safety Office conducts initial and periodic inspections to ensure that SOP's are appropriately implemented. Any deficiencies in work practices are noted, reported, and followed up by subsequent inspections to ensure that the deficiencies have been corrected.

The handling and storage of other military chemicals and resultant wastes is in accordance with relevant sections of the following codes:

- FM 3-250[17]
- TM 9-1300-214[18]
- AMCR 385-100[19]
- AMCR 385-131[20]
- APGR 200-2[21]

These documents identify the precautions that are necessary to prevent accidental release of these chemicals during storage and handling, including the proper container and the required DOT and DA markings.

Chemicals are stored in bulk (55-gallon drums) and in small (1 liter or 1 kilogram) containers. Storage is regulated by the Army, APG, and CRDEC regulations and SOP's that reflect Federal and state requirements. Small satellite chemical storage and distribution areas are located in most buildings where experimental work with other military chemicals is undertaken. These areas are inspected by the CRDEC Safety Office, EQO, and APG inspectors.

Further management controls are implemented by the Aberdeen Proving Ground SPCC Plan. The plan covers all of the Edgewood Area including CRDEC. As part of the plan, CRDEC has an emergency response center that is activated by dialing "17." This activates CAIC as described in Subsection 4.1.5. These officials are trained in spill control and emergency procedures, and they will handle all emergencies that occur at the Edgewood Area of APG.

4.3 NONMILITARY CHEMICALS/COMMERCIAL CHEMICALS

4.3.1 Definition and Identification

For the purposes of this EA, compatible, nonmilitary/commercial chemicals are grouped in classes. Each class may contain numerous chemicals. This leads to a more-productive approach since chemicals with similar properties can be categorized by class, and the worst-case effect can be calculated from the total quantity of the chemicals in that class.

- Mineral acids - Mineral acids can lower the pH of water.
- Mineral bases and simple amines - Mineral bases and simple amines can raise the pH of water.
- Aromatics - Most of the chemicals with aromatic rings as a portion of their structure are included in this class. These compounds are often carcinogenic and most are resistant to biodegradation. They have a high affinity for body fats and may therefore accumulate in the body.
- Cyanides - Cyanide salts and organic cyanides are strong cellular respiration inhibitors.
- Peroxides - Both organic and inorganic peroxides can cause irritation and have possible carcinogenic, mutagenic, and allergenic effects.
- Phosphorus compounds - Phosphorus compounds readily hydrolyze to phosphates in natural waters. Excessive amounts of phosphates may act as a fertilizer, causing blooms and excessive growth of algae and water weeds that may choke out more economically productive forms of plant and animal life. In natural waters and physiological solutions, most organophosphates readily hydrolyze to simple, nontoxic organic compounds and inorganic phosphates. Except near the point of discharge or when discharged in large amounts, phosphorus compounds are not expected to have lasting toxic effects.
- Chlorinated hydrocarbons - Many chlorinated hydrocarbons: (1) are suspected carcinogens; (2) may be destructive to liver and kidneys in moderate concentrations; and (3) accumulate in fatty tissues that may lead to concentration through the food chain. Moreover, chlorinated hydrocarbons are resistant to biodegradation, are very stable, and may persist in the environment for years.

- Other halogenated compounds - Halogenated compounds contain fluorine, chlorine, bromine, or iodine. The chlorinated hydrocarbons above are in a separate class only because they are used more extensively than the other halogens; otherwise, the comments on the chlorinated forms may apply to other halogens as well.

- Phthalate esters - Phthalate esters are compounds of various alcohols and phthalic acid. Esters hydrolyze in water and physiological solutions. Their toxicity, therefore, resembles that of phthalic acid, a highly-toxic substance (refer to Table 4-1).

- Aliphatic solvents - Aliphatic solvents are straight or branched-chain hydrocarbons with or without substituent groups, e.g., hexane, petroleum ether, acetone, or ethyl ether. Moderate amounts can be narcotic and toxic to the liver. Smaller concentrations are detrimental only in that they increase the BOD.

- Miscellaneous solvents - Solvents in this class have a lower risk of adverse environmental or health effects than the solvents discussed above. In high concentrations (one or more parts per thousand), they may increase the biochemical oxygen demand (BOD), which depletes the supply of oxygen in water needed by fish and other aquatic life.

- Miscellaneous organic substances - Organic substances in this class have a lower risk of adverse environmental or health effects than the organic substances discussed above.

- Heavy metals - At CRDEC, heavy metals are derived principally from heavy metal salts. Heavy metals are biologically active as metal ions that can inhibit a variety of metabolic pathways in organisms. Furthermore, heavy metal poisoning may be cumulative. The neurotoxicity of heavy metals is well documented.

- Miscellaneous toxic substances - Toxic substances in this class are DOT Class A poisons[a] that do not fit into one of the toxic classes above.

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[a] DOT defines a Class A poison as one capable of killing 50 percent or more rats exposed to an oral dose of 50 mg/kg or of rabbits exposed percutaneously to 200 mg/kg or of rats exposed by inhalation to 2 mg/liter of air for one hour. Numbers of animal deaths are recorded 48 hours after exposure.

Chemicals for use at CRDEC are ordered through the Property Book Office of the RDES Directorate. Chemicals can be delivered directly to the laboratory or to receiving at APG.

Most solvents and other laboratory chemicals are used in bench-scale research. The quantities are often small. Solvents are transported from the Chemical Stockroom in an approved safety bucket. All laboratory personnel are supplied with MSDS sheets for chemicals utilized. Protective glasses, gloves, and clothing are required to be worn by all laboratory staff.

The CRDEC Chemical Stockroom chemical inventory is searched prior to placing orders for the purchase of chemicals to prevent stockpiling. All purchase orders are reviewed by supervisors and also safety in the case of chemical orders. Records of all purchases and procurements are maintained.

Appendix A lists the chemicals maintained at the CRDEC Chemical Stockroom by the Property Book Section of the Engineering Services Divsion, RDES Directorate.

Commercial chemicals are handled in accordance with U.S. Army, APG, and CRDEC regulations including:

- Interim Guidance Chemical Waste Management, CRDEC, April 1987.(22)

- APGR 200-2, Environmental Quality Control (EQC) at APG.(21)

In addition, CRDEC has developed SOPs that indicate how chemicals should be handled, stored, and disposed. CRDEC personnel are required to observe all pertinent safety and environmental requirements when handling chemicals.

CRDEC has a procurement review system to check the ordering of chemicals that are not standard inventory items. The Operations Division of the Safety Office must review and approve all requests for nonstandard chemicals prior to their being ordered.

A MSDS must also be supplied by the manufacturer and accompany the shipment of chemicals. A MSDS must be available to the employee before beginning work with any chemical. An individual or laboratory group must also have an SOP in place prior to starting an experiment, listing all the chemicals that will be used. This SOP must be approved by the appropriate supervisor prior to initiating any experimental work. The Safety Office and EQO review laboratory SOPs. The EQO also reviews any environmental documents prepared for an experiment.

4.3.2 Handling and Storage

Handling of nonmilitary hazardous chemicals is accomplished under an integrated program of training, Standing Operating Procedures, and inspections. The responsibility for safe handling of hazardous chemicals is the direct responsibility of each directorate with oversight by the Safety Office at CRDEC. The Safety Office is the focus of all hazardous chemical-related activities and provides dedicated staff to support the hazardous chemical handling activities of each directorate. All employees handling chemicals are instructed in safe handling procedures (see Subsection 3.4.4.3).

The Safety Office, EQO, and HVSO are responsible for reviewing SOPs prior to the implementation of any activity that involves the use of hazardous materials. The SOP review includes a detailed analysis of physical, chemical, and toxicological compatibilities, and ensures that handling, storage, and disposal practices are designed to be consistent with these properties. The EQO, Safety Office, and HVSO participate in initial pre-operation inspections. EQO re-inspections ensure environmental compliance. The CRDEC/EQO Environmental Inspection Checklist utilized during these inspections is presented in Figure 4-2.

Any deficiencies in work practices are noted, reported, and followed up by subsequent inspections to ensure that the deficiencies have been corrected. The Safety Office is also responsible for reviewing requests for nonstandard chemical items to ensure their safe handling, storage, and disposal.

Storage of laboratory quantities of nonmilitary chemicals for each laboratory is maintained in accordance with relevant sections of the following codes: APGR 200-2[21], National Fire Protection Association (NFPA), the Occupation Safety and Health Administration (OSHA), and the American National Standards Institute (ANSI).

Chemicals are stored in several locations by various directorates by the CRDEC at the Edgewood Area of APG. Chemicals are stored in bulk and in small (5 gallons or less) containers. Storage is regulated by the Army, APG, and CRDEC regulations and SOPs which reflect Federal and state requirements. There is a main chemical storage and distribution location at Edgewood Area for standard chemicals. Smaller satellite chemical storage and distribution areas are located in most buildings where experimental work is undertaken. These areas are inspected by the CRDEC Safety Office and APG inspectors.

The Aberdeen Proving Ground SPCC Plan covers the Edgewood Area, including CRDEC. The CRDEC uses the emergency response center for spill response, activated by dialing "17." The responding officials are trained in spill control and emergency procedures.

CRDEC/EQO September 87

ENVIRONMENTAL INSPECTION CHECKLIST

1. General Information:

Building #________ Room #________ Directorate/Office________

POC ________________ Phone #________

Building/room use Gen Lab____ Storage____ Date ________

Adm___ Other (specify)________ EQO Rep____________

2. Hazardous Wastes Handling and Storage:	Yes	No	NA	Comments
a. Satellite Storage				
(1) Are hazardous waste-containing containers labelled with their contents and dated?				
(2) Are Radiation wates containing solvents and/or chemicals that quality as hazardous waste labelled as #RAD WASTE/Hazardous Waste Mixture specifying constituents?				
(3) Are hazardous wastes properly stored?				
(a) Stored away from drains, or, if not possible, drains plugged or otherwise kept secured from leakage.				
(b) Containers closed when not in use?				
(c) Absorbent material readily available?				
(d) Personnel aware of 55gal/1 qt. satellite hazardous waste storage rule?				
(e) Filled-containers dated and moved to 90-day storage site within three days?				
(4) Are there obvious ways to reduce wastes?				
(5) Are personnel aware of the Army's Hazmin Program?				
b. Temporary (90 day) Storage Facilities				
(1) Name of responsible POC				
(2) Are hazardous waste containers labelled with their contents and date moved to the temporary storage area?				
(3) Is an inventory of the wastes or record of wastes stored at the site available and kept up to data, per COMAR 10.51.03.06?				
(4) Is Secondary containment being maintained (berm, overpack, or absorbent)?				
(5) Are materials compatibly stored, per HMIS?				
(6) Are Requirements for emergency procedures per COMAR 10.51.05.04 met, via maintenance of copies of the APG Installation Spill Contingency Plan at the facility?				
(7) Are weekly inspections of the storage area for compatibility and signs of leakage or spillage being conducted and logged?				
(8) Any evidence of leakage or spills?				
(9) Facility properly equipped, per COMAR 10.51.05.03, including periodic testing and maintenance of equipment:				
(a) Communications available (if site is remote)?				
(b) Fire-extinguisher available?				
(c) Spill control equipment available (containers, absorbant, shovels)?				
(d) Water or auto sprinklers available?				
(e) Any RCRA waste exceeding the 90-day temporary storage limit?				
(f) Aisle-space to allow unobstructed movement of personnel and equipment in case of fire or spill?				

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FIGURE 4-2
EXAMPLE OF THE CRDEC/EQO ENVIRONMENTAL INSPECTION CHECKLIST

3. Sumps/Tanks/Drains:	Yes	No	NA	Comments
a. Does Facility have any Sumps?				
(1) Are they active?				
(2) Tested for integrity? When?				
(3) Contents sampled and analyzed?				
(4) Log of contents maintained?				
(5) Discharge to STP?				
(6) Discharge to outside storm drain?				
(7) Do contents require disposal as HW?				
(8) Is Secondary Containment in place if required?				
b. Does facility have holding tanks:				
(1) Are they active?				
(2) Below ground?				
(3) Tested for integrity? When?				
(4) Secondary Containment?				
(5) Contents sampled/analyzed?				
(6) Log of contents maintained?				
(7) Discharge to STP?				
(8) Discharge to storm drain?				
(9) Contents require disposal as hazardous waste?				
c. Does Facility have open drains?				
(1) Discharge to STP?				
(2) Discharge to storm drains?				

4. Training/Environmental Awareness	Yes	No	NA	Comment
a. Are personnel aware of restrictions on disposing wastes down drains?				
b. Are personnel aware of satellite storage requirements?				
c. Are personnel familiar with spill/emergency response requirements?				
d. Personnel trained as per COMAR 10.51.05.02G and EQO message dated 9Mar87, "Environmental Requirements"?				
e. Are personnel aware of the RCRA hazardous wastes list and characteristics criteria?				
f. Have personnel, including first-line supervisors, seen copies of training information lists sent out by the EQO?				

5. Building Exterior:	Yes	No	NA	Comments
a. Any storage of chemicals/HW outside bldg?				
b. Does storage area have secondary containment?				
c. Any visual evidence of environmental damage?				
d. Any evidence of spills including odor or vegetation damage?				
e. Any ditches/streams nearby?				
f. Is there a requirement for soil analysis?				
g. Is there a requirement for water analysis?				

6. Action Required	Yes	No	NA	Comments
a. Action required by Directorate/Office?				
b. Action required by others?				

7. Follow up visit :	Yes	No	NA	Comments
a. Follow up visit required?				
b. Tentative date of revisit?				

8. General comments/Observations

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FIGURE 4-2 (CONTINUED)

Commercial chemicals are utilized by the various Directorates at CRDEC for testing and/or synthesis purposes. Most chemicals are used up in testing protocols and any material remaining (or waste product) is sent to segregated storage areas. Chemicals past their expiration date are also sent to storage areas. Waste chemicals and products are transported off-post by licensed haulers for disposal at approved RCRA facilities. Arrangements for RCRA waste transport and disposal are made by APG. The APG generator ID number is utilized on all wastes manifested and shipped from the Edgewood Area of APG.

4.4 BIOLOGICAL DETECTORS, SIMULANTS, AND DECONTAMINANTS

4.4.1 Definition and Identification

The efforts of the Biotechnology Division, Research Directorate and the Biotechnology/Chemical Kits Group of the Detection Producibility Engineering Division, and the Detection Technology Division, Detection Directorate are for chemical and biological defense. To this end, CRDEC Edgewood carries out bench-scale investigations in four primary biotechnology areas:

1. Receptor technology.
2. Enzymes for decontamination and detection systems.
3. Development of pathogen detectors.
4. Immunochemistry.

Their mission is part of the Department of the Army Receptor Technical Program Plan (RTPP). The objective of RTPP is to use receptor technology to develop defensive receptor-based biosensors to detect lethal or incapacitating compounds (LICs).

The extreme potency of many agents or LICs is due to their selective interaction with recognition sites that are vital for cellular function. These sites are referred to generically as "receptors" and functionally may be neurotransmitter or hormone receptors, enzymes, carriers, or ion channels. LICs are dangerous because of their high affinity for receptors and because of their biological effectiveness at extremely low concentrations.

Advances in biotechnology have created the potential for large-scale production of toxins and other LICs as well as the capability to genetically engineer pathogens for military purposes. The rapid detection of chemical and biological LICs is complicated by the diversity of potential LICs and has required a reformulation of existing detection strategies that rely on specific recognition of known agents.

A strategy that has evolved from these considerations emphasizes the use of a relatively limited number of receptors as the recognition element rather than the development of specific assays for the essentially unlimited number of potential LICs. This strategy is based on two assumptions. First, that anything that interacts with these receptors can be construed as a threat. Second, that the number of possible receptors is lower than the number of potential LICs and, therefore, that a battery of receptors can feasibly be utilized as an all-encompassing LIC defense system.

The CRDEC mission focuses on characterization of receptors as well as development of systems for immobilizing receptors onto artificial supports. These complexes will then be coupled to sensitive microsensors that amplify and process signals resulting from receptor/LIC interactions. A fiber optic wave guide and capacitive sensor are currently being investigated as candidate sensors. In addition, investigations are being conducted into the enzymatic degradation of agents.

The CRDEC biotechnology program is involved only in bench-scale research. There is no culturing or maintaining of viruses, no vaccine development, and no involvement with incapacitents, crop pathogens, or insects. All biologicals used at CRDEC are either killed or inactivated materials supplied through USAMRIID located at Fort Detrick.

Molecular biological techniques are available (with adaptation) for identification, purification, and reconstitution of receptors. Production of antibodies and receptors will be conducted using hybridoma and standard molecular biology techniques. Monoclonal antibody methodology will enable production of specific antibodies for various receptor sites, and these antibodies will be employed in immunoaffinity columns used to isolate large quantities of receptor site proteins. In addition, these monoclonal antibodies may be used in other ways to develop biodetectors.

The production of large quantities of receptor sites necessitates the use of genetic engineering. The basic protocols needed for preparation and cloning of receptor DNA have been published and are now common biotechnological methods.[23]

Specific research areas investigated by CRDEC, both ongoing and planned, are detailed below:

- Development of proteins to identify threat compounds, which includes the development of antibodies to respond to specific antigens.

- Investigation of the transfer of genes coding for specific enzymes from thermophilic bacteria to E. coli, which is a commonly-utilized cloning organism.

- Isolation of enzymes for amplifying a signal created by the interactions of antigens and antibodies. These enzymes will be oxidases or peroxidases, which mediate innocuous reactions. They will be isolated from thermophilic organisms in order to gain temperature stability of protein under ambient conditions.

- Investigation of the mechanism of enzymatic agent breakdown.

- Development of a generic toxin detection system. This involves cellular level chemistry with the histamine and acetylcholinesterase receptors. In specific, receptors are bound to a matrix containing a transducer, and a capacitance change is sought when antigens bind to a receptor. Specific antigens studied include a variety of biological toxins and chemical agents.

4.4.2 Handling and Storage

When biological studies conducted at CRDEC require microorganisms for testing and evaluation, nonpathogenic, nontoxic, biological simulant microorganisms are used in lieu of pathogenic microorganisms whenever possible. The biological simulant most-frequently used is Bacillus subtilis var. Niger[a] (BG). BG is a naturally occurring soil microorganism that presents no known pathogenicity to humans.[24] Other biological simulants less frequently used are: Serratia marcescens (SM)[b], phenolated (killed) when used as an aerosol in chamber studies; whole and selected embryonated egg slurries; commercial baker's and brewer's yeast; and various naturally-occurring mold spores, e.g., puff ball spores.

CSM are utilized as test substances by these missions. As described elsewhere, an agent handling certification program is required for all personnel working with chemical agents. SOPs exist for all operations requiring agents.

(a) Previously known as bacillus globigii, hence the commonly-used acronym, "BG."

(b) SM is generally considered to be a nonpathogenic species of bacteria; however, under certain conditions, it has caused infections. The reported infections have occurred with persons who have developed a sensitivity after working with SM over a long period of time, and with debilitated patients who have undergone hospital treatment for other conditions. For these reasons, laboratory personnel working with SM are required to follow strict procedures to ensure that SM will not be released into the work area and into the atmosphere.

Biologicals are also utilized for the research activities, but these are either killed or attenuated, and consequently are no longer of a hazardous nature. Containment level P2[(a)] facilities are available for use at CRDEC. Some microorganisms used in research are isolated from APG soil, but most are either obtained commercially or through USAMRIID located at Fort Detrick.

A variety of biological toxins are used at CRDEC. An updated inventory of these toxins and other biological material used by CRDEC is listed in Appendix B. SOPs exist for toxin handling, and a certification for toxin handling is required to be renewed on an annual basis. Toxins are obtained from commercial sources. T2 toxin is present at approximately the 1- to 1.5-gram level, but all others are stored and used at the milligram level. Toxins are required to be double-contained at all times. Experiments using toxins are done in fume hoods, and stored toxins are kept in secured areas.

Radiolabeled materials are utilized according to NRC regulations. As in the case of agent and toxin handling, training programs are required for isotope handling. These operations are also subject to guidelines from the CRDEC Radiation Safety Officer as discussed in Subsection 4.5.

Recombinant DNA technology is not inherently hazardous, although solvents and various other chemicals are utilized. Very little recombinant DNA work is presently conducted at Edgewood, but what is done is in accordance with NIH guidelines.

Waste biological materials are placed in plastic bags, autoclaved, and placed in a dumpster. All hazardous materials are handled according to safety SOPs. Only water is disposed of down drains.

No emissions are released from either the toxin or biological work. Gas chromatographs are vented to fume hoods having charcoal filters maintained according to procedures described in Subsection 4.9. Waste collected from HPLCs is handled according to RCRA specifications.

After performing an experiment with a toxin, all glassware, equipment, and solid waste is decontaminated using a bleach solution. The glassware is then washed, while the disposables are dried in a hood, double-bagged, and disposed. Potentially contaminated solvents are cleaned on a rotovap and are placed in a container for pickup by APG. The amount of waste solvent produced in one biological toxin experiment is small, approximately 5 to 10 ml.

(a) A P2 level facility has a hood that is designed to facilitate cleaning and disinfection. Access is limited to persons with knowledge of the biohazard potential.

Binding studies are conducted using radiolabeled materials and nanomolar amounts of toxins in volumes less than 0.1 ml. Wastes from these studies are decontaminated and disposed of as radioactive waste according to NRC regulations.

All safety and spill response activities are carried out according to standard procedures, and these are not unique to biotechnological research. These procedures are taught to all personnel as part of training programs. Dial 17 is utilized as an emergency response when required.

Field and laboratory test chamber trials of biological simulants require handling and storage of test microorganisms. BG and SM are stored as frozen pellets with the appropriate diluent and refrigerated during storage.

Simulant assay is performed under filtered ventilated hoods. Enclosed chambers[a] are used to generate the simulant aerosols for study. Immediately following each operation, the remaining simulant, culture medium, and work area are decontaminated chemically[b] and or autoclaved (steam sterilized). These methods have been determined to be 100-percent effective.

4.5 RADIONUCLIDES

4.5.1 Definition and Identification

Radionuclides produce radiation that can remove electrons from one atom and attach them to another atom, resulting in a positive and negative ion pair, hence the term "ionizing" radiation. The three ionizing radiations of primary ecological

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(a)For the purpose of this subsection, a chamber is defined as any enclosed aerosol generating system used for studying the aerosol characteristics of biological simulants in a controlled environment. The chamber can be a cylinder, box, wind tunnel, etc.

(b)The chemical solutions used at CRDEC for decontaminating biological simulants are: 1 percent phenol, 1 percent sodium hypochlorite, 1 percent quartenary ammonium compound, 2-1/2 percent peracetic acid, and ethylene oxide gas.

concern are alpha particles (parts of helium atoms), beta particles (high-speed electrons), and gamma rays (an ionizing form of electromagnetic radiation).[c] (See Subsection 4.6.)

The Safety Office is responsible for the day-to-day activities associated with radioactive materials. The Safety Office has been conducting regular radiological surveys since the 1950's. The Radiation Protection Officer (RPO) within the Safety Office operates a laboratory to conduct tests on samples suspected of radioactive contamination. RPO's responsibilities stretch beyond CRDEC directorates to the Institute of Chemical Defense (ICD) and Armament Munitions and Chemical Command (AMCCOM) support elements.

CRDEC holds Nuclear Regulatory Commission (NRC) licenses and Department of the Army authorizations that allow the use of limited quantities of radioactive material for research, development, test, and evaluation at the Edgewood Area of APG. In accordance with license conditions, radioactive material cannot be used in field applications where radioactivity could be released into the environment and also cannot be used on humans.

For outdoor operations, only sealed radiation sources or sources in nondispersable form (e.g., plated foils) are used. All work with unsealed (primary liquid) radionuclides is done in designated laboratories with approved chemical fume hoods as exhaust systems. The predominant radionuclides used at CRDEC in unsealed conditions are tritium and carbon-14 in millicurie quantities. As determined by the compounds with which they are combined, much of the radionuclide work is done in fume hoods equipped with high-efficiency particulate absorbers and charcoal exhaust filters.

(c) Alpha particles travel a few centimeters (cm) in air and are stopped by layers as thin as one sheet of paper. When stopped, they produce a large amount of local ionizing radiation. Beta particles travel a few meters (m) in air and up to 2 cm in tissue, giving up their energy over a longer path than alpha particles. Gamma rays may pass through an organism without causing any damage. They release their energy over a long path, causing ionization anywhere along its length. Thus, the alpha, beta, gamma series is one of increasing penetration but decreasing localized damage. Alpha and beta particles are considered hazards when lodged inside a body, while gamma rays are considered hazards when outside of a body.

Table 4-8 presents the list of radionuclides used/stored at CRDEC (as of October 1987). The quantities of these items vary with time.[25]

In 1980, AMC directed APG that the installation Environmental Radiation Monitoring (ERM) program be expanded with the full participation and support of tenant organizations. CRDEC prepared a plan to this effect (submitted to APG in March 1980), which described methods to monitor within the APG boundaries, but outside the workplace of property assigned to CRDEC and other organizations supporting CRDEC that possess radioactive materials. The plan was intended to verify CRDEC's compliance with regulatory requirements pertaining to the release of radioactivity to unrestricted areas and to detect radioactivity that might be deposited on CRDEC property by other operations or activities supplementing the overall APG program. The plan was approved by AMC and the NRC through radioactive material licensing processes.

4.5.2 Handling and Storage

At CRDEC, radionuclides are used primarily for calibration, irradiation of materials, tracer materials, and ionization sources in gas chromatographs and chemical agent alarms. Many radionuclides are in sealed containers so that their ionizing radiation cannot escape the container.

The Radiation Protection Officer maintains a laboratory to test and analyze samples from various other laboratories for any radioactive contamination.

The Radiation Protection Officer inspects all other laboratories and other areas of CRDEC where radioactive materials are used, takes samples of their wastes, and brings them to the laboratory under the Safety Office where the tests are conducted. If any of these samples exhibit the presence of radioactive materials in excess of the levels outlined in Table 4-3 of AR 385-11[27], the source of that sample (i.e., the responsible laboratory) is informed of the findings and is given directions for segregating the contaminated area and to arrange for decontamination. The individual source (or laboratory) is responsible for decontamination under the supervision of the Radiation Protection Officer. These tests find, on an average, one laboratory or source per month with low-level radioactive contamination that is above background levels, but below the reportable levels listed in 10 CFR 20. Once the decontamination activity is completed, the RPO will conduct a resurvey of the facility before restarting any new activities at that facility.

Table 4-8

Radionuclides Used/Stored at CRDEC as of October 1987

Type	Half-Life (years)	Radiation(26) Emitted[a]
Tritium-^{3}H	12.3 yr	Very low energy beta
Carbon-^{14}C	5,730 yr	Very low energy beta
Sodium-^{22}Na	2.6 yr	High energy beta and gamma
Sulfur-^{35}S	0.25 yr	Very low energy beta
Cobalt-^{60}Co	5.26 yr	High energy beta and gamma
Nickel-^{63}Ni	92 yr	Very low energy beta
Krypton-^{85}Kr	10.76 yr	Rel. low energy beta and gamma
Strontium-^{90}Sr	28.1 yr	Rel. low energy beta
Cesium-^{137}Cs	30 yr	Very low energy beta
Promethium-^{147}Pm	2.62 yr	Very low energy beta
Thallium-^{204}Tl	3.8 yr	Rel. low energy beta
Radium-^{226}Ra	1,602 yr	High energy alpha
Thorium-^{230}Th	80,000 yr	High energy alpha
Thorium-^{232}Th	over 10^{5} yr	High energy alpha
Uranium-^{238}U	over 10^{5} yr	High energy alpha
Americium-^{241}Am	458 yr	High energy alpha
Califorium-^{252}Cf	over 10^{5} yr	High energy alpha
Calcium-^{45}Ca	0.45 yr	Rel. low energy beta

[a]Very low energy: less than 0.2 million electron volts (MeV)
Relatively low energy: 0.2 to 1 MeV
High energy: 1 to 3 MeV

The various CRDEC laboratories have solid and liquid radioactive wastes from their operations. These wastes are brought into the central area used for the storage of such wastes in plastic bags or 5-gallon plastic jugs once a week by the RDES Directorate staff. The smaller containers go into 55-gallon drums for temporary storage at the central storage area and are picked up by Chem-Nuclear of South Carolina, which packages, transports, and buries these wastes in its South Carolina site. The RPO maintains the inventory card, while a copy is attached to the drums containing the radioactive wastes.

Currently, the total radioactive wastes collected at the temporary storage area is at a rate of one drum every 2 weeks. These drums are kept at the temporary storage area for a maximum period of 90 days before they are picked up by the contractor for their final destination. The RPO is the final clearinghouse for all radioactive wastes and maintains a complete record of the source and the quantity of wastes brought in from various laboratories and later sent out of the Edgewood Area.

It may be pointed out that an NRC license does not permit any of these radioactive wastes to go into the drains of any laboratories. Additionally, the Army regulations and monitoring schedules are more stringent than those of the NRC. The current license is effective through 1989. The Safety Office staff, in coordination with the Environmental Quality Office, provides training to the laboratory staff in handling radioactive materials.

The primary document governing work with radionuclides at CRDEC is CRDEC R 385-3.[28] This document incorporates all current Federal substantive and procedural requirements for handling radionuclides, including Code of Federal Regulations (CFR), Title 10[29], which governs licensing, safety, precautions, personal dosimetry, etc. Also, there are specific SOPs that govern hazardous operations at CRDEC laboratories with radionuclides.

Chemical, biological, and radiological (CBR) filters contaminated with radionuclides are stored in the radiological waste disposal facility.

4.6 ELECTROMAGNETIC RADIATION

4.6.1 Definition and Identification

Electromagnetic radiation (EMR) exists as a potential pollutant in almost all natural and man-made environments. It is the type of radiation that makes up the electromagnetic frequency spectrum and includes radio frequencies, infrared, visible light, ultraviolet, X-rays and gamma rays (in ascending order of frequency). The EMR of most concern at CRDEC is that produced by lasers and X-ray equipment.

4.6.2 Handling and Storage

Table 4-9 presents an inventory of laser devices used at CRDEC as of October 1987. All laser devices are operated under the provisions of the Department of the Army's Medical Department Technical Bulletin (TB MED 524)[30] and AR 40-583.[31] These devices are used as detection devices and for critical alignment of components used in various test equipment.

All X-ray machines at CRDEC are operated under the provisions of AR 385-11.[27] These machines are used for nondestructive testing.

4.7 USE OF LABORATORY ANIMALS

4.7.1 Definition and Identification

The Toxicology Division, Research Directorate, provides all the animals used in research and testing, and is responsible for all animal care. The HVSO provides the oversight through the Laboratory Animal Use Review Committee (LAURC). The primary animals used are rodents and rabbits. Guinea pigs, pigeons, chickens, sheep, and pigs are also used on occasion. Animals are maintained in a central animal facility. However, five other buildings that house CRDEC operations have animal rooms where rodents and rabbits are stored.

Care of animals follows NIH guidelines specified in the Guide for Care and Usage of Lab Animals. Animal caretakers go through a 20-week training program on animal care and diseases.

The CRDEC LAURC reviews all protocols requiring the use of animals. LAURC's function is to avoid duplication of experiments and to ensure that the lowest number of animals required is utilized. All research projects using animals must have a protocol and an SOP. LAURC also serves as a review and reporting panel for the Commander regarding animal use.

Table 4-9

Types of Laser Devices at CRDEC
as of October 1987

Type	Hazard Class (Laser)[a]
HeNe (helium-neon)	III
Tunable Diode	III
HeNe	I
HeNe	II
Ruby	IV
He Cadmium (Cd)	I
HeCd	III
Carbon dioxide (CO_2)	IV
Neodymium: yag	IV
Argon	IV
Nitrogen	IV

(a)Laser Hazard Classification. In general, the higher the class of laser, the more control measures are necessary. For example, a Class I laser device does not emit hazardous laser radiation under any operating or viewing condition, and is therefore exempt from any control measures. Conversely, a Class IV laser device must be enclosed in such a manner as not to emit any hazardous radiation beyond the test environment.

4.7.2 Handling and Storage

Experiments requiring the use of primates need the approval of LAURC on a case-by-case basis. In addition, approval of primate use requires a review by an AMC committee and the Surgeon General's Office.

Animals are used in a variety of exposure experiments. Materials tested include smokes, obscurants, vesicants, LIC's, and a variety of unknowns supplied, for example, by foreign intelligence agencies. The operation of exposure chambers and other experimental procedures is carried out by the Toxicology Division, Research Directorate.

Exposed animals are checked for effects. Prior to this examination, the exterior of the animals is decontaminated. Once inside an animal, agents are considered to no longer be agents, and the animal containing the material is no longer handled according to agent protocols.

Dead animals are double-bagged and disposed of in a pathological waste incinerator operated by USAMRICD. Prior to disposal, tissues from exposed animals may be archived in glass slides or formalin solutions.

The Veterinary Services Branch uses detergents, dilute acids, and industrial disinfectants to clean and maintain cages. These are compounds routinely utilized in the laboratory animal industry. After use, these cleansing materials are disposed of down drains.

4.8 MUNITIONS AND EXPLOSIVES

CRDEC handles and stores moderate quantities of munitions. Responsibility for the handling and storage of these materials rests with RDES Directorate and Munitions Directorate.

Table 4-10 further identifies some explosives, propellants, and pyrotechnic components used at CRDEC.[a] The greatest hazard is from accidental explosion, and this is limited primarily to the initiating charges. The documents central to the methodology for handling and storage of other military chemicals include: FM 3-250[17], which provides instructions for all except propellants and explosives; TM 9-1300-214[18], which covers propellants and explosives; and APGR 200-2[21], which incorporates all Maryland and Federal substantive and procedural requirements for the handling of these chemicals as wastes. These documents identify the precautions that are necessary to prevent accidental releases of these chemicals during storage and handling, including the proper container and the required DOT and DA markings.

4.8.1 Handling and Storage

Munitions are stored by explosive class and compatibility grouping. Class 1.1 munitions are mass-detonating (those items for which practically instantaneous explosion or detonation of virtually the entire quantity may be expected in the event of fire). Class 1.2 munitions are nonmass-detonating; the principal hazards are fragmentation and blast, either individually or in combination. Class 1.3 munitions are mass fire hazards (those items burn vigorously with little or no possibility of extinguishment in storage situations). Class 1.4 munitions have a moderate fire hazard without blast or fragmentation hazards. Compatibility groups are identified by a single letter (A-Z). Similar items may be stored together if the letter groups are compatible.

Munitions are used for testing purposes at CRDEC. Special (nonstandard) ammunition requests for other Army and agency (DOD) units are also handled by CRDEC. These requests are filled by assembling the munitions at CRDEC, determining an interim hazard classification, and shipping them via TEU to the procurer. All munitions are handled in accordance with DOT, U.S. Army, APG, and CRDEC regulations.

(a) Explosives are so sensitive to heat, impact, and friction that they undergo detonation when subjected to flame or percussion. Low explosives require the explosion of an initiating charge for detonation. Explosives are also used as boosters and bursting charges for blasting and demolition.

Table 4-10

Explosives and Propellants Used at CRDEC

Type	Code Name	Chemical Name
Initiating charges	DDNP	Diazodinitrophenol
	None	Lead azide
	None	Lead styphnate
	None	Mercury fulminate
	None	Tetracene
Explosives	None	Ammonium nitrate
	HMX	Cyclotetramethylene tetranitramine
	RDX	Cyclotrimethylenetrinitramine
	None	Explosive D
	None	Nitrocellulose
	None	Nitroglycerin
	None	Nitroguanidine
	None	Nitrostarch
	PETN	Pentaerythrite tetranitrate
	None	Tetryl
	TNT	Trinitrotoluene
Propellants[a]	DNT	Dinitrotoluene
	None	Nitrocellulose
	None	Nitroglycerin
	None	Nitroguanidine
Pyrotechnics	None	Aluminum
	None	Charcoal
	None	Potassium nitrate
	None	Sodium nitrate
	None	Sulfur

[a]Ingredients comprising 10 percent or more of the mix.

The distance from the storage magazine to the nearest inhabited building and/or public highway establishes the limits of each class that can be stored in that magazine (quantity-distance). The quantity-distance tables in U.S. Army Materiel Command (AMC) R385-100[19] are followed at CRDEC. Ammunition is stored in above-ground magazines and earth-covered igloos in the Bush River Storage Area.

Munitions and chemicals used in making munitions are ordered by the Munitions Directorate, received at APG, and shipped to CRDEC - Edgewood by TEU. Small quantities of these materials are stored at locations where they will be used in research laboratories, testing facilities, etc. Medium- to long-term storage of these materials occurs at three locations:

- Edgewood - CRDEC (Bush River Storage Area)
- Logistic Directorate, Aberdeen Area, APG.
- Letterkenny Army Depot (near Chambersburg, Pennsylvania)

Transfer of these materials is carried out by APG. APG maintains accountability for the ammunition.

The munition fill can be CSM, simulant, riot control materiel, smokes, binary components, or other military chemicals. The handling and storage of these chemicals are discussed in Subsections 4.2 and 4.10.2.

4.8.2 Disposal

CRDEC generates very little, if any, liquid munitions waste. Wash-down water is collected, tested, and properly disposed. Solid materials are held in segregated storage until there is a sufficient quantity to be turned in. These wastes include:

- Dud munitions.
- Wastes from testing and fabrication protocols.
- Out-of-date and off-spec munitions.

Prior to 1983, munitions and pyrotechnic wastes were disposed of at Edgewood by open-air burning. This practice has been banned since then.

Open burning/open detonation is still used for solids contaminated with pyrotechnics, explosives, and propellants. Such operations are conducted at J-Field by the TEU's Explosive Ordnance Disposal (EOD) Unit.

J-field is currently operated under interim status. EPA recently issued a set of standards under Subpart X of Part 264 that are applicable to hazardous waste management units not covered elsewhere in RCRA. These standards apply to open burning/open detonation facilities. J-field will be upgraded to meet the requirements under the new subpart and an application for a Part B permit will be prepared for J-field.[45]

The wastes are disposed of in accordance with Federal (RCRA), Maryland, and Army regulations. Liquid, solid, and pyrotechnic wastes are collected, stored, and disposed of separately. Pyrotechnic wastes are leached prior to being turned in. Liquid wastes, primarily wash-down water, are tested for hazardous components. These wastes, if found to be nonhazardous, are discharged to the APG wastewater treatment plant. Hazardous liquids are disposed of off-site by a RCRA-licensed contractor hired by APG.

The Munitions Directorate and RDES Directorate maintain tracking systems for all hazardous munitions-related materials (munitions and RCRA materials) maintained at Edgewood. All munitions products are tracked by lot numbers, and their ingredients can be ascertained by examining the appropriate laboratory notebook.

4.9 SOURCES OF DISCHARGE TO THE ENVIRONMENT

4.9.1 Laboratory Fume Hoods

Potentially-hazardous laboratory operations at CRDEC are conducted within laboratory fume hoods, which are specified, installed, operated, and maintained to direct hazardous constituents away from the laboratory environment, and to remove hazardous constituents from the airstream prior to release to the atmosphere.[a] Laboratory operations involving any of the following constituents are conducted exclusively within laboratory fume hoods:

1. Military chemical surety materiel (Subsection 4.1).
2. Other military chemicals (Subsection 4.2).
3. Toxic nonmilitary chemicals (Subsection 4.3).
4. Biological simulants (Subsection 4.4).

(a) Laboratory hoods consist of an enclosed work space equipped with a high-powered exhaust fan that pulls air in from the surrounding laboratory across the work space through one or more filters before being exhausted outside the building. The system establishes a negative pressure inside the entire laboratory space relative to the remainder of the building, thus restricting the release of hazardous chemicals in the event of spills outside the exhaust hood.

4.9.1.1 Chemical Fume Hoods

The design, specification, installation, and operation of chemical fume hoods for hazardous operations must be approved in advance by the Safety Office for particular agent and chemical handling operations. Hoods are tested prior to initial use and semi-annually by the Safety Office for the following parameters:

- Face velocity.
- Internal turbulence.
- Hood stops.
- Cross drafts.
- Alarm operation.

Backup generators are checked monthly by the Directorate of Engineering and Housing (DEH).

All agent and hazardous chemical fume hoods are equipped with at least one activated charcoal filter and one High Efficiency Particulate-Aerosol (HEPA) filter. Additional inspection is conducted periodically by DEH to measure the pressure drop across filters and to inspect motors, belts, and other mechanical components of the exhaust system. Chemical fume hoods are equipped with audible or visual alarms that monitor either air flow through the system (e.g., 120 linear feet per minute), or negative pressure upstream of filters (e.g., in inches water pressure). All incidents of alarm activation in surety hoods are treated as CSM "incidents" requiring the establishment of decontamination zones and testing by the Monitoring Branch of the Demil/Environmental Engineering Division. Filters are replaced at regular intervals, depending upon the use of the fume hood, and when inspection indicates an excessive pressure drop across the filter. Used filters are sealed in plastic bags and are thermally treated in the Decon/Detox Incinerator.

For laboratory work involving nominal quantities of typical laboratory chemicals and other solvents, an unfiltered chemical fume hood is permissible.

A second type of enclosure for hazardous chemical laboratory operations is the laboratory glove-box, a sealed atmospheric chamber that is vented through a laboratory fume hood. The pressure in the glove-box is negative with respect to room air through the action of the fume hood. The interior of the glove-box is accessible through a pair of butyl rubber gloves fitted to the exterior wall. Gloves are checked before each operation, and are replaced if any leak is detected. Equipment and chemicals are inserted and removed from the glove-box by means of a pass-box, which allows for these operations without release of contaminants to the laboratory or external environment.

4.9.1.2 Biological Hoods

Biological simulant operations are conducted in biological laboratories in chemical fume hoods with absolute biological filters designed to completely remove all aerosolized simulant microorganisms generated by laboratory operations. The construction and operation of biological hoods are completely analogous to that of the chemical fume hoods previously described. Absolute biological filter media are periodically replaced, decontaminated, and disposed of as hazardous waste.

4.9.2 Incinerator

The CRDEC operates an incinerator used for treating 3X material to 5X status. The existing incinerator is currently operating under a CHS permit in accordance with Code of Maryland Title 10, Subtitle 51, Disposal of Controlled Hazardous Substances. The incinerator is permitted to treat 144 tons per year of corrosive waste (hazardous waste code D002) and reactive waste (hazardous waste code D003). No ignitable waste (hazardous waste code D001) can be treated at this facility. There is no limit on the amount of nonhazardous waste that can be treated by the incinerator.

Corrosive wastes (D002) at this facility are:

- Solids that have been exposed to CSM, have been decontaminated, and are coated with residual levels of sodium carbonate solution or sodium hydroxide solution with which they have been treated.
- Spent sodium carbonate solutions or spent sodium hydroxide solutions that have been used to treat items exposed to CSM.

Reactive wastes (D003) at this facility include:

- Solids that have been exposed to CSM and decontaminated, and are contaminated with residual levels of calcium hypochlorite solution (HTH) or supertropical bleach (STB) slurry (a mixture of calcium oxide and calcium hypochlorite) with which they have been treated.

In the past, liquids contaminated with agent and subsequently decontaminated to the 3X condition and neutralized to pH 7 have been incinerated as a nonhazardous waste or discharged to the sanitary sewer. The CRDEC considers these wastes to be nontoxic. The State of Maryland has recently listed the residual from the treatment of agent as a hazardous waste. Since the incinerator permit does not allow the treatment of listed hazardous waste, these wastes cannot be treated in the incinerator. The Army has requested that Maryland delist residues from the chemical treatment of agent, allow the treatment of such waste in the incinerator, or discharge to the sanitary sewer. Since the Army does not allow decontaminated CSM waste to be treated commercially unless it is treated under government control in a State or EPA permitted facility, the contaminated liquid waste is being stored on-site. The State is planning to issue a consent order for this storage until the waste is delisted.

CRDEC is planning to modify its CHS permit for the incinerator. The plan is to improve the liquid waste feed system and improve the solid waste input mechanism.

The incinerator has a caustic scrubber used to clean exhaust gases. The blowdown from the scrubber formerly went to the sanitary system. Analysis has shown the blowdown to be RCRA hazardous. The scrubber, therefore, is presently operated as a closed-loop system.

The scrubber water is continually filtered through both a 10-micron filter and a cartridge filter. The system is cleaned out approximately twice a year. At this time, the scrubber water is filtered through charcoal, pH neutralized, and tested for hazardous constituents. The nonhazardous wastewater is then discharged to the sanitary sewer, and all filters are treated as hazardous wastes.

The residues from incineration are either sold (metals) as scrap or sent (ash) to a commercial landfill.

4.9.3 Open Air Testing

CSM is not tested in the open air. Rather, open air tests are conducted with small amounts of other military chemicals (see Subsection 4.2). Tests of a larger nature are conducted at other military installations by the U.S. Army Test and Evaluation Command. Tests with small amounts of other military chemicals (for example, smoke tests) involving few munitions rarely exceed 30 minutes duration.

Open-air testing at CRDEC is not conducted on a regular basis. Specific operating procedures are written for each test to protect health and maximize safety. The M-field is the area used for CRDEC open-air testing.[16]

No tests are conducted during air pollution alerts. The noise levels during these open-air tests are below hazardous levels of hearing impairments (i.e., no adverse effects) since the items used for these tests do not explode with loud noise.

4.9.4 Storm Drains and Sanitary Sewers

CRDEC liquid nonhazardous, nontoxic wastes are presently discharged into the sanitary sewer system in accordance with NPDES permit allowances and only with approval of USAAPGSA, EMD. These wastes are treated by the APG Edgewood Area wastewater treatment plant.

A potential source of wastewater discharge is in the building where the Experimental Fabrication Division (X-Fab), RD&ES Directorate provides a full range of metal and plastic fabrication support to the CRDEC, including sheet metal fabrication, welding, metal cleaning, coating, pattern-making, injection molding, precision machining of metal parts, and plastic and rubber heat treating. Table 4-11 presents a list of chemicals and approximate quantities used in the metal cleaning operation.

The majority of water used at this facility occurs in the metal-cleaning operation. To minimize the release of inorganic constituents into the waste stream, wastewaters are neutralized to a pH of 6 to 8, and pumped to a flocculator. In the flocculator, the pH is again monitored and adjusted to a pH of 6 to 8, if necessary, and a polymer is added to the flocculator to induce settling of inorganic materials. The system is designed so that, once the inorganic material has flocculated and settled to the bottom of the 500-gallon flocculator, the liquid is tested for hazardous constituents. The nonhazardous wastewater is discharged to the sanitary sewer. The hazardous liquid is drummed and properly disposed of.

As the metal-cleaning tanks are emptied, an inorganic sludge remains at the bottom of many of the tanks. This sludge is tested to see if it is a hazardous or nonhazardous waste, and disposed of accordingly. In support of the Army's Hazardous Waste Minimization Program, a still will be installed to recycle the trichloroethylene.

The Visual Information Division of the Management Information Systems Directorate is responsible for producing all photographic and photo art products, including television, movies, still photography, and graphic arts. The Division makes extensive use of automatic processing machines, which use a variety of proprietary photographic processing chemicals. These chemicals, which are procured through the Army Depot in Richmond, Virginia from Eastman Kodak, Hunt Chemical Company, and Ilford Chemical Company, are shipped in containers ranging in size from 1-ounce plastic bottles to 5-gallon polyethylene cubes. Approximately 90 percent of chemical quantities are used for machine processing, with the remainder for hand processing of photographic products.

While the bleach fixes and black and white films are set aside in polyethylene cubes for silver reclamation at APG, the developers, conditioners and stabilizers, which are continually fed to the automatic processing equipment during processing, are disposed of in the sanitary sewer. In addition to a wide range of proprietary chemicals, the disposed materials are known to contain formaldehyde, hydroquinone, and sodium selinite.

An independent evaluation of CRDEC's discharge monitoring reports by the Chesapeake Bay Foundation[32] verified that CRDEC was operating under an appropriate NPDES permit.

Table 4-11

Chemicals and Quantities Used in the Metal Cleaning Operation at CRDEC

Chemical	Operation Use	Container Size	Containers Per Year	Tank Size (gal)	Dilution
1,1,1-Trichloro-ethylene	Vapor degreasing	55 gal	12	30	None
Caustic soda	Surface preparation	400 lb	1.5	2 at 200	5 oz/gal
Sulfuric acid	Anodizing aluminum	15 gal	3	200	12 oz/gal
Hydrochloric acid	Pickling steel	15 gal	2	100	a
Phosphoric acid	Rust removal	55 gal	2	200	25 oz/gal
Zinc phosphate (aq)	Phosphatizing	55 gal	1	200	2 oz/gal
Phosphoric/ chromic acid	Coating rinse	30 gal	1	200	a
Alkaline dyes	Dyeing aluminum	5-10 lb	1	30	10 g/liter
Nickel acetate	Sealer	1 lb	5	30	1 oz/gal
Potassium dichromate	Sealer	5 lb	1	30	1 oz/gal
Mineral acids	Surface preparation	55 gal	1	100	1:3
Sodium bicarbonate	Buffer	1 lb	3	a	a
Chromate	Chromate finish	1 lb	1	a	a
Iso-Prep 184	Deoxidizer and desmutter	55 gal	1	200	22%

[a]Information not available or highly variable.

Potentially, small quantities of liquid wastes may enter the environment either through the storm drains or through leaks in the lines to the sanitary sewer treatment facility. To monitor for these inadvertent releases and to verify the effectiveness of water pollution abatement efforts, APG established surface and groundwater monitoring programs in May 1979. The programs require quarterly sampling at 16 surface water locations and 55 groundwater wells in the Edgewood Area. Surface water sites are monitored for 24 water-quality parameters and 29 sediment-quality parameters (mostly pesticides).

Groundwater wells are monitored for 11 groundwater-quality parameters. Data obtained to date indicate no significant problem to the off-post environment.[33,34] An additional study to identify possible industrial discharges in the Edgewood Area revealed no unpermitted discharge from CRDEC activities.[35]

4.9.5 Chambers

4.9.5.1 Chemical

Chemical chambers are large enclosures for generation of gases, vapors, and mists in order to study CSM and other military chemicals under a variety of environmental conditions. The chambers are operated at a pressure negative to that of the outside environment with filter systems that filter the air before, during, and after testing. Chamber operation is consistent with the policy for total containment of toxic emissions. The life expectancy of a chamber filter is determined before installation, and filters are replaced and disposed of according to standard procedures.

4.9.5.2 Biological

The biological chambers at CRDEC are also operated at negative pressure. The exhaust air is filtered through absolute biological filters before entering the atmosphere. (For further discussion of biological chambers, see Subsection 4.4.)

4.10 OTHER OPERATIONS

4.10.1 Masks and Filters

The Collective Protection Team of the Producibility Engineering Division, Physical Protection Directorate, fabricates, fills and tests gas-absorbing filters. Filters are filled with ASC Whetlerite (consisting of activated carbon and silver, chromium, and copper salts mixed in ammonium hydroxide solution).

The ASC Whetlerite is tested for leaks by monitoring the absorption of Freon gas through the filter. An average of two to three standard industrial cylinders of Freon gas are used per month in this operation. The fabrication of filters involves extensive use of adhesives, ranging from water-based wood glues to epoxies, elastomeric-based rubbers, mucilages, room temperature vulcanizing compounds (RTV's), cyanoacrylates, and potting compounds. Filters are also tested with dimethylmethyl phosphonate (DMMP) as a simulant for agent materials.

4.10.2 Binary Munitions

The binary munitions concept entails the formation of a lethal chemical warfare agent from two nonlethal precursors by means of chemical reaction occurring during flight of the munition to a target. The use of binary munitions allows for manufacture, storage, and transportation of less hazardous compounds. The binary munitions would also eliminate the substantial difficulties now encountered when disposing of munitions filled with lethal chemical agents.

Several Directorates/Offices are involved in the research and development of these binary weapons. The Munitions Directorate conducts laboratory reaction studies utilizing a binary process formation of a lethal chemical warfare agent from two nonlethal precursors when mixed in a reaction.

All operations are conducted in hoods, glove boxes, or chambers with a negative pressure to the room. These facilities are operated and maintained to direct hazardous materials away from the laboratory environment and to remove hazardous constituents from the air stream prior to release to the environment.

Chemicals used in these operations are QL, DF (Table 4-7), and various alcohol/amines to complete the reactions. Quantities used are several liters per month for hood/glove box operations and a maximum of 30 gallons per test for large-scale test operations.

Testing of the binary weapons occurs in the test chambers (described in Subsection 4.9.5).

5. ENVIRONMENTAL SETTING

This section addresses the general environmental setting of the area that pertains to CRDEC activities at the Edgewood Area of APG. Since CRDEC is a tenant of APG, most land uses, vegetation, and utilities systems are handled by APG. APG is also responsible for water supply, wastewater collection and treatment, and solid and hazardous wastes generated by CRDEC activities. Hence, this section is limited to only those aspects of the environment that may be affected by the activities of CRDEC as described in Section 4. More-detailed information on the environmental setting of the Edgewood Area of APG is provided in the APG Installation Environmental Assessment.

5.1 TOPOGRAPHY

The CRDEC activities are located in the Edgewood Area of APG. The Edgewood Area is within the low-lying Coastal Plain Province adjacent to the Chesapeake Bay with gently-rolling, low-lying terrain and elevations below 50 feet (15 meters). The general topography of the site is so low that much of the land area is below the 1-percent chance floodline elevation as determined by the contour line of 8 ±0.5 foot established by the U.S. Army Corps of Engineers.[8] Land that is lower than this elevation is susceptible to flooding. The most-recent floods that severely affected APG were those following Hurricane Agnes in June 1972.

5.2 CLIMATE

The Edgewood Area lies on the coast; hence, its climate is mainly influence by both continental and off-shore maritime air masses. The general flow of the atmospheric currents from west to east brings cold, dry continental air masses into the area. However, the Appalachian Mountains to the west shelter the area from the severity of the cold air masses. Also, the moderating effects of the Atlantic Ocean and Chesapeake Bay combine with other currents to produce warmer, milder winters in the area than are experienced by the inland regions further west.

The Chesapeake Bay causes higher humidity in the area year around than it would have otherwise. Low-pressure frontal systems that sweep across the continent often follow a path through the area. These systems influence the area weather with frequent changes especially during spring and fall. The flow of warm, moist air from the south from large semi-permanent high pressure systems centered over the Atlantic Ocean contributes to high temperatures and humidity and results in frequent afternoon and evening thundershowers in summer and early fall. The distribution of monthly precipitation is fairly uniform throughout the year, with maximum rainfall in August.

The warmest period of the year in this area is during the second half of July when temperatures reach approximately 88°F, while, on an average of 20 days in a year, temperatures are as high as 90°F. The coldest period of the year in this region is from the mid-January to mid-February when the minimum average temperature falls to approximately 18°F. For about 119 days in a year, the minimum temperature falls below the freezing point (32°F). Snowfall occurs an average of 20 days each year yielding 22 inches per year, with amounts in excess of 1 inch for six days a year. The annual average snowfall varies considerably from year to year.

Prevailing winds are from the west to northwest. During summer, the winds are more southerly. The annual average wind velocity is approximately 10 mph, and occasionally during severe thunderstorms, hurricanes, or intense winter storms, it reaches 50 to 60 mph.

5.3 HYDROLOGY

5.3.1 Surface Water

The Edgewood Area of APG is a peninsula extending between the Bush River and the Gunpowder River, the two major tributaries on the western shore of the Chesapeake Bay south of the Susquehanna River. The area is drained by seven major creeks, including Lauderick Creek and King's Creek on the Bush River, and Wright's Creek and Canal Creek draining into the Gunpowder River (see Figure 5-1).

CRDEC laboratory operations are located on the Wright's Creek and Canal Creek basins, while the open-air operations are located on the Dove Cove, Watson Creek, and Boon Creek drainage basins.

A recent (1983) environmental survey[36] of the Edgewood Area of APG found contamination of several surface waters. White

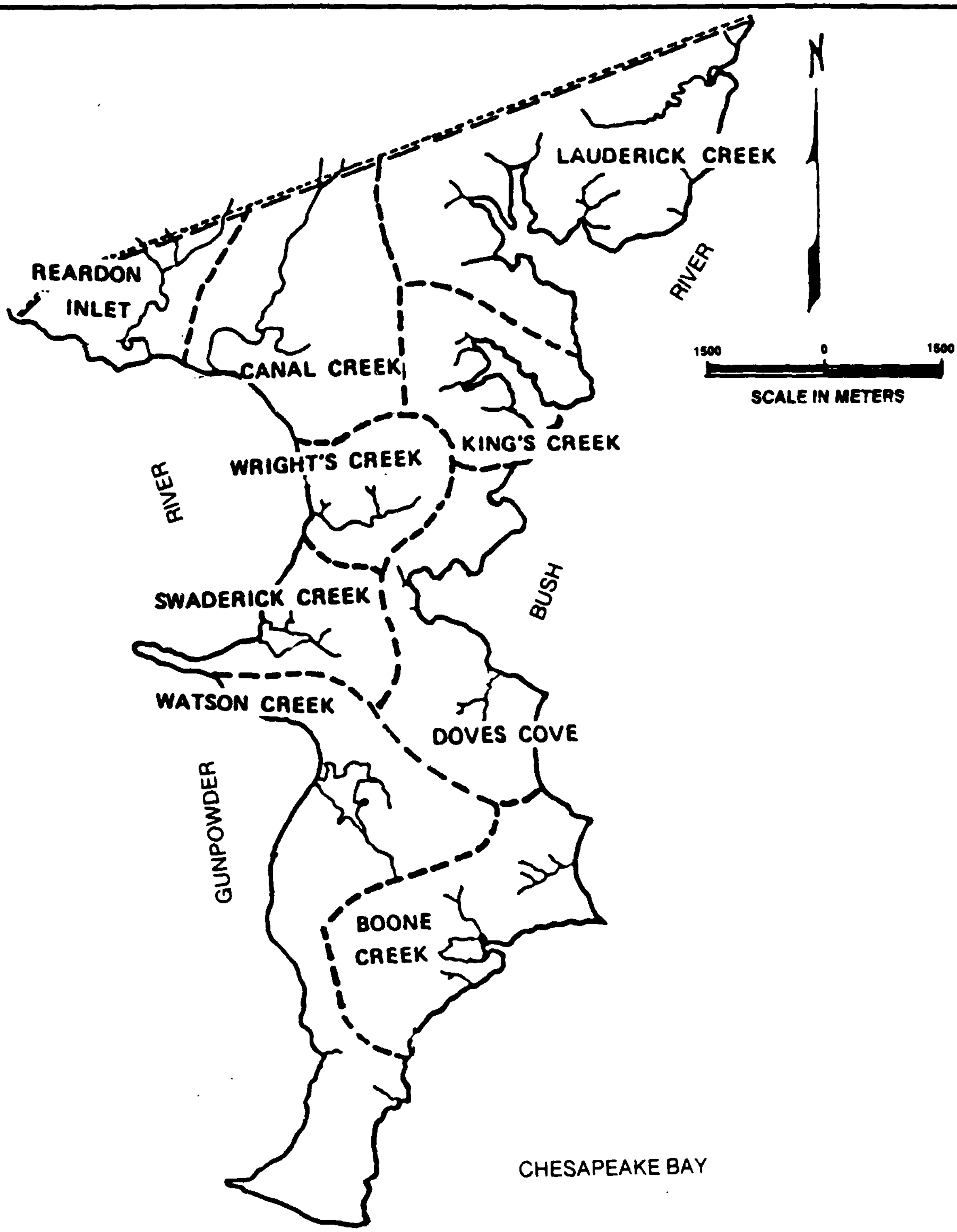

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FIGURE 5-1
MAP OF DRAINAGE SYSTEMS ON THE EDGEWOOD AREA OF ABERDEEN PROVING GROUND

phosphorus was found in the upstream portions of Canal Creek. Also, compounds associated with the former manufacture of a clothing-impregnating agent were detected in the sediments of the Gunpowder River. Contaminants were found at detectable levels in Watson Creek, adjacent to the "O" Field disposal area.

5.3.2 Subsurface Water

The water table is close to the surface at the Edgewood Area of APG. The maximum depth is 10 m. Quite frequently, the water table is 0.5 to 1 m below the surface. In many low areas, it is at the surface, creating numerous, shallow ponds and wet areas. In general, the gradient of the water table reflects surface topography with drainage toward the low areas. However, there are vertical and lateral sand and clay pockets that channel the flow. The flow rate is usually 0.2 to 2 m per year. However, in sand, it can be as much as 0.3 m per day.

All wells in the Edgewood Area of APG are used for sampling or emergency sources of water. The 1977 field investigations conducted for Baltimore Gas & Electric Company concluded that the quality of groundwater in the region around APG was generally good. However, within the Edgewood Area of APG, the 1983 Environmental Survey(36) indicated that groundwater was contaminated in some locations and that very low levels of hydrocarbons were found at "J" Field, Carroll Island, and Graces Quarters, and the vicinity of the "O" Field disposal area.

5.4 ECOLOGY

5.4.1 Habitats

The distribution of the four major habitat types found in the Edgewood Area of APG is presented in Figure 5-2.

Cleared areas or meadows that are intensely or periodically mowed are a mixture of many types of grasses, forbs, and herbaceous weeds. Most of the woodlands are hardwoods with sweet gum oaks and tulip trees predominant. There is little, if any, virgin woodland. Much of the woods are in advanced stages of succession.

The primary aquatic habitats in the Edgewood Area of APG are the small freshwater creeks draining the low-lying marsh areas and the low salinity estuaries. From the available information on Wright's Creek and Canal Creek, it is understood that these creeks have experienced long-term degradation, as evidenced by their low numbers of aquatic species.

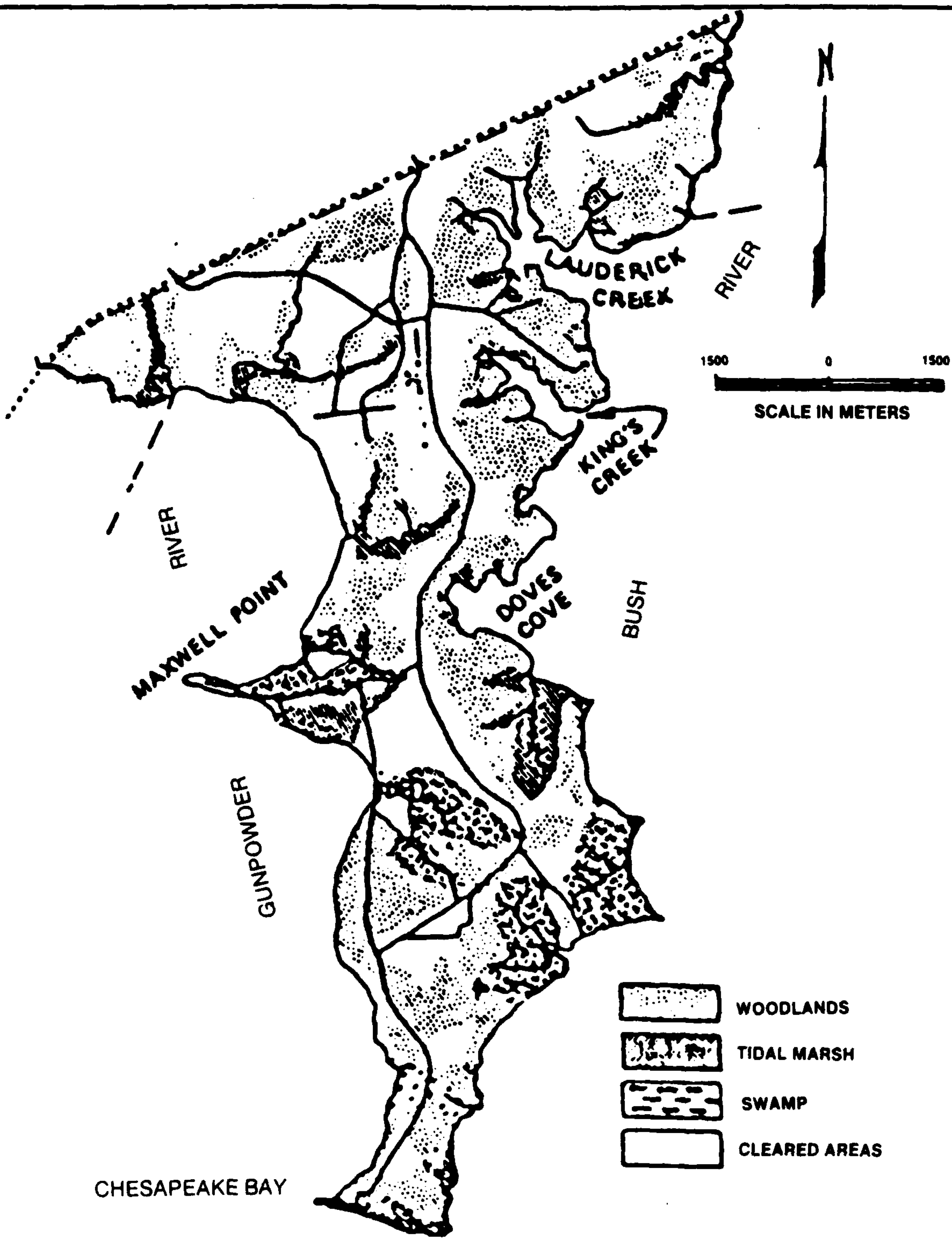

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FIGURE 5-2

MAP OF HABITAT TYPES ON THE EDGEWOOD AREA OF ABERDEEN PROVING GROUND

The marshes of the Edgewood Area of APG are coastal, freshwater marshes that are affected by tidal action. Some of the attributes of such marshes include: providing habitat for furbearing mammals, game fish, and waterfowl; supporting trapping, fishing, and hunting; providing flood control; aiding in the natural purification of water; providing nursery areas for aquatic and terrestrial wildlife; and producing large quantities of aquatic plant life that are a source of organic matter consumed by shellfish and other aquatic life.

5.4.2 Threatened and Endangered Species

A pair of bald eagles (Halicetus leucocephalus) nest in the southern portion of the Edgewood Area of APG. There are no other known sightings of nests of Federally-listed threatened or endangered species in the Edgewood Area. Other eagles are known to feed and stay at the C-Field, Lauderick Creek, and Gunpowder Neck.

5.5 GEOLOGY AND SOILS

5.5.1 Geology

There is no known major fault near or beneath the Edgewood Area of APG. One known fossil site occurs in the Edgewood Area of APG. It is a Pleistocene sandstone formation containing late to Post-Wisconsin specimens of fresh and brackish water invertebrates. The site has been examined by a team of paleontologists from the Smithsonian Institution and eight species were identified. The assemblage is nearly identical to one below Washington, DC, and one in the middle part of the Rappahannock River in Virginia. Because this is only the third site of its type known to exist, its importance cannot be overstated. The precise location of this site has been omitted from this document to protect the site. Persons with a bona fide need-to-know may have access to a site map and may obtain further information through the Environmental Management Office of APG.

5.5.2 Soils

The soils in the Edgewood Area of APG are of the Atlantic Coastal Plain type; they are mostly well-drained soils deposited as sediments. The 1983 EA[3] refers to four major soil types within the Edgewood Area of APG (See Figure 5-3). Since the APG property is outside the limits of Soil Conservation Service (SCS) soils analysis and mapping, the current names of these soil types are not available. However, from contacts in the Harford County SCS Office, it was concluded that

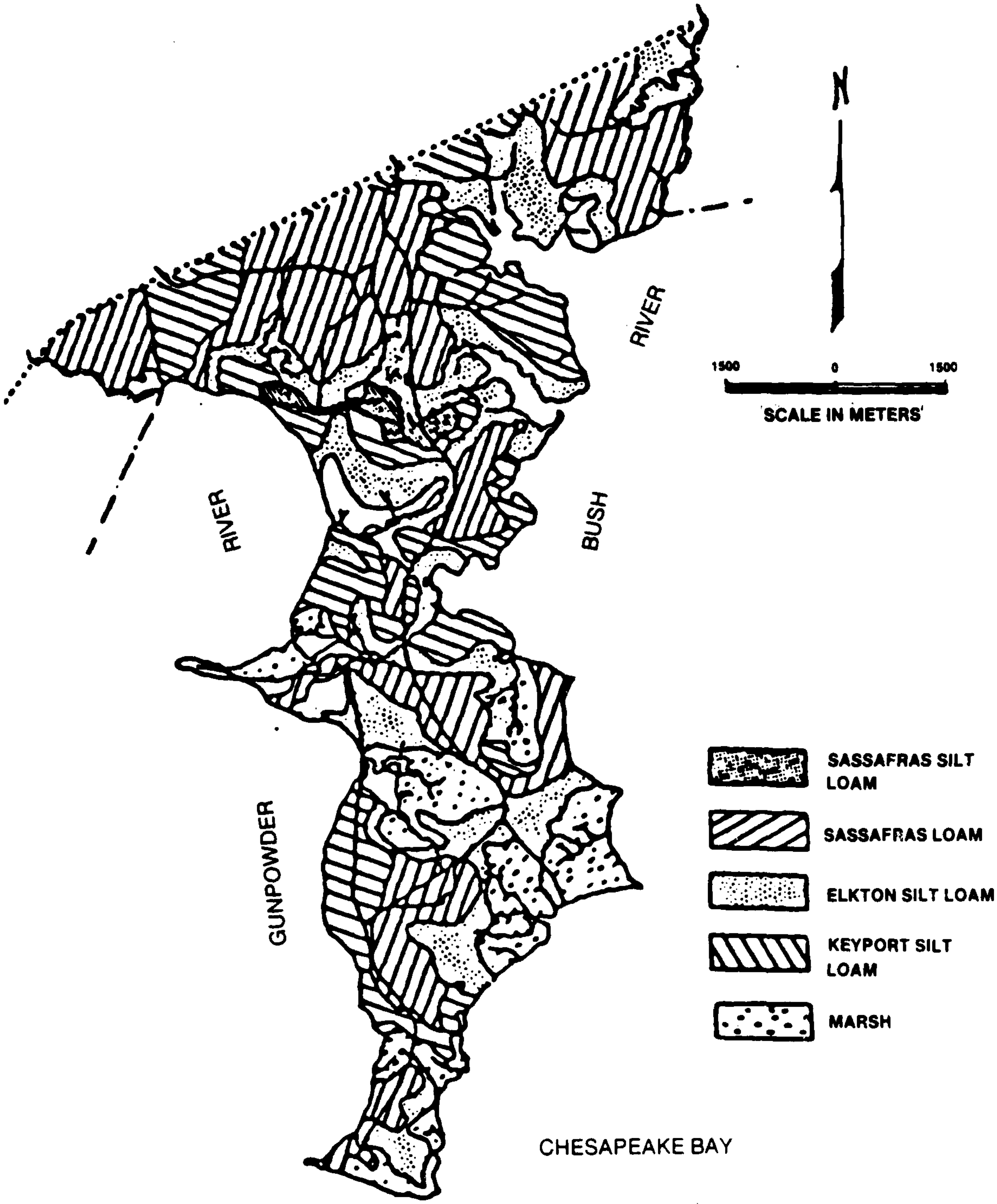

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FIGURE 5-3

MAP OF SOIL TYPES ON THE EDGEWOOD AREA OF ABERDEEN PROVING GROUND the soils of the Edgewood Area of APG could be described using the following associations[37], although it is difficult to map these types precisely without reviewing any soil surveys initiated by the Army for analysis purposes in the past (soil types in the parenthesis refer to those listed in the 1983 EA):

- Neshaminy-Chillum-Sassafras association - Deep, nearly level to steep, well-drained soils, on uplands (Sassafras silt loam, and Sassafras loam included).

- Beltsville-Loamy and Clayey land-Sassafras association - Deep, nearly level to steep, well-drained soils, on uplands (Keyport silt loam included).

- Codorus-Hatboro-Alluvial land associations - Deep, nearly level, moderately well-drained to very poorly drained soils, on flood plains (Elkton silt loam and marsh included).

Another source for information on soil types within the County is the Natural Soil Groups map compiled by SGS in July 1979; however, this map does not cover the APG Area.

5.6 CULTURAL RESOURCES

Harford County is rich in historical and archaeological resources. There is a total of 150 structures in the County that are listed in the National Register of Historic Places. The Edgewood Area of APG has its share of historic places, but the only remaining ones are the Presbury family home (or the Quite Lodge) and the Presbury Church at Gunpowder Neck. The house, built in 1740, was reconditioned and enlarged in 1924 and has since been used as quarters for field-grade officers. The church (dated 1772 partially, and completed in 1889), possibly the oldest standing Methodist church in the U.S., was used both as a Church and school for many years, but has been unused since 1919.

The entire Edgewood Area of APG has a rich archaeological heritage. There are numerous archaeological sites within Edgewood Area, primarily from Native American or early colonial origin. Details on the locations and history of these sites are available to bona fide "need-to-know" persons through the Environmental Management Office of APG.

5.7 RECREATIONAL RESOURCES

There are numerous sites and amenities within the Edgewood Area of APG for various types of recreational activities, including: hunting and trapping, fishing and boating, and swimming and picnicking. There are designated areas and spots for the various recreational activities that are governed by APG Regulation 210-5.[38]. A hunting/trapping permit is required to hunt or trap on APG.

The more popular wild game species hunted in the area include the white-tailed dear, gray squirrel, cotton tail rabbit, bob-white quail, ring-necked pheasant, Canada goose, and the various species of ducks.

Fishing and crabbing, as well as boating, are also very popular recreational activities at Edgewood Area. The major sport fish species include bass, perch, catfish, and crappie. A dock that provides sailboats, rowboats, and canoes is operated by the APG Recreation Services Division from the Rod and Gun Club building. The boating season is from 1 May to 15 October.

The Gunpowder Boat Club is used by civilian and military personnel of APG with powerboats and sailboats. The club sponsors a variety of activities during the boating season.

Recreation Services Division of APG and the APG club system operate two swimming pools on post. No swimming is permitted in the waters adjacent to CRDEC activity areas. There are attractive, well-equipped picnic areas at Skipper's Point and CAPA field, which are used extensively during summer months.

6. IMPACT OF CRDEC ACTIONS ON THE ENVIRONMENT

This section contains an assessment of the possible effects on the environment from actions related to the CRDEC mission. This assessment is based primarily on the current activities of CRDEC directorates and offices as described in Section 4 and from extensive interviews with related personnel of these directorates and offices during September-October 1987.

Most of the potential impacts associated with the operation of CRDEC occur when substances are discharged to the environment. The potential for environmental impact during handling and storage is remote, resulting almost exclusively from spills involving military chemical surety materiel, other military chemicals, and toxic nonmilitary chemicals. The frequency of such spills is extremely low.

6.1 SPILLS OF CHEMICAL SURETY MATERIEL

6.1.1 Handling and Transport of Military Chemical Surety Materiel

The extensive precautions given in the various regulations and procedures minimize the chance for environmental release during handling and laboratory use of military CSM. An accidental spill during an escort operation provides the only realistic possibility for an environmental impact. The numerous CAIC exercises are designed specifically to respond rapidly to such an accident, thereby minimizing contamination of the environment. In the event military CSM spills on the ground, containment is addressed by personnel from the Technical Escort Unit. They dig a sump around the spot and flush the spot with decontaminant until it fills the sump. The area is covered with a plastic sheet to prevent spurious evaporation until decontamination is completed. The removed soil and liquid are handled as 3X waste. The worst environmental effects that could occur would be the death of some wildlife in the immediate area of a spill.

The potential for such discharge is minimized by the high degree of care provided during transport of the material by TEU personnel who are trained in high-security escort of CSM, as well as in emergency response to spills. Furthermore, since only limited quantities of CSM are transported at one time, and due to special precautions (such as double over-packing of containers of CSM) in handling/transporting the material, the potential for the release of CSM to the environment in the unlikely event of accident or attack is minimized.

6.1.2 Bulk Storage of Chemical Surety Materiel

The extensive precautions given in the regulations and established procedures minimize the chance for environmental release during bulk storage of CSM.

CASY is monitored daily by HMB. In the event of a spill or leak within the storage yard, the alarm system would be activated. CASY personnel dressed in protective clothing would seal the "leaker" in a container to prevent further contamination. The container is then transferred to the CTF by TEU. The HMB is responsible for the final disposition of the leaker. Transport can also be conducted by HMB. If agent is detected on the ground, the soil would be decontaminated and removed by TEU for disposal as 3X waste.

Following an incident, an investigation would be conducted as required by Army Regulations and SOPs.

Valves/plugs on agent storage containers have demonstrated the greatest potential for leaking agent. If leakage occurs, it is very slow, and the amount of spill is typically less than one gram.

A one-percent lethality hazard distance[a] has been estimated for military CSM stored in CASY. In hypothesizing the ways in which toxic agent will be handled within CASY, it is apparent that the Maximum Credible Event (MCE)[b] would result if a ton container of HD was dropped while being handled within CASY. It is assumed that, as a result of this drop, the valves on the end of the ton container would be sheared off, allowing agent to leak out onto the gravel (pervious) surface. In this case, an alarm would be sounded immediately and the CAIC plan activated. It is estimated that neutralization, decontamination, and control of such a spill could be accomplished within 10 minutes. It is estimated that a 10-minute leak from a ton container of HD would result in a puddle of 77 kg of agent.

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[a] A distance from the point of release at which a hazardous material would have dissipated sufficiently so that it would be fatal to only one percent of a theoretical population of exposed personnel (located at that distance) in 99 out of 100 instances.

[b] That unintended, unplanned, or accidental adverse occurrence which causes release of agent from an ammunition item, bulk container, or process. It must be realistic with a reasonable probability of occurrence.

The degree of hazard depends upon the quantity of agent that would evaporate from the puddle during the 10-minute period and be carried downwind. The rate of evaporation is a function of agent volatility, agent temperature, puddle size, and rate of air flow over the puddle. The quantity of agent evaporated from the above puddle at 86°F (32°C) under worst daytime meteorological conditions has been estimated to be 67.4 grams.

This release of agent would result in a downwind distance to the one-percent lethality limit not to exceed 4 meters (Figure 6-1). Under worst-case night time conditions, only 7 grams will be evaporated. With the associated lesser dispersion rates, the smaller spill still could cause a 1-percent lethality limit of 3 meters. The CAIC procedures reduces the chances for human injury to a minimum.

6.2 DIRECT OPERATIONAL EFFECTS

6.2.1 Air Quality

6.2.1.1 Chemical

The Edgewood Area of APG is located in the Metropolitan Baltimore Intrastate Air Quality Control Region, which has been designated better than National Ambient Air Quality Standards (NAAQS) for sulfur dioxide and total suspended particulate matter, cannot be classified or better than NAAQS for nitrogen dioxide and carbon monoxide, and does not meet primary NAAQS for ozone. The Prevention of Significant Deterioration (PSD) regulations which apply to any facility constructed at APG are affected by CRDEC operations.

A 1978 study(40) evaluated the air emissions from CRDEC buildings where hazardous chemicals were used. It concluded:

1. Toxic air emissions arer not detectable from buildings protected with CBR filters.

2. Under normal conditions, CBR filters negate significant toxic challenge to the stack.

3. In the event of overloading, the output from the stack filters would be below detectable limits of state-of-the-art monitors.

A massive toxic agent challenge or degradation of the stack filters as measured by the air flow rate are the only reasons for filter replacement.

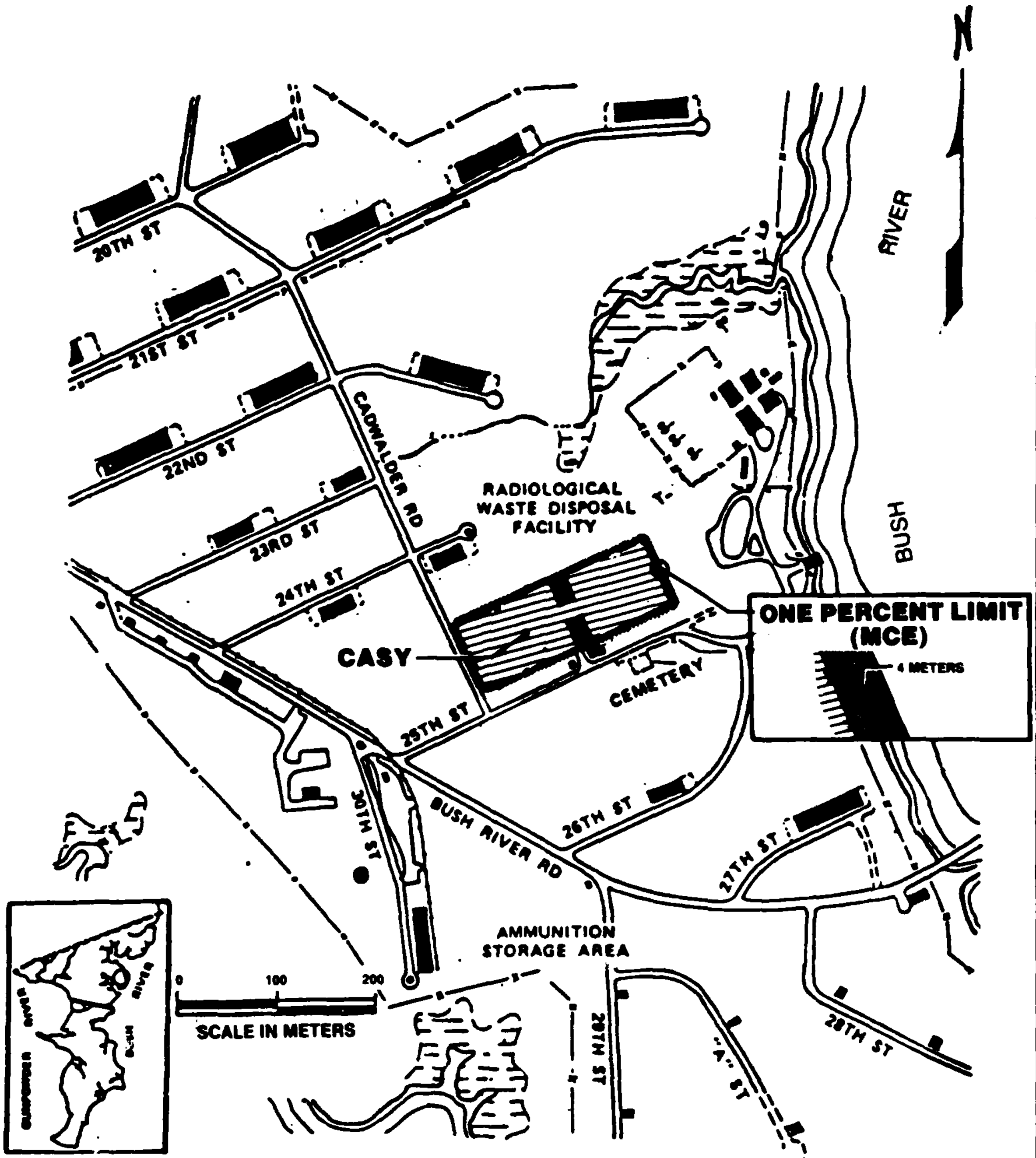

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FIGURE 6-1
ONE PERCENT FOR MCE AT CASY ON THE EDGEWOOD
AREA OF ABERDEEN PROVING GROUND

Air quality impacts related to the use of smokes/obscurants and simulants are addressed in separate environmental assessments.[16, 41, 42, 43, 44] No tests are conducted during air pollution alerts and the impacts are short-term and negligible.

Toxicity of air emissions from laboratory operations conducted within an unfiltered chemical fume hood is not significant since:

- The chemicals used in these hoods are of low toxicity compared to those used in filtered hoods.
- The quantities evaporated are small.
- The vapor is extensively diluted within the hood by the large volume of intake air.

6.2.1.2 Biological

Simulant microorganisms used at CRDEC are nonpathogens which are ubiquitous in the natural environment. All experiments using simulants, toxins, and other biologicals are conducted in fume hoods containing HEPA or CBR filters. These fume hood filters remove 99.97 percent of all microorganisms, as well as organics. Consequently, the hoods discharge highly purified air to the environment. Periodic testing is performed to ensure high adsorption/filter efficiency.

Filter media for these hoods are replaced periodically. The old filters are decontaminated and are disposed of as hazardous waste. Consequently, CRDEC's research programs cause no direct impact on ambient air quality.

6.2.1.3 Incineration

The Decon/Detox incinerator operated by CRDEC is subject to a rigorous RCRA permit process to assure environmental compliance with state and Federal regulations, and to demonstrate no adverse air quality impact from the normal operation of the incinerator. The air pollution control system utilized here consists of: (1) a packed absorption tower; (2) a high-energy venturi caustic scrubber; and (3) an entrainment separator. A system of interlocks shuts down the incinerator if there is a failure in the air pollution control equipment. In the case of a liquid flow failure to the scrubbing system, the system is bypassed to a dump stack to protect the scrubber system from destruction. The scrubber system is checked for proper operation before the incinerator is fired, assuring the removal of air contaminants during incinerator operation.

6.2.1.4 Other Air Quality Impacts

One operation potential, albeit minimal, for adverse impact on air quality is the testing of collective protective devices conducted by the Physical Protection Directorate, Producibility Engineering Division. Collective protection devices are tested for leaks by monitoring the absorption of Freon gas through filters. After testing, the Freon gas is desorbed by heating in ovens which discharge to the interior of the building, and is eventually released to the atmosphere. An average of 2 to 3 standard industrial cylinders of Freon gas are used each month in this operation.

U.S. Environmental Protection Agency banned the use of Freon-12 (chlorofluorocarbon-CCF_2F_2) materials in consumer aerosol products in the mid-1970's because of their potential for damaging the ozone layer of the earth's atmosphere. Since this is a global, rather than a local phenomenon, the effect of CRDEC's action on the ozone layer is considered insignificant.

Potential air quality impact from the bulk storage of commercial chemicals at CRDEC is estimated to be minimum. Using the Army's D2PC dispersion model, calculations similar to those done for bulk storage of CSM (Subsection 6.1.2) were made for the nearly impossible release scenario of an outdoor spill of a large quantity of sodium hydroxide (NaOH). The largest quantity of any commercial chemical stored in bulk at CRDEC is NaOH in an 18,000-gallon tank. A spill of the entire quantity in this tank onto a 2,050-square foot nonporous surface could result in day and night evaporations of 1.83 kg and 0.52 kg, respectively. Under the worst-case (f-stability) at night, such a release could cause the LC-50 concentration to occur at 43 meters. For more typical daytime weather conditions, this distance would be 15 meters.

6.2.2 Water Resources

Certain activities at CRDEC have the potential to adversely impact the surface and groundwater resources of the Edgewood, Maryland area. Potential impacts to the water resources include:

- Accidental spilling of laboratory chemicals into sinks and drains which flow into the wastewater treatment plant, and which the plant is potentially incapable of properly treating.
- Wastewater treatment plant malfunction which could result in the discharge of pollutants at levels higher than permitted in the NPDES permit.

- Underground tanks and piping which may leak and migrate to the groundwater if not immediately detected and contained.

- Spills and runoff from test site (e.g., simulant release) activities which may migrate to the groundwater if not properly contained.

Undoubtedly, small quantities of untreated liquid wastes enter the environment either through the storm drains or through leaks in the lines to the sanitary sewer treatment facility. Also, the high water table in the Edgewood Area of APG can cause these wastes and other spilled chemicals being carried over to the nearby water bodies. To monitor for these inadvertent releases and to verify the effectiveness of water pollution abatement efforts, APG established surface and groundwater monitoring programs in May 1979. The programs require quarterly sampling at 16 surface water locations and 55 groundwater wells in the Edgewood Area. Surface water sites are monitored for 24 water quality parameters and 29 sediment quality parameters (mostly pesticides). Groundwater wells are monitored for 11 groundwater quality parameters. Data obtained to date indicate no significant problem to the off-post environment. An additional study to identify possible industrial discharges in the Edgewood Area revealed no unpermitted discharge from CRDEC activities.

The potential for spills from biotechnology related activities at CRDEC which might contaminate surface or subsurface water is extremely low. As described in Subsection 4.4, no biological materials are disposed by sewer drains. Experimental activities and storage are conducted such that any spills occurring within CRDEC facilities would be contained.

Field trials of biotechnology related experiments employ naturally-occurring soil microorganisms which would be carried to surface waters under normal conditions of runoff. Consequently, the type of microbes reaching surface waters as a result of field trials are expected to occur naturally.

The discharge of CSM to surface or groundwater during transport in and around the Edgewood Area via an accidental discharge is highly unlikely. The use of the Technical Escort Unit, which is trained in high-security escort of CSM as well as in emergency response to spills, minimizes the potential for accidental release during transport. Furthermore, the small quantity of CSM transported at any one time, as well as the double over-packing of vials of CSM, minimizes the potential for the release of CSM in the unlikely event of accident or attack.

The Decon/Detox incinerator has accompanying caustic and fuel oil storage tanks. The caustic tank is indoors in a diked area and has little potential for an adverse effect on the environment. The fuel oil tank is underground and was installed before underground storage regulations were promulgated. As part of the Spill Prevention Containment and Countermeasure (SPCC) Plan for APG, these tanks are routinely inspected for leaks and to assure structural integrity. The potential exists for spills during the filling of the tanks. The SPCC Plan addresses this issue on how to minimize the environmental impact of such events when and if they occur.

There is a storm drain near the scrubber system. In the event of a structural failure of the scrubber system, the potential exists for the scrubber liquid to enter the storm drain. The pH of this scrubber water is approximately 8. The discharge would include nonhazardous, non-RCRA material.

Waste awaiting incineration is stored indoors in metal buildings. These three-sided lean-to buildings are diked to prevent spills from leaving the buildings. One of the buildings has a break in the dike at the doorway which will be corrected by the installation of a ramp.

At present, 550 drums of used decontamination solution are being stored for anticipated incineration in five different metal buildings across post; four are fully-enclosed and the fifth one is a 3-sided lean-to building (see Subsection 4.9.2, Incineration). These drums are not stored in a permitted RCRA storage area. RCRA regulations require that hazardous waste stored over 90 days be kept in a RCRA-permitted storage area. The state is planning to issue a Consent Order allowing CRDEC to store these wastes.

The Visual Information Division, Management Information Systems Directorate discharges small quantities of photographic chemicals to the wastewater system. The small quantities of these chemicals compared to the significant dilution volume presented by the sanitary sewer system suggest that the concentration of these chemicals in the photographic solutions present little or no impact to the waters to which they are discharged.

Periodic discharging of certain industrial chemical solutions in the Experimental Fabrication Division (X-FAB) presents the potential for impact on nearby waterways. These solutions, which are used in the metal-cleaning operations, include a variety of mineral acids and caustics which are neutralized prior to release.

As discussed in Subsection 4.9.4, the batch discharge of metal-cleaning solutions is pH-adjusted and passes through a flocculator designed to allow inorganic materials to settle so they may be separated from the wastewater prior to discharge. The recent analyses confirmed the absence of any heavy metals among the settled materials.

The good management practices employed by CRDEC, such as following regulatory and Army storage requirements, monitoring and testing of underground tanks and piping, inspections by the Safety Office and EQO to ensure compliance with regulatory requirements, and prompt response by CRDEC to spill or emergency events involving CSM (e.g., CAIC Plan), minimize the chances for environmental impact to the groundwater and surface water resources.

6.2.3 Animal and Plant Life

CRDEC operations are primarily restricted to laboratories within the buildings leased from APG. Only a small percentage of CRDEC activities affect the land area within the Edgewood Area of APG; this is primarily on sites used for open-air testing as part of the experimentation process. The conditions for open-air testing are such that disseminated materials have no or low toxicity, involve small quantities, and dissipate rapidly. When these tests occur, the effect of such tests is limited to the immediate vicinity of the test site and consist primarily of grass fires started by pyrotechnics and their associated impacts on flora and fauna. Since the testing is normally planned and conducted only during suitable climatic conditions for optimal dissipation, its effect on the environment is reduced considerably. The plant community rapidly recovers through regrowth and recolonization. During these tests, animals survive either by fleeing or retreating into burrows. Two fire trucks are on-station to control the spread of grass fires.

Only under conditions of accidental spill or release could toxins and other laboratory chemicals have the ability to adversely impact animal and plant life. Under normal operating conditions, toxins are decontaminated or controlled as described in Subsection 4.4.2. Biological materials are autoclaved, and consequently inactivated. Chemical waste is handled according to SOPs previously described. As a result, there is little potential for impact to animal and plant life from activities of CRDEC's biological or chemical research programs. Since field trials use naturally occurring microorganisms, animal and plant life would not be expected to be affected by exposure.

6.2.4 Solid and Hazardous Waste Disposal

As described in Section 4, actions at CRDEC result in the generation of various types of solid and hazardous wastes. Sanitary wastes generated at the CRDEC are collected and transported off-site for disposal at approved landfills.

Hazardous wastes, except liquid decontamination wastes are transported to USAAPGSA custody for long-term storage prior to ultimate disposal by commercial treatment, storage, and disposal (T/S/D) facilities. Different subsections within Section 4 provide details on hazardous wastes generated and operations which produce hazardous wastes at CRDEC. Subsections 4.3.2 and 4.3.3 provide details on handling and turn-in procedures.

Decontaminated (3X status) military surety wastes are burned on-site in a thermal treatment facility (incinerator).

Radioactive wastes are transported to a central area weekly for temporary storage. These wastes are stored for a maximum of 90 days before they are picked up by a licensed contractor such as Chem-Nuclear of South Carolina, for disposal.

The State of Maryland has recently listed the residuals from the treatment of agent as a hazardous waste. In the past, these 3X wastes were considered nonhazardous and were thermally treated to 5X status in the Decon-Detox incinerator. Since the listing, these wastes have been stored on-site. The State has determined that the storage of excess agent at the CTF, the storage of miscellaneous recovered munitions at "N" field, and the storage of residuals from the treatment of bulk (4 liters or less) agent at the CTF represent the storage of hazardous waste. The Army is preparing CHS storage permits for the CTF and "N" field. These permit applications will be part of the existing Part B permit renewal application, which will be submitted to the state by 24 March 1988. In addition, the Army is preparing information for submittal to the state to support the delisting of the residuals from the treatment of agent as a hazardous waste.

Toxins are inactivated using a decontamination procedure. Biologicals are autoclaved, rendering them innocuous. Other wastes generated as part of the biological testing/biotechnology program (e.g., solvents) are handled according to chemical SOPs and are not unique to the biological program.

Potential impacts associated with solid and hazardous waste treatment, storage, and disposal at CRDEC include:

- Spills and runoff from on-site storage of wastes into surface and groundwaters.

- Airborne emissions from the on-site incinerator.

- Contamination of the air, waters, and ground resulting from the improper management of hazardous wastes treated and disposed by commercial TSD facilities.

- Spill and runoff from the improper transportation of wastes generated by CRDEC.

CRDEC has a daily inspection program that includes the checking (inspection) of all areas where hazardous wastes are stored. These safeguards and the emergency response procedures act effectively in preventing or controlling the unlikely situation of a spill of hazardous wastes.

The on-site incinerator will be immediately shut off in the unlikely event of a malfunction that could create airborne emissions of adverse nature, and corrective measures will be taken prior to restart.

CRDEC minimizes the chance for environmental impact from hazardous waste storage by following all appropriate Federal (RCRA) and state regulations for storage of hazardous wastes. The proper operation by CRDEC of the on-site incinerator for destruction of wastes reduces the chance of environmental impact. The use of licensed, well-run TSD facilities for the ultimate disposition of hazardous wastes generated at CRDEC minimizes the potential for environmental impacts.

6.2.5 Public Health and Safety

There are no significant public health or safety issues present as a result of CRDEC operations. A potential, but highly unlikely, impact to the general public exists with regard to the on- and off-post transport of CSM. The unlikely event of accident, sabotage, or terrorist attack is minimized by the training and professionalism of the TEU in the transport and handling of CSM. Because the transport is conducted via heavily armed, escorted convoys authorized to employ deadly force to prevent the release or theft of CSM, such an impact is deemed highly unlikely. Convoys consist of multiple, unmarked vehicles, and routes are randomly selected a few hours before actual transport, minimizing the potential for a successful terrorist attack. The precautions taken in packaging CSM containers prior to transport, as well as the training of TEU personnel and available clean-up equipment, minimize the potential for accidental release of CSM during transport.

The safe handling and storage of both military and nonmilitary chemicals allows minimal potential for impacting the general public health and safety in the vicinity of the Edgewood Area. If materials were mishandled or stored improperly, they could conceivably react, ignite, or otherwise be released to the air or water and find their way off-post. However, the potential for this to occur is remote given CRDEC's integrated program of training, Standing Operating Procedures, and inspections. All employees using hazardous chemicals are trained in the use of MSDSs for chemicals encountered during specific activities. MSDSs are used as the basis for instruction on the specific chemicals, environmental and human toxicity, as well as on their safe handling, storage-handling, and disposal procedures. Use of MSDS management controls and strict adherence to standing operating procedures minimize the potential for unsafe handling and storage of hazardous materials and their subsequent impact on public health and safety.

Air emissions from the normal operation of the incinerator will not have an adverse impact on the health and safety of the people living or working in the area. The emergency services, spill prevention, and contingency plans for the incinerator are part of the general environmental plan managed by APG.

No biological releases or emissions occur from CRDEC's biotechnology program. Consequently, public health and safety are not threatened by the laboratory projects underway. Emissions from fume hoods are filtered using HEPA filters. Liquids poured down drains (e.g., media) are innocuous and are not unique to the biological program. Biological simulants used in field trials are naturally-occurring organisms and do not, therefore, pose a threat to human or environmental health and safety.

6.3 INDIRECT EFFECTS

6.3.1 Population

For more than 60 years, the Army has been the major employer in Harford County. There are a total of nearly 1,200 employees at CRDEC, including permanent and temporary civilian employees, and less than 100 military personnel. The continuation of the current operations at CRDEC is essential to the civilian labor force of the County currently employed at this location. These employees contribute to the local economy of the County and the incorporated places within, while the County and the local governments provide community services for them.

6.3.2 Land Uses

There is no adverse impact on the land uses within the Edgewood Area of APG by the continuation of current CRDEC operations at this site. Operations at the Edgewood Area also have no noticeable impact on the land uses of the surrounding communities.

6.4 UNAVOIDABLE ADVERSE ENVIRONMENTAL CONSEQUENCES

When initially developed, urban land uses (such as offices, buildings, etc.) will have adverse effects on the environment, such as increased traffic, local disturbance, noise, stormwater runoff, and minor air and water contamination. Since CRDEC activities have existed at APG for the past 60 years, these effects have stabilized, and currently have only insignificant effects on the environment.

6.5 MITIGATING MEASURES

Subsections 6.1.1 through 6.2.5 have identified mitigating measures to minimize any possible adverse impacts on the environment via the air, water, and land.

7. ALTERNATIVES TO THE CRDEC ACTIONS

7.1 NO ACTION

Because CRDEC is an ongoing operation, the alternative of "no action" would be closure of the facility. Two aspects of closure are significant:

- Military - The Army has always relied upon the research and development (R&D) facilities at CRDEC to conduct major R&D programs relating to chemical defense. Today, with a growing interest in the development of chemical defense equipment, the Army must rely more than ever on the facilities at CRDEC. Therefore, closure would require the construction of a similar facility elsewhere. The construction would cause considerable environmental impact. In addition, transport of stored CSM and other hazardous materials at CRDEC to a new location would constitute a risk.

- Community - For more than 60 years, the Army has been the major employer in Harford County, a military-industrial community that depends on the presence of the military complex. CRDEC is part of the military complex. Therefore, closure would cause unemployment and create a substantial gap in the economic base of Harford County. The attending environmental impacts would be varied and significant.

7.2 OUTSIDE CONTRACTING OF SOME CRDEC OPERATIONS

This alternative may reduce the number of probable sites or buildings in active use for CRDEC functions and could result in lesser volumes of waste being generated in comparison to the current level of activities. However, the waste would be generated in another location. There would also be a potential impact during the transportation of the current stocks. There is no environmental benefit to relocating the CRDEC activities.

7.3 CRDEC OPERATIONS AT ANOTHER ARMY SITE

This alternative is a viable one if there are other DOD locations where sufficient buildings, laboratories, and field-test sites are available for use by a CRDEC-type research organization. Environmentally, this alternative would have only limited impact occurring during the transport of the current experimental units and the chemicals that remain after the closure of CRDEC operations at the Edgewood Area of APG.

There is, however, no cost or environmental benefit to relocating the CRDEC-missioned activities.

8. CONCLUSION

The Chemical Research, Development and Engineering Center manages and conducts the research, development, and engineering activities to provide defense against chemical and biological attack and to provide deterrent and retaliatory capability against chemical attack.

All operations of CRDEC were evaluated for possible environmental impacts. The good management practices employed by CRDEC, such as following regulatory and Army storage requirements, monitoring and testing, inspections, and prompt response by CRDEC to spill or emergency events, minimize the chances for environmental impacts. Operations are conducted in accordance with applicable Federal, State, local, and Army regulations and are not anticipated to result in significant adverse impacts to the environment.

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APPENDIX A

CRDEC Stockroom Chemical Inventory
(as of 24 June 1987)

Nomenclature	Total
Propylene Glycol	3 kg
Propylene Glycol	6 lb
Sodium Nitrite	6 lb
Buffer Solution pH 7.0	0 ml
Buffer Solution pH 3.0	20 pt
Buffer Solution pH 10.0	7,500 ml
Buffer Solution pH 4.01	8,000 ml
Buffer Solution pH 6.0	23 pt
Buffer Solution pH 8.0	18 pt
Sodium Sulfite	20 lb
Acetic Anhydride	0 oz
Cupric Sulfide	5 lb
Oxalic Acid	56 oz
Potassium Carbonate Anhydrous	32 oz
Potassium Phosphate	36 oz
Sodium Acetate	44 oz
Sodium Carbonate Anhydrous	8 oz
Sodium Carbonate Anhydrous	2,000 gm
Sodium Nitrate	40 oz
Sodium Nitrate	13 oz
Sodium Sulfite	10 lb
Sulfuric Acid	72 lb
Sodium Hydroxide	1 lb
Acetic acid	10 pt
Glycerol	2 pt
Acetone	4 pt
Nitric Acid	91 lb
Hydrochloric Acid	0 ml
Lithium Sulfate	4 oz
Ethyl Alcohol Absolute	2 gal
Sodium Dichromate	12 lb
*Acetone	8 gal
*Ethyl Acetate	0 L
Phosphorus Pentoxide	0 gm
Ferrous Ammonium Sulfate	18 lb

*RCRA Chemical

Chemical Inventory (continued)

Nomenclature	Total
*Ethyl Ether	
Ferric Chloride Hexahydrate	24 oz
*Xylene	120 L
*Xylene	40 gal
Ammonium Hydroxide	54 L
Ammonium Hydroxide	1,400 ml
Sodium Hypochlorite (Bleach)	35 gal
*Methanol	65 gal
*Formaldehyde	176 L
*Formaldehyde	4 gal
Ammonium Acetate Crystalline	200 gm
Chloramine T Crystalline	3,500 gm
Mecuric Thiocyanate	100 gm
*Acetonitrile	8,000 ml
*Acetonitrile	8 L
*Acetonitrile	3 gal
Acetylthiocholine	100 gm
Agar Powder	10 lb
Ammonium Chloride	8,500 gm
Ammonium Chloride	10 kg
Ammonium Nitrate	7,500 gm
Ammonium Peroxydisulfate	2,500 gm
Beeswax	5 lb
*Benzene	60 L
*Benzene	35,500 ml
Antimony Potassium Tartrate	4,000 gm
Barbituric Acid	150 gm
Barbituric Acid	400 gm
Chromium Trioxide	6,000 gm
Disodium Ethylenediamine Tetraacetate	500 gm
Hydrazine Sulfate Powder	600 gm
Hydrogen Peroxide 30%	12,000 ml
Potassium Hydrogen Phthalate	500 gm
Phenolphthalein	200 gm
1-Propanol	1 L
Silver Nitrate	2,600 gm
Silver Nitrate	24 oz
Starch, Soluble, Powder	500 gm
Starch Indicator Solution	3 L

* RCRA Chemical

Chemical Inventory
(continued)

Nomenclature	Total
Sodium Lauryl Sulfate	3,000 gm
Talcum Powder	2,000 gm
Triethylenediamine	3,500 gm
Methyl Red pH Indicator	120 gm
p-(p-Dimethylaminophenylazo)B	150 gm
2-Propanol	
Sodium Hydroxide 50%	3 pt
Sodium Phosphate Dibasic Anhydrous	1,000 gm
Sodium Phosphate Dibasic Anhydrous	300 gm
Sodium Phosphate Dibasic Anhydrous	1,500 gm
Sodium Phosphate Dibasic Anhydrous	3 kg
Ferric Nitrate	2,000 gm
Hypophosphorous Acid 50%	2,500 ml
o-Phosphoric Acid 85%	5,500 ml
THAM (Tris Hydrox Aminomethane)	3,000 gm
3-Methyl-1-Phenyl-2-Pyrazolin-5-One	400 gm
Benzylamine	400 gm
Cadmium Chloride	2,500 gm
Potassium Phosphate Crystal	5,500 gm
Carbon, Activated	5 lb
4-Picoline	500 gm
HEPES	30 gm
Ethylenediamine	15,000 ml
Ethylenediamine	2,500 gm
n-Butyl Phthalate	6 gal
1,2-Dichloroethane	76 kg
1,2-Dichloroethane	16 gal
N,N-Dimethylformamide	4 gal
N,N-Dimethylformamide	4,500 gm
*Isobutyl Alcohol	11,500 ml
Sodium Acetate	11 lb
Sucrose	6,000 gm

*RCRA Chemical

Chemical Inventory
(continued)

Nomenclature	Total
*Trichloroethylene	12,000 ml
Trichloroacetic Acid	100 ml
Ammonium Persulfate	1,500 gm
o-Dianisidine	100 gm
Potassium Dichromate	1,500 gm
Calcium Sulfate	500 gm
Sodium Phosphate	3,500 gm
EDTA	400 gm
Citric Acid, Anhydrous	4,500 gm
Potassium Phosphate	5,500 gm
Thyodene	600 gm
Sodium m-Arsenite	100 gm
Dipropylene Clycol	0 kg
2-Methyl-2,4-Pentanediol	6 kg
Nitrobenzene	8 L
Corn Oil	10 L
Triethyl Phosphite	4 kg
Methyl Salicylate	2 gal
Dibutyl Phthalate	12 L
Glycine	3,000 gm
Cesium Chloride	100 gm
2,2'-Azinobis (3-Ethylbenzthiazoline)	6 gm
EGTA	50 gm
Hydrochloric Acid 0.05 mol/L	0 ml
Tris Hydrocholoride	600 gm
*Benzene	8 pt
Boric Acid	5,000 gm
Calcium Chloride	6,500 gm
Calcium Chloride	3 lb
Citric Acid	3 lb
Citric Acid	2,500 gm
Cupric Sulfate	2,500 gm
*3,3'-Dimethoxybenzidine	400 gm
Ethyl Phthalate	112 L
Ferric Ammonium Sulfate	6,500 gm
Ferric Ammonium Sulfate	125 gm

*RCRA Chemical

10

Chemical Inventory
(continued)

Nomenclature	Total
Ferric Citrate	10 lb
Hexane	
Hexanes	4 L
Karl Fisher Reagent	3,000 ml
Magnesium Sulfate Crystal	14,000 gm
Manganese Chloride Crystal	2,125 gm
Manganese Chloride Crystal	6,000 gm
*Methanol	3 L
*Methylene Chloride (Dichloro-methane)	0 L
Octane	200 gm
Petroleum Ether	
*Phenol	10 pt
Potassium Chloride	16,500 gm
Potassium Hydroxide	3,500 gm
Potassium Iodide	1,375 gm
Potassium Iodide	7 lb
Potassium Permanganate	11,000 gm
Potassium Thiocyanate	20 oz
Potassium Thiocyanate	200 gm
*Pyridine	0 ml
Sodium Bicarbonate	7 lb
Sodium Bisulfite	4,500 gm
Sodium Carbonate	5 kg
Sodium Carbonate	4,500 kg
Sodium Chloride	0 gm
Sodium Perborate	6 lb
Sodium Perborate	6,000 gm
Sodium Perchlorate	14,500 gm
Sodium Thiosulfate	1,500 gm
Stannous Chloride	5,000 gm
Sulfuric Acid	5,000 ml
*1,1,2,2-Tetrachloroethane	0 kg
*Tetrahydrofuran	4,000 ml
*Toluene	6 L
*Toluene	28 L
Zinc Chloride	1,500 gm
Zinc Chloride	100 gm
Fluoresein	1,900 gm
Boileezers	6 Bottle
Congo Red	150 gm

* RCRA Chemical

Chemical Inventory
(continued)

Nomenclature	Total
Diethyl Succinate	5,000 gm
*1,1-Dimethylhydrazine	1,000 gm
*Ethyl Acetate	0 L
*Ethyl Acetate	6 pt
Indole Crystal	50 gm
Indole Crystal	1,200 gm
Iodine	300 gm
Iodine	40 oz
Phthalic Acid	9,000 gm
Meta-Sodium Arsenite	5 lb
Dimethylsulfoxide	6 L
Ethylene Glycol	15,000 ml
4-(p-Nitrobenzyl) Pyridine	15 gm
Petroleum Ether	2,000 ml
*Methanol, Absolute	500 ml
Sodium Sulfate	25 lb
Ammonium Molydate	6,000 gm
Ammonium Carbonate Lump	5,500 gm
Disodium Pyrophosphate	3,000 gm
Guanidine	600 gm
Ethylene Glycol Monoethyl Ether	12 L
Ethylene Glycol Monomethyl Ether	5 gal
o-Dinitrobenzene	300 gm
m-Dinitrobenzene	200 gm
Glycerol	8 gal
Saline Solution, 85% PF	10 L
1-Octanol	2,000 ml
1-Pentanol	4 L
Isopropanol	0 oz
n-Butanol	4,000 ml
sec-Butanol	3,000 ml
Methyl Ethyl Ketone	2,000 ml

*RCRA Chemical

Chemical Inventory
(continued)

Nomenclature	Total
Hydrochloric Acid 1.0 mol/L	0 gal
Malonic Acid Dimethyl Ester	4 L
Acetylthiocholine Chloride	20 gm
5,5-Dimethyl-1,3-Cyclohexanedione	200 gm
p-Aminoacetophenone	300 gm
DTNB	200 gm
DTNB	5 gm
4-(p-Nitrobenzyl) Pyridine	100 gm
Potassium Iodide	1,000 gm
Barium Nitrate	11,500 gm
Polyethylene Glycol	500 gm
Magnesium Sulfate	500 gm
Potassium Nitrate	3,000 gm
MOPS Buffer	150 gm
D(+)-Glucose	600 gm
Potassium Acetate	3,000 gm
Magnesium Chloride	600 gm
Potassium Nitrate	500 gm
Ethanolamine	500 ml
Silica Gel	10 kg
Tri-n-Butyl Phosphate	1,000 ml
Sodium Hydroxide 1.0 N	4 gal
Sodium Hydroxide 0.5 mol/L	4 gal
Sodium Metal	
Carbon Disulfide	1,000 ml
Ethyl Acetate	500 ml
p-Dioxane	4 L
Cyclohexane	1,000 ml
n-Hexane	4,000 ml
Triethylamine	3,000 ml
Phenyl Acetate	1 10/20 gm
Polyvinyl Alcohol	8 oz
Ammonium Perchlorate	22.5 kg
Sodium Chlorate	5 kg

*RCRA Chemical

Chemical Inventory
(continued)

Nomenclature	Total
Lead Nitrate	100 gm
Bromine	1 lb
Phosphorus Pentoxide	12,000 gm
Zinc Sulfide	500 gm
Potassium Ferricyanide	100 gm
Phenol Crystal	0 lb
Lithium Chloride	500 gm
Ferric Chloride	200 gm
Copper Chloride	500 gm
Cobalt Chloride	250 gm
Nickel Chloride	500 gm
Sodium Saccharin	3,000 gm
Basic Fuchsin	4,700 gm
Thymolphthalein	400 gm
Sodium Thiocyanate	500 gm
Iron Chloride Anhydrous	1 kg
Zinc Dust	5 kg
2-Methyl-2-Butanol	3 kg
Sodium Borate	24 lb
Trioxane	9 kg
2-Hydroxyethyl Ether	4 kg
Paraformaldehyde	15 kg
Trifluoroacetic Anhydride	700 gm
4-Nitrophenol	1,800 gm
2,2,4-Trimethylpentane	6,000 gm
Sodium Ethoxide	1,000 gm
Quinoline	9 kg
Benzyl Chloride	4 kg
Mesityl Oxide	3 kg
Copper (II) Sulfate Pentahydrate	1 kg
Triethylbenzene	3 kg
Phenyl Ether-Biphenyl Eutectic	3 kg
Chloropicrin	4,500 gm
N,N-Diethyl-m-Toluamide	500 gm
Chromyl Chloride	250 gm

*RCRA Chemical

Chemical Inventory
(continued)

Nomenclature	Total
4-Methyl-2-Pentanol	16 L
tert-Amyl Chloride	800 gm
1-Dodecanethiol	4,000 gm
2,3-Dimethyl-2-Butene	1 kg
Valeraldehyde	2 kg
4-Hydroxy-4-Methyl-2-Pentanone	9 kg
Amyl Acetate	11,500 ml
Alcohol, Denatured	3 gal
Cholorform	500 ml
Drierite Dessicant	0 lb
Dessicant Blue	0 lb

* RCRA Chemical

Blank

APPENDIX B

Biotechnology Inventory
(as of 22 January 1988)

Hybridoma Cell Lines

HYBRIDOMAS	ANTIBODY SPECIFICITY
1. 3H5-1 Type specific ab to Dengue Type 2 virus	New Guinea C strain
2. 15F3 Type specific ab to Dengue Type 1 virus	Hawaiian strain
3. 1H10-6 Type specific ab to Dengue Type 4 virus	H241 strain
4. 5D4-11 Type specific ab to Dengue Type 3 virus	H87 strain
5. M2-1C6-4R3 Anti-Influenza A	Matrix protein
6. H16-L10-45R Anti-Influenza A	Type A nucleoprotein
7. 46/4 Anti-Influenza A	Type A nucleoprotein
8. VD-10 Anti-saxitoxin binding/sodium channel protein	250 Kd protein from *E. electricus* electroplex membrane
9. AE-1 Anti-human acetylcholinesterase (from erythrocytes)	Erythrocyte and nuero-muscular AChE
10. AE-2 Anti-human acetylcholinesterase	As above, different site
11. D3-2H2-9-21 Anti-Dengue virus complex	All 4 Dengue virus types
12. mAb35 Rat-mouse hybridoma	AChR alpha subunit
13. CEM-CM3 Human acute lymphoblastic leukemia	Human-human fusion partner
14. P3X63-Ag8.653 Non-secreting mouse myeloma	Balb/C mouse fusion partner
15. SP2/O-Ag14 Nonsecreting mouse myeloma	Balb/C mouse fusion partner
16. 2D12 Anti-Yellow Fever virus	Envelope protein of wild-type Asibi and vaccine strains
17. PEG-1-6 Mouse anti-Influenza virus	Not yet totally characterized
18. 73/1 Anti-Bangkok Influenza A virus	Bangkok A (1/79) strain

Microorganisms

Bacteriophage

Lambda gt 10
Lambda gt 11

Bacteria and Yeast

Acinetobacter sp.
Bacillus subtilus
Escherichia coli - HB 101
- JM 103
- JM 103/pBR322
- JM 103/M13mp10
- JM 103/M13mp11
- JM 103/M13mp18
- JM 103/M13mg19
- JM 103/PUC8
- JM 103/PUC9
- c600 hflA
- c600
- Y1089
- Y1090

Flavobacterium sp.
Pseudomonas putida strains
Saccharomyces cerevisiae strain
Salmonella typhimunium strains
Thermus aquaticus
Thermus thermophilus
Vibrio strains
Unidentified bacterial strains
Mustard resistant isolates
Obligate halphilic isolates
Obligate thermophilic isolates

Fungi

Unidentified fungal isolates

Toxins

2-cobratoxin
Mojave toxin
Cyclopiazonic acid
Aflatoxin
Maitotoxin
Staphlococcal enterotoxin B
Ricin toxin
Histrionico toxin
2-bungarotoxin

Verruculogen
Aflatrem
Picrotoxin
Ciguatoxin

Mycotoxins

Simple Trichothecenes
- T-2 Toxin
- T-2 Tetraol
- Neosolaniol
- Nivalenol
- Deoxynivalenol
- Verrucarol

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APPENDIX C

GLOSSARY OF ACRONYMS AND ABBREVIATIONS

A	Army
AMC	Army Materiel Command
AMCCOM	Armament, Munitions, and Chemical Command
AMCR	Army Materiel Command Regulation
AMEDD	Army Medical Department
ANSI	American National Standards Institute
APG	Aberdeen Proving Ground
AR	Army Regulation
ARRADCOM	Armament Research and Development Command
ARRCOM	Armament Materiel Readiness Command
BG	Bacillus subtilis var. Niger
BOD	Biochemical Oxygen Demand
BTU	British Thermal Unit
Bldg	Building
C	Celsius
CAIC	Chemical Accident/Incident Control
CAICC	Chemical Accident/Incident Control Center
CASARM	Chemical Agent Standard Analytical Reference Material
CASY	Chemical Agent Storage Yard
CB	Chemical and Biological
CBR	Chemical, Biological, and Radiological
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations

CHS	Controlled Hazardous Substance
cm	Centimeter
CPRP	Chemical Personnel Reliability Program
CRDC	Chemical Research and Development Center
CRDEC	Chemical Research, Development, and Engineering Center
CSL	Chemical System Laboratory
CSM	Chemical Surety Materiel
CSO	Chemical Surety Office
CSP	Chemical Surety Program
CTF	Chemical Transfer Facility
CW/CBD	Chemical Weapons and Chemical and Biological Defense
CXs	Categorical Exclusions
Co.	Company
DA	Department of the Army
DARACOM	Development and Readiness Command
DDESB	Department of Defense Explosive Safety Board
DEH	Directorate of Engineering and Housing
DMMP	Dimethyl Methyl Phosphonate
DOD	Department of Defense
DOT	Department of Transportation
DDT	Dichlorodiphenyl Trichloroethane
EA	Environmental Assessment
EIS	Environmental Impact Statement
EMD	Environmental Management Division of the Directorate of Health, Safety, and Environment
EMR	Electromagnetic Radiation

EOD	Explosives Ordnance Disposal
EQC	Environmental Quality Control
EQO	Environmental Quality Office
ERM	Environmental Radiation Monitoring
FM	Field Manual
FONSI	Finding of No Significant Impact
FR	Federal Register
gal	Gallon
GB	Nerve Agent, Sarin
H	Sulfur mustard
HD	Sulfur mustard (distilled)
HEPA	High-Efficiency Particulate Aerosol
HMB	Hazardous Materials Branch
HPLC	High Pressure Liquid Chromatography
HT	Sulfur mustard
HVSO	Health and Veterinary Services Office
ICD	Institute of Chemical Defense
ILS	Integrated Logistic Support
IRP	Installation Restoration Program
Incl	Inclosure
Kg	Kilograms
Km	Kilometers
Kph	Kilometers per hour
L	Liter
LAURC	Laboratory Animal Use Review Committee
LIC	Lethal Incapacitating Compound
LSD	Lyseric Acid Diethylamide

m	Meter
MCA	Military Construction Activities
MCE	Maximum Credible Event
MSDS	Material Safety Data Sheet
mg	Milligrams
N/A	Not Applicable, Not Available
NBC	Nuclear Biological Chemical
NEPA	National Environmental Policy Act
NFPA	National Fire Protection Association
NIH	National Institute of Health
NMR	Nuclear Magnetic Resonance
NPDES	National Pollutant Discharge Elimination System
NRC	Nuclear Regulatory Commission
NSTL	National Space Technology Laboratory
No.	Number
OSHA	Occupational Safety and Health Administration
PAD	Product Assurance Directorate
PEG 200	Polyethylene glycol
PL	Public Law
pp.	Pages
PRP	Personnel Reliability Program
PSD	Prevention of Significant Deterioration
R	Regulation
R&D	Research and Development
RCRA	Resource Conservation and Recovery Act
RDES	Research, Development and Engineering Support

RPO	Radiation Protection Officer
RTPP	Receptor Technical Program Plan
Rm	Room
SOP	Standing Operating Procedure
SPCC	Spill Prevention Containment and Countermeasure
STB	Supertropical Bleach
TAP	Toxicological Agent Protection
TBMED	Technical Bulletin, the Medical Department
TDD	Technical Data Division
TDP	Technical Data Package
TEU	Technical Escort Unit
TM	Technical Manual
US	United States
USAMRICD	United States Army Medical Research Institute of Chemical Defense
USAMRIID	United States Army Medical Research Institute of Infectious Diseases
USAAPGSA	United States Army Aberdeen Proving Ground Support Activity
VX	O-ethyl-S-(2-diisopropylaminoethyl) methylphosphonothiolate (a nerve agent)
Vol	Volume
w/	With

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APPENDIX D

LIST OF PREPARERS

The following WESTON (Roy F. Weston, Inc.) personnel were involved in the preparation of this Operational Environmental Assessment of CRDEC.

<u>Kenneth J. Salamon, Ph.D.</u> - Project Direction
Project Director

B.S., Biology - Fordham College (1967)

M.S., Environmental Science - Fordham University (1975)

Ph.D., Environmental Physiology - Fordham University (1979)

Postdoctorate, Environmental Toxicology - New York University (1980)

Dr. Salomon has twelve years experience in the design, implementation, and management of complex environmental studies, including integration and analysis of multimedia toxics transport, pathway, and exposure data. Skill areas include risk assessment/management of hazardous chemicals and wastes; environmental baseline, impact and siting studies; fate/effect and treatability of chemicals and wastes; and regulatory compliance analysis and management.

<u>Richard T. Williams, Ph.D.</u> - Project Management
Section Manager

B.A., Microbiology/Zoology - University of New Hampshire (1973)

M.A., Biology - Washington University (1976)

Ph. D., Environmental Microbiology/Ecology - University of Minnesota (1982)

Postdoctorate, Industrial Microbiology - Butler Research and Engineering (1982-1983)

Postdoctorate, Biotechnical Hazardous Substance Treatment - Freshwater Biological Institute (1983)

Dr. Williams has twelve years broad-based and interdisciplinary experience in: aquatic and terrestrial environmental fate and effects, exposure evaluations, toxic hazard assessments, industrial and environmental microbiology, technical assessments, and research and development of the use of biotechnical and genetic technology for toxic substance destruction in environmental media. His most recent experience has been with multidisciplinary project development and management.

Korah T. Mani, AICP - Report Coordination
Principal Planner

B.S., Civil and Structural Engineering - Sambalpur University, India (1967)

M.S, City Planning - Indian Institute of Technology, Kharagpur, India (1969)

M.S., Transportation Engineering - Villanova University (1982)

Mr. Mani has nineteen years experience in a wide range of environmental, transportation, and socioeconomic impact analyses and assessments for water and wastewater management facilities, industrial siting, hazardous and low-level radiation waste handling, treatment and disposal sites, and industrial and municipal co-generation facilities. Mr. Mani also has experience with a range of projects involving public participation and presentation, regulatory agency interface, project coordination, and report preparation.

Donald M. MacGregor - Data Analysis
Associate Planner/Cartographer

Undergraduate work in Architecture/Engineering - McGill University

Mr. MacGregor has twelve years experience in a wide range of environmental and engineering projects including: regional planning; land use/suitability studies; socioeconomic base line studies, impact analysis, hazardous/low level radioactive waste storage/stabilization feasibility studies; and environmental regulatory review and compliance audits. His experience has also been in multidisciplinary cartography; data collection, review, and analysis; design and development of presentations; and report writing and production.

John S. Howell, P.E. - Incineration/Air Quality
Senior Project manager

B.S., Chemical Engineering - Drexel University (1970)

M.S. Environmental Engineering-Drexel University (1971)

Mr. Howell has twenty years experience in air quality and related environmental engineering experience in the development of toxic air pollutant programs; environmental audits for chemical plants, machinery plants, and hazardous waste treatment and disposal sites; hazardous waste management programs; regulatory requirements analysis and compliance management. He has worked at the U.S. Environmental Protection Agency and a number of manufacturing companies and consulting firms.

Walter J. Wujcik, Ph.D., P.E. - Environmental Engineering Section Manager

B.S., Civil Engineering - Manha Ham College (1973)

M.Eng., Environmental Engineering - Manhalforn College (1974)

Ph.D., Environmental Engineering - Cornell University (1980)

Dr. Wujcik has over twelve years environmental engineering experience in the design and permitting of industrial waste treatment and disposal systems; development of hazardous waste disposal technologies; groundwater monitoring programs; innovative sludge and wastewater treatment processes and on-site treatment technologies; environmental auditing and hazardous waste/solid waste incineration facility permit application development.

Patrick J. Rafferty, CIH - Industrial Hygiene Department Manager

B.S., Chemistry - University of Delaware (1975)

M.S.P.H., Environmental Chemistry and Biology - University of North Carolina (1977)

Certified Industrial Hygienist, American Board of Industrial Hygiene - Comprehensive Practice (1986)

Mr. Rafferty has over ten years experience in the evaluation of public health and industrial hygiene aspects of environmental hazards. He has conducted assessments for the Office of Regulatory Analysis of the U.S. Occupational Safety and Health Administration and has served as a technical consultant on public health issues to Federal, state, and local governmental agencies. Mr. Rafferty has conducted industrial hygiene evaluations of numerous industrial facilities and is qualified as an expert witness in the field of industrial hygiene.

Kurt R. Philipp - Environmental Resources Analysis Section Manager

B.A., Biology - University of Delaware (1973)

M.S., Geography - University of Delaware (1977)

Ph.D., Marine Studies - University of Delaware (1987)

Dr. Philipp has ten years experience in: botanical and vertebrate taxonomy; community ecology; computer programming; environmental impact assessment; thermal hydrographic surveys; climatic modeling; design and supervision of climatological data collection; toxico-toxicology; hazardous and radioactive waste siting and impact, wetland delineation.

The following CRDEC staff was involved in the preparation of this Operational Environmental Assessment.

Kathleen M. Buchi, Ph.D. - Contract Officer Representative

B.S., Chemistry - Carnegie Mellon University (1975)

Ph.D., Physical Chemistry - Loyola University of Chicago (1983)

Dr. Buchi has eleven years broad-based and interdisciplinary experience in: handling toxic chemicals, exposure evaluation, toxic hazard assessments, preparation of environmental documents, and permitting of industrial treatment facilities.

APPENDIX E

List of Personnel Contacted by Office/Directorate

Technical Escort Unit	CPT Kenneth A. Crotty
Advance Systems Concept	Robert A. Breschi
Chemical Surety Office	Michael B. Dezearn SGT Seankevin A. Lakeman
Detection Directorate	James C. Chalcraft Joseph S. Mirenda Thomas R. Gervasoni George K. Reynolds Michael T. Goode
Environmental Quality Office	Teresa M. Mann Robert L. Muhly John M. Bane Daniel J. Wenz C. Reed Magness
Management Information Systems Directorate	Ralph F. Falcone Sol H. Heller
Mask Management Office	John J. Franz
Munitions Directorate	Elizabeth S. Catalano Carl E. Gepp Joseph A. Domanico
NBC Survivability Office	Frank J. Belcastro
Physical Protection Office	Leonard J. Beeson Robert C. Grue Louis Kanaras Brian K. MacIver Robert R. Gavlinski
Research Directorate	Raymond E. Miller MSG Gary L. Fenstamaker Dr. Edmund G. Cummings Paul M. Davis LTC Stanley P. Liebenberg SGT David C. Squire

Research, Development and Engineering Support Directorate	William H. Collins Donald D. Bauman Patricia R. Miskelly Bruce Lewbart Narendra N. Desai Timothy A. Blades Jeffrcy L. Hinte Millie L. Bensch Derinda J. Heaps Arnold E. Wagner James E. LaPlume David E. Greene Michael Burke
Safety Office	George E. Collins Frank G. Lattin Raymond Z. Mastnjak Carol A. Eason
Test and Evaluation Office	Michael D. Smith
Product Assurance Directorate	Dr. William J. Maurits William C. Ng