United States General Accounting Office

GAO

Report to the Chairman, Committee on Governmental Affairs, U.S. Senate

January 1993

CHEMICAL AND BIOLOGICAL DEFENSE

U.S. Forces Are Not Adequately Equipped to Detect All Threats

GAO/NSIAD-93-2

GAO

United States
General Accounting Office
Washington, D.C. 20548

National Security and
International Affairs Division

B-248932

January 26, 1993

The Honorable John Glenn
Chairman, Committee on Governmental Affairs
United States Senate

Dear Mr. Chairman:

This report responds to your request that we review the Department of Defense's (DOD) program to design, develop, and field chemical and biological agent detection equipment. Our specific objectives were to determine

- whether U.S. forces had adequate chemical and biological detection capability during Operation Desert Storm;[1]
- what emphasis the Army, as DOD's executive agent for chemical and biological defense, has placed on the development of biological threat detection; and
- whether chemical and biological detection requirements are identified early enough to direct basic agent detection research and preliminary equipment development.

Results in Brief

At the outset of Operation Desert Storm, U.S. military forces had the capability to detect all known Iraqi chemical agents and to warn its forces of an attack. However, they had an extremely limited capability to detect biological threats. Prior to the start of Operation Desert Storm, the Army provided its troops with biological detection kits that could manually detect two biological warfare agents. However, these kits could not give advance warning of a biological attack and, thus, would not have prevented casualties. Rather, they would primarily have been useful in aiding diagnosis and treatment of troops following biological agent contamination. Information contained in an Army document on the lessons learned during Operation Desert Storm indicates that if Iraq had used the biological warfare agents that were available to it, such as anthrax and botulinum toxin, there could have been enormous fatalities and the Army's medical treatment system could have been overtaxed.[2]

[1]The use of the term "Operation Desert Storm" includes both the buildup of allied troops and equipment during Operation Desert Shield and their use in combat against Iraqi forces during Operation Desert Storm.

[2]Lessons Learned From Operation Desert Shield/Desert Storm, Headquarters, Department of the Army, Office of the Deputy Chief of Staff (Operations), July 19, 1991.

The Army's biological detection capability was limited in part because it has not placed a high priority on improving this capability. In the 6 years preceding Operation Desert Storm, less than 7 percent of total chemical and biological detection research and development funds went to biological agent detection. DOD and Army program officials stated that, although the intelligence community had warned about the increasing availability of biological agents, little emphasis was placed on their detection because DOD's analyses discounted the use of biological warfare. As a result of Operation Desert Storm, biological detection research now accounts for approximately 30 percent of total chemical and biological detection research and development funding.

The Army has been slow to develop and field adequate chemical and biological detection equipment because its early research efforts are not based on specific field requirements to defeat known enemy threats. Specific field requirements are not identified until equipment being developed transitions from exploratory development to advanced development. As a result, early research efforts have tended to produce items of marginal utility and little effort is given to developing new technology to address specific threats.

Background

The Army is DOD's executive agent for developing, testing, and fielding chemical and biological detection equipment for the military services. The Battlefield Development Plan (BDP) is the planning document that identifies the capabilities the Army needs to fight a war such as the capability to detect chemical and biological agents. The plan also identifies and prioritizes critical capabilities needed to correct battlefield deficiencies. The U.S. Army Chemical School, Fort McClellan, Alabama, a component of the U.S. Army Training and Doctrine Command (TRADOC), represents the forces that use these capabilities. The Chemical School's Combat Development Directorate is responsible for developing the materiel requirements for chemical and biological detection equipment. The U.S. Army Chemical Research, Development, and Engineering Center (CRDEC), Aberdeen Proving Ground, Maryland, had primary responsibility for the research and development of chemical and biological detection equipment until October 1, 1992.[3] Technology base research and development funding for chemical and biological detection equipment was

[3]Effective October 1, 1992, Headquarters, U.S. Army Materiel Command (AMC) established the U.S. Army Chemical and Biological Defense Agency (CBDA). Formerly CRDEC, the agency is commanded by the Deputy Chief of Staff for Chemical and Biological Defense, AMC. Within CBDA is the Army Edgewood Research, Development and Engineering Center with a civilian director.

controlled until October 1, 1992, by the U.S. Army Laboratory Command, a subordinate activity of the U.S. Army Materiel Command.[4]

There are two types of chemical and biological detectors, point and standoff. Point detectors must have contact with the agent to be activated, thus giving troops little time to react to a chemical and biological attack. Personnel in the area of the point detector would most likely be contaminated by the time they became aware that an attack was occurring. Standoff detectors, on the other hand, can detect the presence of agents some distance from the detection system, thus giving troops time to take protective measures against the coming attack.

Both point and standoff detectors may be either automatic or manual. Automatic detectors immediately alert personnel of the presence of a chemical and biological warfare agent. Manual detectors, on the other hand, are used by individuals to analyze a sample of air or soil for the presence of chemical and biological agents.

Chemical Detection Capabilities Existed but Biological Capability Was Limited

U.S. forces in the Persian Gulf possessed chemical agent detectors capable of identifying all of the chemical agents believed to be in the Iraqi arsenal. However, at the outset of Operation Desert Storm, they did not have the capability to detect any biological agents. During Operation Desert Storm, a rudimentary biological point detection system was made available. This system would have provided no advance warning of a biological attack, but would have aided in the process of confirming that an attack by some agents had occurred.

U.S. Forces Possessed Chemical Detection Capabilities

At the start of Operation Desert Storm, U.S. forces possessed an array of chemical point detectors. These included (1) an automatic detector/alarm capable of detecting nerve agents; (2) a hand-held, manually operated device for monitoring chemical agent contamination on personnel and equipment; (3) a nuclear, biological and chemical reconnaissance vehicle (called the Fox), that contains a manually operated mass spectrometer[5] capable of detecting various chemical agents; and (4) various chemical agent detection kits and detection papers. In addition, the Army deployed

[4]Effective October 1, 1992, Headquarters, AMC established the U.S. Army Research Laboratory (ARL). Formerly the U.S. Army Laboratory Command, ARL presently controls basic research funding allocations. CBDA is now directly funded for the remainder of the technology base research (exploratory development and advanced non-systems development) through AMC.

[5]A mass spectrometer is an analytical instrument that identifies a substance by sorting a stream of electrified particles according to their mass.

an automatic standoff chemical detection system, the XM21 nerve and blister agent detector. However, this system was still under development and had only a relatively short range. Officials responsible for the chemical defense readiness of U.S. forces stated that, between them, these detectors were capable of identifying all of the chemical warfare agents believed to be in the Iraqi arsenal.

U.S. Forces Provided a Rudimentary Biological Detection Capability Prior to the Onset of Hostilities

At the outset of Operation Desert Storm, the Army had no equipment capable of detecting any Iraqi biological agents. However, the Army was able to develop and deploy rudimentary point biological agent detection kits prior to the start of hostilities. These kits were capable of detecting anthrax and botulinum toxin, but they would not have provided the troops using them with any advance warning of a biological attack. Further, the kits would have provided no confirmation of a biological attack until 13 to 24 hours after the attack had occurred. While their use would have aided in the earlier treatment of biological casualties, the Army concluded that had Iraq used biological warfare agents, the result could have been an enormous number of fatalities and a breakdown of the Army's medical treatment system.

Army Has Placed a Low Priority on Biological Detection

In the years preceding Operation Desert Storm, the Army placed little emphasis on developing biological detection equipment, focusing instead on improving its chemical detection capabilities. DOD and Army program officials stated that they did not view biological warfare as a major threat. The vulnerability of U.S. forces to an Iraqi biological attack increased attention on the need for improved biological detection capabilities. The result has been a significant increase in the percentage of funds applied to biological detector development.

Little Past Emphasis on Biological Detection

Although chemical and biological warfare agents have the same prominence in the Army's Battlefield Development Plan, the Army has placed its primary focus on developing technologies to detect chemical, rather than biological, agents. Only $18.9 million (or 6.8 percent) of the $276.9 million spent to research and develop chemical and biological detection from fiscal years 1984 through 1989 went for biological detection. The remainder was spent on chemical detection. Not until after Operation Desert Storm was there a significant increase in expenditures for developing biological detection equipment. Total chemical and biological detection expenditures during fiscal years 1990 and 1991

amounted to $168.1 million, of which $42.8 million (or 25.5 percent) was spent on biological detection. In fiscal year 1992, the percent increased to 29.6 percent ($20.9 million out of a total of $70.5 million in research and development funds allocated for chemical and biological detection).

The Army's wargame modeling scenarios reflect the lack of emphasis on chemical and biological agents. Although chemical warfare has not been made a part of the computer model, its impact has been considered during analysis of the computer-generated data. However, the biological threat has not been considered at all.

Both the Deputy to the Assistant Secretary of Defense for Acquisition (Atomic Energy) and Army program officials told us that biological warfare did not warrant focus as a major threat prior to the recent events in the Persian Gulf. However, other opinions existed within the defense community. For example, an Army medical intelligence officer testified before the Senate Governmental Affairs Committee in 1983 about the potentially devastating effects of biological warfare and discussed the increasing availability of biological agents. That same year, the Under Secretary of the Army for Materiel Acquisition expressed concern about the Army's readiness against biological agents, requesting that the schedule for developing remote detectors for nuclear, biological and chemical threats be shortened by 4 years. Similarly, the Army's 1985 Reconnaissance, Detection, and Identification Master Plan for chemical and biological defense cited the lack of an established science and technology base for standoff biological detection as a problem that needed to be overcome.

Following Operation Desert Storm, the Army accelerated its schedule to field two different biological point detectors that were under development. These two detectors—a vehicle mounted chemical/biological mass spectrometer and a hand-held biological detector—were originally planned to be fielded by fiscal year 2002. The Army is now planning to field them by fiscal year 1995. It also plans to continue research to develop standoff biological agent detectors.

DOD Does Not Identify Threats Early Enough

Army efforts to develop and field biological and chemical detection equipment have been impeded by a research and development process that is not based on specific field requirements to defeat known enemy threats. Instead, early research efforts tend to be directed toward general deficiencies, such as detection, that can be addressed with existing

technology. As a result, the Army has not developed the new technology that is needed to address specific field requirements, such as a standoff biological detection capability. Also, it has slowed the Army's efforts to develop new technology needed to address emerging threats, such as microencapsulated[6] and genetically engineered agents.

DOD Instruction 5000.2, Defense Acquisition Management Policies and Procedures, dated February 23, 1991, does not require a Mission Needs Statement to support the development of a specific item until the item is in transition from exploratory development to advanced development.[7] In other words, there is no documented consideration of actual user needs to counter validated threats until after the conclusion of the research and exploratory development phases. At this time the Chemical School prepares the initial requirements document to support further work on the item. As a result, exploratory research primarily addresses deficiencies identified in BDP and the Army's established Science and Technology Objectives.[8] However, neither BDP nor the Science and Technology Objectives provide CRDEC with specifically focused capability requirements.

TRADOC, Chemical School, and CRDEC officials acknowledged that available technologies, rather than user needs, drive the chemical and biological detection equipment research, development, and acquisition process. This approach is due to the perceived difficulty of developing new technologies to meet user needs. As a result, researchers have tended to concentrate on adapting existing technologies.

TRADOC, Chemical School, and CRDEC officials agreed that the Chemical School needs to issue a mission area requirement statement that defines the capabilities required to defend against an assessed threat. TRADOC officials agreed that the statement should cite a mission area deficiency, such as lack of an automatic standoff biological detector capable of providing troops with sufficient advance warning to take measures to avoid contamination. Further, these officials contend that it is up to CRDEC to determine whether the technology is available, and if not, CRDEC should

[6]Microencapsulation is a process by which a chemical or biological agent (either solid or liquid) is encased by an inert polymeric shell.

[7]Prior to February 23, 1991, the initial requirements document to support a program was called an Operational and Organizational Plan. It was required to be prepared prior to milestone I for all programs.

[8]Science and Technology Objectives (STO) were first listed in the November 1990 Army Technology Base Master Plan. Laboratory and Center leadership used these STOs to focus and manage a significant portion of their technology base program.

initiate the research to develop it. The fact that current detection technology was lacking should not have precluded the Chemical School from establishing a mission area requirement. Further, the lack of technology should have indicated to CRDEC that it needed to initiate research to develop the technology to satisfy the mission area requirement.

TRADOC officials advised us that as part of the Army's current concept studies, TRADOC is determining how to directly influence technology base research to ensure that material developers are developing technology responsive to the user's need to counter chemical and biological warfare agents. However, these officials state that it will be difficult to influence the technology base programs without greater influence over the funding process.

Little Emphasis on Emerging Chemical and Biological Threats

The Army's exploratory research program also places little emphasis on detecting emerging threats, such as microencapsulated and genetically engineered agents. As a result, future chemical and biological detection capabilities could also be limited. For example, the hand-carried biological detector under development could be defeated by a microencapsulated shell designed to withstand degeneration. Similarly, with the possible exception of the mass spectrometer, none of the detectors under development would be able to detect genetically engineered agents. CRDEC and Chemical School officials stated that since the mass spectrometer breaks the sample down into its various parts, it should theoretically be able to detect most genetically altered agents. However, this will not be known until it is tested against such agents.

Further, technological barriers must be overcome before the Army's hand-held biological detectors can detect known biological warfare agents. For example, point detectors generally use antigens to identify specific biological agents (antigens are substances that react to the presence of a specific biological agent). However, a CRDEC official explained that antigens are not yet available for all currently recognized biological agents, and some available antigens are not adequate for use in the detector. Therefore, improved antigens must be developed.

Recommendations

To reduce the vulnerability of U.S. military forces to possible biological attack, we recommend that the Secretary of Defense

- ensure that the current chemical and biological detection research and development priorities are compatible with the requirements to meet current and emerging or anticipated threats and
- strengthen policies and procedures to ensure that those responsible for determining materiel requirements, for developing chemical and biological detection equipment, and for representing the forces that will actually use the equipment work closely together early in the process to address specific field requirements.

As requested, we did not obtain agency comments on this report. However, we discussed the report's contents with Army and DOD program officials and incorporated their comments where appropriate. Our scope and methodology are discussed in appendix I.

Unless you publicly announce this report's contents earlier, we plan no further distribution of this report until 30 days after its issue date. At that time, we will send copies to the Secretaries of Defense and the Army; the Director, Office of Management and Budget; and other interested parties.

Please contact me at (202) 275-4141 if you or your staff have any questions concerning this report. Major contributors to this report are listed in appendix II.

Sincerely yours,

Henry L. Hinton, Jr.
Director, Army Issues

Scope and Methodology

To accomplish the review objectives, we discussed the capabilities of the various detection devices available for use in Operation Desert Storm with officials from the U.S. Army Chemical School, Fort McClellan, Alabama; the U.S. Army Chemical Research, Development, and Engineering Center, Aberdeen Proving Ground, Maryland; the Armed Forces Medical Intelligence Center, Fort Detrick, Maryland; and the U.S. Army Foreign Science and Technology Center, Charlottesville, Virginia. We also obtained information from the Army Chemical School on the chemical and biological detection deficiencies noted during Operation Desert Storm.

To obtain an understanding of the Army's current research, development, and acquisition process, we reviewed applicable DOD directives and Army regulations and spoke to officials from the U.S. Army Training and Doctrine Command, Fort Monroe, Virginia; the Army Chemical School; TRADOC Analysis Center; Combined Arms Command, Fort Leavenworth, Kansas; and the Army Chemical Research, Development and Engineering Center. These discussions included the basis for research and development work, perceptions of biological warfare threat, and the need for requirements documents before milestone 0 in the research, development, and acquisition process.

We also discussed the Army's efforts to research and develop equipment to defeat both existing and emerging chemical and biological warfare threat agents with officials from the Army Chemical Research, Development and Engineering Center; the Army Training and Doctrine Command, the Army Chemical School; the Armed Forces Medical Intelligence Center; and the Army Foreign Science and Technology Center.

Further, we discussed DOD's plans to enhance U.S. capabilities to detect and warn military personnel of the presence of biological warfare agents with officials from the Office of the Assistant to the Secretary of Defense for Atomic Energy, Washington, D.C.

Our audit work was completed prior to the establishment of the U.S. Army Chemical and Biological Defense Agency and the U.S. Army Research Laboratory. The material discussed in this report is in the context of the prior organizational structures.

We conducted our review from September 1991 to August 1992 in accordance with generally accepted government auditing standards.

Major Contributors to This Report

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