

May 1991

CHEMICAL WARFARE

Soldiers Inadequately Equipped and Trained to Conduct Chemical Operations



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The Honorable John Glenn
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United States Senate

The Honorable John Conyers, Jr.
Chairman, Legislation and National
Security Subcommittee
Committee on Government Operations
House of Representatives

The Honorable Earl Hutto
Chairman, Subcommittee on Readiness
Committee on Armed Services
House of Representatives

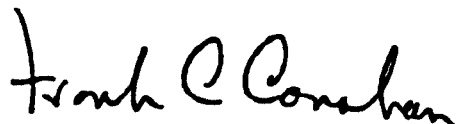
This report responds to your requests that we review the Department of the Army's Chemical Defense Program and determine whether U.S. Army forces are routinely trained and equipped to survive and sustain operations in a chemical environment. We found that the Army active and reserve units we visited, varying in size from an artillery battery to an infantry battalion, had not been adequately trained or equipped to survive and sustain operations in a chemical environment. On January 15, 1991, we issued a classified report on our findings. This is an unclassified version of that report.

Our review reflects the Army's training policy and practices and the equipment status of units before Operation Desert Shield began. According to Army officials, (1) the units that deployed to the Middle East received increased training for conducting operations in a chemical environment; (2) the deployed forces were not lacking in chemical protective clothing; and (3) sufficient chemical protection, detection, and decontamination equipment to meet both individual and unit requirements was available to deploying forces.

This review did not cover the training or equipment provided personnel involved in Operation Desert Shield. However, our evaluation demonstrated significant systemic problems in the Army's Chemical Defense Program. We are reviewing specific equipment provided to people deployed in Desert Shield.

We are sending copies of this report to the Chairmen of the House and Senate Committees on Armed Services and on Appropriations, the Secretaries of Defense and the Army, and the Director of the Office of Management and Budget. We will also provide copies to others upon request.

This report was prepared under the direction of Richard Davis, Director, Army Issues, who may be reached on (202) 275-4141 if you or your staff have any questions. Other major contributors to this report are listed in appendix II.

A handwritten signature in black ink that reads "Frank C. Conahan". The signature is written in a cursive style with a large initial 'F'.

Frank C. Conahan
Assistant Comptroller General

Executive Summary

Purpose

The number of countries possessing or attempting to acquire chemical weapons has increased. Several of the nations suspected of possessing these weapons are located in regions where the United States has a strategic interest.

The Chairmen of the Senate Committee on Governmental Affairs; the Subcommittee on Readiness, House Committee on Armed Services; and the Legislation and National Security Subcommittee, House Committee on Government Operations, asked GAO to determine whether U.S. soldiers were routinely trained and equipped to survive and sustain operations in a chemical environment. GAO's specific objectives were to determine whether

- soldiers were adequately trained to survive and sustain operations in a chemical environment and
- Army units were adequately equipped to carry out chemical training and wartime missions.

GAO's review did not cover the training or equipment provided personnel involved in Operation Desert Shield. However, according to Army officials, (1) the units that deployed to the Middle East have since received increased training for conducting operations in a chemical environment; (2) the deployed forces are not lacking in chemical protective clothing; and (3) sufficient chemical protection, detection, and decontamination equipment to meet both individual and unit requirements is being made available to deploying forces.

Background

Chemical training is intended to provide the individual soldier with the capability to survive a chemical attack and accomplish the assigned mission in a chemically contaminated environment. Army training policy requires that

- soldiers spend at least 4 continuous hours in full chemical protective gear during both basic training and field training exercises conducted at branch schools,
- soldiers perform their military occupational specialties and fire their weapons to standards while in full chemical protective gear, and
- unit chemical training be realistic and fully integrated into mission training.

Results in Brief

Many of the soldiers in 36 Army active and 4 reserve units GAO visited in the United States said they had not met the minimum time standards for training and unit training was not carried out under realistic conditions or integrated into mission training exercises as required.

Army evaluations of exercises carried out at its two main combat training centers in the United States also showed that units that did not stress chemical training throughout the year did not perform well and sustained heavy simulated casualties during the chemical scenarios of the exercises at the centers.

Although the Chemical School has updated the Army chemical warfare doctrine and performed studies to refine it, the other branch schools had not integrated the updated doctrine or the results of the studies into their doctrinal and training publications as required.

Three reserve units GAO visited in the United States were not adequately equipped to survive and sustain operations in a chemical warfare environment. Similarly in Europe, the levels of stocks in theater reserves and the prepositioned equipment storage sites GAO visited had major shortages of collective protection shelters, decontamination apparatuses, chemical alarms, and certain individual protection gear.

Over the past few years, the Army has developed and produced new chemical defense equipment. However, shortages and limitations in certain equipment items continue to hamper the Army's ability to effectively carry out sustained operations during a chemical attack. Further, some new equipment, although developed, has not been produced and delivered to the units.

Principal Findings

Chemical Training Is Inadequate

Army standards for training in full chemical protective gear were not being met. Soldiers' responses to specific questions asked by GAO showed that

- 35 of the 93 had not trained as required in full protective gear for 4 continuous hours since joining the Army,
- 26 of the 93 soldiers had never performed their job specialties in the full protective gear since joining the Army, and

- 30 of the soldiers were not sure they could survive a chemical attack because of a lack of training in the gear and a concern regarding the effectiveness of the gear itself.

Chemical specialists and unit commanders also confirmed that soldiers would not be able to perform combat operations in full gear for extended periods because they had not trained in it long enough to build endurance.

The training that GAO observed did not take place in realistically simulated chemical environments and was not integrated into mission or specialty training. At the Army's two main combat training centers in the United States, three of the four units GAO observed during exercises were not prepared to survive in a chemical environment. Evaluator/controllers at the centers told GAO that, in their opinion, the units had not properly trained for chemical warfare throughout the year.

At the Army's Chemical School, GAO found that most Army chemical warfare doctrine had been updated and studies had been performed to refine and identify weaknesses in doctrine. However, the three other branch schools within the Training and Doctrine Command visited by GAO had not integrated the updated doctrine or the results of the studies into their doctrinal or training publications. As a result, unit commanders did not know which mission-essential tasks needed to be modified or which ones could not be performed in a chemical environment.

Because of the potentially serious physical and psychological problems involved in wearing chemical protective gear for extended periods, soldiers should become accustomed to wearing it while performing mission-essential tasks. For example, the Army predicts that 25 percent of the casualties in a chemical attack will be caused by the claustrophobia, apprehension, and panic created by wearing protective gear for extended periods.

The major reasons for inadequate training are as follows:

- Unit commanders have little incentive to emphasize chemicals in mission training.
- Training guidance has not fully incorporated (1) the latest chemical warfare doctrine, which requires the integration of chemical and mission training, or (2) results of studies assessing the effects of chemicals on military operations.

Significant Equipment Shortages and Deficiencies Exist

Three of the four reserve units in the United States that GAO visited lacked the authorized chemical protective equipment they needed for training and wartime missions. Similarly, many of the 17 support units in Europe and 5 of the 7 that also have significant numbers of essential local national employee support have serious shortages of the equipment. In addition, theater reserves and prepositioned stocks, which would be used to supply units during a war, were below authorized levels. These shortages could contribute to training problems and could prevent units from performing their missions if attacked with chemicals.

A number of identified limitations in some existing equipment have not been corrected because of the lack of technological breakthroughs. In addition, some new equipment is not being delivered to units because of production difficulties.

Recommendations

GAO recommends that the Secretary of the Army ensure that (1) commanding officers responsible for conducting training fully comply with the minimum training standards set forth in Army regulations and (2) commanding officers of the Training and Doctrine Command and the Chemical School jointly evaluate the integration of chemical doctrine into the training guidance at the other branch schools and take the necessary corrective actions.

GAO also recommends that the Secretary of the Army ascertain whether (1) the funding level and priorities for developing, producing, and delivering chemical protective equipment should be changed; (2) authorized chemical equipment levels should be modified and equipment availability increased; and (3) production problems being encountered with new chemical protective equipment are being resolved.

Other recommendations that are designed to improve the ability of the Army to conduct military operations in a chemical environment are included in chapters 2 and 3.

Agency Comments

As requested, GAO did not request official agency comments on a draft of this report. However, the views of responsible officials were sought during the course of the work and are incorporated in the report where appropriate.

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Abbreviations

CANE	Combined Arms in a Nuclear and Chemical Environment
DOD	Department of Defense
GAO	General Accounting Office
P2NBC2	Physiological and Psychological Effects of the Nuclear, Biological, and Chemical Environment and Sustained Operations on Systems in Combat
POMCUS	Prepositioning of Material Configured in Unit Sets
TAACOM	Theater Army Area Command
TRADOC	Training and Doctrine Command

Introduction

In recent years, chemical weapons have proliferated throughout the world. Called the “poor man’s atomic bomb” by one head of state, chemical weapons are cheap and deadly. According to Department of Defense (DOD) estimates, about 20 countries, including many third world countries, have or are trying to acquire these weapons. Many of these countries are in the Middle East, where the United States has a vital strategic interest, and some countries, such as Iran and Iraq, have shown a willingness to use such weapons. In addition, some sources estimate that the Soviet Union maintains a chemical agent stockpile several times greater than that of the United States.

The Presidents of the United States and the Soviet Union signed an agreement on June 1, 1990, to dispose of the majority of their chemical weapons stockpiles by 2002. However, both countries will retain some chemical warfare capability into the foreseeable future. Further, only limited progress has been made in obtaining a worldwide ban on the production and use of chemical weapons.

It is DOD’s policy that military forces be prepared to survive and carry out their missions in a chemically contaminated environment. The policy further states that soldiers must be (1) provided equipment that will protect them from the effects of chemicals and (2) trained in the use of this equipment and aware of the effects of the equipment on their performance. As shown in the most recent Iran-Iraq war, the use of chemical weapons on a force unprepared to face such weapons can inflict heavy casualties.

In a July 1986 report, we discussed the readiness of U.S. troops for chemical warfare and assessed U.S. progress in meeting defense objectives concerning equipment, training, and doctrine.¹ We reported that, while doctrine (the theory on which the military forces base their actions in support of national objectives) had been notably improved, enhancements in the areas of equipment and training had been minimal.

This report addresses how well the Army has trained and equipped its forces to conduct operations on a battlefield where chemical weapons are used.

¹Chemical Warfare: Progress and Problems in Defensive Capability (GAO/PEMD-86-11, July 1986).

U.S. Chemical Warfare Policy

In 1969, the United States unilaterally stopped the production of new chemical weapons and equipment designed for chemical warfare, even though the Soviet Union continued such production. However, in 1982, citing Soviet superiority in all aspects of chemical warfare and the U.S. failure to obtain a treaty banning such weapons, DOD presented to the Congress a 5-year plan for increasing the U.S. chemical warfare capability from 1983 to 1987. The activities included in the plan were estimated to cost about \$6 billion to \$7 billion.

DOD's 5-year plan restated the U.S. policy of "no first use" of chemical weapons in a conflict. It also called for maintaining a chemical warfare capability sufficient to deter the use of chemical weapons against the United States and its allies by denying a significant military advantage to any possible initiator. Endorsing this policy, the current administration continues to develop and produce defensive equipment and to train military personnel in the use of it.

Chemical Warfare Responsibilities

In 1985, DOD appointed the Army as the executive agency responsible for coordinating the military services' chemical warfare programs and chemical research, development, and acquisition programs. The Army's Chemical Research, Development, and Engineering Center and the Natick Research, Development, and Engineering Center research and develop the services' chemical defensive equipment. Within the Army's Training and Doctrine Command (TRADOC), the Army Chemical School is responsible for

- writing Army chemical warfare doctrine;
- developing training programs, publications, and mission training plans to be used by Army chemical units;
- providing basic and advanced individual chemical training to officers and enlisted personnel;
- training chemical specialists, who are assigned to units to assist in chemical training and chemical equipment management; and
- identifying equipment requirements and needed chemical warfare capabilities.

In addition, the Chemical School reviews the doctrine and training literature developed by other branch schools, such as the Armor School, to assess their coverage of chemical matters and to suggest changes when necessary.

Objectives, Scope, and Methodology

At the request of the Chairmen of the Senate Committee on Governmental Affairs; the Subcommittee on Readiness, House Committee on Armed Services; and the Legislation and National Security Subcommittee, House Committee on Government Operations, we evaluated how well the Army had trained and equipped its forces to operate in a chemically contaminated environment. We limited our review to the Army because it is responsible for coordinating chemical matters and for conducting research and development of chemical defense equipment for all the services. Our specific objectives were to determine whether

- soldiers were adequately trained to survive and sustain operations in a chemical environment and
- Army units were adequately equipped to carry out chemical training and wartime missions.

We reviewed chemical warfare doctrine and examined studies on improving it. We also interviewed officials responsible for writing, reviewing, and approving doctrine and doctrinal changes at the Chemical School and three other branch schools we visited. We visited the Army Chemical School to determine what improvements were being made to Army chemical warfare doctrine and training. At the Armor, Infantry, and Signal Schools, we examined training programs and interviewed officials to determine whether chemical defense doctrine had been integrated into their doctrine and training guidance.

We visited various active and reserve units in the United States and in Europe to assess chemical defense training plans, programs, and equipment. We chose 36 active units in the United States with various missions: 17 active units stationed behind the combat area (rear combat zone units) in Europe, many of which had essential civilians as part of their organizations; and 4 of the 19 reserve component decontamination units that would deploy to support active units in the event of war. (See app. I for a list of the schools and units we reviewed.) We also observed 34 home training exercises and 4 training exercises at the Army's National Training Center and Joint Readiness Training Center.

During our visit to the 36 active units in the United States, we interviewed 71 chemical specialists,² 23 unit commanders, and 93 individual soldiers to obtain their opinions on the quantity and quality of chemical warfare training conducted in their units and the adequacy of equipment available for training.

²Chemical specialists are soldiers who have been trained in the chemical area as their job specialty.

During our evaluation of the Army's plans to supplement or replace existing chemical defense equipment, we reviewed required operational capabilities, milestones, and program funding status. In evaluating the Army's progress in acquiring new equipment, we reviewed production schedules and inventory levels. We interviewed research and development and procurement officials, item managers, and quality assurance and engineering staff. We also reviewed documents such as briefings, program fact sheets, and milestone status reports, which we obtained at the Army locations listed in appendix I.

We did not specifically review the training or equipment provided personnel involved in Operation Desert Shield. However, according to Army officials, (1) the units that deployed to the Middle East received increased training for conducting operations in a chemical environment; (2) the deployed forces did not lack chemical protective clothing; and (3) sufficient chemical protection, detection, and decontamination equipment to meet both individual and unit requirements was made available to deploying forces.

We conducted our review from May 1989 to July 1990 in accordance with generally accepted government auditing standards.

As requested, we did not obtain official DOD comments on a draft of this report. However, we discussed its contents with responsible officials, who generally agreed with our findings, and considered their comments in preparing this report.

Wartime Readiness Impaired by Inadequate Training

To survive and carry out military operations in a chemically contaminated environment, Army forces must receive adequate training in peacetime. Because of the serious physical and possible psychological problems involved in wearing the chemical protective gear for extended periods, soldiers should become accustomed to wearing the gear while carrying out mission-essential tasks. Further, they should learn basic contamination avoidance, protection, and decontamination skills using individual and unit equipment.

Army policy requires units to train as they will fight. However, commanders of the active and reserve units we visited did not provide soldiers with the prescribed quantity or quality of chemical training and did not emphasize carrying out mission-essential tasks in a chemical environment. For example, 35 of the 93 soldiers we interviewed had not trained for 4 continuous hours in full chemical protective gear, as required, since they had joined the Army. Furthermore, Army evaluations of unit exercises at its two major combat training centers disclosed that three of the four units we observed were not prepared to survive in a chemical environment because they had not been properly trained. The major reasons for inadequate training deficiencies follow:

- Army performance evaluation criteria provide commanders little incentive to emphasize chemical training.
- Training guidance has not fully incorporated (1) the latest chemical warfare doctrine or (2) results of studies assessing the effects of chemicals on military operations.

In addition, European fixed sites do not have the decontamination plans required to operate in a contaminated environment. These plans identify the priorities and resources needed to rapidly recover from a chemical attack and to assist other units in decontamination. (Figure 2.1 shows a soldier in full chemical protective gear.)

Figure 2.1: Soldier in Full Chemical Protective Gear



Soldiers Not Trained for Chemical Warfare Conditions

The Army has conducted two studies—(1) “Combined Arms in a Nuclear and Chemical Environment” (CANE) and (2) “Physiological and Psychological Effects of the Nuclear, Biological, and Chemical Environment and Sustained Operations on Systems in Combat” (P2NBC2)—to access the effects of full protective gear on the accomplishment of mission objectives. According to these studies, wearing full chemical protective gear causes serious physical problems and can cause psychological problems. For example, protective masks cause difficulties in breathing, seeing, and communicating, and the gloves and the overgarment hinder dexterity and agility. In addition, the longer soldiers wear the gear, the more disoriented they can become, causing them to become lost or unable to find the correct direction to reach their objective.

One Army field manual predicts that 25 percent of the casualties in a chemical environment will be caused by the claustrophobia, apprehension, and panic created by wearing full chemical protective gear for extended periods.¹ This manual recommends extensive training in the gear during peacetime to prepare soldiers for these experiences.

Another field manual states that after 6 hours in full protective gear, soldiers will experience severe performance degradation.² However, 70 of the 93 soldiers we interviewed had never been in full protective gear for more than 6 continuous hours. Furthermore, 35 of the 93 soldiers had not met the Army’s 4-hour minimum requirement for wearing full gear. According to chemical specialists and unit commanders, soldiers will not be able to perform combat operations in full gear for extended periods because they have not trained in the gear long enough to build endurance.

Army Training Policy Has Not Been Followed

According to Army policy, training should ensure that soldiers, leaders, and units achieve and maintain chemical proficiency for combat operations. The policy also requires that chemical training be realistic and fully integrated into mission training and that soldiers carry out routine mission tasks and weapons qualification while wearing full chemical protective gear.

¹NBC Protection (U.S. Army Field Manual 3-4, Oct. 1985).

²Military Leadership (U.S. Army Field Manual 22-100, June 1989).

Because many units have not trained according to Army policies, soldiers may be unable to perform assigned tasks at a minimally acceptable level under chemical conditions.

Minimum Training Standards Not Met

To prepare soldiers for chemical defense and warfare, Army training policy sets the following minimum standards:³

- Each soldier must train a minimum of 4 continuous hours in full chemical protective gear during basic training. This training is to be reinforced during field training exercises conducted by branch schools, where soldiers will again spend 4 continuous hours in full protective gear while performing their military occupational specialty tasks.
- Soldiers must fire their weapons to standards prescribed in weapons training policy while wearing full protective gear.
- Units must annually conduct individual- and crew-fired weapons⁴ qualification and have individuals perform their military occupational specialties while wearing full chemical protective gear.
- Unit chemical training must be realistic and fully integrated into training for missions.

Of the 93 soldiers interviewed, 68 told us they believed the chemical training they had received had not prepared them to survive and perform their missions on a chemically contaminated battlefield. Thirty of the soldiers told us that they were not sure they could even survive a chemical attack. Further, many of these soldiers told us they had not received minimum chemical training. Table 2.1 compiles the answers of soldiers we interviewed at active combat units in the United States to the question of whether they had trained to standards.

Table 2.1: Responses of the 93 Soldiers GAO Interviewed to Questions on Their Chemical Protective Training

Training standard	Number of interviewee responses	
	Yes	No
Trained 4 continuous hours in full gear during Army career?	58	35
Performed occupational specialty in full gear during Army career?	49	26 ^a
Fired individual weapon in full gear during Army career?	69	24

^a18 soldiers did not respond to this question.

³Army Regulation 350-42, "Nuclear, Biological and Chemical Defense and Chemical Warfare Training."

⁴Crew-fired weapons are weapons that require more than one soldier to operate.

Although 69 of the 93 soldiers we interviewed stated that they had fired their weapons while in full protective gear, another audit effort reported a more serious situation. A July 1989 report by the Army's Inspector General⁵ stated that—except for the M-1 Abrams and the Bradley units—most of the 66 U.S.-based units reviewed had not fired crew weapons in full protective gear to standards prescribed in weapons training policy.⁶ As a result, many soldiers were not aware of the difficulty of hitting a target while in full gear.

Realistic Chemical Warfare Environment Not Simulated in Field Training

To be adequately prepared for a wartime role in a chemically contaminated environment, soldiers must become sensitized to chemical warfare conditions through realistic training. Although Army policy⁷ encourages the use of riot control gases, other simulants, and other devices to add realism to chemical training, these simulants are rarely used:

- Over two-thirds of the 71 chemical specialists we interviewed said that the chemical training in their units was not realistic because they rarely used riot control gases or other simulants. According to the specialists, installation regulations, which are based on environmental and safety considerations, severely restricted the use of such simulants.
- Most of the 34 home-station training exercises we observed failed to create realistic chemical environments. Units rarely used simulants; instead, leaders verbally informed them that chemical strikes had been launched. In addition, chemical training was not fully integrated. For example, soldiers wore full protective chemical gear during a vehicle decontamination exercise but removed the gear immediately after the exercise without checking for contamination or performing personal decontamination as required.
- An Army field manual states that chemical agents are most effective at night because stable temperatures allow the chemicals to linger close to the ground.⁸ However, 43 of the 93 soldiers we interviewed had never trained at night in full chemical gear.

⁵Followup Inspection of Chemical Biological Warfare (CBW) (Army Inspector General Report, July 1989).

⁶Standards in Weapons Training (Army Pamphlet 350-38, Sept. 1988).

⁷NBC Operations (U.S. Army Field Manual 3-100, 1985).

⁸NBC Protection (U.S. Army Field Manual 3-4, Oct. 1985).

- Although the role of reserve decontamination units is to support active units in wartime, the reserve component units we visited had few opportunities to practice decontamination activities with other units. Decontamination unit officials said that the lack of realistic training opportunities had adversely affected preparedness and morale.

The July 1989 Army Inspector General's report also stated that the lack of training devices to simulate chemical warfare conditions was a major problem in chemical training. TRADOC, which is responsible for developing such devices, is trying to develop simulants that are environmentally safe for use during training but has not yet been successful.

Chemical Training Not Integrated Into Mission Training

Army policy requires that chemical training be fully integrated into offensive and defensive operational mission training and that chemical defense be treated as a combat condition and not as a separate task. But most of the units we visited did not follow that policy.

The 34 home-station chemical training exercises we observed in the United States were neither integrated into unit mission training nor treated as conditions of the battlefield. Most often, units deployed to a site; conducted chemical training, such as individual decontamination; and returned to the installation. In other instances, soldiers moved into mock battles already wearing most of their protective gear, although no chemical threat was present. According to current chemical doctrine, soldiers would not be wearing any chemical gear under this condition. After being verbally informed that a chemical strike was in process, soldiers put on their protective masks and gloves. However, they stayed in full protective gear for only about 10 minutes to less than 1 hour before they were told to unmask and resume their tasks.

Some commanders discourage the integration of chemical and mission-related exercises because it reduces mission performance. For example, one brigade commander believed that practicing firing missiles in chemical protective gear would reduce soldiers' confidence in the missiles' accuracy because of the difficulties presented by the gear. Also, a battalion commander said that mission plans and doctrine needed to be revised to show how units could integrate chemical training into the overall training plan.

Lack of Adequate Training Makes Mission Sustainment in a Chemical Environment Doubtful

Because of inadequate training, soldiers might not be prepared for the problems presented by wearing protective gear under extended chemical warfare conditions. Army evaluations of unit exercises we observed at two of the Army's major combat training centers⁹ stated that, because the units were not prepared for chemical scenarios, a large percentage of casualties were sustained. In addition, the 71 chemical specialists we interviewed estimated that over 50 percent of the soldiers would not survive a chemical strike because of inadequate training. Of the 93 soldiers we interviewed, 30 were not sure they could survive a chemical attack. Many soldiers lacked confidence in the protective equipment and said that they had not been adequately trained in its use.

In addition, five of the seven rear combat zone units we visited in Europe that have a large majority of local national civilians in their work forces may be unable to carry out wartime missions because (1) the essential civilians on whom the units depend have not been trained or equipped to survive and operate in a chemical environment and (2) the units have not developed or practiced decontamination plans.

Difficulties Encountered During Training Exercises

During the 34 home-station training exercises we observed, the units encountered difficulties carrying out tasks collectively, and soldiers appeared to be unfamiliar with chemical equipment, especially decontamination equipment. In addition, soldiers made significant mistakes on basic individual skills that might have caused unnecessary casualties during a chemical attack. For example, at an exercise conducted to give soldiers confidence in the mask's effectiveness, 7 of 23 soldiers failed to properly don and adjust their masks to obtain an airtight fit.

In another exercise at the Army's Joint Readiness Training Center, we observed that the unit had not taken precautionary actions to protect soldiers and equipment. Training evaluations provided by Center officials for the battalion being trained stated that:

"The unit received adequate information indicating chemical attacks were probable but no precautions were taken to protect troop positions or supplies. When hit with a persistent chemical agent in the BSA [Brigade Support Area] an unacceptable number of casualties (134 KIA/DOW) [killed in action/died of wounds] were incurred and large amounts of equipment and supplies were contaminated. . . many soldiers

⁹National Training Center, Fort Irwin, California, and the Joint Readiness Training Center, Fort Chaffee, Arkansas.

did not properly mask or conduct individual decontamination. This lack of proficiency resulted in a high number of casualties.”

The Center’s evaluation further stated that the chemical specialist responsible for decontamination needed further training on individual chemical skills. Specifically, the evaluation stated that, while these soldiers were expected to be the experts, they were in many cases less proficient than combat service support personnel.

Essential Civilians Not Prepared to Operate in a Chemical Environment

Many rear combat zone units in Europe depend heavily on essential civilian employees to perform transition-to-war and wartime missions such as supply activities¹⁰ and evacuation of U.S. dependents and visitors. Essential civilians in the units we reviewed comprised over half of the total work force, and over 90 percent of these civilians were local national employees.

Although the United States requested permission many times from the then-West German government to equip and train local national employees and contractor personnel for chemical warfare, the German government has not yet given its permission. In the interim, the U.S. Army, Europe, has directed units to purchase and store the necessary equipment and to develop plans for training local nationals. Of the 17 units we visited, 7 had essential local national civilians as a majority of the work force. Of those seven, however, five did not have chemical defense equipment on hand for local national essential civilians, and none had the required training plans.

Without adequate training, essential civilians will be unable to survive and operate in a chemical environment, and rear combat units may be unable to carry out wartime operations. Officials at two of these seven units said that they could not perform their missions without the essential civilians, and officials at two other units said that loss of the civilians would severely degrade mission performance.

¹⁰An Army official advised us that U.S. civilian contract maintenance personnel were sent to support Operation Desert Shield. Other Army officials told us that the U.S. contractor personnel had been trained in the use of chemical protective equipment and that such equipment would be provided to them.

European Fixed-Site Decontamination Plans Not Developed or Practiced

Fixed sites, such as supply depots, ammunition depots, and Prepositioning of Materiel Configured in Unit Sets (POMCUS) sites, in European rear combat areas are required to have decontamination plans. The plans, which must be approved by the 21st Theater Army Area Command (TAACOM), should identify priorities and resources necessary to rapidly recover from a chemical attack and to assist chemical units stationed in Germany in efficiently responding to decontamination needs. Six of the seven units we visited did not have current approved defense plans that addressed issues critical to mission sustainment.

Of the seven units we visited, only the Combat Equipment Group, Europe, which is responsible for POMCUS sites, had approved fixed-site decontamination plans that were practiced regularly. No units we visited had developed and practiced plans that addressed collective protection. (Collective protection is required because people at a contaminated site would have to work in shifts and be transported back and forth to uncontaminated locations for decontamination and rest.) This aspect of sustainment planning had not been practiced.

Unit officials responsible for planning at the units we visited told us that there was a lack of command emphasis on preparing the required plans and on conducting practice exercises.

Training Problems Are Caused by Insufficient Command Emphasis and Inadequate Training Guidance

The failure to carry out Army chemical training policy stems from a lack of command emphasis. According to unit commanders and chemical specialists we interviewed, (1) present Army training and evaluation criteria provide little incentive to emphasize training under chemical conditions; (2) chemical proficiency testing is not a critical part of unit evaluations; (3) chemical training is focused on key events rather than on sustaining proficiency in a chemically contaminated environment; and (4) chemical warfare doctrine and the results of studies have not been incorporated into manuals and training developed by the other branch schools.

Commanders Lack Incentives to Train Soldiers Under Chemical Conditions

On average, the 71 chemical specialists we interviewed spent about 50 percent of their time on chemical-related activities; the rest of their time was spent on nonchemical duties of higher priority to their commanders. Two commanders we interviewed acknowledged that chemical training did not receive sufficient emphasis because of other mission-related priorities. In Europe, we were told that command emphasis was lacking because (1) rear units had less of a battle focus than forward units,

(2) commanders were evaluated on peacetime mission performance, and
(3) chemical scenarios were not emphasized in command training.

The central problem, however, is that commanders have no reason to emphasize chemical training because the accomplishment of a unit's mission tasks in a chemical environment is not critical to receiving good scores during externally evaluated training exercises. In fact, operating in chemical protective gear may lower a unit's overall score because combat tasks may not be done as well or may take more time and could affect the commander's performance evaluation.

Chemical Proficiency Testing Not Critical to Unit Evaluations

A unit's proficiency in chemical training, according to Army policy,¹¹ is determined by having the unit accomplish its mission under chemical conditions during Army Training and Evaluation Program exercises.¹² However, units may receive passing scores for their overall evaluations even though they fail to demonstrate proficiency under chemical conditions.

Before an evaluation, the unit commander generally selects tasks aligned with the unit's primary missions. To be successful, the tested unit must complete 80 percent of the 15 to 20 tasks generally in the exercise. The commander, rather than the evaluators, determines which tasks are critical to mission achievement, that is, those that must be passed. Therefore, if the commander does not consider the chemical tasks critical, the unit can achieve a passing rating on combat mission capabilities even though it completely fails the chemical tasks. Furthermore, we were told that the chemical events were brief to avoid their interfering with other exercise objectives and events considered more critical.

¹¹Army Regulation 350-42, "Nuclear, Biological and Chemical Defense and Chemical Warfare Training."

¹²The Army Training and Evaluation Program consists of mission tasks that a unit must perform during externally evaluated exercises. These tasks are evaluated by observers from other units, and the scores are given to the unit commander with an explanation of how the unit performed each task.

Training Focused on Key Events, Not on Sustaining Proficiency

Contrary to Army policy, commanders focused training merely on succeeding at infrequent, significant training exercises, rather than on developing and sustaining chemical proficiency.

For units based in the continental United States, one important evaluation of combat capabilities occurs at the Army's combat training centers. During the 2-week training exercises at the centers, units must perform mission-essential tasks under conditions that closely replicate actual warfare. During these training exercises, chemical warfare tasks are included in many of the missions. Because senior commanders can use the evaluations provided by the training centers to assess the leadership potential and tactical performance of junior commanders through the brigade level, unit commanders try to prepare their units for expected scenarios at the centers. Since chemical training receives little attention during most of the year, however, chemical specialists and soldiers describe their efforts to prepare for the centers' chemical scenarios as similar to cramming for an examination.

We observed one night scenario at the National Training Center that included a chemical strike on a task force comprised of five companies. The attack caught the unit by surprise, and many soldiers were asleep. They had been expecting an attack after dawn and had failed to set out chemical detection alarms, as required. The chemical strike caused many simulated casualties in four of the five companies.

According to one of the Center's observer/controllers, such poor reactions are common. He explained that a unit's performance in a chemical environment could be related to the command's emphasis on chemical training throughout the year; units that do not routinely emphasize chemical training perform poorly. The views of the Center's observer/controller are confirmed when home-station training's emphasis on chemical warfare is compared with proficiency demonstrated during exercises. For example, one unit we observed that did not conduct extensive chemical training in home-station exercises because of environmental factors had significant difficulties in accomplishing missions when subjected to chemical attack. As the Center's evaluation states:

"The Chemical Liaison Officer had half a plan, but kept it in his head. He was not ensuring the task force was prepared to survive the chemical attack. He was not ensuring supplies, plan, and preparation were complete and ready for the battle."

Conversely, another unit we observed at the National Training Center that does routinely include chemical defense as part of its home-station

training program was not as inhibited in accomplishing its mission in the face of a chemical threat. The Center's evaluation of the unit's performance states that the battalion Tactical Operations Center/Fire Direction Center responded quickly to the chemical attack. Testing, reporting, and unmasking procedures were done to standard. Evacuation of chemical casualties was timely and well managed at the battalion Tactical Operations Center. All battalion units responded rapidly to both chemical and artillery attacks and provided prompt and complete chemical reports.

Chemical Warfare Doctrine Has Not Been Fully Incorporated Into Branch Schools' Manuals and Training Guidance

The military services develop requirements from, and measure performance against, chemical warfare doctrine that is based on national objectives. The doctrine, which is refined by feedback from peacetime training and the use of equipment, helps to define how forces are expected to fight and how equipment is expected to operate in a chemical warfare environment.

In 1985 and 1987, the Chemical School published field manuals for chemical corps personnel. These manuals contain doctrinal changes—to the primary chemical warfare defense functions of contamination avoidance, protection, and decontamination—that address the need to continue combat and support missions even when a unit finds itself in a chemical warfare environment.

The Army's other branch schools are required to incorporate chemical warfare considerations and doctrinal changes into their doctrinal and training publications. However, the three other branch schools we visited had not fully incorporated specific changes on continuing operations in a chemical environment. As a result, commanders and soldiers did not have training references for measuring the potential effects of a chemical environment on their ability to survive and sustain operations.

In 1 of the 23 field manuals we reviewed, we found that chemical warfare doctrine was well integrated. In 10 of the field manuals, the writers had simply paraphrased portions of Chemical School manuals, provided general discussions of chemical operations, or inserted a paragraph or appendix with descriptions of chemical survival skills; they had not integrated the doctrine into the specific operations of their branches.

Field Manual FM 100-10, *Combat Service Support*, dated February 1988, is a well integrated manual in that it addresses how combat service support organizations must react in chemical conditions to perform their

missions. The manual discusses the maintenance of contaminated equipment and the effects of chemical conditions on supply, maintenance, storage, and salvage. Conversely, Field Manual FM 17-15, Tank Platoon, dated October 1987, does not mention chemical warfare in the main body.

Some of the doctrine writers at the other three schools we visited said that soldiers should be able to perform operational tasks under chemical conditions and that, therefore, no special guidance for doing so was required. Also, two Signal School writers and one Armor School writer equated chemical survival tasks and chemical detection, identification, and decontamination with "operations in the chemical environment." Such generalizations indicate that doctrine writers continue to view the chemical environment as a series of defensive tasks that must be performed for protection, rather than for a continuity of operations as required.

In addition, most resident and unit training guidance at the Signal, Armor, and Infantry Schools continues to emphasize chemical survival tasks and not the effects of chemicals on war-fighting or support capabilities. Most schools' resident instruction programs meet the minimum requirements for chemical training, according to the Chemical School. While resident students are required to perform mission training tasks in chemical protective gear for a total of 6 noncontinuous hours, the primary focus of the classroom training we observed was on survival. Of 30 unit training manuals we reviewed, only 10 contained information on sustaining mission operations in a chemical environment; 17 other publications addressed chemical survival tasks, such as crossing a chemically contaminated area and performing hasty decontamination; and 3 contained no reference to chemical training.

Because training guidance does not fully address the effects of chemicals on mission performance, commanders did not know which mission tasks would be degraded and which tasks would need to be modified in a chemical environment. However, TRADOC Regulation 310.2, which is in draft, will require branch schools to evaluate all tasks in terms of soldiers' ability to perform them in a chemical environment. It will also require training publication writers to include a statement of whether a task must be performed under chemical conditions and, if so, how it would be performed differently. In some cases, schools may need to define new training tasks. For example, the Armor School plans to add the task of entering and exiting armored vehicles in a chemical environment to future mission training.

**Studies on Performance
Degradation Not
Integrated Into Branch
Schools' Publications**

The Army Chemical School has sponsored a number of studies that have identified degradation of task performance in a chemical environment. However, the three other branch schools we visited had not incorporated, as required, the study results into their doctrine and training literature.

For example, the CANE tasks, approved in 1981 and first reported in 1984, quantitatively measured degradation of combat, combat-support, and combat service-support units during operations in a nuclear/chemical environment and compared the results with those of the same units operating in a nonchemical environment. While previous studies addressed the effects of a chemical environment on individuals or crews, the CANE studies were the first to assess the effects on entire units. The initial CANE results revealed that nuclear/chemical conditions caused "grave problems," such as increased time required to carry out attacks, decreased firing rates, and a decreased ability of leaders to manage the battle.

In 1986, the TRADOC Commander tasked the Chemical School to develop solutions to the deficiencies identified in the CANE studies. Army officials advised us that as of October 3, 1990, 74 actions had been evaluated, and 13 had been implemented. However, knowledge of the CANE results varied widely among doctrine writers and trainers at the schools we visited. While 13 of 17 doctrine writers and training officials at the Armor School were aware of the results, only 4 of the 25 at the Signal School and 9 of the 20 at the Infantry School were aware of them.

Another important study, the P2NBC2 was initiated in 1984 to

- quantify the levels of degradation of operations;
- identify deficiencies in doctrine, training, organization, or equipment;
- determine appropriate fixes; and
- disseminate information to the field.

The first year's results reported in 1986 showed the effects of a chemical environment on soldiers and included vital information on building unit cohesion, dealing with direct attacks, and managing fear. However, only 11 of the 62 doctrine writers and training officials at the Armor, Signal, and Infantry Schools were aware of the tests and their results.

According to an Army official, the first year's P2NBC2 results were not widely distributed because they were published in a 1986 field circular

to field commanders¹³ and TRADOC considered field circulars to be internal information. The Army has since published the final results of the studies in a report entitled "Extended Operations in Chemically Contaminated Areas," dated March 1990.

Conclusions

Many soldiers have not been adequately prepared to survive and sustain operational missions in a chemical environment. Unit commanders have not provided sufficient mission training under realistically simulated chemical conditions and continue to view chemical defense as a separate task rather than as a condition of combat. Furthermore, many rear combat units in Europe may be unable to carry out their wartime missions because they have not been able to train and equip essential civilians and have not developed or practiced decontamination plans.

Unit commanders have not adequately emphasized chemical training because their own and their units' ratings are based on overall mission performance, not on mission performance in a chemical environment. Also, the Army's branch schools have not incorporated into their training guidance recent doctrinal changes concerning the effects of a chemical environment on mission performance. As a result, commanders do not know which mission tasks would be degraded in a chemical environment and cannot use this knowledge during training.

Recommendations

We recommend that the Secretary of the Army ensure that

- commanding officers responsible for conducting training fully comply with the minimum training standards set forth in Army regulations and
- the commanding officers of TRADOC and the Chemical School jointly evaluate the integration of chemical doctrine into the training guidance at the other branch schools and take the necessary corrective actions.

The evaluation, as a minimum, should (1) emphasize the need to conduct routine training in full protective gear until all personnel are capable of recognizing and adequately responding to the performance degradation that occurs after extended periods in the gear and (2) require that all combat and support personnel undergo the required chemical training under realistic conditions and demonstrate the ability to perform

¹³U.S. Army Combined Arms Combat Development Activity Field Circular 50-12, Extended Operations in Contaminated Areas, November 1986.

assigned tasks at a minimally acceptable level while in full protective gear.

We also recommend that the Secretary of the Army

- require that commanding officers annually report to their rating officials the extent to which all combat and support personnel have undergone the required chemical training and demonstrated the ability to perform assigned tasks at a minimally acceptable performance level while in full protective gear;
- require commanding officers' rating officials to consider the officers' reports on chemical training in evaluating their performance; and
- direct the Commander of the U.S. Army, Europe, to comply with the existing requirements that fixed sites have approved chemical decontamination plans and that the plans be practiced at least annually.

Equipment Shortages and Deficiencies Contribute to Concern About Readiness for Chemical Operations

U.S. Army combat units in Europe depend on combat support units for supplies needed to sustain combat operations. However, many support units we reviewed did not have the authorized levels of decontamination equipment that would allow them to sustain operations in a chemical attack. Chemical equipment in theater reserves and in POMCUS sites is below authorized levels. In addition, reserve component units are not adequately equipped to train for or to perform their wartime missions.

Although the Army has identified performance limitations in some equipment in use since the 1960s and 1970s, it has not yet overcome those limitations. However, initiatives are currently underway to supplement existing equipment and to improve future chemical defense capabilities.

Authorized Equipment Is Not Always Available to Units

Many active support units in Europe, as well as reserve component units in the United States, are experiencing shortages of authorized chemical equipment. These shortages contribute to training problems and could prevent units from performing their missions if they are attacked with chemicals.

Units in Europe Lack Authorized Equipment

Many of the units we visited in Europe lacked authorized equipment needed for chemical decontamination and for detecting chemical contamination. Such equipment is needed to recover and clean contaminated equipment and material during wartime so that it can be reissued.

Reserve Components Short of Essential Equipment

Three of the four reserve component chemical units we visited lacked essential equipment or had problems keeping their equipment properly maintained. For example, three units did not have the vehicles they needed to transport their decontamination and water systems. One unit had none of its 26 authorized 5-ton trucks. Another unit substituted 2.5-ton trucks; however, these trucks, while capable of carrying the M12A1 decontamination apparatus and its water heater, were not designed to carry the 500 gallons of water needed for decontamination operations. Army officials said that there was an Army-wide shortage of 5-ton trucks that was not expected to be relieved in the near future.

Additional equipment shortages mentioned or reported by reserve officials are summarized as follows:

- Three units either did not have enough decontamination systems or had trouble maintaining and keeping them operational. Chemical units use these systems to draw water from a source; mix it with decontaminating chemicals; heat the mixture; and spray it, under pressure, on contaminated areas, vehicles, and equipment. The systems can also be used to rinse the decontaminant off when it has neutralized the contaminant.
- Because soldiers in chemical units are expected to be exposed to chemicals for extended periods of time, soldiers in chemical units are authorized two sets of protective overgarments. One unit did not have enough overgarments to issue one per soldier.
- One unit had been issued no chemical detection alarms.
- One company had only 1 of 26 authorized tactical radios. Without these radios, units cannot exercise proper command and control over dispersed subordinate units or communicate with higher headquarters.

These equipment shortages severely restrict unit training. For example, units lacking 5-ton trucks cannot carry the water they need to conduct decontamination training. Consequently, they must use limited training time to plan for securing other water sources. Units that do not have pumps, hoses, or fittings cannot practice drawing water from lakes, streams, or hydrants, and without radios, unit leaders cannot control convoys or tactical training.

Shortages of Equipment Stocked for Resupply During Wartime

Units stationed in Europe depend on theater reserves of chemical defense equipment for resupply. Also, while reinforcing units from the continental United States are required to bring individual chemical defense equipment with them, they depend on chemical equipment stored in POMCUS stocks to sustain operations. However, both reserve stocks are short of the levels needed for the timely resupply of units.

Theater Reserves of Chemical Equipment Are in Short Supply

Many chemical defense items in theater reserves are significantly below authorized levels. According to an official at the 200th Theater Army Material Management Center, which is responsible for maintaining theater reserves, shortages are caused by procurement, production, and funding problems. The more expensive equipment, such as decontamination apparatus and chemical alarms, is funded by the Department of the Army, and shortages are due to stateside procurement and production problems. Other items, such as chemical suits, boots, and personal decontamination kits, are funded by U.S. Army, Europe, and shortages of these items are related to both stateside procurement problems and a lack of funds provided by U.S. Army, Europe. Since these items are only

partially funded, the Center cannot requisition equipment up to authorized amounts.

**POMCUS Is Short of
Chemical Defense
Equipment**

Due to shortages in POMCUS stocks, some reinforcing units arriving from the United States may not be able to obtain the chemical equipment needed to sustain operations or support combat units in a chemical environment.

**Needed Equipment Is
Not Authorized**

According to commanders and chemical officers in Europe, some critical equipment has not been authorized for use. Some officials believe that this lack of equipment may be the biggest problem that rear combat units face. For example, units have not been authorized to procure and stock collective protective shelters. To operate in a chemical warfare environment, personnel must be protected from chemical agents either in individual protective suits or in chemical shelters. The individual protective suits reduce combat efficiency when worn for more than several hours. Therefore, in an area where chemical agents remain effective for more than several hours, chemical shelters are needed to allow personnel to work and rest.

At all the European units we visited, officials said that they needed collective protection shelters to provide soldiers safe places to periodically remove and exchange individual protective gear and to do mission tasks that could not be done in protective gear. However, they did not have authorization to procure and stock them. After a chemical attack, a unit without collective protection would have to move to a "clean" area to continue operations. However, some units do not have the transportation or the material-handling resources to relocate, and units at fixed locations, such as ammunition and supply depots, cannot be readily moved. As of December 1989, only Headquarters, 21st TAACOM, had been authorized collective shelters.

Also, several Army officials said that the rear units' authorized fire-fighting equipment, which is used to wash off decontamination solutions, had serious limitations. The equipment requires water pressure in public water lines, which is frequently unavailable in wartime. Other officials cited dependence on fire hydrants as a limitation on selecting potential decontamination sites. One official said that some preplanned sites did not even have fire hydrants. He said that units needed portable decontamination equipment, such as the M17 lightweight decontamination apparatus, but did not have the authorization for it.

Long-Standing Limitations in Some Existing Equipment Have Not Been Overcome

The Army has identified, but has not yet overcome, limitations in some existing chemical defense equipment now in use that has been produced over the past 25 years (see table 3.1).

Table 3.1: Performance Limitations of Existing Protective Equipment

Item	Limitations	Year first issued
Decontamination Solution 2 (DS2) ^a and supertropical bleach	Both highly corrosive to some metals and damaging to electronic components; DS2 is also flammable, softens leather, and may remove or discolor painted surfaces.	1960
M8 detector paper	Unreliable in detecting the completeness of decontamination.	1965
M51 collective protection shelter	Time-consuming to assemble and disassemble, insufficient capacity (approximately six persons), deficient airlock operation, lack of natural ventilation, and narrow entry and exit ways.	1976
Chemical protective gloves	Not resistant to oils and lubricants, flammable, and results in perspiration buildup.	1976
Chemical protective overgarment	Results in degradation of soldiers' performance due to heat stress.	1976
Green vinyl overshoes	Flammable, not resistant to oils and lubricants, and cannot be decontaminated.	1976
M256 chemical agent detector kit	Takes up to 15 minutes to detect chemical agents.	1979
M9 detector paper	Can show false readings in extremely low and high temperatures and cannot detect chemical vapors.	1983

^aGAO issued a report on "DS2" decontaminant entitled *Hazardous Material: DOD Should Eliminate DS2 From Its Inventory of Decontaminants* (GAO/NSIAD-90-10, Apr. 25, 1990).

Some Army officials told us that the major difficulty in eliminating chronic deficiencies in existing equipment is the lack of technological breakthroughs. However, researchers at the Army's Natick Research, Development, and Engineering Center and Chemical Research, Development, and Engineering Center continue to seek solutions to the identified problems.

Improved Capabilities Are Being Produced and Developed

Since 1985, the Army has developed six new pieces of equipment at a total cost of about \$476.9 million. This equipment will enhance defense capabilities in the areas of individual and collective protection, detection, and decontamination. However, some of this equipment is far behind production schedules. The Army also has several advanced research and development programs that will yield first-time capabilities in the areas of detection and decontamination.

New Equipment Being Produced

The Army is producing or is about to produce new pieces of equipment that will enhance soldiers' ability to survive and sustain operations while engaging in chemical warfare. Table 3.2 shows the major performance benefits anticipated from this equipment.

Table 3.2: Expected Benefits of New Chemical Defense Equipment

Equipment	Benefits
M40 protective mask (replaces the M17 mask for ground soldiers)	Better fit, better respiration, North Atlantic Treaty Organization-compatible external canister that can be worn on either side of the mask, and provisions for radio and telephone communication.
M42 protective mask (replaces the M24 mask for combat vehicle crew)	Better fit, better respiration, improved eye and face protection, canister hooks into vehicle's ventilation system, and microphone plugs into vehicle's communication system.
M43 protective mask (replaces the M25 mask for aviators)	Better fit, better respiration, air-flow distribution assembly, electronic microphone, chemical-biological hood, and skull-type suspension system.
M17 lightweight decontamination system	Compact pump and water-heating system, easier access to control panel, and provision for soldiers to shower.
Chemical agent monitor	Continuous monitoring for chemical contamination and instant chemical detection and identification.
M20 simplified collective protection shelter	Collapsible, pressurized protection entrance; chemical and biological vapor resistant; high mobility; and provides rest and relief station.

Despite the anticipated benefits, delivery of this equipment to Army units is years behind schedule. Only half of the approved pieces of equipment have been delivered to some of the tactical units—the M43 protective mask, the chemical agent monitor, and the M17 lightweight decontamination system. The Army has failed to meet the initial delivery dates planned for the remaining equipment. Profiles of the newly developed equipment, including production delivery dates, are presented in table 3.3.

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Table 3.3: Profiles of Newly Developed Chemical Defense Equipment

Dollars in millions

System	Need approved	Quantity required	Cost^a	Development completed	Production contract awarded	Initial unit equipped
M40 mask/M42 mask ^b	May 1985	1,761,554 ^b	\$112.0	May 1987	June 1987	May 1991
M43 mask	Apr. 1984	32,492	22.6	Sept. 1986	Feb. 1987 June 1990	Oct. 1988 ^c Dec. 1992
M20 simplified collective protection shelter	Feb. 1985	7,517	37.7	June 1986	Aug. 1986	Mar. 1991
Chemical agent monitor	July 1984	26,865	8.2 ^d	Dec. 1987	Jan. 1986 Aug. 1990	Sept. 1989 ^c May 1991
M17 lightweight decontamination system	Oct. 1983	6,071	19.8 ^d	May 1987	Sept. 1984 Sept. 1987	Aug. 1986 ^c Sept. 1990
Total			\$200.3			

^aIncludes both development and initial production costs.

^bRequirement for 1,560,000 M40 and 201,554 M42 masks.

^cLimited issue to some Army units.

^dNondevelopmental item issuance to fill urgent requirements. The chemical agent monitor and the M17 lightweight decontamination system are the result of redesign.

Delivery of the M40 and M42 masks, which was scheduled for June 1988, has continually been delayed due to various contracting problems, including the contractor's failure to (1) meet equipment design specifications, (2) deliver tooling to other contractors, and (3) meet production delivery schedules. In spite of these difficulties, the Army has a product improvement program for the M40 mask. The improvements include an enhanced communication system, improved optical correction, laser and ballistic eye protection, and a second skin hood. The improvement program has also experienced delays. For example, efforts on the improvements ceased at the end of fiscal year 1987 due to a lack of funds. However, funding resumed in fiscal year 1989, when the Marine Corps funded various portions of the program. The Army allocated funding in fiscal year 1990 for the remaining program improvements.

The M20 simplified collective protection shelter, which was scheduled for initial delivery in September 1988, also has experienced contractor problems. Due to problems with chemical agent and first-article testing, the contract was terminated. However, the shelter is currently being enhanced through a product improvement program, and initial delivery of the new shelters is scheduled for August 1993. Some of the key improvements over the basic M20 shelter include the addition of a medical airlock for litter patients, the capability to speed up the entry and

exit rate, increased resistance to liquid agents, an expansion of the protected area, and reduced electromagnetic interference.

The M17 lightweight decontamination system is a modification of a Norway-produced system called the nuclear, biological, chemical sanator system. The Army purchased a limited quantity of these systems to fill urgent requirements and delivered them to some Army units in fiscal years 1986 through 1988. The Army then contracted for system modification to improve the reliability and to redesign and relocate the operator's control panel, the engine fuel supply, the burner fuel controls, and the trigger-actuated spray wands. Production delivery was scheduled to start in August 1989.

Future Chemical Defense Capabilities Are Under Development

The Chemical Research, Development, and Engineering Center is developing several new chemical defense capabilities at an estimated cost of about \$714.1 million. The new equipment, summarized as follows, will increase chemical defense capabilities:

- In October 1978, the Army began developing a remote-sensing chemical agent alarm at an estimated cost of about \$212.6 million. Its purpose is to detect vapor clouds of nerve and blister agents from as far away as 5 kilometers. According to the Army, this equipment will represent the world's first automatic stand-off detection alarm. Program completion was expected in April 1991, with an initial delivery to the Chemical School¹ in February 1996.
- Development of the nonaqueous equipment decontaminating system, which began in February 1985, is estimated to cost about \$28.4 million. The system will decontaminate avionic devices, electronics components, communication devices, and optical sight devices without using water or causing damage or performance degradation. According to the Army, this system will represent its first capability to decontaminate such equipment. Program completion is expected in September 1992, with an initial delivery to the Chemical School in May 1995.
- Development of the automatic chemical agent alarm, which began in May 1985, is estimated to cost about \$134.1 million. This alarm, an advanced point-sampling system, is designed to detect and identify chemical agents, improve sensitivity to nerve agents, improve interference rejection, and provide a data communications interface. Program

¹New equipment, except overgarments, is first provided to the Chemical School for initial training in its use, and units receive the equipment about 18 months later.

completion is expected in July 1992, with an initial delivery to the Chemical School in December 1996.

- Development of the nuclear-biological-chemical reconnaissance system, which began in February 1988, is estimated to cost about \$276.6 million. This system is to detect contamination in its immediate and distant environments and automatically integrate contamination information. This program was completed during March 1990; an initial delivery to the Chemical School is scheduled for May 1992.
- Development of the chemical agent detector network, which began in October 1989, is estimated to cost \$56.9 million. The equipment will automatically transmit, within 1 to 2 minutes, warning of a chemical attack to the unit using the network, to higher headquarters, and to adjacent units. Program completion is expected in September 1992; initial delivery to the Chemical School is scheduled for June 1995.
- In June 1981, the Army began research on the microclimate conditioning air vest and connector and the individual soldier Microclimate Cooling System program. About \$5.5 million has been allocated for this program, which is scheduled for completion in November 1994. The vest and connector, which are being designed to regulate air supply to parts of the body, will allow the soldier to hook into a combat vehicle's ventilation system. The Microclimate Cooling System is being designed to provide the soldier with independently powered air circulation to the body without vehicular power or other cooling sources. Both pieces of equipment are expected to allow soldiers to perform mission tasks in a chemically contaminated environment without suffering heat stroke.

Conclusions

Because of equipment shortages, some combat support units in Europe will probably be unable to provide sustained support to forward combat units during a chemical attack. In addition, the chemical equipment in theater war reserves and prepositioned stocks is below authorized levels. As a result, troops may be unable to sustain wartime operations.

Also, some reserve units lack essential chemical decontamination equipment needed for training and for meeting the active units' decontamination needs.

The Army has made some progress with its recent development of several chemical defense items, as well as its ongoing advanced research efforts, that will offer new capabilities. In spite of these advancements, however, the new equipment is not expected to be available to units for several years. Further, numerous long-standing deficiencies in some

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existing equipment have not been resolved, although the Army has several near-term developments that will generally supplement the existing equipment's capabilities.

Recommendations

We recommend that the Secretary of the Army ascertain whether (1) the funding level and priorities for developing, producing, and delivering chemical protective equipment should be changed; (2) authorized chemical equipment levels should be modified and equipment availability increased; and (3) production problems being encountered with new chemical protective equipment are being resolved.

U.S. Army Activities Included in GAO's Review

Training and Doctrine Command Branch Schools

U.S. Army Chemical School, Fort McClellan, Alabama
 U.S. Army Armor School, Fort Knox, Kentucky
 U.S. Army Infantry School, Fort Benning, Georgia
 U.S. Army Signal School, Fort Gordon, Georgia
 U.S. Army Logistics Center, Fort Lee, Virginia

Active Units in the United States

82nd Airborne Division, Fort Bragg, North Carolina
 4th Infantry Division, Fort Carson, Colorado
 7th Infantry Division, Fort Ord, California

Fort Sill, Oklahoma

6/27th Field Artillery, B Battery
 3/18th Field Artillery, Service Battery
 5/18th Field Artillery, B Battery
 2/17th Field Artillery, A, B, C, Service, and Headquarters Batteries
 6/32nd Field Artillery, A, B, C, and Service Batteries
 4/31st Infantry Battalion, B Company

Fort Hood, Texas

6/1st Cavalry Squadron
 1/82nd Field Artillery, B and Service Batteries
 124th Support Battalion, B Company
 3/1st Air Defense Artillery, A and C Batteries
 1/8th Field Artillery, Service Battery
 15th Military Intelligence Battalion, B and Service Batteries
 163rd Military Intelligence Battalion, A and Service Batteries

Fort Riley, Kansas

4/1st Aviation Battalion, E and Service Batteries
 5/16th Infantry Battalion, A, C, and Headquarters Companies
 4/37th Armor Battalion, D and Headquarters Batteries
 716th Military Police, 1st Company
 1/5th Field Artillery, Service Battery
 12th Chemical Company
 937th Engineering Group
 101st Military Intelligence Battalion, Headquarters Battery

Training Centers

National Training Center, Fort Irwin, California
 Joint Resources Training Center, Fort Chaffee, Arkansas

Active Units in Europe

21st Theater Army Area Command, Headquarters

Combat Equipment Group, Europe
Combat Battalion, West
5th Combat Equipment Company
6th Combat Equipment Company
200th Theater Army Materiel Management Center
Mainz Army Depot

60th Ordnance Group

10th Chemical Company
33rd Ordnance Company
87th Ordnance Company
Reserve Storage Facility, Miesau

37th Transportation Group

53rd Transportation Battalion
66th Transportation Company

Other Units

28th Transportation Battalion
109th Transportation Company
Military Community Activity, Zweibruecken
29th Area Support Group
7th Army Training Command

Reserve Component Units

128th Chemical Company, Philadelphia, Pennsylvania
129th Chemical Company, Roanoke, Virginia
377th Chemical Company, Fort Lee, Virginia
413th Chemical Company, Florence, South Carolina

Army Headquarters Organizations

U.S. Army Headquarters, Washington, D.C.
U.S. European Command
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