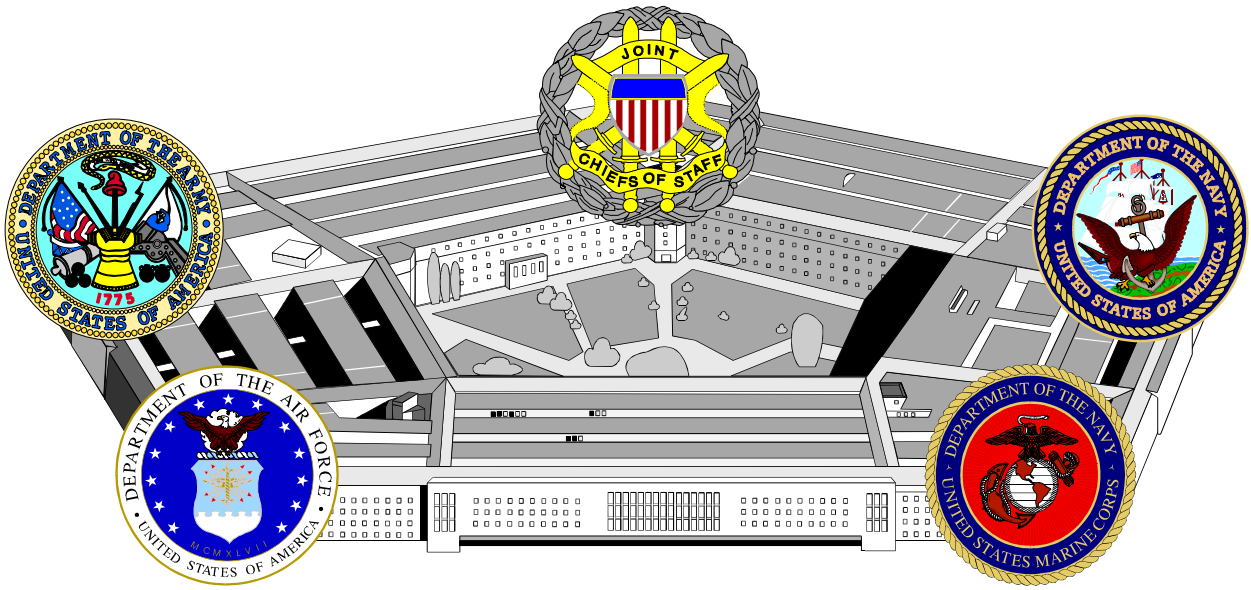
Department of Defense Chemical and Biological Defense Program



Volume I:

Annual Report to Congress

APRIL 2002

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The information in this report is updated as of February 28, 2002 unless specifically noted otherwise.

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Executive Summary

The vision of the DoD Chemical and Biological Defense Program (CBDP) is to ensure U.S. military personnel are the best equipped and best prepared force in the world for operating in future battlespaces that may feature chemically and biologically contaminated environments. To fulfill this vision, the CBDP has defined the mission of the program to provide world-class chemical and biological defense capabilities to allow the military forces of the United States to survive and successfully complete their operational missions across the entire spectrum of conflict—from peacetime contingency missions through overlapping major conflicts—in environments contaminated with chemical or biological warfare agents. The CBDP supports the overall Department of Defense policies and strategies outlined in the September 2001 Quadrennial Defense Review Report.

The DoD Joint Service CBDP FY 2003 President's budget has been submitted to Congress. In accordance with 50 USC 1523 (Section 1703, Public Law No. 103-160) this annual report on the CBDP is submitted to Congress, and it is intended to assess:

(1) the overall readiness of the Armed Forces to fight in a chemical-biological warfare environment and steps taken and planned to be taken to improve such readiness; and

(2) requirements for the chemical and biological warfare defense program, including requirements for training, detection, and protective equipment, for medical prophylaxis, and for treatment of casualties resulting from use of chemical and biological weapons.

This report is provided in two volumes. Volume I provides an assessment of the plans and programs, and Volume II provides a performance plan for the CBDP in accordance with the Government Performance and Results Act.

The request for FY 2003 funding totals $1.374 billion. The DoD Chemical and Biological Defense Program provides development and procurement of systems for U. S. forces to operate in all battlespaces contaminated with chemical and biological (CB) agents in support of U. S. counterproliferation policy. The probability of U. S. forces encountering CB agents remains high. In FY 2003, the CBD Program expands to support homeland security and combating terrorism initiatives of the President and the Department by providing those systems necessary to effectively defend against and respond to acts of CB terrorism. The CBD Program continues to implement congressional direction to improve joint CBD capabilities and reflects an integrated jointly developed modernization program. This year's program funds the passive defense counterproliferation initiatives, enhances military support to civilian authorities with consequence management capabilities, and initiates strong homeland security programs to enhance CB defense preparedness.

The DoD CBD program invests in technologies to provide improved capabilities that have minimal adverse impact on the warfighting potential. Joint and Service unique programs support the framework of the three tenets of CB defense:

- *Contamination Avoidance* (detection) and NBC Battle Management (reconnaissance and warning of battlespace contamination to enable units to maneuver around them),

- *Force Protection* (individual, collective, and medical support), and
- *Restoration*.

The FY 2003 budget adjusts CBD modernization efforts to meet the strategy as outlined in the September 2001 Report of the Quadrennial Defense Review and includes resources for CB sensors, early-detection systems and an integrated joint warning and reporting network for CB attacks; biological warfare defense vaccines, medical countermeasures and surveillance systems; improvement of protective suits and masks; and modernized decontamination systems that minimize environmental impact and are suitable for use on sensitive aircraft and electronic systems and for area decontamination of ports and airfields. These modernization efforts build on the accomplishments continuing during the current fiscal year.

- Continued procurement of the Biological Integrated Detection System (BIDS).
- Continued procurement of the Critical Reagents Program (CRP) to ensure the quality and availability of reagents critical to the successful development, test and operation of biological warfare detection systems.
- Installation of the Improved Point Detection System (IPDS) on amphibious, combat and select combat support ships, and Coast Guard vessels.
- Initiation of Low Rate of Initial Production (LRIP) of the Joint Biological Point Detection System (JBPDS) in preparation for transition to full rate production.
- Initiation of procurement the Joint Service Lightweight Standoff Chemical Agent Detector (JSLSCAD), a chemical vapor detection system that will furnish 360-degree on-the-move coverage from ground, air, and sea-based platforms at distances of up to five kilometers.
- Completion of the production of the Air/Base Port (Portal Shield) Advanced Concept Technology Demonstration (ACTD) program.
- Initiation of production of Aircrew Eye/Respiratory Protection (AERP) and the Second Skin Mask (MCU-2/P).
- Continued procurement of individual protective gear for naval construction forces and naval shore activities.
- Continued procurement of protective clothing to include the Joint Service Lightweight Integrated Suit Technology (JSLIST) protective ensembles.
- Continued procurement of the CB respiratory system.
- Continued procurement of the Chemical Biological Protective Shelter (CBPS) for Army medical units.
- Installation of the Collective Protection System backfit on three Navy amphibious ship classes.
- Installation, and the Joint Collective Protection Equipment (JCPE) improvements to currently fielded systems.
- Full approval of all aspects of their Biologics License Application supplement Licensure of the anthrax vaccine production.
- Licensure of SERPACWA (Skin Exposure Reduction Paste against Chemical Warfare Agents).
- Licensure of multichambered autoinjector for chemical agent treatment.

- Completion of production of the M45 Aircraft Protective Mask, the Chemical-Biological Protective Field Mask M40/M40A1, and the Collectively Protected Deployable Medical System (CP DEPMEDS).
- Continues procurement of the Modular Decontamination System (MDS).
- Procurement of the Sorbent Decontamination System (SDS).
- Initiates the Joint Service Fixed Site Decontamination (JSFXD).

The FY03 President's Budget Request for the CBDP includes a $420 million allocation from the President's Office of Homeland Security to be executed by the Department of Defense to accelerate efforts to develop better biological pathogen detection, identification, collection, and monitoring technology. Additionally, scientists working under the Department of Defense auspices will support the law enforcement, national security, and medical communities by improving our understanding of how potential bioterrorism pathogens may be weaponized, transported, and disseminated. The increased funding levels are intended to establish test beds at two urban areas in addition to National Capital region to integrate Biological Defense technologies. Additionally, DoD has provided increased funding to establish a pilot program to provide comprehensive chemical and biological force protection at nine CONUS DoD installations as well as providing CB defense equipment and training to WMD Civil Support Teams and U.S. Army Reserve Reconnaissance and Decontamination Teams. A detailed description of this request is provided as special issue at the end of Chapter 2 of this report.

Chemical and biological defense programs are currently managed jointly by the Services under the oversight of the OSD CB Defense Steering Committee. The Deputy Assistant to the Secretary of Defense for Chemical and Biological Defense, DATSD(CBD), exercises day-to-day oversight of the DoD CBDP and serves as executive secretary for the Committee. The DoD CBDP coordinates its programs with other DoD components (including the Defense Advanced Research Projects Agency), international partners, and other federal agencies, whose primary focus is on the development of capabilities to protect the civilian population from exposure to chemical or biological agents. During FY02, the Department is reviewing improved organizational options to improve the management and coordination of chemical and biological defense efforts, and as a first result of this review has established a Joint Requirements Office (JRO) under the Joint Staff to improve the requirements generation process for the Chemical and Biological Defense Program.

All CB defense capabilities are integrated into a system-of-systems to provide the most effective approach to avoid contamination and sustain operational tempo on an asymmetric battlefield. Moreover, sound joint doctrine and realistic training remain fundamental to the defense against CB weapons. Descriptions of CB defense capabilities are detailed in this report. In summary, the DoD CBDP continues to focus on a jointly integrated research, development, and acquisition approach—balancing short-term procurement and long-term science and technology efforts—to obtain needed CB defense capabilities for U.S. forces.

OVERVIEW OF REPORT

The ***INTRODUCTION*** provides a background of the rationale and purpose of the DoD Chemical and Biological Defense Program (CBDP). This section summarizes the key counterproliferation priorities and the current CB warfare threats to U.S. forces. Intelligence documents tailored to the

threat are essential for developing and updating requirements for CB defense programs. Each CB defense research, development, and acquisition effort funded within the program responds to a defined or validated threat. Variations among chemical and biological agents and each agent's unique physical, toxicological, destructive, and other properties such as means of delivery require a capabilities-based response. Intelligence efforts continue to emphasize collection and analysis of nations' "dual-use" chemical and biological industrial capabilities and develop the indications and warning of adversarial use or diversion of dual-use capabilities to weapons programs.

CHAPTER 1 describes the accomplishments, processes, and issues related to DoD CBDP management and oversight. DoD is currently undertaking a major revision to improve the overall joint management and coordination of the CBDP. *50 USC 1522 has been a critical tool for ensuring the elimination of redundant programs, focusing funds on program priorities, and enhancing readiness*.

CHAPTER 2 provides information on medical and non-medical NBC defense requirements and research, development, and acquisition programs. This chapter outlines plans and strategies for the development and acquisition of capabilities in each of the program commodity areas, including contamination avoidance, individual protection, collective protection, modeling and simulation, medical chemical defense, and medical biological defense. In addition, this chapter includes a "Special Report on Anthrax Vaccine Costs, Acquisition Strategy, and Related Issues," in section 2.8 in accordance with the request for information as stated in the National Defense Authorization Act for Fiscal Year 2001 - Authorization Conference Report (106-945, Section 217, Joint Biological Defense Program, p. 719). RDA efforts to address homeland security, especially the threat from bioterrorism, are described at the end of this chapter.

CHAPTER 3 provides an analysis of NBC defense logistics posture. This analysis shows a continuing trend of maintaining a significant portion of NBC defense items at low logistical risk, thus enhancing the warfighters' abilities to sustain operations in an NBC contaminated environment. The analysis reviews the status of quantities, characteristics, and capabilities and limitations of all fielded NBC defense equipment, industrial base requirements, procurement schedules, and problems encountered. Much of the information is based on the model of Joint Chemical Defense Equipment Consumption Rates (JCHEMRATES IV). Additional information is derived from the Joint NBC Defense Logistics Support Plan. This chapter reflects the logistics status at the end of FY01 and is based on the FY01 requirement for supporting two nearly simultaneous major theater wars. Assessments are being conducted during FY02 to determine the specific warfighter requirements based on the new force sizing structure as a result of the 2001 Quadrennial Defense Review and additional mission requirements for force protection, consequence management, and homeland security.

CHAPTER 4 assesses the status of NBC defense training and readiness conducted by the Services. Each of the Services' training standards and programs is reviewed. In accordance with Section 1702 of P.L. 103-160 (50 USC 1522) all chemical and biological warfare defense training activities of the Department of Defense have been consolidated at the United States Army Chemical School.

CHAPTER 5 provides information on the status of DoD efforts to implement the Chemical Weapons Convention (CWC), which was ratified by the United States and entered into force during

1997. This chapter also includes a summary of plans and activities to provide assistance to other countries in response to an appeal by another State Party to the CWC, pursuant to Article X of the CWC.

Finally, there are several ***ANNEXES*** to this report. ***Annexes A through E*** provide detailed information on Joint and Service-unique NBC defense equipment, including: (A) contamination avoidance, (B) modeling and simulation, (C) protection, (D) decontamination, and (E) medical programs. Detailed descriptions are provided for systems and equipment that have been fielded, are in production, or under development. ***Annex F*** provides a summary of funds appropriated, budgeted, and expended by the DoD CBDP. One of the successes of the DoD NBC Defense Program has been the consolidation of all DoD NBC Defense research, development, test, and evaluation (RDT&E) and procurement program funds under defense-wide program elements, rather than throughout numerous Service accounts. ***Annex G*** provides NBC defense logistics readiness data and a breakout of service war requirements, stocks on-hand, and planned acquisitions. This information supplements information in Chapter 3. ***Annex H*** provides a statement regarding chemical and biological defense programs involving human subjects as required by 50 USC 1523. As detailed in the annex, no such testing has been conducted in over two decades and none is planned. ***Annex I*** provides the text of the congressional language requiring this report. ***Annex J*** provides a list of the many acronyms and abbreviations that are used throughout this report.

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Introduction

I. PURPOSE OF REPORT

In accordance with 50 USC 1523, this report provides Congress with an assessment of the overall readiness of the Armed Forces to fight in a chemical and biological warfare environment. This is the ninth report submitted under 50 USC 1523.*

II. GOVERNMENT PERFORMANCE AND RESULTS ACT (GPRA)

The Department of Defense (DoD) Chemical and Biological Defense Program (CBDP) has prepared a performance plan (included as Volume II of this report) to align itself more closely with the tenets of the GPRA. This performance plan demonstrates full compliance with the requirements of the GPRA, which requires agencies to submit an annual performance plan to Congress. This establishes a *process* by which the CBDP can measure the effectiveness of the various projects under the CBDP and assess their contributions to the operational goals and the mission of the program. This process provides a tool for identifying strengths and weaknesses in the development and execution of programs. This plan will act as a reference document for the effective oversight and management of the program. The Office of the Secretary of Defense (OSD) Chemical and Biological Defense Steering Committee prepared this performance plan in order to provide targets—both planned and actual—for the current assessed year (FY2001) and the next two planning years (FY2002 & 2003).

VISION, MISSION, AND GOALS OF THE CBDP

Ensure U.S. military personnel are the best equipped and best prepared force in the world for operating in future battlespaces that may feature chemically and biologically contaminated environments.

Figure 1. Chemical and Biological Defense Program Vision

The vision of the CBDP is shown in **figure 1**. This vision statement provides focus to chemical and biological defense research, development, and acquisition efforts within the CBDP. There are two key aspects of this vision statement. The first is that the focus of the CBDP is on equipping *military personnel*. DoD does nsot have the responsibility or the authority to develop or acquire chemical and biological defense capabilities for civilians organizations. Chapter 1 of Volume 1 of the annual report describes some of the cooperative activities that DoD participates in to support chemical and biological defense homeland security needs. The other key aspect of the vision statement is "*operating in future battlespaces*." While the vision statement has not been revised in light of the terrorist attacks of September 11, 2001 or the anthrax-contaminated letters in 2001, DoD recognizes the changing threat

* The text of 50 USC 1523, *Annual report on chemical and biological warfare defense*, (implemented as part of Public Law 103-160, the FY94 National Defense Authorization Act) is included at Annex I.

environment, factors, and conditions that must be understood to successfully apply combat power, protect the force, or complete the mission. The definition of future battlespaces is being broadened to incorporate not only traditional military operations on the battlefield and foreign deployments, but it will also incorporate increasing roles in support of homeland security within the United States.

The *Quadrennial Defense Review Report*, September 2001, serves as the overall strategic planning document of the Department. For FY01, the requirements were based on supporting two nearly simultaneous Major Theater Wars (MTWs). The Quadrennial Defense Review (QDR) defines a new force-sizing construct, which replaces the 2 MTW construct. This new force-sizing contruct specifically shapes forces to:

- Defend the United States;
- Deter aggression and coercion forward in critical regions;
- Swiftly defeat aggression in overlapping major conflicts while preserving for the President the option to call for a decisive victory in one of those conflicts - including the possibility of regime change or occupation; and
- Conduct a limited number of smaller-scale contingency operations.

In doing so, DoD will maintain sufficient force generation capability and a strategic reserve to mitigate risks.

In order to support the force-sizing construct defined in the QDR and to implement to program vision, **Figure 2** defines the mission for the Chemical and Biological Defense Program. Over the next year, the Department plans a review of this mission and the supporting operational goals to address the evolving role of the Department in various new and expanded missions, including combating terrorism and homeland security.

Provide world-class chemical and biological defense capabilities to allow the military forces of the United States to survive and successfully complete their operational missions across the entire spectrum of conflict—from peacetime contingency missions through overlapping major conflicts—in environments contaminated with chemical or biological warfare agents.

Figure 2. Chemical and Biological Defense Program Mission

A key element in providing a means to establish progress in fulfilling the program mission is the definition of corporate goals for the CBDP, as shown in **figure 3**. Corporate goals provide the broad warfighter requirements for NBC defense operations. These operational goals provide direction for the development, acquisition, and fielding of NBC defense equipment. The CBDP thus develops, acquires, and fields equipments that meets warfighter requirements while reducing acquisition costs and time of development. Figure 3 defines the corporate operational goals (and provides a summary of the key materiel capabilities that support these goals.)

- **View NBC Warfare Agents within the Theater Area of Operations**
  (Early Warning and Stand-off Detection of NBC Agents)
- **Dominate the Battlespace through Reconnaissance, Surveillance, and Target Acquisition (RSTA)**
  (NBC Reconnaissance Systems)
- **Enhance the Situational Awareness of Unit Battlespace**
  (Expanded Sensor Capability of Automatic Point and Remote Detection of NBC Agents)
- **Provide Real-Time Hazard Information to Influence Current Operations**
  (NBC Battle Management, Warning & Reporting, and Modeling & Simulation)
- **Enhance Personnel and Equipment Survivability**
  (Individual Detection, Individual Protection, Medical defenses, Decontamination, and NBC Contamination Survivability)
- **Maintain Ground, Air and Maritime Operational Tempo**
  (Operational Decontamination and Mobile Collective Protection)
- **Sustain Operations, Recovery and Reconstitution Efforts**
  (Thorough Decontamination, Fixed Site Collective Protection, Medical Diagnosis and Treatment, Training, and Readiness)

Figure 3. Chemical and Biological Defense Program Corporate Goals

All of the capabilities integrated together as a system-of-systems are essential to avoid contamination and to sustain operational tempo on an asymmetric battlefield. Sound Joint doctrine and realistic training remain fundamental to defense against NBC weapons. U.S. forces must have numerous capabilities in order to respond and deploy quickly to various worldwide needs. Counterproliferation capabilities are required by forces to meet worldwide needs, and NBC defense is integral to counterproliferation capabilities. In a February 2001 Joint Warfighting Capabilities Assessment (JWCA) study approved by the Joint Requirements Oversight Council, the Commanders-in-Chief identified their priorities for counterproliferation capabilities. These priorities are shown in **Table 1**. Capabilities that are supported by the Chemical and Biological Defense Program are highlighted in **bold**. As currently identified, NBC defense capabilities are listed in four of the top ten CINC priorities. *Individual protection* includes capabilities for physical protection, medical countermeasures (vaccines, prophylaxes and pre-treatments), and NBC mass casualty medical treatment. These capabilities must be supported by the development of effective concepts of operation. *Detect and Monitor Use of WMD* includes establishing and maintaining the necessary capabilities to detect NBC use, including medical diagnostics. *Communicate the Ability and Will to Employ Defensive Capabilities* includes demonstrating the capacity to employ defensive capabilities and the ability to operate effectively in contaminated environments and effective concepts of operation to reduce an enemy's perceived utility in developing, producing, and threatening to use or actually using NBC weapons. *Collective protection* provides relief from sustained operations in full individual NBC protective equipment, shelters for sensitive equipment not easily decontaminated, and clean environments for operations that can not be performed under NBC contaminated conditions. *Establish/Maintain*

Ability to Restore from WMD use includes establishing and maintaining the necessary capabilities to restore operations after the employment of NBC contamination, and may include decontamination operations. contamination detection and monitoring, medical diagnostics and post-exposure treatments, and education and training in effective concepts of operation.

Table 1. Finalized Geographic CINC Prioritized Counterproliferation Requirements

Rank	Counterproliferation Requirement
1	**Provide individual protection to forces and assist allies/coalition partners with relief from the effects of NBC**
2	Detect and Monitor Development, Production, Deployment, Employment* and Transfer of WMD and Determine Vulnerabilities
3	Communicate the Ability / Will to Employ Interdiction / Response Capabilities
4	Intercept the Conventional Delivery of WMD with Minimal Collateral Effects
5	**Detect and Monitor Use of WMD**
6	Conduct Off-Site Attack to Destroy, Disable, and Deny WMD Targets
7	**Communicate the Ability and Will to Employ Defensive Capabilities**
8	Establish and Maintain Relations with Allies, and Potential Adversaries to Discourage Development, Production, and Use of WMD
9	**Provide Collective Protection to Forces and Assist Allies / Coalition with Relief from the Effects of NBC**
10	Seize, Destroy, Disable, and Deny Transport of WMD
11	Conduct Information Warfare to Destroy, Disable, and Deny WMD Development, Production, Deployment, and Employment
12	Determine vulnerabilities in decision-making process related to WMD
13	Conduct On-Site Attack to Seize, Destroy, Disable, and Deny WMD Targets
14	Provide Alternatives to the Pursuit of WMD
15	Support treaties, export controls, and political/diplomatic efforts
16	Destroy, Disable, and Deny Actor's Non-WMD Resources and Capabilities
17	**Establish / Maintain Ability to Restore from WMD use**
18	Provide personnel, training, materiel, equipment, to support security assistance
19	Provide intelligence collection capabilities in support of USG NP efforts

* Detecting “employment” refers to the capability to detect prior to actual use.

The response to the threat of CB weapons must be based on the nature of this threat, not just where the threat occurs. A key part of DoD’s strategy is to stem the proliferation of such weapons and to develop an effective capability to deal with these threats. To focus the response to the threat, DoD and the intelligence community have completed several classified reports providing threat assessments on chemical and biological threats to U.S. forces. To minimize the effect of these threats to U.S. forces, DoD continues to improve defensive capabilities. These continuing improvements also contribute to our overall deterrence by demonstrating to an adversary that use of CB agents or weapons provides little or no military advantage. The DoD CB Defense Program continues to work towards increasing the capabilities of Joint Forces to survive and continue their mission during conflicts that may involve the use of CB agents or weapons.

Those countries that persist in offensive chemical weapons programs are adding agents and more sophisticated delivery systems. Similarly, the sophistication of CB weapons capabilities is

increasing. Proliferation of weapons technology, precision navigation technology, nuclear technologies (medical, power, and industrial applications), and advanced chemical and biological technologies to developing nations presents the United States with a complicated national security challenge. Intelligence efforts include collection and analysis of nations' "dual-use" nuclear, chemical, and biological industrial capabilities, and development of the indications and warning of diversion of dual-use capabilities to weapons programs. Tailored intelligence documents are essential for assessing, developing and updating requirements for CB defense programs. Numerous threat documents tailored to the CB threat have been produced and are updated periodically. The Intelligence Community continues to review U.S. chemical and biological warfare intelligence requirements and assess the adequacy of intelligence assets to execute the required intelligence program.

III. THE CURRENT CHEMICAL AND BIOLOGICAL WARFARE THREAT

Introduction

Chemical and biological weapons are generally easier to develop, hide, and deploy than nuclear weapons and will be readily available to those with the will and resources to attain them. More than two dozen states or non-state groups either have, or have an interest in acquiring, chemical weapons; there are a dozen countries believed to have biological warfare programs, and terrorist groups also are knoiwn to be interest in these weapons. The proliferation of chemical and biological weapons is expected to continue, and these weapons could well be used in a regional conflict or terrorist attack over the next 15 years.

Northeast Asia

North Korea has acceded to the Biological and Toxin Weapons Convention, but nonetheless has pursued biological warfare capabilities since the 1960s. Pyongyang's resources presently include a rudimentary (by Western standards) biotechnology infrastructure that is sufficient to support the production of limited quantities of toxins, as well as viral and bacterial biological warfare agents, such as anthrax, cholera, and plague. North Korea is believed to possess a sufficient munitions-production infrastructure to accomplish weaponization of BW agents and it may have biological agents available for use.

By comparison, North Korea's chemical warfare program is believed to be mature and includes the capability, since 1989, to indigenously produce bulk quantities of nerve, blister, choking and blood chemical agents, using its sizeable chemical industry. North Korea is believed to possess a sizable stockpile of chemical agents and agent filled munitions, which it could be employ in offensive military operations against the South. In fact, the United States believes that North Korea has some long-range artillery deployed along the demilitarized zone (DMZ) as well as ballistic missiles, some of which could deliver chemical warfare agents against forward-based U.S. and allied forces, as well as against rear-area targets.

North Korea has also devoted considerable scarce resources to defensive measures aimed at protecting its population and military forces from the effects of chemical weapons. Such measures include extensive training in the use of protective masks, suits, detectors, and decontamination systems. Though these measures are ostensibly focused on a perceived threat from U.S. and South

Korean forces, they could also support the offensive use of chemical weapons by the North during combat. North Korea has yet to sign the Chemical Weapons Convention (CWC) and is not expected to do so in the near term, due to intrusive inspection and verification requirements mandated by the agreement.

China possesses an advanced biotechnology infrastructure as well as the munitions production capabilities necessary to develop, produce and weaponize biological agents. China has consistently claimed that it never researched, produced, or possessed any biological weapons and would never do so. Nevertheless, China's declarations under the voluntary BWC declarations for confidence building purposes are believed to be inaccurate and incomplete, and there are some reports that China may retain elements of its biological warfare program.

China is believed to have an advanced chemical warfare program that includes research and development, production and weaponization capabilities. While China claims it possesses no chemical agent inventory, it is believed to possess a moderate inventory of chemical agents. It has a wide variety of potential delivery systems for chemical agents, including artillery, multiple rocket launchers, mortars, land mines, bombs, and short and medium range missiles. Chinese military forces likely have a good understanding of chemical warfare doctrine, and routinely conduct defensive chemical warfare training. Even though China has ratified the CWC, made its declaration, and subjected its declared chemical weapons facilities to inspections, DoD believes that Beijing has not acknowledged the full extent of its chemical weapons program.

South Asia

India has well-qualified scientists, numerous biological and pharmaceutical production facilities, and biocontainment facilities suitable for research and development of dangerous pathogens. At least some of these facilities are being used to support research and development for biological warfare defense work. India has ratified the BWC.

India is an original signatory of the CWC. In June 1997, it acknowledged that it had a chemical warfare production program. This was the first time India admitted that it had a chemical warfare effort. India also stated that all related facilities would be open for inspection, as called for in the CWC, and subsequently, it has hosted all required CWC inspections. While India has made a commitment to destroy its chemical weapons, its extensive and well-developed chemical industry will continue to be capable of producing a wide variety of chemical agent precursors should the government change its policy.

Pakistan is believed to have the resources and capabilities to support a limited biological warfare research and development effort. Pakistan may continue to seek foreign equipment and technology to expand its biotechnology infrastructure. Pakistan has ratified the BWC.

Pakistan ratified the CWC in October 1997 and did not declare any chemical agent production or development. Pakistan has imported a number of dual-use chemicals that can be used to make chemical agents. These chemicals also have commercial uses and Pakistan is working towards establishing a viable commercial industry capable of producing a variety of chemicals, some of which could be used to make chemical agents. Chemical agent delivery methods available to Pakistan include missiles, artillery, and bombs.

While *Afghanistan* itself does not have any biological or chemical warfare programs, evidence discovered since October 2001 indicates that the Al Qaeda network in Afghanistan was interested in obtaining these capabilities.

The Middle East and North Africa

Iran has a growing biotechnology industry, significant pharmaceutical experience and the infrastructure capable of supporting its biological warfare program. Tehran has expanded its efforts to seek considerable dual-use biotechnology materials and expertise from entities in Russia and elsewhere, ostensibly for civilian reasons. However, this equipment and know-how could be applied to Iran's BW program. Iran's biological warfare program began during the Iran-Iraq War. Iran is believed to be pursuing offensive biological warfare capabilities and its effort may have evolved beyond agent research and development to the capability to produce small quantities of agent. In fact, it may hold some stocks of BW agents and weapons. Iran has ratified the BWC.

Iran ratified the Chemical Weapons Convention (CWC) and acknowledged the existence of a past chemical weapons program. Iran admitted developing a chemical warfare program during the latter stages of the Iran-Iraq war as deterrent against Iraq's use if chemical agents against Iran. Moreover, Tehran claimed that after the 1988 cease-fire, it "terminated" its program. However, Iran has yet to acknowledge that it used chemical weapons during the Iran-Iraq War.

Nevertheless, Iran has continued its efforts to seek production technology, training, equipment, expertise and precursor chemicals from entities in Russia and China that could be used to create a more advanced and self-sufficient chemical warfare infrastructure. In the past, Tehran has manufactured and stockpiled blister, blood, choking and probably nerve l agents, and weaponized some of these into artillery shells, mortars, rockets, and bombs. Iran could employ these agents during a future conflict in the region.

Prior to the Gulf War, *Iraq* developed the largest and most advanced biological warfare program in the Middle East. Though a variety of agents were studied, the Iraqis declared anthrax, botulinum toxin, and aflatoxin to have completed the weaponization cycle. Iraq also admitted that during the Persian Gulf War it had deployed biological agent-filled munitions to airfields and that these weapons were intended for use against Israel and coalition forces in Saudi Arabia. Iraq stated that it destroyed all of these agents and munitions in 1991, but it has provided insufficient credible evidence to support this claim.

The UN believes that Baghdad has the ability to reconstitute its biological warfare capabilities within a few weeks or months. Iraq also has continued dual-use research that could improve BW agent R&D capabilities. With the absence of a monitoring regime and Iraq's growing industrial self-sufficiency, we remain concerned that Iraq may again be producing biological warfare agents.

During the Iran-Iraq War, Iraq used blister and nerve agents against Iranian military forces on numerous occasions; Iraq also used chemical agents against Kurdish elements of its own civilian population in 1988.

Since the Gulf War, Baghdad has rebuilt key portions of its chemical production infrastructure; it has not become a state party to the CWC. Some of Iraq's facilities could be converted fairly quickly to production of chemical warfare agents. Following OPERATION DESERT FOX,

Baghdad again instituted a rapid reconstruction effort on those facilities to include former dual-use chemical warfare-associated production facilities, destroyed by U.S. bombing. In addition, Iraq appears to be installing or repairing dual-use equipment at chemical warfare–related facilities. Previously, Iraq was known to have produced and stockpiled mustard, tabun, sarin, and VX, some of which likely remain hidden. It is likely that an additional quantity of various precursor chemicals also remain hidden.

In late 1998, UNSCOM reported to the UN Security Council that Iraq continued to withhold information on its chemical program. UNSCOM inspectors discovered that Iraq had not consumed as many chemicals munitions during the Iran-Iraq War as had been declared previously. This report suggests that Iraq may have an additional 6,000 chemical munitions hidden. Similarly, UNSCOM's discovery in 1998 of evidence of VX in Iraqi missile warheads showed that Iraq had lied to the international community for seven years when it repeatedly said that it had never weaponized VX.

Syria has a limited biotechnology infrastructure but could support a limited biological warfare effort. Though Syria is believed to be pursuing the development of biological weapons, it is not believed to have progressed much beyond the research and development phase and may have produced only pilot quantities of usable agent. Syria is a signatory to, but has not ratified, the BWC.

Syria is not a state party to the CWC and has had a substantial chemical warfare program for many years, although it has never used chemical agents in a conflict. Syria already has a stockpile of the nerve agent sarin that can be delivered by aircraft or ballistic missiles. Additionally, Syria is trying to develop the more toxic and persistent nerve agent VX. In the future, Syria can be expected to continue to improve its chemical agent production and storage infrastructure.

Libya has ratified the BWC, but has continued a rudimentary biological warfare program. This program has not advanced beyond the research and development stage, although it may be capable of producing small quantities of biological agent. Libya's program has been hindered by the country's poor scientific and technological base, equipment shortages, and a lack of skilled personnel, as well as by UN sanctions in place from 1992 to 1999. However, with the suspension of sanctions, Libya's ability to acquire biological-related equipment and expertise has increased.

Following the suspension of UN sanctions in April 1999, Libya reestablished contacts with foreign sources of expertise, parts and precursor chemicals for its program. Libya still appears to have a goal of establishing an offensive CW capability and an indigenous production capability for weapons. Prior to 1990, Libya produced about 100 tons of chemical agents—mustard and some nerve agent—at a chemical facility at Rabta. However, it ceased production there in 1990 due to intense international media attention and the possibility of military intervention, and fabricated a fire to make the Rabta facility appear to have been seriously damaged. Libya maintains that the facility is a pharmaceutical production plant and announced in September 1995 that it was reopening the Rabta pharmaceutical facility. After 1990, the Libyans shifted their efforts to trying build a large underground chemical production facility at Tarhunah. However, the pace of activity there has slowed, probably due to increases international attention.

Russia

The Soviet offensive biological warfare program was the world's largest and consisted of both military facilities and civilian research and development institutes. According to Ken Alibek, the former Deputy Director of BIOPREPARAT, the principal government agency for biological weapons research and development, by the early 1970s, the Soviet Union had developed a biological warfare employment doctrine, where biological weapons were categorized as strategic or operational to rationalize use of its significant weapons holdings.

The Russian government has publicly committed to ending the former Soviet biological weapons program and claims to have ended the program in 1992. Nevertheless, serious concerns remain about Russia's biological warfare activities and the status of some elements of the offensive biological warfare program inherited form the FSU.

Since the breakup of the Soviet Union, more extensive downsizing and restructuring of the program have taken place. Many of the key research and production facilities have taken severe cuts in funding and personnel. However, some key components of the program remain largely intact and may support a possible future mobilization capability for BW program. Despite Russian ratification of the BWC, work outside the scope of legitimate biological defense may be occurring now at selected facilities, and the United States continues to receive unconfirmed reports of some ongoing offensive biological warfare activities.

Russia has acknowledged the world's largest stockpile of chemical agents of approximately 40,000 metric tons. The Russian chemical agent inventory consists of a comprehensive array of blister, choking, and nerve agents in weapons and stored in bulk. These agents can be employed by tube and rocket artillery, bombs, spray tanks, and SRBM warheads. However, DoD believes that the Russians probably have not divulged the full extent of their chemical agent and weapon inventory. In addition, since 1992, Russian scientists familiar with Russia's chemical warfare development program have been publicizing information on a new generation of agents, sometimes referred to as "Novichoks." These scientists report that these compounds, some of which are binaries, were designed to circumvent the CWC and to defeat Western detection and protection measures.

As a state party to the CWC, Russia is obligated to declare and destroy its chemical weapons stockpile and to forego the development, production, and possession of chemical weapons. However, in June 2001, Russian officials stated that Russia could not meet its commitment to destroy its declared chemical warfare arsenal by 2007 and will request a five-year extension. Even if Russia is granted such a five-year extension by the OPCW, it is unlikely that Russia's declared stockpile will be completely destroyed by 2012 because of serious technical, ecological, financial, and political problems.

Terrorism

The threat of terrorists obtaining and employing biological or chemical materials has increased in the wake of the 11 September attacks. Several of the 30 designated foreign terrorist organizations and other non-state actors, including the Al Qaeda network, have expressed interest in these weapons. In fact, we have confirmed that the Al Qaeda network was working to acquire chemical agents and toxins, and was pursuing a sophisticated biological weapons research program. In addition, the relative ease of producing some chemical or biological agents has increased concern that their use may

become more attractive to terrorist groups intent on causing panic or inflicting large numbers of casualties.

PROLIFERATION

The United States faces a number of regional proliferation challenges. Many of these are detailed in the January 2001 report published by the Office of the Secretary of Defense, *Proliferation: Threat and Response*. Additional information is provided by the Central Intelligence Agency in the *Unclassified Report to Congress on the Acquisition of Technology Relating to Weapons of Mass Destruction and Advanced Conventional Munitions*.* Entities in Russia and China are the main suppliers of biological and chemical related equipment and technology. In the Middle East, Iran continues with a concerted effort to acquire an independent production capability for all aspects of its chemical weapons program. It continues its efforts to seek production technology, expertise and precursor chemicals from entities in Russia and China that could be used to create a more advanced and self-sufficient chemical warfare infrastructure. Iran also is pursuing a program to purchase dual-use biotech equipment from other countries, ostensibly for civilian uses. Russia is a key source of biotechnology for Iran. Meanwhile, Iraq again may be producing biological agents and it also has rebuilt portions of its chemical infrastructure, including former dual-use CW facilities.

Proliferation of chemical and biological warfare technology in South Asia also raises several important issues. In the past, India has exported a wide array of chemical products, including Australia Group-controlled items, to numerous countries of proliferation concern in the Middle East. The controlled items include specific chemical agent precursors, pathogens with biological warfare applications, and dual-use equipment which can be used in both chemical and biological warfare programs. Pakistan, on the other hand, may continue to

Australia Group

The proliferation of chemical and biological warfare related technology remains a critical threat to peace and stability throughout the world. One mechanism through which industrialized countries have agreed to control the proliferation of key chemical and biological warfare related technologies is the Australia Group. The Australia Group (AG) is a consortium of countries organized to slow the proliferation of chemical and biological warfare programs by harmonizing national export controls and sharing information on trends in proliferation, entities of concern, chemical and biological warfare (CBW) terrorism, and licensing and enforcement experiences. The AG is not a treaty, and hence has no formal guidelines, charter, or constitution. Initial efforts of this group began in June 1985 and focused on precursor chemicals used in the manufacture of chemical agents. However, convinced of the threat posed from biological weapons, AG countries subsequently agreed, in December 1992, to also control the sale of items that most likely could be used to develop biological agents and weaponry. The AG developed control lists of dual-use chemical- and biological-related materials that are particularly suited for use in CBW. These lists currently contain 54 chemical precursors (34 of these chemicals are on the Chemical Weapons Convention (CWC) Schedules); 93 human, animal, and plant biological pathogens and toxins; and dual-use chemical- and biological-related production equipment. The listed items include animal and plant pathogen that could be used for anti-crop and anti-animal biological warfare. The U.S. has initiated an effort to strengthen AG export control lists to better target BW related production and dissemination items.

* This report is updated every six months and is available on the internet at http://www.cia.gov/cia/publications/bian/bian_jan_2002.htm.

seek foreign equipment and technology to expand its biotechnology infrastructure. In addition, Pakistan has imported a number of dual-use chemicals that can be used to make chemical agents.

In North Africa, following the suspension of UN sanctions in April 1999, Libya has re-established contacts with foreign sources of expertise, parts, and precursor chemicals for its program and still appears to have the goal of establishing an indigenous chemical warfare production capability. In addition, with suspension of UN sanctions, Libya's ability to acquire biological-related equipment and expertise will increase.

OUTLOOK

In the next 10 years, the threat from the proliferation of CBW weapons will certainly increase. This will result from the development of chemical and biological agents that are more difficult to detect, from the adoption of more capable delivery systems, and from the spread of production technology.* DoD expects that more states with existing programs will master the production processes for complete weapons and will be less dependent on outside suppliers. States will be more proficient at incorporating chemical or biological agents into delivery systems and will be focusing on battlefield training as well as employment strategy and doctrine. Therefore, the threshold of some states to consider using these capabilities may be lowered.

DoD does not expect significant increases in the number of government-sponsored offensive CBW programs. Nevertheless, the United States and its allies must be alert to this possibility. Any nation with the political will and a minimal industrial base could produce CBW agents suitable for use in warfare. In addition, a variety of non-state groups, including the Al Qaeda network, are showing increased interest in attaining and employing biological or chemical weapons.

Efficient weaponization of these agents, however, does require design and production skills usually found in countries that possess a munitions development infrastructure or access to such skills from cooperative sources. On the other hand, crude agent dispersal devices could be fabricated by almost any nation or group. Such weapons might be capable of inflicting only limited numbers of casualties; nevertheless, they could have significant operational repercussions due to the psychological impact created by fears of CBW agent exposure.

* An assessment of potential new biological agents that may challenge U.S. forces is in a DoD report to Congress entitled *Advances in Biotechnology and Genetic Engineering: Implications for the Development of New Biological Warfare Agents*, June 1996.

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Chapter 1

DoD Chemical and Biological Defense Program Management and Oversight

1.1 INTRODUCTION

In compliance with public law, chemical and biological defense programs within the Department are overseen by a single office within the Office of the Secretary of Defense. The vision and mission of the Department's Chemical and Biological Defense Program (CBDP) are outlined in the introduction of this report. A key value in support of the program vision is to emphasize a Joint Service approach to chemical and biological defense research, development, and acquisition. This value provides a process that eliminates unnecessary redundancies among the Services, leverages common technologies and requirements, provides capabilities for Service-unique missions, and coordinates among U.S. government agencies and U.S. allies to field the best available chemical and biological defense capabilities. This chapter provides an overview of the processes involved in the oversight, management, and execution of the CBDP.

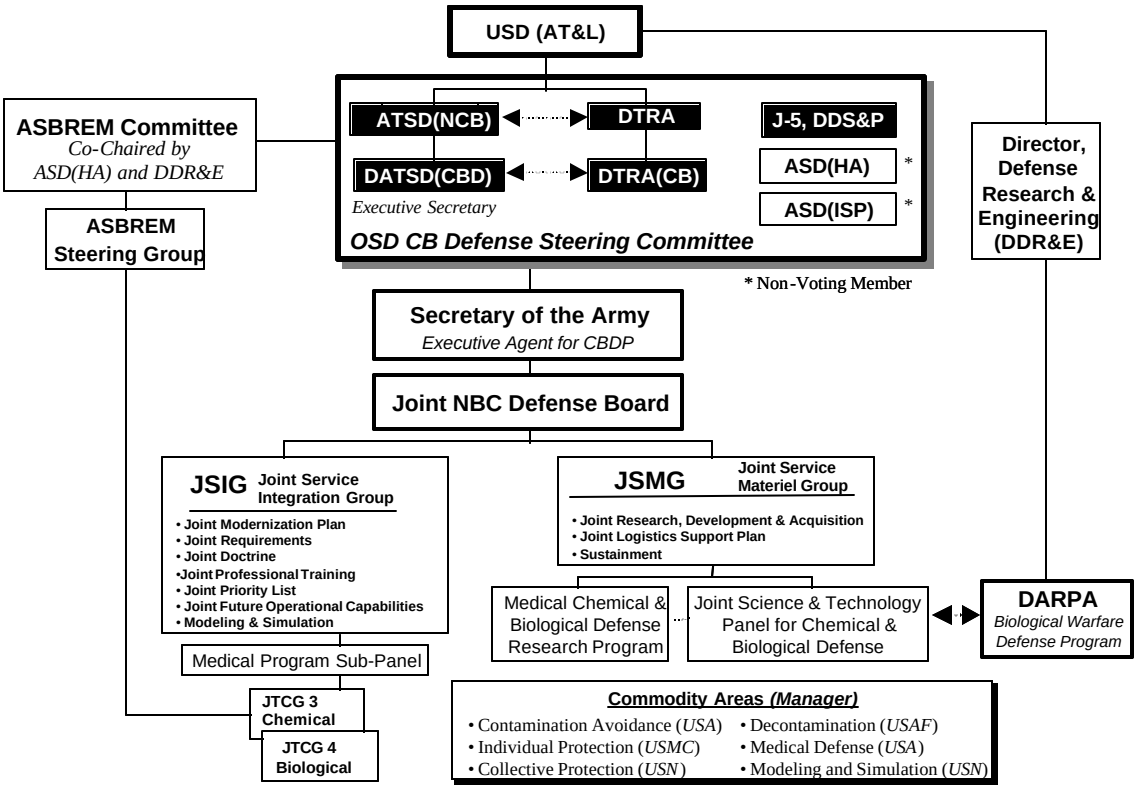
1.2 MANAGEMENT IMPLEMENTATION EFFORTS

The Department of Defense (DoD) implemented a process to consolidate, coordinate, and integrate the chemical and biological (CB) defense requirements of all Services into a single DoD CB defense program. Additionally, DoD continues to refine organizations and processes to ensure close and continuous coordination between the Chemical and Biological Warfare Defense program and the Medical Chemical Biological Defense program.

Through the Joint Service Agreement on NBC Defense, the Military Services have established a program management structure to ensure that Service operational needs are fully integrated and coordinated from their inception and that duplication of effort is eliminated from NBC defense research, development, and acquisition. The series of reviews conducted by the Joint Service Integration Group (JSIG) and the Joint Service Materiel Group (JSMG), both separately and together, have served as an appropriate organizational method to accomplish the coordinating and integrating function. Section 1.3 details organizational relationships within the CBDP. Section 1.4 highlights organizational relationships between the CBDP and related organizations within the Department of Defense, with other U.S. Government organizations, and international efforts with U.S. allies. As discussed in Section 1.7 at the end of this chapter, the organization structure is under review, and a new structure will be proposed to be implemented during FY2002 that will improve acquisition management and improve the integration of requirements generation.

1.3 ORGANIZATIONAL RELATIONSHIPS

The CB Defense Program management structure, portrayed in **Figure 1-1**, represents organizational relationships in place through FY2001. This management and oversight structure was developed in late 1996 to provide integration of formerly separate service programs and of medical and non-medical CB defense efforts at the Service level. The organization represents all key stakeholders within the Department and provides a balance between operational requirements and research, development, and acquisition (RDA) programs.



ASBREM - Armed Service Biomedical Research Evaluation and Management
ASD(HA) - Assistant Secretary of Defense for Health Affairs
ASD(ISP) - Assistant Secretary of Defense for International Security Policy
ATSD(NCB) - Assistant to the Secretary of Defense for Nuclear and Chemical and Biological Defense Programs
DARPA – Defense Advanced Research Projects Agency
DATSD(CBD) - Deputy Assistant to the Secretary of Defense for Chemical and Biological Defense
DTRA - Director, Defense Threat Reduction Agency
DTRA(CB) - Director, DTRA Chemical and Biological Defense Directorate
J-5, DDS&P – Joint Staff, J-5, Deputy Director for Strategy and Policy
JTCG - Joint Technology Coordinating Group
USA - United States Army
USAF - United States Air Force
USD(AT&L) - Under Secretary of Defense for Acquisition, Technology & Logistics; serves as the chairman of the Defense Acquisition Board
USMC - United States Marines Corps
USN - United States Navy

Figure 1-1 CBDP Management & Oversight (FY2001)

The Office of the Secretary of Defense (OSD) CB Defense Steering Committee provides direct oversight of the DoD Chemical and Biological Defense Program. The OSD CB Defense Steering Committee is composed of the following voting members:

- Assistant to the Secretary of Defense for Nuclear and Chemical and Biological Defense, ATSD(NCB),
- Deputy Assistant to the Secretary of Defense for Chemical and Biological Defense, DATSD(CBD),
- Director, Defense Threat Reduction Agency (DTRA),

- Director, Chemical Biological Defense Directorate, DTRA, (DTRA(CB)),
- Deputy Director for Strategy and Policy, Joint Staff, J-5 (DDS&P, J-5)

Additionally, the Assistant Secretary of Defense for Health Affairs, ASD(HA), and the Assistant Secretary of Defense for International Security Policy, ASD(ISP), participate as non-voting members on the steering committee.

The Steering Committee provides the fiscal and programming guidance to the Joint NBC Defense Board (JNBCDB) to develop the Program Objectives Memorandum (POM). The JNBCDB issues POM Preparation Instructions to the subordinate groups and builds the POM strategy in accordance with guidance. The OSD CB Defense Steering Committee is overseen by the Under Secretary of Defense for Acquisition, Technology, and Logistics, USD(AT&L), who approves the POM for the CBDP.

The DATSD(CBD) serves as the Executive Secretary of the OSD CB Defense Steering Committee. The DATSD(CBD) is the single office within OSD responsible for oversight of the DoD CB Defense Program. As Executive Secretary, DATSD(CBD) is responsible for ensuring coordination between the medical programs and the non-medical CB defense efforts, and management oversight of the DoD CBDP in accordance with 50 USC 1522. The DATSD(CBD) is responsible for the overall coordination and integration of all CB defense RDA and military construction efforts. DATSD(CBD) provides the overall guidance for planning, programming, budgeting, and executing the CB defense program. The Services retain responsibility for operations and maintenance (O&M) support for chemical and biological defense.

The Secretary of the Army is the Executive Agent for the CBDP and is responsible to coordinate, integrate, and review all Services' CB defense requirements and programs. The Secretary has delegated this responsibility to the chairperson of the Joint NBC Defense Board. The military departments' acquisition organizations execute the individual CB defense programs according to Service and DoD directives.

The CBDP is divided into six commodity areas, with each commodity area being managed by one of the Services in accordance with the Joint Service Agreement, as follows:

Commodity Area	**Commodity Area Manager**
Contamination avoidance	Army
Individual protection	Marines Corps
Collective protection	Navy
Decontamination	Air Force
Medical systems	Army
Modeling & simulation	Navy

The commodity areas correspond to the projects under the budget program elements, which includes a program budget element to support program management and oversight, user testing (*i.e.*, Dugway Proving Grounds), and doctrine development in accordance with the Joint Service Agreement. The JSIG is the principal steering group that oversees the coordination and integration of Service and CINC requirements and priorities for RDT&E and initial procurement. The JSMG is the principal steering group that manages the execution of RDT&E materiel development efforts to ensure

that program risk is mitigated across commodity areas, and the ongoing efforts are complementary but not duplicative.

The Medical Program Sub-Panel (MPSP) continues to be an integral part of the JSIG. The purpose of the MPSP is to identify medical program needs and requirements as developed by the Service users. The MPSP has the primary responsibility for prioritizing medical CB defense requirements; however, medical radiological and nuclear defense requirement development also play an important role. The MPSP uses technical expertise from a variety of sources including Service medical CB Defense Agencies/Activities, the Joint Staff, the Armed Service Biomedical Research Evaluation and Management (ASBREM), the Service schools, Service environmental, reference, and clinical laboratories as well as Service-unique centers of excellence. The users and JTCG 3 (Medical Chemical Defense Research Program), JTCG 4 (Medical Biological Defense Research Program), and JTCG 7 (Medical Nuclear Defense Research Program) review medical NBC defense capabilities and provide input/review of medical needs that the Combat Developers form into Medical Requirements (as well as medical applications of non-medical requirements) to the MPSP. The MPSP coordinates, integrates, and prioritizes all of the user requirements input. It provides the consolidated, integrated, and prioritized list of medical CB defense requirements to the JSIG. The priority listing process has become fully integrated. Medical requirements and programs are prioritized together with the non-medical requirements and programs with an integrated priority list provided to the JNBCDB for approval. The JNBCDB may make changes to the Integrated NBC Defense Priority List.

The U.S. Army is the Executive Agent for the Joint Medical Chemical and Biological Defense Research Program (JMCBDRP) as prescribed in DoD Directive 5160.5 and, as such, is the lead requirements coordinator. The JMCBDRP integrates DoD in-house and external efforts. JTCG 3 and JTCG 4 of the ASBREM Committee are responsible for the programs' joint consolidation, coordination, and integration. The ASBREM Committee maximizes efficiency among the Services by coordinated planning, and minimizes unnecessary program overlaps and costly materiel retrofits. The *Chemical and Biological Defense Technology Area Plan* and *The Joint Service Chemical and Biological Defense Research, Development, and Acquisition Plan* are the primary program planning documents for joint CB defense research programs.

Science and technology encompasses a progression through Concept and Technology Development (basic and applied research and concept exploration phases) directed toward the development of medical countermeasures for chemical and biological threat agents. Early in Concept and Technology Development, basic principles are observed and reported. This is accomplished through the identification of threat agents, developing an understanding the disease process (pathophysiology), and developing hypotheses/concepts. Activities later in the process include development of animal models that are predictive of the human response, development of and assays and reagents to characterize concepts/technologies, and preliminary evaluation of hypotheses and concepts/technologies to determine their potential as new medical countermeasures (pre-treatments, vaccines, therapeutics/treatments, and diagnostics technologies). As the concepts/technologies mature through these phases, they may be formulated as Defense Technology Objectives (DTOs), which are essentially strategic plans for specific concept development efforts. The JMCBDRP executes its DTOs through the U.S. Army Medical Research and Materiel Command (USAMRMC) lead laboratories for medical chemical defense—U.S. Army Medical Research Institute of Chemical

Defense (USAMRICD)—and biological defense—U.S. Army Medical Research Institute of Infectious Diseases (USAMRIID)—with scientific input from researchers at other Army laboratories—Walter Reed Army Institute of Research (WRAIR), U.S. Army Research Institute of Environmental Medicine (USARIEM)—and from Navy and Air Force laboratories. Private sector laboratories and universities also participate and contribute to these research efforts through extramural contracting arrangements and Collaborative Research and Development Agreements (CRADAs).

Successful completion of key DTO milestones/metrics events will lead to a *Milestone A* review that will then initiate the analytical and experimental critical function and characteristic proof of concept for the medical concept/technology. Following a Milestone A decision, model vaccines, pre-treatments, therapeutics, and diagnostic capabilities are further developed and characterized. Safety and efficacy trials for potential vaccines, pre-treatments, and therapeutics are performed in various animal models and diagnostic capabilities are evaluated with rigid laboratory test protocols. Following this, a Component Advanced Development In Process Review (IPR) is conducted and the technologies may transition to advanced development. The advanced development program for medical biological defense products is directed by the Joint Program Office for Biological Defense (JPO-BD). The Joint Vaccine Acquisition Program (JVAP) is an Acquisition Category II (ACAT II) program under the JPO-BD whose mission is to develop and produce FDA licensed medical products (vaccines) to protect the warfighter in a biological warfare environment. The USAMRMC U.S. Army Medical Materiel Development Activity (USAMMDA) directs advanced development for medical chemical defense products.

1.4 COORDINATION WITH RELATED PROGRAMS AND INITIATIVES

The DoD Chemical and Biological Defense Program coordinates efforts with other U.S. government agency and with other countries to achieve the vision of equipping U.S. forces with the best available chemical and biological defense equipment. This section provides an overview of some key cooperative efforts.

1.4.1 Other U.S. Government Agencies

There are several organizations within the U.S. government developing chemical and biological defense technologies. Three organizations with which the CBDP currently has formal coordination efforts include: (1) the Defense Advanced Research Projects Agency (DARPA), (2) the Technical Support Working Group (TSWG), and (3) the Department of Energy (DOE) Chemical and Biological Nonproliferation Program (CBNP). An overview of these programs is provided below. There also are other governmental agencies with chemical and biological defense related programs with which the CBDP maintains various levels of coordination and cooperation. These include the Office of Homeland Security, the National Security Council, Department of Health and Human Services (including the Food and Drug Administration, and the Centers for Disease Control and Prevention), U.S. Department of Agriculture, and the Department of Justice, among others.

1.4.1.1 DARPA Biological Warfare Defense Program. DARPA is charged with seeking breakthrough concepts and technologies that will impact our national security. DARPA's Biological

Warfare (BW) Defense Program is intended to complement the DoD CB Defense Program by anticipating threats and developing novel defenses against them. The DARPA program is unique in that its focus is on the development of technologies with *broad applicability* against *classes* of threats. DARPA invests primarily in the early technology development phases of programs and the demonstration of prototype systems.

The FY98 National Defense Authorization Act directed the Secretary of Defense to ensure that the DARPA biological warfare defense program is coordinated and integrated under the program management and oversight of the DoD CBDP. The DARPA BW Defense Program coordinates its efforts with a large number of organizations, including the DATSD(CBD) through regular briefings to both DATSD(CBD) and DTRA(CB) and by participation in the Technology Area Review and Assessment (TARA) process. The Advanced Diagnostics portion of the DARPA BW Defense Program is closely coordinated with the U.S. Army Medical Research and Materiel Command (MRMC) and is represented on the recently formed Common Medical Diagnostic Systems Executive Committee. A panel of chemical and biological defense experts is routinely consulted by DARPA to evaluate programs and to ensure that National Institutes of Health (NIH) efforts are not being duplicated. DARPA representatives actively serve in a non-voting capacity on the Joint Science and Technology Panel for Chemical and Biological Defense (JSTPCBD) and attend CBDP committee meetings, such as ASBREM sub-committee meetings. DARPA also participates in the BW Seniors Group, which provides Government coordination outside of DoD and works closely with the military Services to ensure that technologies are effectively transitioned into the hands of the user community.

1.4.1.2 Technical Support Working Group. The TSWG is an interagency forum that identifies, prioritizes, and coordinates interagency and international research and development (R&D) requirements for combating terrorism. Policy oversight is provided by the Department of State and execution oversight is provided by the Department of Defense, specifically the Assistant Secretary of Defense for Special Operations and Low Intensity Conflict, ASD (SO/LIC). The TSWG rapidly develops technology and equipment to meet the high-priority needs of the combating terrorism community, and addresses joint international operational requirements through cooperative R&D with the United Kingdom, Canada, and Israel. The TSWG also has an effective outreach program so that state and local agencies can benefit from new technology developments.

TSWG membership includes representatives from nearly eighty organizations across the Federal Government. These representatives work together by participating in one or more of TSWG's nine subgroups. One of the subgroups is the Chemical, Biological, Radiological, and Nuclear Countermeasures (CBRNC) subgroup, which is co-chaired by representatives from the Federal Bureau of Investigation (FBI) and the Intelligence Community (IC). The CBRNC subgroup identifies and prioritizes interagency chemical, biological, radiological, and nuclear combating terrorism requirements, and identifies solutions for detection, protection, decontamination, containment, mitigation, and disposal.

The DoD CBDP and TSWG coordinate requirements and projects to maximize leveraging opportunities. However, equipment requirements for combating terrorism often differ from equipment requirement for the warfighter.

1.4.1.3 DOE Chemical and Biological Nonproliferation Program (CBNP). The CBNP was established in 1997 in response to the *Defense Against Weapons of Mass Destruction Act* ("Nunn-Lugar-Domenici") passed by Congress in 1996. The CBNP was established to ensure the full engagement of the DOE National Laboratories in responding to the threat posed by chemical and biological weapons to U.S. civilians. The strategy of the CBNP relies on close linkages between technology development and systems analysis and integration to systematically and comprehensively address the domestic chemical and biological terrorism threat. The CBNP is comprised of three key components:

- Definition of operational needs to guide the development and implementation of enhanced preparedness and response systems.
- Use of accelerated system demonstrations to enable rapid fielding of the best available systems and technologies to meet critical needs.
- Development of individual technologies to enhance capabilities across the full spectrum of chemical and biological threats.

Many technologies under development may support both CBNP and CBDP missions. There are formal agreements between the CBNP and CBDP to ensure that efforts are coordinated and duplication is avoided. Some cooperative efforts include DOE representation on the Joint NBC Defense Board as a non-voting member, DOE participation in the Technology Area Review and Assessment (TARA) of science and technology base programs, and DoD participation in the annual CBNP program review.

1.4.1.4 Other Interagency Coordination. The CBDP participates in efforts to coordinate research, development, and other efforts related to chemical and biological defense with other organizations throughout the federal government. Following are some highlights of these coordination efforts:

- *The InterAgency Board for Equipment Standardization and Interoperability* (known as the IAB), is a partnership with federal, state, and local agencies focused on the capabilities necessary for fire, medical, and law enforcement responses to WMD terrorism.
- Interagency Agreements with departments of Justice's Office Domestic Preparedness to purchase equipment in support of Justice's grant program.
- The White House Office of Science and Technology Policy chaired Weapons of Mass Destruction Program, Research and Development Subgroup.

1.4.2 Chemical and Biological Defense Research, Development and Acquisition (CBD RDA) Focus Group

The CBD RDA Focus Group was established in 1999 under the auspices of the Counter-proliferation Program Review Committee (CPRC) to review and coordinate DoD and DOE R&D technologies and identify future capabilities needed to provide for a more cohesive, integrated effort to broadly address CB proliferation. The primary goal of this group is to avoid duplication of development efforts between military and domestic defense programs while minimizing investment costs. Since the submission of its initial report to Congress in 2000, the Focus Group has established roadmap committees that are currently developing a series of detailed, integrated CBD RDA reports

to formally integrate programs. Representation on the roadmap committees is expanding to include participation from other government agencies such as the TSWG, National Institute of Justice, and the Defense Threat Reduction Agency in addition to the CBDP, DARPA, and the DOE Chemical and Biological Nonproliferation Program (CBNP).

The most significant portion of the detailed integrated CBD RDA reports is the development of interagency technology roadmaps that depict rapid transition mechanisms for Science and Technology (S&T) products over time. During the roadmap development process a comparative analysis of R&D programs is conducted to facilitate identification of technology gaps, potential duplication of efforts across agencies, as well as, opportunities to cooperate and leverage synergies across programs and demonstrations. A report on biological point detection technologies along with an integration process model was completed in March 01. Replicating the process developed in the biological point detection report, the Focus Group recently completed an integrated CBD RDA report that includes a roadmap and results of an analysis for decontamination technologies and CB point detection technologies, which expands on activities contained in the Biological Point Detection Report. An integrated report for Modeling and Simulation technologies is planned for FY03. The Focus Group and roadmap committees will develop a separate report for each technology area culminating in a single comprehensive CBD RDA plan for CB technologies.

The integration plan development effort will facilitate interagency awareness, coordination and cooperation among DoD, DOE and other government agencies at all levels. Capitalizing on this coordination and leveraging of resources will improve application of emerging technologies, eliminate unwarranted redundancies and optimize investments. Integrated plans and reports are submitted to Congress as a part of the CPRC Annual Report to Congress.

1.4.3 International Cooperation

The CBDP participates in numerous international cooperative and collaborative efforts to leverage technology development and to achieve commonality, interoperability, and systems integration among U.S. allies and coalition partners. (In addition, there are numerous cooperative efforts in doctrine and training, which are described in Section 4.2 of this report.) In order to exchange information or conduct government to government cooperation, an appropriate agreement must be in place. Types of agreements include (1) Data Exchange Agreements (DEAs), (2) Foreign Military Sales, (3) Engineer and Scientist Exchange Programs, (4) Foreign Comparative Testing, (5) Technology Development Project Agreements, and (6) Research, Development and Acquisition Memoranda of Understanding (MOU). **Table 1-1** list examples of international cooperative efforts in FY01.

Table 1-1. International Cooperative Efforts in Chemical and Biological Defense.

- Smallpox Vaccine Development and Acquisition.
- Next Generation Urban Dispersion Model.
- Next Generation Biological Detection Technologies.
- Non-incineration Technology for CW Agent Destruction.
- New Technologies for CB Agent Monitoring in Aqueous Environments.
- Testing of CB Protective Clothing in a Hot and Humid Environment.
- Ecotoxicology due to CW Agents and Remediation of Soil and Water.
- Medical Countermeasures to CB Agents.
- Anthrax Letter Tests.
- Toxic Industrial Chemicals.
- CB Events in Operations Other Than War.
- Collective Protection.
- Effects of Wearing Individual Protective Equipment (IPE) in a Hot/Dry Environment.
- Fate and Effect of Chemical Agents.
- Next Generation Plague Vaccine.

During FY01, the United States participated in numerous international cooperative research and development efforts. Highlights of these efforts include (1) 50 DEAs with 15 countries, (2) seven Technology Development Project Agreements in place or in development, (3) two MOUs, and (4) one Engineer and Scientist Exchange Program.

All cooperative agreements yield benefits to all participants in the agreement. In addition, there have been numerous CB defense capability gains from FY98 and through FY01 as a result of international cooperation. During FY01 under the Foreign Comparative Testing (FCT) program, the Graseby modified Lightweight Chemical Agent Detector (LCAD) and the Environics Oy M100 were tested as a possible alternative to the Joint Chemical Agent Detector (JCAD). The FCT is the same program that saw successful procurement of the NBC Reconnaissance System (Fox Vehicle), Improved Chemical Agent Monitor (ICAM), the Automatic Chemical Agent Detector and Alarm (ACADA) and components of the Biological Integrated Detection System (BIDS).

1.5 TECHNOLOGY BASE REVIEW AND ASSESSMENT

The DATSD(CBD) is responsible for chemical and biological defense programs science and technology base programs. The DATSD(CBD) provides technical oversight of all Service and Defense Agency chemical and biological defense science and technology base (S&T) programs and reviews these programs. The Joint Science and Technology Panel for Chemical and Biological Defense (JSTPCBD) coordinates all Service science and technology base activities for the JSMG. The JSTPCBD prepares the relevant chemical and biological defense portions of the Defense Technology Area Plan (DTAP), and provides input to the Joint Warfighting S&T Plan (JWSTP). The DTAP and JWSTP are submitted to Congress separately in accordance with public law.

Science and technology programs are reviewed annually through the Technology Area Review and Assessment (TARA). The TARA includes a review of S&T programs by an independent panel of experts from academia, national laboratories, and other organizations. This panel provides assessments of key projects, overall areas within the program, and identifies any major findings or issues related to CB defense science and technology. A summary of the FY2001 TARA results is provided in Section 3 of the CBDP Performance Plan included as Volume II of this report.

1.6 FUNDS MANAGEMENT

Figure 1-2 illustrates the funds management and execution process for the CB defense program and the coordination between funding and executing organizations. The key organizations in this process are: DATSD(CBD) as the OSD focal point; the JNBCDB Secretariat representing the Executive Agent; the Defense Threat Reduction Agency (DTRA) is the funds manager); the JSMG as coordinator and interface between the participating organizations; and the operating agencies and performers which execute the programs. For budget distribution, the JNBCDB Secretariat provides funds distribution information to DATSD(CBD) based on the appropriated budget. The DATSD(CBD) prepares funds suballocation instructions (with support provided by DTRA(CB)) and submits them to the DTRA Comptroller for distribution to the operating agencies.

The lead components or operating agencies provide notification of all funding adjustments to the JSMG Executive Office. The JSMG Executive Office, in turn notifies other components and agencies and the JNBCDB Secretariat. The JSMG Executive Office forwards reprogramming requests with recommendations and any concerns raised by the other components and operating agencies to the JNBCDB Secretariat. The JNBCDB Secretariat reviews the reprogramming actions and forwards recommendations to DTRA(CB) for DATSD(CBD) approval. Once approved, DATSD(CBD) authorizes the JNBCDB Secretariat to update the database, and the DTRA Comptroller to execute the reprogramming. For medical programs, the Headquarters, U.S. Army Medical Research and Materiel Command, staffs all actions resulting from the requirement to reallocate funds between the Services.

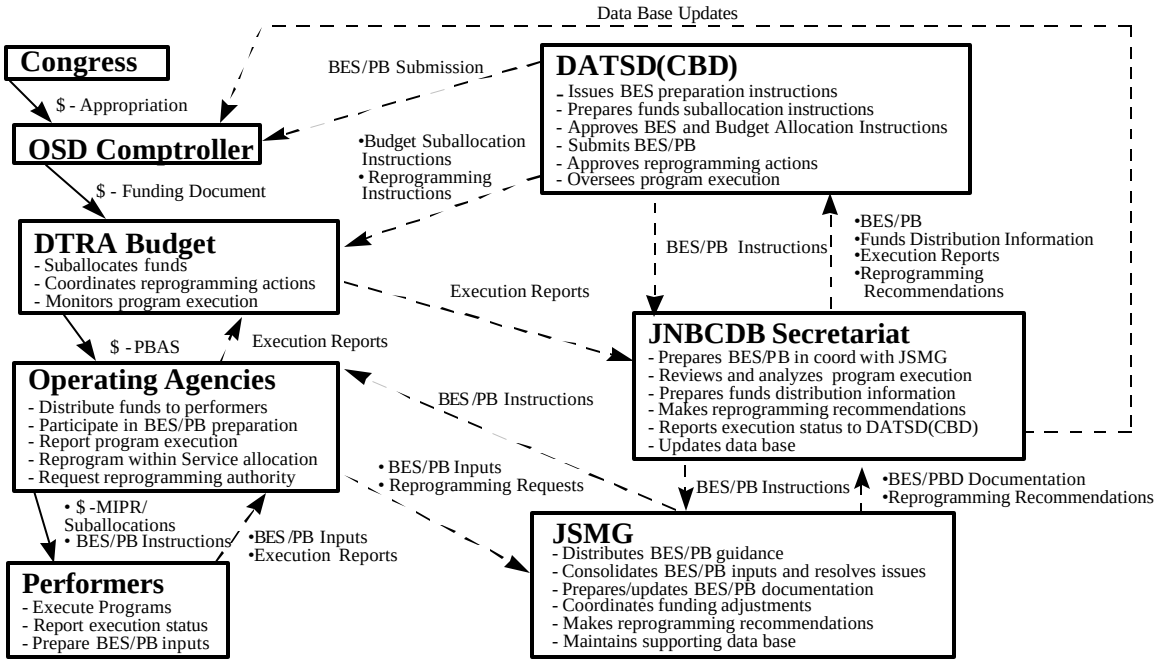


Figure 1-2. Chemical and Biological Defense Funds Management Process

DATSD(CBD), with the support of DTRA(CB), instructs the DTRA Comptroller to issue execution and program status reporting instructions to the operating agencies. The operating agencies report execution status to the DTRA Comptroller on a monthly basis. The DTRA Comptroller for-

wards all program funds execution reports to the JNBCDB Secretariat and DTRA(CB) for program and budget database update and analysis, respectively. DTRA(CB) reports execution status to DATSD(CBD) on a quarterly basis. DTRA(CB) is responsible to notify the DATSD(CBD) when programs deviate from or are in danger of not meeting OSD obligation and execution goals.

The DTRA Comptroller serves as the funds manager for the CB defense program. This office issues funding documents, per DATSD(CBD) direction, and performs all required accounting functions, with the assistance of the Army staff which represents the Executive Agent. The JNBCDB Secretariat updates the OSD comptroller program and budget databases as necessary after the POM, Budget Estimate Submission (BES), and President's Budget (PB). DATSD(CBD), with support provided by DTRA(CB), ensures that the JNBCDB Secretariat is kept informed of all OSD comptroller guidance, directives, and schedules.

1.7 CB DEFENSE PROGRAM MANAGEMENT ASSESSMENT

ISSUE: **In a memorandum issued on 19 October 2001, the Under Secretary of Defense for Acquisition, Technology, and Logistics, USD(AT&L) reviewed the current management structure of the CBDP and a number of alternatives, and concluded that establishing a single Milestone Decision Authority (MDA) would be of great benefit to the process. The USD(AT&L) directed the DATSD(CBD) to establish a task force, comprising representatives from Service Acquisition Executives, the Joint Staff, and appropriate OSD principals, to assess the need for a JPEO and, depending on the outcome of that review, to develop an implementation plan for a Joint Program Executive Office for Chemical and Biological Defense (JPEO-CBD). The task force also will develop any legislative proposal that may be required to conform section 1522 of title 50, United States Code, to the proposed, revised management structure.**

SOLUTION: USD(AT&L) is considering several recommendations to improve the current program management structure for CBDP and will make a decision on how to proceed during FY2002. Following this decision by the USD(AT&L), a task force will develop an implementation plan.

ISSUE**: In a memorandum issued on 23 November 2001, the USD(AT&L) requested the Director of the Joint Staff to form a task force to assess how to best structure the joint requirements generation process for CB defense, and to consider not only the requirements within traditional MTW scenarios but also force protection, homeland defense, and consequence management. This task force, composed of representatives from the four Services and Joint Staff, developed recommendations on a Joint Requirements Organization for NBC Defense, for JROC approval and forwarding to USD(AT&L).**

SOLUTION: The task force's recommendation to establish a Joint Requirements Organization (JRO), which was approved by the JROC in March 2002, will be integrated into the JPEO-CBD implementation plan.

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Chapter 2

Nuclear, Biological, and Chemical (NBC) Defense Requirements and Research, Development, and Acquisition Program Status

2.1 INTRODUCTION

This chapter describes the consolidation of Joint Service non-medical and medical NBC defense requirements and assesses how these programs meet the needs of U.S. forces. The discussion of requirements and the status of research and development assessments are conducted within the framework of the six operationally oriented commodity areas:

- Contamination Avoidance
- Modeling and Simulation
- Decontamination
- Individual Protection
- Collective Protection
- Medical Systems

There are three principles of NBC defense as defined in Joint Publication 3-11, *Joint Doctrine for Operations in Nuclear, Biological, and Chemical (NBC) Environments*. The first principle, contamination avoidance, includes the Contamination Avoidance Commodity Area, which comprises detection and avoidance (bypassing contaminated areas). Individual Protection, Collective Protection, and Medical Systems make up the second principle—Protection. Decontamination, the third principle of NBC defense, restores combat power and is essential for sustaining operations in a contaminated environment. The commodity area of Modeling and Simulation has application in the other five commodity areas and spans the three principles.

The threat from the continued proliferation of NBC weapons creates a continuous need to ensure that U.S. forces can survive, fight, and win in an NBC threat environment. The increasing danger from these weapons demands that we look for every opportunity to avoid technological surprises. Evolving operational requirements demand that the joint program progressively capture and leverage advances in technology to provide the best in NBC defense equipment for the forces.

The non-medical research, development, and acquisition (RDA) goal is to equip the joint warfighting forces with sufficient quantities of the best available equipment and in the shortest time possible to win decisively, quickly, and with minimal casualties. The goal of the medical RDA is to provide the warfighter with medical protection to prevent, or reduce the effects of exposure to chemical or biological warfare agents. Products intended for medical protection (vaccines, pre-treatment drugs, post-exposure treatments, diagnostics capabilities) require approval by the Food and Drug Administration (FDA) before they enter the distribution chain. If an item is not approved by the FDA but is considered a necessary medical countermeasure, it will be distributed in accordance with regulations as an

Investigational New Drug (IND) product. As authorized under the Joint Service Agreement and in cooperation with the Armed Services Biomedical Research, Evaluation, and Management (ASBREM) Committee for medical programs, the Army as executive agent coordinates, integrates, and reviews the DoD CB Defense Program. The results of these reviews, conducted with all Services participating, are documented in the Joint Service Modernization and Joint Service RDA Plans. These documents form the basis for the consolidated CB Defense Program Objectives Memorandum (POM).

The Services decide if a materiel solution is needed to satisfy a requirement for a warfighting capability. They first examine doctrinal, training, or organizational solutions (non-materiel solutions), and when these cannot fulfill the need, they seek equipment or materiel solutions through the materiel acquisition process. If a valid need exists, then the research and development modernization process will identify technological approaches that may provide a new system or medical product or upgrade an existing system or medical product.

During FY00 the Joint Service Integration Group documented the Joint Future Operational Capabilities (JFOCs) in an integrated format merging the medical and non-medical needs. The purpose of the JFOCs is to identify and prioritize Joint User (Services and CINCs) far-term future operational capabilities as expressed in the emerging Joint NBC Defense Concept. Priorities of the JFOCs were not changed in FY01. The overall intent is to provide enhanced user guidance to the Joint NBC defense science and technology (S&T) community to assist in S&T program planning and execution. JFOCs will also support the development of new NBC Defense Joint Mission Needs Statements (JMNSs) and future Joint Operational Requirement Documents (JORDs). The prioritized list of JFOCs establishes a clear link between near and long-term Joint NBC defense research and development efforts and user needs. **Table 2-1** provides a synopsis of the current (FY01) JFOC priorities, descriptions, and objectives. JFOCs have become an integral part of the Joint Service NBC Defense Modernization Plan and related S&T plans, specifically the Joint Warfighting Science and Technology Plan (JWSTP) and the Defense Technology Area Plan (DTAP).

In accordance with the national strategy of achieving and applying technological superiority, several underlying concepts form the foundation of acquisition modernization. The first is the need to reduce cycle time in the acquisition of new systems or medical products or the integration of emerging technologies into existing systems. The use of Advanced Concept Technology Demonstrations (ACTDs), open systems and architectures, along with the new emphasis on commercial standards and practices, allow us to shorten the acquisition cycle time. The program acquisition process reduces lifecycle costs through practices such as design-to-cost and concurrent engineering to ensure that equipment is easy to maintain and repair even with the inherent complexity in most new systems.

Table 2-1. Prioritized NBC Defense Joint Future Operational Capabilities

1: NBC Battle Management—Capability to access, assimilate and disseminate NBC information from throughout the battlespace via standard, joint service and automatic information/ data transmission systems. Enhance warfighter protection by providing the critical link between detection and protection. Commanders at all levels will be provided sufficient, timely information through early and direct warning. Commanders will be able to quickly and effectively quantify the risk associated with various courses of action and provide real-time display with local 3-D digital terrain graphics to portray the current status of the NBC battlespace.
2: Contamination Avoidance—An enhanced capability to detect, locate, identify, and confirm the presence or absence of any standard or non-standard NBC hazard. Significantly improve tactical, operational, and strategic NBC situational awareness by rapidly detecting, locating, identifying, confirming and disseminating NBC and toxic industrial material (TIM) detection information to the joint force.
3: Individual Protection—To protect individual members of the joint force, allowing it to operate safely, at near-normal levels of effectiveness, while under NBC threat, or in NBC, TIM or other environmental hazards area.
4: Restoration Capability—Enhanced capability to provide rapid, effective, and safe removal/ neutralization of hazards resulting from NBC or TIM contamination to enable restoration of unit operational capabilities. Protect and sustain the Joint force by rapidly returning equipment and personnel to normal operating modes/efficiencies after exposure to an NBC or TIM contaminated environment.
5: Collective Protection—To protect the joint force collectively, allowing it to operate safely, at near-normal levels of effectiveness, while under NBC threat, or in NBC, TIM or other environmental hazards area. Enhance filter systems on existing vehicles, aircraft, shipboard, communications vans and other static/mobile structures.

2.2 NBC DEFENSE MISSION AREA REQUIREMENTS AND RDA SUMMARY

As noted previously, NBC defense programs are categorized broadly under three operational principles: contamination avoidance, protection, and decontamination. The Services have been workng closely together to increase jointness in ongoing programs for each of these areas. This report highlights improvements during FY01 and discusses cooperative efforts for further Joint development of requirements. This section summarizes the requirements in each of the mission commodity areas. This chapter provides a focus on research, development, and acquisition efforts. Fielded items are discussed separately in Chapter 3. Detailed descriptions of non-medical developmental and fielded equipment can be found in Annexes A, B, C, and D; medical accomplishments are listed in Annex E.

The following sections (2.3 though 2.7) provide an overview of the goals and timeframes, potential payoffs, and major technical challenges for specific commodity area science and technology (S&T) efforts. A detailed account of S&T efforts for all commodity areas is provided in two separate reports: (1) the *Joint Warfighting Science and Technology Plan*, especially Chapter XII, "Counterproliferation of Weapons of Mass Destruction," and (2) the *Defense Technology Area Plan*, especially Chapter II, "Chemical and Biological Defense." The *Basic Research Plan*, also provides descriptions of various supporting sciences—including chemistry, biological sciences, materials science, and others—that support CB defense S&T activities. Within the *Joint Warfighting Science and Technology Plan* and the *Defense Technology Area Plan*, key projects are defined as Defense Technology Objectives (DTOs). A DTO states specific technology advancements to be developed or

demonstrated, the schedule, costs, specific warfighter payoffs (stated quantitatively against two or more metrics), and the customers for whom the technology is being developed (*e.g.*, a specific Commander in Chief). DTOs represent only a portion of science and technology base funding, yet represent high priority projects, consistent with strategy and guidance. DTOs provide a key means for S&T planning and programming and for fulfilling GPRA requirements. DTOs are proposed or updated annually.

In addition to technology base thrusts supporting materiel development, the CB defense technology base program incorporates basic and applied research, including CB threat agents and chemical toxicology, which support development across multiple commodity areas. Understanding both established and emerging CB threats is a critical factor that drives the overall CB defense program. Toxicological and pathological determination of operationally significant dosages of threat agents is fundamental to developing target requirements for materiel solutions across all commodity areas.

Investments are being made in the establishment of a comprehensive threat agent infrastructure, to acquire threat agents (both recognized and emerging), using chemical synthesis, biological manipulation, and procurement. Emphasis is placed on the characterization of the properties of threat agents needed by Joint Service materiel and medical developers. Emphasis is also placed on developing appropriate simulants for use in the RDT&E process. Execution and funding of the work are integrated among DoD and DOE performers and coordinated with the Intelligence Community. Deliverables from this program are threat agents, technical data on threat agents, and simulants for developmental and operational testing.

CW toxicology data support all commodity areas, at all levels, including protection, decontamination, and detection. Primary data gaps include the lack of complete agent dose-response curves and probit slopes. Secondary data gaps include the toxicology of mixtures found in munitions and of by-products resulting from agent degradation or decontamination.

A multi-year program involving both the non-medical and medical communities is currently underway to address the medical and operational issues of low level exposures to chemical agents. Assessment, prevention, diagnosis, and treatment of possible persistent health effects are central aspects of the medical program. The toxicological emphasis is airborne exposure to low concentrations of agent for exposure durations extending out to several hours, determination of the lowest chemical concentrations that are operationally significant, and characterization of the concentration-time response curve. Medical emphasis is on the determination of exposure thresholds for effects from chemical warfare agents. The order in which the agents will be addressed is responsive to user input and requirements.

2.3 CONTAMINATION AVOIDANCE (Detection, Identification and Warning)

The operational concept of contamination avoidance includes NBC reconnaissance, detection, identification, warning and reporting. Earliest possible warning is a key to avoiding NBC contamination. For fixed sites where contamination cannot readily be avoided and for missions requiring operations in a contaminated environment, detection, identification, and warning are equally critical to ensure that forces can (1) assume the optimal protective posture so that they can continue to sustain operations and (2) rapidly identify and decontaminate (if possible) affected areas, equipment, and personnel.

Sensors for the individual warfighter and systems capable of detecting multiple agents and characterizing new agents are being developed. Advances in technology are being pursued in chemical and biological standoff, early warning detection, miniaturization, interconnectivity, improved detection sensitivity, improved interference rejection, improved logistics supportability, and affordability. The following sections detail contamination avoidance science and technology efforts, modernization strategy, and Joint Service programs.

2.3.1 Contamination Avoidance Science and Technology Efforts

2.3.1.1 Goals and Timeframes. The goal of contamination avoidance is to provide real-time capability to detect, identify, characterize, locate, and warn against all known or validated NBC warfare agent threats below threshold effects levels (see **Table 2-2**). To meet near term needs a number of sensor technologies are being optimized while alternative detection technologies mature. Mid-term technologies focus on developments to improve tactical detection and identification capabilities for both chemical and biological warfare agents. Far-term science and technology efforts focus on multi-agent sensors for NBC agent detection and remote/early warning CB detection. These far-term objective technologies seek to integrate chemical and biological point and remote/early warning detection modules into a single system. Research and Development (R&D) efforts seek to optimize and balance system sensitivity, size/weight, cost, power consumption, signature and false alarm rate. Ultimately the goal is direct integration of CB detectors as a single system into various platforms, and command, control, communication, computer, and intelligence (C^4I) networks.

As identified in the *Defense Technology Area Plan* and the *Joint Warfighting Science and Technology Plan*, the following are Defense Technology Objectives (DTOs) focused on near and mid-term science and technology goals.

Ongoing DTOs:*

- Chemical Imaging Sensor
- Biological Sample Preparation System for Biological Identification
- Stand-off Biological Aerosol Detection
- Chemical Biological Agent Water Monitor
- Biological Warfare Defense Sensor Program
- Activity-Based Detection and Diagnostics
- Force Medical Protection/Dosimeter ACTD
- Terrorist Chemical/Biological Countermeasures

Completed DTOs:

- Laser Standoff Chemical Detection Technology
- Chemical Add-On to Airbase/Port Biological Detection ACTD

2.3.1.2 Potential Payoffs and Transition Opportunities. Future CB detection systems will provide the capability to detect, identify in real time, map, quantify, and track all known CB contamination in a theater of operations. This will enable commanders to avoid CB contamination, determine the need for and verification of effective reconstitution procedures, and assume the appropriate protection required

* Complete DTO descriptions are provided in Volume II, *CBDP Performance Plan.*

to continue fighting and sustain their mission with minimal performance degradation and casualties. CB detection technologies have dual use potential in monitoring air pollution, noxious fumes inside enclosed areas, and municipal water supplies.

Table 2-2. Contamination Avoidance Science and Technology Strategy

By 2002	By 2007	By 2012
• Complete installation of the Joint Portal Shield biological detection network sensor systems at CINC fixed site locations and transition to full production status • Complete demonstration of integrated point biodetection capability (Advanced Technology Demonstration) • Demonstrate lightweight (30% weight reduction) chemical point detector in the laboratory with a capability to detect and identify a wide range of chemical threat agents and high-threat toxic industrial chemicals. Demonstrate enhanced aerogel-based biological agent sample collection capability. • Initiate development of the Joint Biological Standoff Detection System (JBSDS) Block I	• Demonstrate Chemical Imaging Sensor for wide area detection • Complete development of Joint Service Lightweight Standoff Chemical Agent Detector (JSLSCAD) • Complete development of Joint Service Warning and Identification LIDAR Detection (JSWILD/Artemis) • Complete development of Joint Chemical Agent Detector (JCAD) • Complete development of Block II Joint Biological Point Detection System (JBPDS) • Complete fielding of JBSDS Block I • Complete development of the JBSDS Block II • Complete fielding of Portal Shield production systems to 21 critical sites	• Demonstrate integration of chemical and biological agent detection modules into a single sensor suite • Complete fielding of the Block II JBPDS • Complete development of CB water monitor • Initiate development of the Joint Modular Chem/Bio Detection System (JMCBDS)

2.3.1.3 <u>Major Technical Challenges</u>. The major technical challenges are in the areas of biological collection, detection and identification, including remote/early warning sensing, improved agent discrimination and quantification, sample processing, interferent (*i.e.*, false positive and negative alarms) and ambient biological background rejection, and genetic probe development. Size, weight, and power reduction of detectors, power generation and consumption, development of integrated biological and chemical detection systems, and the fusion of sensor data with mapping, imagery, and other data for near real-time display of events are other areas of challenge.

There are two critical needs focused on biological agent detection. Current technologies require a *high level of logistical support* and *lack discrimination in biological standoff detection*. The challenge in reducing logistical support stems from the dependence on reagents and size, weight, and power requirements of the systems. Several efforts are aimed at providing minimum reagent requirements with higher sensitivity, better stability, and fewer supporting reagents, and scientific and engineering strategies to reduce size, weight, and power requirements, especially in the sample collections components. There are several factors directly limiting the ability to discriminate biological agents using standoff detection technologies. Key factors include: (1) a lack of fundamental data in understanding the spectral properties of biological warfare agents, (2) range limitations due to atmospheric absorption, and (3) natural background interference. Over the last two years, a number of strategies and concepts have been developed to improve the discrimination capability of standoff detection for biological materials. Further efforts in FY02 and FY03 will begin to validate the feasibility of providing an enhanced level of discrimination of biological material using standoff detection.

2.3.2 Contamination Avoidance Modernization Strategy

The increased lethality and heightened operational tempo of future battlespaces demand responsive NBC detection and warning capabilities in order to reduce force degradation caused by contamination. These capabilities—which encompass NBC reconnaissance, detection, identification, and reporting—are critical for force readiness and will continue to be emphasized by the DoD community in the near and far term. **Table 2-3** shows the roadmap of DoD requirements for contamination avoidance. While the near-term requirements meet service-specific needs, those in the mid to far-terms demonstrate the increase in joint development and modernization since the founding of the CBDP.

Early detection and warning are keys to avoiding NBC contamination. As a result, DoD is concentrating RDA efforts on providing its warfighters real-time capabilities to detect, identify, quantify, and warn against all CB warfare threats below threshold effects levels. Real time detection of biological agents below threshold effects levels is unlikely in the near to mid-term. Current emphasis is on developing lightweight, automated CB sensors capable of providing enhanced detection and early warning of all biological and chemical threat agents. To meet the needs in the near to mid term, several stand-alone detectors and sensors are being developed. Developmental efforts are focusing on system miniaturization, improved sensitivity and specificity, agent characterization and range, decreased false alarm rate, and decreased operation and support costs. This focus will facilitate the integration of chemical detectors into personal warfighter gear, chemical and biological detectors onto various air, sea, and ground platforms, and integration of detectors into automated warning and reporting networks. **Table A-1** in Annex A provides an overview of RDA efforts and Service involvement.

The management challenge involves the coordination and consolidation of numerous detection and warning RDA efforts across the Services. This strategy, led by the JSMG through the Contamination Avoidance Commodity Area Manager, resulted in the initiation of RDA efforts which shared common technical goals, but were constrained to Service unique requirements. Management organizations and initiatives, such as the Joint Program Office for Biological Defense (JPO-BD) and the Joint NBC Defense Board are building Joint Service coordination across the mission area.

Since the establishment of the Joint CB Defense Program, the JSMG and JSIG, through the Contamination Avoidance Commodity Area Manager, and with assistance from JPO-BD, transformed and consolidated 44 separate contamination avoidance developmental efforts into eleven fully coordinated joint projects. The Joint Programs are:

- Automatic Chemical Agent Detection Alarm (ACADA).
- Joint Chemical Agent Detector (JCAD).
- Joint Service Lightweight Standoff Chemical Agent Detector (JSLSCAD).
- Joint Service Warning and Identification LIDAR Detector (JSWILD/Artemis).
- Joint Biological Point Detection System (JBPDS).
- Joint Biological Standoff Detection System (JBSDS).
- Joint Service Light NBC Reconnaissance System (JSLNBCRS).
- Joint Warning and Reporting Network (JWARN).
- Joint Chemical Biological Agent Water Monitor (JCBAWM).
- Joint Portal Shield (JPS).
- Critical Reagents Program.

Table 2-3. Contamination Avoidance Modernization Strategy

	NEAR (FY02-03)	MID (FY04-09)	FAR (FY10-19)
Chemical Point Detection	• Surface off-gas sampling capability (ICAM) • Automatic point detection of nerve and blister agents (ACADA) • Navy-*Ship based improved automatic point detection of nerve/blister (IPDS)*	• Improved, all-agent programmable automatic point detection; portable monitor, miniature detectors for aircraft interiors; interior ship spaces; wheeled and tracked vehicles; and individual soldiers (JCAD)	• Improved surface contamination monitor • Detection of CB contamination in water (Joint Chemical Biological Agent Water Monitor, JCBAWM)
Biological Point Detection	• Detection System, Biological Agent: Joint Portal Shield provides an automated network biological detection capability to protect high value fixed sites. • Automatic long line source and point/mobile biodetection to detect and identify bio-agents; programmable (JBPDS Block I) • Navy-*Ship based Interim Biological Agent Detector (IBAD)* • Army-*Biological Integrated Detection System (BIDS)*	• Complete development of Block II JBPDS – increase number of agents detected and identified with increased sensitivity, lower false positive rates; smaller and lighter with increased reliability.	• Automatic point biodetection, to detect and identify; programmable (JBPDS Block II) • Automated, integrated detection of both biological and chemical agents in a single sensor package (Joint Modular Chemical/Biological Detector System, JMCBDS) • JCBAWM (See above)
NBC Reconnaissance and CB Remote and Stand-off Detection	• Improved NBC Reconnaissance Vehicle with remote/early warning and data fusion capabilities (M93A1) • Limited long range particulate cloud detection and tracking (LR-BSDS NDI)	• Lightweight passive stand-off detection for chemical agent vapors (JSLSCAD) • Add biological detection and identification capabilities (JSNBCRS P3I) • Light reconnaissance vehicle (JSLNBCRS) • Integrated NBC detection (point/standoff)/identification/ sampling (Army-NBCRV Block II/IAV-NBCRV) • Automated biological remote detection and early warning capabilities (JBSDS Block I)	• Automated biological remote detection and early warning capabilities (JBSDS Block II) • Stand-off detection, ranging, and mapping of chemical vapors and aerosols (JSWILD/Artemis) • Wide area detection • Single, fully-integrated multifunctional NBC Recon platform with NBC Unmanned Ground Vehicle System (UGVS) capability (IAV-NBCRV)
Battle Management Systems	• Automated warning and reporting (JWARN Phase I)	• Automatic NBC warning and reporting interoperable with all Services (JWARN Phase II)	• Integrated and automatic warning and reporting (JWARN Phase III)
Radiation Detection	• Army-*Compact, digital whole body radiation measurement (AN/UDR-13)*		• Stand-off radiation detection and measurement • Portable radiation meter

1. All programs shown are joint or multi-service, unless indicated as a Service-unique effort (italicized text).
2. Where applicable, systems which meet requirements are listed following the entry.

2.3.3 Joint Service Contamination Avoidance Programs

Consolidation of Joint Service contamination avoidance programs has been completed. All detection programs have been restructured to meet current multi-Service needs. **Table 2-3** highlights Joint programs; Service-unique programs are italicized. Detailed descriptions of Joint contamination avoidance programs are provided in Annex A.

Chemical Warfare Agent Contamination Avoidance. An ACADA non-developmental item (NDI) is being procured for point detection of chemical (nerve and mustard) agent vapors. ACADA is suitable for many vehicle-mounted and man-portable applications. A shipboard version of ACADA, which addresses unique shipboard interferents, is being built to provide the Navy with an interim monitoring capability until JCAD is fielded. The Improved Chemical Agent Monitor (ICAM) is being procured and fielded for post attack monitoring of chemical agent vapors. The ICAM is three times more reliable than its predecessor and much simpler and cheaper to repair. Both the ACADA and ICAM will be replaced by the JCAD.

JCAD provides point chemical vapor detection and is in Phase II (Engineering and Manufacturing Development, EMD) of the acquisition cycle. JCAD will function as a chemical point detection system in order to accomplish a variety of mission requirements on multiple service platforms. The requirements are for the detector to be considerably smaller (within 40 cubic inches) and lighter (2 lbs. or less) than the ACADA and to be configurable for a variety of applications, such as individual soldier detectors, post-attack monitoring, shipboard chemical agent monitoring, special operations forces applications, and aircraft interior detection. JSLSCAD provides passive standoff, on-the-move detection of chemical agent vapor and is in Phase II (EMD) of the acquisition cycle. The JSLSCAD program is a joint program with a Joint Operational Requirements Document (ORD) approved by all Services. The basic JSLSCAD system (Operator display unit, scanner and sensor/electronics module) will weigh approximately 50 pounds and occupy approximately one cubic foot. The system may be modified to accommodate a variety of requirements, including a 360° x 60° scanner for Armored Systems Modernization applications (tracked and wheeled vehicles), a 60° forward looking scanner for Marine Corps helicopters and a gimbal mount for unmanned aerial vehicle (UAV) contamination avoidance roles. The Air Force's primary use for this system will be in air base defense. The Navy will install JSLSCAD on shipboard and airborne platforms and at high priority oversea installations. This system will be fully evaluated by all the Services during EMD.

In the near-term, the Army, Air Force, and Marine Corps have agreed to focus on the development of a Joint Service Light NBC Reconnaissance System (JSLNBCRS). The proposed system will consist of a suite of detectors required for a specific mission that could be easily integrated into the platform of choice. Currently two configurations are proposed: a light and a medium version, to fulfill expeditionary and armored mission profiles, respectively. The M93A1 NBCRS fulfills heavy requirements. The M93A1 NBCRS is being upgraded to include a chemical standoff detection capability and other electronic improvements including data fusion.

In the far-term, the Army, Air Force, and Marines have agreed to a Joint Chemical Biological Agent Water Monitor (JCBAWM). JCBAWM is a system that will detect the presence of contaminants in potable water. A requirement for an agent water monitor has been identified by the Army, Air Force, and Marines and a technology base program is underway. The operational scenarios defined in the JCBAWM ORD include source water, water distributions systems, and verification of water treatment. The Army and Air Force have identified a need for an early warning and identification detector. The Joint Service Warning and Identification LIDAR Detector (JSWILD/Artemis) is a technology base effort to address this problem. JSWILD/ Artemis is a laser-based standoff detection system being developed to meet the need for the detection of chemical liquids, aerosols, and vapors. Although this system is much heavier than its passive counterpart (JSLSCAD), it provides the ability to detect

chemical agents in all forms—liquids, vapors, aerosols—as well as mapping and ranging information. The integrated multifunctional platform technologies developed for the Interim Armored Vehicle—NBC Reconnaissance Vehicle (IAV-NBCRV) will be leveraged to develop the NBC Unmanned Ground Vehicle (NBC-UGV).

Biological Warfare Agent Contamination Avoidance. Currently, the Joint Program Office for Biological Defense (JPO-BD) manages the following biological detection efforts:

(1) Joint Biological Point Detection System (JBPDS), Block I and II.
(2) Joint Biological Standoff Detection System (JBSDS).
(3) Joint Portal Shield (JPS).
(4) Critical Reagents Program.
(5) Technology Transfer Program.
(6) Biological Integrated Detection Systems (BIDS NDI and P3I).
(7) Interim Biological Agent Detector (IBAD).

Currently fielded systems include the Navy's rapid prototype shipboard detection system (IBAD), the Joint Portal Shield that provides an automated networked biological detection system, and the Army's land-based system (BIDS-NDI and P3I). The Army's LR-BSDS NDI is a helicopter mounted infrared LIDAR system for the detection, ranging and tracking of aerosol clouds that may indicate a biological warfare (BW) attack. A reevaluation of the user's requirements has led to the termination of the follow-on effort, a P3I version called the Counterproliferation (CP) LR-BSDS.

The Air Base/Port Biological Detection (Portal Shield) ACTD was developed and has demonstrated the capability of an automated network of biological detection systems to protect high value fixed sites against BW attacks. The system consists of a variable number of biological sensors forming a network under the command and control of a centralized command post computer (CPC). The CPC communicates with and monitors the operation of each sensor. The sensor can detect and presumptively identify up to 8 biological warfare agents simultaneously in less than 25 minutes. The system network increases the probability of detection while decreasing false alarms and consumables. The Joint Portal Shield (JPS) has been deployed to a total of nine sites in Southwest Asia (SWA) and Northeast Asia (NEA). Twelve additional sites will be fielded with Portal Shield production systems in FY02. JBPDS will be produced to meet each of the four Services' needs for an integrated biological point detector. This program is developing a standard biological detection suite that will be integrated on Service designated platforms. Fielding of the JBPDS Block I is scheduled for FY03. In response to the national emergency, PM-JBPDS has deployed a network of 8 Block I JBPDS systems in the National Capital Region. These LRIP Phase I systems were deployed in a commercial trailer configuration that was jointly developed and produced by the PM-JBPDS and the Edgewood Chemical/Biological Center (ECBC) of the Soldier, Biological, Chemical Command (SBCCOM). These systems, referred to as the Homeland Defense Trailer (HDTR), were deployed November 28, 2001 and were fully operational on December 3, 2001. This deployment may serve as a method to collect additional effectiveness and suitability data to support the acceleration of an Army-only operational test and evaluation in June-July 2002 (IOT&E for the other Services will take place on or about October–November 2002).

In addition, the Critical Reagents Program (CRP) supports all services within DoD to include DoD first responders and NATO countries. The CRP consolidates all DoD antibody, antigen and gene probe/primer developments and requirements. The CRP is tasked with ensuring the availability of reagents critical to the development, test and operation of biological defense systems; supporting research, development and acquisition efforts to ensure the best possible reagents are available against current and emerging threat agents and producing Hand Held immunochromatographic Assays (HHAs) and DoD Biological Sampling Kits. The CRP also maintains a rigorous quality assurance and quality control program and ensures the security of the aforementioned CRP products.

The CRP ensures the quality, availability, and security of BW reagents, HHAs and DoD Biological Sampling Kits, which are critical to the successful development, test, and operation of DoD biological warfare detection systems and medical biological diagnostic products. The program maintains an R&D effort to ensure the best possible reagents are available for use against both current and emerging threats and to include analysis of commercially available reagents and technologies. The CRP has instituted a program-wide quality assurance program and addresses relevant security issues. The CRP consolidates all DoD antibody, antigen, gene probe/primer, HHA, and DoD Biological Sampling Kit developments and requirements. The CRP currently has reagents and HHAs to detect ten BW threat agents from the ITF-6A threat list. The CRP provides required reagents and HHAs to support fielded DoD BW detection systems (BIDS NDI and P3I, XM-99 Joint Portal Shield, IBAD, and DoD Biological Sampling Kits) and developmental systems (JBPDS), as well as the detection needs of other Federal Agencies and NATO allies. The next three years requires the development of 12 additional reagents to support the development and fielding of JBPDS Block II and the development of environmental and diagnostic molecular reagents for the JBAIDS. Outlying years will focus on the development of reagents to identify new and emerging threats and on the procurement of improved reagents to replace older stocks.

From 5–29 September 2000, the JPO-BD, in conjunction with the United States European Command (USEUCOM), conducted a technical and operational assessment of the Joint Biological Remote Early Warning System (JBREWS) ACTD. The JBREWS ACTD was comprised of an integrated suite of components, organic to a tactical unit, designed to detect, identify, and warn of on/off target point biological attacks (*e.g.*, Scud missiles). The principle finding from the assessment was that JBREWS was not successful in demonstrating the required capabilities with sufficient functionality, reliability and maturity to warrant consideration as a residual within the operational units under USEUCOM. The JBREWS ACTD was completed in January 2001 with no residual equipment fielded.

In the mid-term the JPO-BD will develop the JBPDS Block II. This operational level biological detection system will provide significant enhancements in number of agents detected and identified with increased sensitivity and lower false positive rates. The system will be smaller and lighter with increased reliability. The JPO-BD will also begin development of the next generation biological standoff detection system. The Joint Biological Standoff Detection System (JBSDS) will be the first joint biological standoff detection program. JBSDS will be capable of providing near real time detection of biological attacks/incidents and standoff early detection/warning of BW agents at fixed sites or when mounted on multiple platforms, including NBC reconnaissance platforms. It will be capable of providing standoff detection, ranging, tracking, discrimination (bio *vs*. non-bio) of BW aerosol clouds for

advanced warning, reporting and protection. JBSDS will augment and integrate with existing biological detection systems to provide a biological detection network capable of near real time detection and warning, theater-wide, to limit the effects of biological agent hazards against U.S. forces at the tactical and operational level of war. The JPO-BD will use an evolutionary acquisition strategy for the JBSDS program with block developments. JBSDS Block I will provide an initial operationally useful and supportable capability in as short a time as possible. JBSDS Block II will operate on the move, increase range and sensitivity while decreasing weight, power, and size over the JBSDS Block I.

In the far-term, chemical and biological detection will be integrated into a single system. The Joint Modular Chemical and Biological Detection System (JMCBDS) is envisioned to be modular, miniaturized, multi-technology, automated system capable of detecting all CW/BW agents. The JMCBDS is envisioned to integrate advanced chemical detection with miniaturized biological point detection capabilities into a single system. It will automatically warn troops and provide fused sensor data to JWARN.

2.3.4 NBC Battle Management

The Battle Management area seeks to develop the capability to use automatic collection and fusion of medical and non-medical information from all NBC defense assets throughout the battlespace and integrate that with other relevant battlespace information and C^4I systems. It will integrate threat information, NBC sensor and reconnaissance data, protective posture, environmental conditions, and other data pertaining to the NBC conditions in the battlespace. The end result of this capability is the rapid dissemination and display of operationally meaningful information to commanders and units at all levels to support decision making related to joint force protection, restoration of operational tempo, and casualty care treatment.

Warning and reporting is a critical component of this capability. It provides the critical link between NBC detection and NBC protection and provides situational awareness to the commander. Warning and reporting provides the hardware and software to connect detection systems into the overall command and control architecture. Additionally, it provides modeling and simulation capabilities to enhance hazard forecasting and assessment. The goal of warning and reporting is to provide sufficient, accurate, and timely information to commanders at all levels through early and direct warning capabilities so they assume appropriate protective postures and develop options to continue mission-essential operations.

The Services have agreed to expedite development of this capability by integrating ongoing hardware and software into a Joint Warning and Reporting Network (JWARN). This network will be compatible with, but not duplicate, all C^4I equipment, both current and developmental. The JWARN Phase I effort began fielding the first version of software in FY98. The JWARN Phase II EMD effort commenced in FY01. This will address hardware and software integration onto Service designated platforms and installation at fixed sites.

An integrated warning and reporting network will enhance the overall approach used in the chemical biological defense strategy. The enhancements will come from a warning and reporting network that is linked to numerous point detectors, such as JCAD, which can identify and quantify chemical threats, and which are cued by early warning systems, such as JSLSCAD and

JSWILD/Artemis. The information from all the sensor systems in the operational theater becomes available to various command levels with appropriate levels of resolution determined by the command decision needs. For example, a fixed facility commander can determine the appropriate level of protective posture by monitoring the direction of an ongoing attack or the effects of weather in moving contamination in a post attack situation.

2.3.5 Other Contamination Avoidance Programs

Detection and warning requirements have various mission profiles and technical specifications. While in some instances the development effort may leverage the technical achievements of a closely related detection and warning project, the application beyond its intended mission is limited and accordingly supports only one or a few specific requirements. The Navy awarded a production contract in FY97 for the Improved (chemical agent) Point Detection System (IPDS), and began installation in FY99. IPDS is used to automatically detect and alarm in the presence of chemical agents in vapor form and will provide continuous detection and alarm capability in the harsh shipboard environment. The IPDS replaces the existing shipboard Chemical Agent Point Detection System (CAPDS), improving detection thresholds, response time, rejection of shipboard interferents, and adding the capability to detect mustard agents.

The Marine Corps conducted a Force Medical Protection/Dosimeter ACTD, the goal of which was to develop an individually worn sampler that can measure and archive exposure levels of chemical and biological agents. The objectives of the system were to warn the wearer, provide real-time analysis of chemical agents, and trap biological agents for later analysis.

2.3.6 Defense Advanced Research Projects Agency (DARPA) Programs

There are four related programs currently ongoing within DARPA that contribute to the development of advanced sensor technology: BW defense environmental sensors, tissue-based biosensors, microfluidic molecular systems, and pathogen genome sequencing.

DARPA BW Defense Environmental Sensors Program. DARPA is developing technologies to enable bioagent detection and identification. Technologies using universal polymerase chain reaction (PCR) probes are being developed to permit the detection and identification of known threats as well as to provide significant potential for identifying engineered agents. Another effort, seeking to use ribosomal RNA to eliminate the need for amplification, is developing a multiplexed chip to reveal BW agent family, genus, and species on a single chip; the chip is structured to take advantage of the environmental hierarchical phylogenetic classification of microorganisms. A mass spectrometer is being miniaturized for potential use in identifying BW agents and contaminants without the use of liquids, with the goal of establishing end-to-end time faster than one minute. A desktop mass spectrometer using an infrared (IR) laser analysis of the biological sample has been developed by DARPA and commercialized for analysis of biological agents. These systems will be automated for unattended operations. Detection technologies that provide information on BW agent pathogenicity, antibiotic resistance and viability are also being developed under the DARPA biological detection program.

DARPA Activity Detection Technologies Program. DARPA is exploring the development of activity detection systems which report on functional consequences of exposure (mechanism and

activity) to a wide spectrum of chemical or biological toxins, whether they are living or dead, or whether they have been bioengineered and are currently undetectable by other means (antibodies, nucleic acid sequencing). These systems incorporate enzyme based, cellular or tissue based assays, and a number of technical issues are being addressed in the program including (1) the fabrication of biocompatible matrices and interfaces for the long-term retention of cell and tissue function, (2) pattern recognition from critical pathways responsible for the processing of toxins, (3) sampling strategies to accurately extract and present the toxin from air, liquid, or solid samples, and (4) systems integration into a functional device. One current focus of the program is the use of neuronal and immunological cells and tissues as detectors for such devices. Engineering of cells and tissues of these origins, including stem cells, is proceeding in order to optimize sensor performance requirements and fabricate prototype devices for testing and evaluation.

DARPA Microfluidic Molecular Systems Program. Micro total analysis systems are being developed through focused research on microfluidic, chip-scale technologies. Automated sample collection and sample preparation are key front-end processes for early biological agent detection, whether it is by immunoassays, DNA assays, or tissue-based assays. To scale down these processes into miniaturized, multiplexed detection systems, microfluidic chip-scale components need to be developed. Microfluidic components/devices currently being developed by DARPA include chip-scale micropumps/valves, particle separation filters, fluidic interconnects, fluidic manipulation of hybridized microbeads, controlled mixing/dosing, *etc*. Several demonstrable handheld prototypes, such as a programmable microfluidic system for remote sensors, are currently being tested.

DARPA Pathogen Genome Sequencing Program. DARPA is sequencing the genomes of high threat BW agents. This effort, undertaken with broad community interaction, will support DARPA BW Defense research activities and is intended to satisfy the needs of DoD components, the Intelligence Community, and other governmental organizations. Interest is focused on BW pathogens, and selected non-pathogenic near neighbors thought to be important to establish a basis for low false alarm detection and identification. The work also contributes to the development of advanced unconventional pathogen countermeasures.

2.4 MODELING AND SIMULATION (M&S)

Chemical and Biological Defense (CBD) Modeling and Simulation provides tools for the Warfighter to fundamentally understand a specific challenge and evaluate proposed solutions. It is intended to provide the warfighter with a full spectrum of capabilities to perform hazard analyses, operational effects analyses, simulation based acquisition, and accurate training when the use of live chemical or biological agents is not available due to legal, ethical, financial, or other constraints. Models and simulations are used to provide situational awareness, to provide hazard warning and prediction, and for planning or modification of operations. In the future, modeling and simulation will be used to provide warfighters and decision makers at every level of command with the ability to analyze courses of action immediately prior to or in concert with combat need. In addition, modeling and simulation information systems aid in the assessment of Joint and Service doctrine, training, materiel development, and equipment design (*i.e.*, Simulation Based Acquisition). They are also used in warfighter training and the training of battle staffs using larger conflict simulations. In the latter aspect, they are used to perform and support analyses of CBD operations within the context of larger

military operations. Models are also critical components of sensor systems, such as the Joint Warning and Reporting Network and Command and Control (C2) systems that function by taking sensor output signals and processing them into meaningful command information. It also supports simulation based acquisition in the development of critical NBC defense capabilities. Modeling and simulation is essential to reduce costs, shorten development schedules, and improve system performance. Thus, models and simulations can be either stand-alone systems or imbedded within other software and hardware systems.

The following sections provide a summary of modeling and simulation science and technology efforts, modernization strategy, and Joint Service Programs.

2.4.1 M&S Science and Technology Efforts

M&S technology base efforts are provided by a refocused business area—Information Systems Technology. This business area includes four sub-areas to fully meet the JFOCs required by the CINCs. The JFOCs focus on capabilities to provide improved battle management, characterization of the CB environment, information systems, and simulation based acquisition. To provide improved characterization of the CB environment, efforts are continuing to provide advanced hazard assessment methodologies, address specific environmental flow regime issues (such as high altitude and urban transport and diffusion (T&D) methodologies) and support first principles physics, chemistry, and meteorology efforts. Battle Management information systems technologies are addressing operational effects and processes for fixed site simulations, as well as, advances in conflict simulation methodologies and distributed information systems. The technology base efforts also collaborate with the weapons effects, medical and larger DoD Modeling and Simulation communities to address source term and toxicology, interoperability and architectural issues. [NOTE: Dispersion is the combination of T&D. T&D only refers to the airborne behavior of a contaminant. The DoE uses transport and fate to address additional physical processes. Hazard assessment includes all of these factors, plus the inclusion of source characterization and toxicity.]

2.4.1.1 Goals and Timeframes.

The goals of CBD M&S science and technology efforts are as follows:

- support the warfighter directly through existing C^4I networks and information systems,
- support the operational and national command authority with CBD environment decision systems,
- support DoD level theater and warfare simulation efforts, and
- support materiel acquisition programs with Simulation Based Acquisition (SBA) tools and architectures.

Table 2-4 shows specific efforts supporting theses goals. Current modeling capabilities are designed to support warfighter efforts to conduct scenario simulations prior to engagements and to train in a realistic manner. Recent advances allow CBD planning to be folded into larger conflict simulation and consequence management tools. SBA tools will be used for detectors in conjunction with other CBD environment models to assess acquisition strategies for several Service/Joint detector and platform acquisition programs. The next generation T&D methodologies will provide a multi-

fidelity capability, which will allow the warfighter increased flexibility and more responsiveness to threat and hazard predictions. The far-term capabilities will include a near-real-time operational hazard prediction capability. An ongoing effort in modeling is the incorporation of specific advances in the characteristics of contamination avoidance, decontamination, medical and protection systems into models so that warfighters are able to evaluate and plan for advances. Integrated conflict simulation capabilities are also envisioned to meet theater and strategic simulation requirements.

Table 2-4. Modeling & Simulation Science and Technology Strategy

By 2002	By 2007	By 2012
• Demo improved VLSTRACK Version 3.1 • Continue efforts with MESO and CBW-CFX technologies • Demo-Fixed Site (STAFFS) capability • Demo multi-fidelity M&S capability • Initiate JEM acquisition program • Provide VLSTRACK, HPAC and D2PC methodologies to JEM	• Demonstrate and transition MESO and CBW-CFX methodologies to JEM • Demo and transition STAFFS and NCBR Simulator to JOEF • Demo and transition JMNBCDST to JOEF • Detection SBA application transitioned to VPS • Collective Protection SBA application to VPS • VERTS transitioned to TSC Block I • Demo emerging advanced info system technologies	• Demonstrate advanced system architectures for JEM and JOEF • Demo real-time, course-of-action decision making options technology • Demo Micro scale weather forecast hazard prediction capability • Demo mobile forces CBD ops effects capability • Demo emerging advanced info systems technologies • Decontamination SBA applications transitioned to VPS

Defense Technology Objectives (DTOs) with an M&S focus include DTO CB.43, Chemical and Biological Warfare Effects on Operations, and DTO BE.10, High-Resolution Meteorological Nowcasting for Chemical/Biological Hazard Prediction. This objective is to develop a general-purpose model of the operations of large fixed-site facilities [air bases, aerial ports of debarkation (APODs) and seaports of debarkation (SPODs)], with the capability to represent chemical and biological warfare (CBW) attacks and their operational impacts.

2.4.1.2 <u>Potential Payoffs and Transition Opportunities</u>. Future CB M&S systems will complement C4ISR systems with a level of situational awareness unknown at this time: accurate information, knowledge, and predictions of threats, the environment, operational alternatives and effects in real time, accelerated time, or as required. This will enable commanders to control the battle, analyze the need for CBD actions, verify effective deployment of CBD assets and reconstitution procedures, and assume the appropriate protection required to continue operations and sustain their mission with minimal performance degradation and casualties. CB M&S technologies have dual use potential predicting and responding to civil support events such as terrorist activities, air pollution, Toxic Industrial Chemical (TIC) and Toxic Industrial Material (TIM) releases both outside and inside enclosed areas, and municipal water supplies. The key payoffs of M&S include: (1) commanders and battle staffs better trained and able to analyze alternate courses of action with advanced simulations, (2) less confusion and more consistent decision making via use of a federation of analytical and real time CBD environment M&S tools, (3) CBD systems and operational concepts that match requirements more closely because warfighter feed back is captured earlier in the development cycle under the tenets of SBA,

and (4) advanced hazard prediction and human effects modeling that has dual use potential in aiding civilian responders or planners to prepare for or respond to terrorist attacks and industrial accidents.

2.4.1.3 Major Technical Challenges. The major technical challenges for M&S include the following: (1) modeling and validating the effects of complex and urban terrain on CB hazards, (2) modeling and validating high altitude threat intercept effects, (3) modeling and validating human effects and small unit behaviors in a CB environment, (4) modeling and validating effects of low level and long term exposures, (5) effectively quantifying the effects that CBW has on complex fixed site operations, (6) integrating CB effects and operations with C4I systems for training and operations, (7) interjecting CB effects into combat and materiel evaluation simulations with adequate fidelity without bringing the simulations to a standstill, and (8) developing engineering level models of CBD equipment that can participate in distributed simulations to support SBA from inception to system retirement.

2.4.2 Modeling and Simulation (M&S) Modernization Strategy

During FY2001, the JSMG and the JSIG prepared a Draft *Modeling and Simulation Master Plan* that details the modernization strategy and RDA efforts for M&S within the CBDP. **Table 2-5** shows the roadmap of DoD requirements for modeling and simulation.

Table 2-5. Modeling and Simulation Modernization Strategy

	NEAR (FY02-03)	MID (FY04-09)	FAR (FY10-19)
Hazards Analysis	• Counterforce hazard prediction (HPAC 4.0) • Passive defense hazard analysis (VLSTRACK 3.1) • High altitude intercept analysis (PEGEM) • Urban environment analysis (MIDAS-AT) • CONUS facilities analysis (D2PC)	• Integrated VLSTRACK, HPAC, and D2PC hazard prediction and effects capability (JEM Block 1) • Increase capability to analyze high altitude intercepts and urban environments (JEM Block 2)	• Multi-fidelity hazard prediction, to move at will from global, to theater, to battle, to building, to individual scale analyses (JEM Block 3) • Micro-scale event analysis (JEM Block 4)
Operational Effects Analysis	• Fixed site analysis (STAFFS) • Medical resources analysis (CREST) • Mobile forces analysis (NCBR Simulator)	• Integrated fixed site and medical simulations with JWARS and JSIMS (JOEF Block I)	• Mobile forces simulations incorporated into the federation (JOEF Block 2) • Automated C4I system integration (JOEF Block 3)
Simulation Based Acquisition Systems	• Navy-Ship based analysis (CWNavSim) • Point and stand-off detector systems (NCBR Simulator)	• Detection (VPS Block 1) • Biological detection and identification capabilities (VPS Block 2)	• Protection and decontamination (VPS Block 3&4)
Training Simulation Systems	• Virtual Emergency Response Training System capability (VERTS TSC)	• VERTS Capability (TSC Blocks 1 and 2) • Individual and crew training systems (TSC Block 2)	• Integrated training systems for battle staffs and commanders (TSC Block 3)

The Master Plan also highlights coordination efforts with other organizations throughout the Department. As a result of the oversight responsibilities for all DoD CBD M&S efforts being assigned to the DATSD(CBD) in November 2000, there were several key changes to the CBD M&S program. The CBD M&S program includes efforts from basic research through full scale engineering and manufacturing development. This is in contrast to past efforts that were limited to technology development and the fielding and support of technology products by the scientists who created them.

Guidance provided by the DATSD(CBD) in January of 2001 directed the initiation of the first M&S acquisition program, the Joint Effects Model (JEM). This program is based upon the proven technologies of existing agent hazard assessment models and the emerging operational requirements document, which articulates the Joint Service needs. The JEM program achieved Milestone A in May 2001. With the start up of this initial M&S acquisition program, the Services and CINCs will receive a system that not only meets their needs, but that will also receive training support in the future. It also creates the transition program for emerging technologies and capabilities to assure the warfighter that they receive the best capability, for the best value, at the earliest time.

In 2002, the Joint Operational Effects Federation (JOEF) program was introduced into the POM process. This is a milestone in that JOEF will be the acquisition program to address the entity-based operational analysis requirements. JOEF will initiate and coordinate all efforts associated with providing the warfighter with the information system required to predict the operational consequences of a given CB hazard event. JOEF will use JEM to predict or analyze the nature of the hazard area, but will take that information and use a federation of other models and simulations to meet a specific operational commander's or other authority's needs. The combination of JEM and JOEF will meet the entire spectrum of the users needs for analytical M&S systems.

Analysis and training are the keys to being prepared for and responding to a CB event. As a result, DoD is concentrating RDA efforts on providing its warfighters and decision makers with analytical systems to predict or forensically analyze events and courses of action for the full spectrum of CB threats. In the near term, efforts are focused on taking advantage of our decade of technology development in hazard assessment methodologies to provide interim accreditation for a number of analysis regimes. In addition, efforts in operational effects and SBA will be prepared to transition to full scale development programs. In the mid-term, first priority has been given to transitioning the most mature technologies to the new start JEM and JOEF programs. These will provide accredited, common use hazard information systems by the years 2005 and 2007 respectively. Largely due to the maturity of the technologies, requirements and the vision for them, the SBA and Training Systems Capability (TSC) will be addressed behind those for analysis. However, both SBA and TSC are also functionally and structurally dependent upon the analytical systems so a delay in their start is appropriate. **Table B-1** in Annex B provides an overview of RDA efforts and Service involvement.

The management challenge involves the coordination and consolidation of numerous previously uncoordinated RDA efforts across the Services and Agencies. This strategy, led by the JSMG through the M&S CAM, established in April 2000, has already resulted in the initiation of the above mentioned Joint Service RDA efforts.

2.5 DECONTAMINATION

When contamination cannot be avoided, personnel and equipment may need to be decontaminated to reduce or eliminate hazards after NBC weapons employment. Decontamination systems provide a force restoration capability for units that become contaminated. Modular decontamination systems are being produced to provide decontamination units with the capability to tailor their equipment to specific missions. Technology advances in sorbents, coatings, catalysis, and physical removal will reduce logistics burden, manpower requirements, and lost operational capability associated with

decontamination operations. The following sections detail CB decontamination science and technology efforts, modernization strategy, and Joint Service programs.

2.5.1 Decontamination Science and Technology Efforts

2.5.1.1 Goals and Timeframes. The goal of decontamination science and technology is to develop technologies that support two key Joint Future Operational Capabilities (JFOCs): (1) the RC-EL (Restore - Equipment/Facilities/Large Areas) JFOC, and (2) the RC-LG (Restore - Logistics) JFOCS. These capabilities will eliminate toxic materials or their effects without performance degradation to the contaminated object, are non-corrosive, environmentally safe, and lightweight (see **Table 2-6**). This area includes decontamination of personnel, individual equipment, tactical combat vehicles, aircraft, facilities, and fixed sites. Decontamination technologies currently being pursued include enzymes, non-chlorine based oxidants, catalysts that improve reactivity, decontaminants that are effective in both fresh and brackish water, improved reactive sorbents, and nanoparticle technology. Supercritical fluid technology, non-ozone depleting fluorocarbons, and solvent wash technologies are being investigated for sensitive equipment decontamination, while thermal approaches, solvent wash technologies, and plasma are among the candidates being evaluated as a decontaminant for interior spaces of vehicles such as aircraft. Enzyme-based decontaminants that are nontoxic, non-corrosive, and environmentally safe are being pursued through DTO CB.09, Enzymatic Decontamination. New oxidative decon formulations that are effective against both chemical and biological agents are being developed through DTO CB.44, Oxidative Formulations. These potential decontaminants will also be nontoxic, non-corrosive, and environmentally safe.

Contamination control involves investigating procedures that minimize the extent of contamination pickup and transfer, and maximize the ability to eliminate the contamination pickup on-the-move as well as during decontamination operations. During the last year, increased emphasis has been placed on aircraft decontamination, especially analyzing material compatibility concerns, as part of the Joint Service Sensitive Equipment Decontamination program, the RestOps ACTD, and other DoD sponsored studies.

Table 2-6. Decontamination Science and Technology Strategy

By 2002	By 2007	By 2012
• Demo improved sorbent delivery systems • Aircraft Interior Decon procedures • Demonstrate Fixed Site decontaminants	• Sensitive Equipment Decon Systems • Demonstrate concentrated enzymatic and oxidative decontaminants • Fixed Site applicators • Demonstrate the next generation of reactive sorbent powders	• New self-decontaminating materials • Improved thorough decon materials • Aircraft and other vehicle interior decontamination

2.5.1.2 Potential Payoffs and Transition Opportunities. The payoff from enhanced decontaminants and decontamination systems will be new non-corrosive, non-toxic, non-flammable, and environmentally safe decontamination systems suitable for a timely elimination of CB agents from all materials and surfaces. This ability will allow forces to reconstitute personnel and equipment more quickly to increase combat efficiency and lessen the logistic burdens. In the future, reactive coatings

may allow the continuation of combat operations without the need to disengage for decontamination. Dual use potential for chemical agent stockpile as well as environmental remediation, especially those dealing with pesticide and toxic industrial chemical contamination, is being exploited.

2.5.1.3 Major Technical Challenges. There are two principal technical difficulties associated with this effort. The first is the development of decontaminants that are reactive, non-aqueous, non-corrosive, safe for use on sensitive equipment, able to decontaminate a broad spectrum of chemical and biological agents, environmentally safe, and pose no unacceptable health hazards. The second technical difficulty is the development of decontamination systems that effectively clean all surfaces and materials, while at the same time reduce the manpower and logistics burden.

2.5.2 Decontamination Modernization Strategy

Decontamination systems provide a force restoration capability for contaminated units. Existing capabilities rely upon the physical application and rinse down of decontaminants on contaminated surfaces. Existing systems are effective against a wide variety of threat agents, yet are slow and labor intensive and present logistical, environmental, material, and safety burdens. In addition, existing systems are inadequate for electronic equipment decontamination, deficient for large area, port, and airfield decontamination, and rely on Decontamination Solution 2 (DS2) and water. To improve capabilities in this functional area, the Joint Services have placed emphasis upon new decontaminating technologies that reduce existing manpower and logistics requirements. These technologies are safer on the environment, the warfighter, and equipment. **Table 2-7** shows the roadmap for modernizing decontamination systems in DoD.

The goal of the NBC decontamination program area is to provide technology to remove and detoxify contaminated material without damaging combat equipment, personnel, or the environment. In FY99 the RDA community worked with the Joint Staff and Services' operations community and completed a Decontamination Master Plan that provide a roadmap that integrates RDA efforts with non-RDA efforts, including policy, doctrine, standards, and revised tactics, techniques & procedures. Research and development of non-corrosive, all-agent multipurpose decontaminants and decontaminating systems for combat equipment, aircraft, and personal gear remains a priority. Alternative technologies, such as sensitive equipment decontamination methods and large-scale decontamination systems attract interest across the Services. **Table D-1** in Annex D provides an overview of Joint Service RDA efforts and Service involvement.

In order to improve interagency coordination with decontamination S&T efforts, the RDA community worked with the Defense Threat Reduction Agency (DTRA), the Defense Advanced Research Projects Agency (DARPA), and the Department of Energy to develop an integrated decontamination RDA plan. This plan allows agency leaders and researchers to have visibility across current and planned RDA efforts to avoid duplication of effort, identify relevant research performed by other agencies, and establish meaningful collaborative efforts.

Table 2-7. Decontamination Modernization Strategy

	NEAR (FY02-03)	MID (FY04-09)	FAR (FY10-19)
Personal Equipment Decontam-inants	• More reactive, high capacity adsorbent (M291/M295) • Army -*Higher efficiency decon methods (Sorbent Decon)*	• Non-caustic, non-corrosive decontaminant for personnel and equipment	
Bulk Decontam-inants	• Non-caustic, non-corrosive, easy to store and manufacture multipurpose decontaminants	• Decontaminants for fixed sites • Navy -*Less caustic capability*	• Mission tailored decontaminants • Navy -*Contamination resistant shipboard materials* • Army -*Environmentally acceptable replacement for DS2* • Army -*Enzymes for chemical agent decontamination*
Expedient Delivery Systems		• Auto-releasing coatings; reduces skin contact hazard & labor requirements	• Self-decontaminating, auto-releasing coatings; reduces man-power and logistic requirements eliminates skin contact hazard
Deliberate Delivery Systems	• High pressure water wash; mech-anical scrubber; improved decon-taminant dispenser (increased vehicle throughput) • Army -*High pressure hot water washing and decontaminate scrubber capability; reduced water, labor, and logistic burden (M21/M22 Modular Decon System)*	• Rapid large scale decon capability for fixed sites; reduced manpower and logistic burden • Non-aqueous capability for electronics, avionics and other sensitive equipment	• Vehicle interior decon capability • Supercritical fluid decontamination apparatus • Army -*Waterless decon capability for electronics and avionics* • Air Force - *Sensitive equipment decontamination system for aircraft interiors*

1. All programs shown are joint or multi-service, unless indicated as a Service-unique effort (*italicized text*).
2. Where applicable, systems which meet requirements are listed following the entry.

2.5.3 Joint Service Decontamination Programs

The Army has developed the M291 skin decontamination kit as a replacement for the M258A1 decontamination kit for all Services, and has introduced the M295 for improved personal equipment decontamination. The M295 provides the warfighter a fast and non-caustic decontamination system for personal gear. A new adsorbent which is more reactive and has higher capacity of absorbing contamination was developed and completed to improve the performance of the M295 kit. The M295 kit filled with the new sorbent became available for requisition in January 2000.

In the near- and mid- term, DoD continues to research new multi-purpose decontaminants as a replacement for bulk caustic Decontamination Solution 2 (DS2) and for corrosive High Test Hypochlorite and Super Tropical Bleach. New technologies, such as reactive decontaminating systems, enzyme-based formulations, and enhanced sorbents are being explored and may offer operational, logistical, cost, safety, and environmental advantages over current decontaminants. Present shipboard chlorine-based decontaminant solutions pose an unacceptable corrosion risk to Naval aircraft. Current procedures require the use of fresh water and normal aircraft detergent solutions.

Ideally, new decontaminant formulations must be extremely reactive with dwell times of under 15 minutes and be effective at a pH below 10.5 in order to eliminate the corrosion risk. Potential new solutions-based approaches consist of organic, aqueous and mixed organic-aqueous systems, which

use catalytic and oxidative chemistries. Some promising decontaminants under consideration are organized assemblies incorporating monoethanolamine-type moieties, non-chlorine containing oxidants, such as stabilized peroxides, peroxycarboxylic acids and dioxiranes, and liquid slurries or suspensions of nanoparticles in organic solvents.

In the far-term, the Services are seeking non-aqueous decontamination systems to provide for sensitive equipment decontamination at mobile and fixed sites. Advancements during the last 18 months in plasma-based systems appear promising for these types of applications. Additionally, there is interest and exploratory research in coatings which can reduce or eliminate the necessity of manual decontamination. The ultimate goal of this coatings effort is to develop a chemically or possibly electrically reactive coating to apply on equipment when operating under high CB threat conditions. This coating would then provide immediate decontamination on contact with CB agents, thus reducing the hazard without any actions required at that time by the warfighter. A detailed description of the decontamination projects is provided in Annex D.

2.5.4 Other Decontamination Programs

In the near-term, the Army is producing the Modular Decontamination System (MDS) to enhance vehicle decontamination. The MDS will support thorough decontamination for ground forces and possess mechanical scrubbing and improved decontaminant dispensing capabilities. It will also offer a reduction in size, weight, logistics burden, and workload requirements over existing decontamination systems. Similarly, the Marine Corps has procured and is fielding an M17 Lightweight Decontamination System that can be operated with Military Standard fuels. The M100 Sorbent Decon System is scheduled for fielding in February 2002. This decontamination system replaces the M11/M13 DAP and associated DS2 used in immediate decon. This system consists of a non-toxic and non-corrosive, powder-based system that provides greater coverage than the M11 at 33% less weight.

2.6 PROTECTION

When early warning is not possible or units are required to occupy or traverse contaminated environments, protection provides life sustainment and continued operational capability in the NBC contaminated environment. The two types of non-medical protection are individual and collective.

- ***Individual protective equipment*** includes protective masks and clothing. Protective masks that reduce respiratory stress on the user while improving compatibility with weapon sighting systems and reduce weight and cost are being developed. Technology advances are being pursued to produce mask systems that provide fully compatible vision capabilities, laser/ ballistic protection, and further reduction in logistics and physiological burden. Protective clothing and integrated suit ensembles are being developed that will improve protection, reduce the physiological and psychological burden, have extended durability, and have less weight and heat stress burden than present equipment.
- ***Collective protection equipment*** consists of various types of NBC protective filters, entry/exit, and air movement devices that provide filtered air to a wide range of applications, transportable shelter systems equipped with NBC filtration systems and, in selected cases, environmental control. Collective protection in the form of overpressure can be applied to mobile and fixed command posts, medical facilities, rest and relief shelters, buildings/fixed sites, vehicles, aircraft, and ships. Lightweight shelters integrated with NBC filtration, environmental control and power generation facilities for medical treatment facilities have been developed and are in production.

Technology improvements are being pursued to reduce power requirements and improve filtration capacity against current and future NBC agents. Technologies that reduce weight, volume, cost, and improve the deployability of shelters and filtration systems are also being pursued.

2.6.1 Protection Science and Technology Efforts

2.6.1.1 Individual Protection Goals and Timeframes. The goal of the individual protection area is to reduce the physiological burden associated with wearing protective equipment while maintaining, and potentially improving, the already high level of protection against CB warfare agents and radiological particles (see **Table 2-8**). Individual protection equipment must also provide protection against emerging threats, such as novel agents or toxic industrial materials (TIMs). To achieve these goals, key physiological performance requirements to the design and evaluation of clothing and respirators are being established. New barrier and filtration materials and selectively permeable materials are being developed and evaluated to accommodate these performance requirements. Maximizing the protection afforded by mask filters is being addressed by Defense Technology Objective Universal End-of-Service-Life Indicator for NBC Mask Filters. The technology is expected to have applications for collective protection and clothing also. Incorporation of agent reactive catalysts and biocides into CB protective materials for increased protection is being addressed by Defense Technology Objective (DTO CB.45) Self-Detoxifying Materials for CB Protective Clothing.

Table 2-8. Protection Science and Technology Strategy

By 2002	By 2007	By 2012
• Demonstrate selectively permeable membranes as a viable alternative to adsorbent lined permeable materials for clothing • Demonstrate improved filtration media and advanced filter bed configurations for protective mask and collective protection applications • Demonstrate lightweight, low cost materials and advanced closures for shelters	• Investigate reactive materials as a means of self-detoxifying clothing and shelters • Investigate residual life indicators for mask filters, collective protection filters, and clothing • Investigate advanced adsorbents and filter bed configurations to provide protection against a wider spectrum of threats (NBC & TIM)	• Investigate membrane/ adsorbent composites for clothing • Investigate nontraditional filtration (non-adsorbent based and/or non-single pass) for collective protection applications • Investigate protective shelter materials to replace general purpose (non-protective) shelter materials

2.6.1.2 Collective Protection (CP) Goals and Timeframes. The goals of the collective protection area are to (1) reduce the weight, size and power requirements of CP systems, (2) reduce the logistical burdens associated with the maintenance of CP filters, (3) improve protection capabilities against current and emerging threat agents, including TIMs, and (4) improve the deployability of transportable shelter systems (see **Table 2-8**). To achieve these goals, improvements to system components (including transportable shelters) are being investigated along with improvements to the current vapor and particulate filtration media. Regenerative vapor and particulate filtration materials processes are being investigated to eliminate the need for filter change and improve the capability against any battlespace NBC threats. The primary effort for investigating adsorbents for both single-pass and regenerative filtration applications is articulated in the Defense Technology Objective Advanced Adsorbents for Protection Applications.

2.6.1.3 Potential Payoffs and Transition Opportunities. Individual protection investments will result in improved respiratory and percutaneous (skin) protection with reduced physiological and psychological burden to the individual warfighter. Improved air filtration systems or technologies for collective protection applications will allow for extended operation in an NBC contaminated environment, reduce the logistics burden associated with filter replacement, reduce weight, volume and power requirements, and improve the capability against current and emerging threats. Filtration technology has commercial application to the chemical industry and automotive applications.

2.6.1.4 Major Technical Challenges. Integrating CB protection into future weapon systems necessitates tradeoffs between performance requirements and limitations of materials and designs. Integral respiratory protection requires tradeoffs between physiological performance parameters such as pulmonary function, field of view, speech intelligibility and anthropometric sizing against constraints such as cost, size/weight, protection time, and interfacing with other equipment. CB protective clothing development requires balancing the physiological and psychological burden imposed upon the warfighter with maximum obtainable CB agent protection. Significant advancements have been made in improving the weight/bulk and power requirements of personal cooling systems, but further work in this area is needed. Air purification systems require tradeoffs with respect to performance, user requirements, size, weight and power constraints, as well as longer life. Addition of threats such as TICs/TIMs increases the need for additional protection and makes the challenge of reducing physiological performance and size/weight constraints more difficult, requiring threat versus design tradeoffs essential and tailoring of equipment to meet the threat.

2.6.2 Protection Modernization Strategy

Forces cannot always avoid NBC hazards, therefore, individual warfighting units must be provided materiel to protect them from the effects of these lethal agents. Protection must be effective against all known threats with minimal degradation to the performance of personnel, weapons, or equipment. Protective measures allow our forces to maintain combat superiority in NBC contaminated environments. A summary of protection modernization requirements is provided in **Table 2-9**.

The goal of the protection RDA area is to provide equipment that allows U.S. forces to operate in a NBC contaminated environment with minimal degradation of the warfighters' performance. Near-, mid-, and far-term objectives are to reduce physiological and logistical burdens while maintaining current protection levels.

Protective masks will be improved to reduce fatigue, thus enhancing ability to perform mission tasks. Mask systems will require increased NBC survivability and compatibility with combat or personal equipment. Future respiratory systems, such as the Joint Service Aircrew Mask (JSAM) and Joint Service General Purpose Mask (JSGPM) will require enhanced compatibility with life support equipment and tactical systems, and JSAM with fixed and rotary wing aircraft. They will also require the capability to remove TICs/TIMs as well as traditional CB agents. In the future, the focus will be on integrated respiratory protective ensembles, which offer optimal compatibility with personal, tactical, and crew support systems. Key technologies for future mask systems include mask service life indicator, advanced materials, improved adsorbents, and improved models and test technologies for protection assessment.

Table 2-9. Protection Modernization Strategy

	NEAR (FY02-03)	MID (FY04-09)	FAR (FY10-19)
Individual Eye/ Respiratory	• Voice amplification; laser/ballistic eye protection; improved decontaminability, better comfort (M40A1/M42A2) • Army - *Aircrew mask compatible with Apache helicopter systems with a significantly lighter motor/blower unit (M48)* • Army -*Improved compatibility with aviation sighting/night vision systems; reduced logistics burden using non-blower systems, selected for Land Warrior (M45)*	• Reduced physiological and psychological burden, improved comfort, enhanced optical and communications, improved compatibility • New mask systems for general purpose and aviation masks (JSGPM, JSAM) • Lightweight CB mask for low threat environments (JSCESM) • Navy -*Improved complete protection for all aircrews (CB Respiratory System)* • Improved mask leakage tester (JSMLT)	• Advanced Integrated Individual Soldier Protection system (Future Soldier System) • Improved multiple agent protection
Individual Clothing	• Advanced protective suit technology; lighter, improved agent protection; reduced heat stress integrated with all respiratory systems. - Improved foot protection (MULO) Improved hand protection	• Improved cutaneous protection • Improved protection for aviators (JPACE) • Service Life Indicator • Army –*Improved protection for short term use for special purposes (ITAP)*	• Integrated multiple threat modular protection (chemical, biological, environmental, and flame) • Self-detoxifying clothing
Collective Protection	• Chemically Protected Deployable Medical Systems (CP DEPMEDS) • Chemically Hardened Air Transportable Hospital (CHATH) • Rapid insertion of technology improvements into existing equipment (JCPE) • Marine Corps -*Protection for all combat vehicles and unit shelters* • Army -*NBC protection for tactical Medical units (CB Protective Shelter, CBPS).* *- Apply regenerable vapor filter to Comanche,* *- Apply collective protection to advanced vehicle concepts.* • Air Force - *Upgrade/install collective protection into existing rest/relief shelters.* • Navy - *Backfit ships with contamination free protected zones - (Collective Protection System Backfit)*	• Improved filters to extend filter life, reduce maintenance and reduce logistical burden • Reduced logistics burden, improved protection against current and future threats • Improved current collective protection filters and equipment (JCPE) • Support medical treatment in a CB environment for Airborne, Air Assault, and Heavy Divisions (CBPS) • Lighter, more mobile, easier setup, more affordable shelters (JTCOPS)	• Family of advanced collective protective systems for vehicles, shelters, ships, and light forces • Regenerable/advanced protective filtration for vehicles/vans/shelters

1. All programs shown are joint or multi-service, unless indicated as a Service-unique effort (italicized text).
2. Where applicable, systems which meet requirements are listed following the entry.

Future protective clothing ensembles for U.S. forces will require reductions in bulk and weight without any loss of protection or durability. To satisfy these needs, the Services have consolidated their mission specific requirements into the Joint Service Lightweight Integrated Suit Technology (JSLIST) program. The JSLIST program developed and is fielding the JSLIST Overgarment and is manufacturing Multi-purpose Overboots (MULO). The JSLIST Block 1 Glove Upgrade (JB1GU)

Program is seeking an interim glove to replace the current butyl rubber glove. The follow on to the JB1GU will be the JB2GU program that will be produce gloves for both ground and aviation units. The Joint Protective Aircrew Ensemble (JPACE) will be developed to provide aviators with the same advantages and improved protection as JSLIST provides to other warfighters. Similarly, clothing systems for Explosive Ordnance Disposal (EOD) personnel and firefighters are required to enhance existing chemical protection systems without undue physiological burdens.

Collective protection equipment (CPE) development efforts are focused on NBC protection systems at the crew, unit, and platform level. New CPE systems will be smaller, lighter, less costly, and more easily supported logistically. New systems are required to provide clean environments for critical operations (*i.e.*, where individual protective equipment (IPE) otherwise places an unacceptable burden upon the warfighter in performing duties) and for essential rest and relief. Modernization efforts will concentrate on: (1) improvements to current vapor and particulate filtration media to extend filter life and to offer improved performance against current and/or emerging threats, (2) advanced air filtration (vapor and particulate) technologies, integrated with environmental control, to greatly reduce the logistical burden and offer greatly improved performance against current and postulated threats, (3) increased application of collective protection systems onto vehicles, vans, shelters, fixed sites, and ships, within the Joint Services, (4) improved transportable shelter system with integrated power/ environmental control/filtration, (5) improvements to current collective protection systems to reduce weight, volume, and power requirements, and (6) standardization of filters within the joint services to address storage and procurement concerns. Efforts are in place to support major weapons systems developments, such as the U.S. Army's Comanche, Crusader, Bradley, Breacher, Heavy Assault Bridge, Future Scout and Cavalry System, the USMC Advanced Amphibious Assault Vehicle (AAAV), and other advanced weapons platforms.

2.6.3 Joint Service Protection Programs

Joint programs are shown in **Table 2-9**; Service-unique programs are italicized. A detailed description of Joint IPE and CPE programs is provided in Annex B.

Individual Protection

Eye/Respiratory. The M40 and M42 series masks (for individuals and armored vehicle crewmen, respectively) are undergoing the final stages of fielding to replace their M17, M9 and M25 series counterparts. The new masks offer increased protection, improved fit and comfort, ease of filter change, better compatibility with weapon sights, and a second skin, which is compatible with Army and Marine Corps protective ensembles. The second skin design also is being reviewed by the Navy and Air Force for potential adoption. The Army, Marines, and Air Force are also fielding the Protection Assessment Test Systems (PATS) to provide users of the M40, M42, and MCU-2/P series masks with a rapid and simple means for validating the fit and function of the mask to ensure readiness. The Navy is evaluating the use of PATS with its MCU-2/P series mask.

The Navy, in coordination with the Marine Corps, is leading an effort to equip all forward deployed fixed and rotary wing aircrew with improved chemical, biological, and radiological (CBR)

protection. The CBR ensembles will feature off-the-shelf items, such as the CB Respiratory System. The Army, in cooperation with the Marine Corps, recently completed a product improvement program for the M40 series mask that allows ground crew to aircrew communication. The Air Force continues to field Aircrew Eye-Respiratory Protection (AERP) systems to protect aircrews from CB hazards. This system complements the recently fielded lighter weight aircrew ensemble. Efforts are planned in the near- to mid-term to develop a Joint Service Mask Leakage Test System as a supplement and/or replacement for the M41 PATS, depending on service specific maintenance concepts.

Mid- and far-term research is focused on improved vapor and particulate filtration technology, and improved masks for light and special operations forces (SOF). Development will be completed in the mid-term for the Joint Service Aircrew Mask and Joint Service General Purpose Mask, which will provide improved eye, respiratory, and face protection against current and future agents. It will maximize compatibility with future weapon systems, be lightweight, and offer modular facepieces to accommodate a variety of mission profiles. A mid-term Joint Service Chemical Environment Survivability Mask (JSCESM) will provide a mask capable of being stowed easily in packs or pocket as an expedient means of CB protection in low threat and special operation situations. Future protective mask efforts will focus on integrated mask-helmet systems supporting specific needs of the Joint Services and integrated warrior programs (Land Warrior, Air Warrior, Mounted Warrior, and Force XXI).

Clothing. In the area of full body protection, the JSLIST program coordinated the selection of advanced technology chemical protective materials and prototype materials. The JSLIST Overgarment and the Multipurpose Overboot (MULO) were adopted by all four services. The JSLIST Overgarment is a 45 day garment (*i.e.*, it may be worn for 45 days over a maximum of 120 days after the suit has been opened) that provides 24 hours of chemical protection. It is launderable and lighter weight than the Battle Dress Overgarment (BDO). The MULO will replace the black vinyl overboot/ green vinyl overboot (BVO/GVO). The MULO is a 60 day boot that provides 24 hours of chemical protection. The boot has increased traction, improved durability, petroleum, oil, and lubricant (POL) and flame resistance.

The JSLIST Pre-Planned Product Improvement (P3I) addressed requirements not met through the baseline JSLIST program. This program sought new JSLIST material technologies, but no candidate materials were found to meet the requirements under this program. Subsequently, the JSLIST Additional Source Qualification (JASQ) was initiated to qualify additional sources of JSLIST materials and to conduct field wear tests and laboratory chemical tests on commercial JSLIST suit candidates. Government and industry are partnering to plan the testing approach. The JASQ candidates that perform as well as, or better than the current JSLIST garment will be considered for placement on a JSLIST qualified products list and may be authorized as additional JSLIST material sources. In addition, the Air Force and Army leveraged technology from the JSLIST program in the development of a chemical protective firefighter's ensemble.

In the far-term, efforts will focus on integrated protection. Next generation technology will be directed toward integrating CB protection into a system that will also provide environmental, ballistic, directed energy, and flame protection, as well as reduced physiological and psychological burdens. A strong emphasis on supporting technologies must continue. Materials that detoxify a broad range of

chemical and biological agents on contact, which can be incorporated into fibers, nanofibers, fabrics, and selectively permeable membranes, are being developed using biotechnology, electrospinning, and more conventional approaches.

Collective Protection (CP)

The Services currently use the M20A1 Simplified CPE and the M28 shelter liners to provide CP collective protection to existing structures. Environmental control is also being added to selected applications. The M20A1 CPE provides resistance to liquid agent and allows expansion of protection area and has been fielded. The M28 Simplified CPE has been integrated into CP DEPMEDS and CHATH field hospitals.

CHATH and CP DEPMEDS are joint programs to integrate environmentally controlled collective protection into already fielded Army and Air Force field hospitals in order to sustain medical operations in a CB contaminated environment for 72 hours. Chemical protection is integrated into existing Tent Extendable Modular Personnel (TEMPER)-based medical tents and shelters and the Modular, General Purpose, Tent, Extendable System (MGPTS) through addition of M28 Simplified CPE, chemically protected heaters and air conditioners, and alarms. CP DEPMEDS also includes CB protective water distribution and latrine systems.

The Chemically and Biologically Protected Shelter (CBPS) is a highly mobile, rapidly deployable shelter system designed to be used for Level I and II divisional and non-divisional forward area medical treatment facilities. The system is self contained/self-sustaining. It is permanently integrated with a M1113 Expanded Capacity Vehicle (ECV) with a Lightweight Multipurpose Shelter. The vehicle tows a trailer and generator set. The vehicle transports a CB protected airbeam supported soft shelter, self-contained environmental support and power generation system, a crew of four and gear, and medical equipment. The CBPS presently is in limited production to meet an urgency of need requirement. Operational Testing was conducted July through November 2000 to verify operational suitability and effectiveness for use in treatment squads to support type classification in April 2001. Further operational testing was initiated in FY01 to obtain approval for fielding for use in medical companies and Forward surgical Teams. Mid-term objectives are to initiate development of CBPS to support medical treatment for Airborne, Air Assault and Heavy Divisions.

Other near to mid-term collective protection efforts, such as the Joint Collective Protection Equipment (JCPE) will use the latest technologies in filtration, environmental controls, and power generation to improve and/or standardize current collective protection equipment so that it is lighter, more efficient, more affordable and less logistically burdensome. The Joint Transportable Collective Protection System (JTCOPS) will be the next generation lightweight, modular, easily transportable, self-supporting collective protection shelter that will provide relief from psychological and physiological stresses during sustained operations in a contaminated environment. Redesign and concept tradeoff assistance regarding advanced filtration technologies, such as Pressure Swing Adsorption (PSA) and Catalytic Oxidation (CatOx) has been provided to the Comanche, Crusader, USMC AAAV, and U.S. Army advanced vehicle efforts. The USAF is currently undergoing a major upgrade to their mobile and fixed site collective protection capabilities.

2.6.4 Defense Advanced Research Projects Agency (DARPA) Protection Programs

This thrust focuses on destroying or neutralizing pathogens and toxins before they enter the body. For example, both personal and collective protection air purification systems under development will have significantly enhanced performance relative to the conventional carbon/ HEPA-filtered gas masks and currently used catalytic oxidizer-based systems in use today. These existing systems suffer from a number of drawbacks including poor selectivity, slow adsorption kinetics, the need for expensive containment techniques, relatively low capacity, and high pressure drops. DARPA is developing air purification systems that (1) provide filtration media with lower pressure drops, greater capacity, improved retention, and possible neutralization of the pathogens using designer carrier systems—such as microfibrous materials—and designer sorbent materials (tailored pore size and pore chemistry for personal protection), (2) destroy and neutralize chemical and/or biological agents using a small catalytic oxidation reactor, and (3) for personal protection, the paper-making technique, prepared and microfibrous sorbent based, highly advanced felt-like filters are designed and packaged for the next generation of a joint service mask. These filters also lend themselves to fabricating low-cost, foldable/ portable emergency smoke hoods with extended gas sorption capabilities and regenerable, biological pathogen-destroying and gas-sorbing aircraft cabin and collective protection filters. The small thermocatalytic air purifier intended for collective protection shelters has been recently selected by the Joint Service CB Defense science and technology program for technology transition funding.

DARPA is also developing a number of innovative approaches to disinfect and purify water in the field from any source. These approaches include the use of mixed oxidants combined with novel and improved filtration methods. A pen-sized or cap-sized mixed chemical oxidant unit kills or inactivates microbial pathogens, prevents re-growth of microbial contaminants for days after initial treatment, and provides an order of magnitude improvement in disinfection effectiveness against spores compared with chlorine or iodine. The mixed oxidant solution can also disinfect equipment, utensils, and possibly wounds inflicted on an individual. During 2001–2002, the mixed oxidant water disinfection pens are being field tested by the Marines in Afghanistan. In the near-term, the USAF and other Special Operations plan to evaluate the device for Escape and Evasion kits. The same mixed oxidants are dispensed into a backpack worn on-the-move, new generation hydration system compatible with the current fighting load carrier and body armor. The oxidants deactivate biological pathogens; a thick film adsorbent removes volatile organics and a direct (forward) osmosis membrane filters undesirable mineral content, pesticides and spore forming bacteria to cover all CB requirements. Recently, a larger scale prototype of the same mixed oxidant technology successfully demonstrated the ability to purify water on board the USS Empire. For improved filtration, newly discovered methods to fabricate and treat the surface of carbon are exploited to create far superior performance (lower pressure drops, contact efficiency, improved viral absorption rates) than existing activated carbon granules.

Projects in the area of decontamination and neutralization are developing methods for destroying agents in a non-corrosive manner without using extremely high power or harmful chemicals. Current decontamination methods either employ concentrated bleach that can be corrosive to materials, people, and electronics or else methods that use extremely high power lasers, lamps, or discharges. One approach in the DARPA program is the development of BCTP—an emulsion made from water, soybean oil, Triton X 100 detergent, and the solvent tri-n-butyl phosphate—that is benign to humans, plants, animals, and electronics but quickly kills bacteria, spores, and most viruses. Stable, highly

effective biological enzyme/polyurethane foam mixtures are also being explored for their ability to neutralize both biological and chemical threat agents and for the decontamination of exposed personnel and materiel.

In addition, under the Immune Building Program, DARPA is developing technologies and systems to allow military buildings to actively respond to attacks by agents of chemical or biological warfare so as to (1) protect human occupants from the lethal effects of the agent, (2) restore the building to function quickly after the attack, and (3) preserve forensic evidence about the attack. The program focus is on the challenging problem of protection from covert agent release inside buildings. Enabling buildings to respond actively, in real time, to the presence of threat agents will not only greatly reduce the effectiveness of such attacks, but will also make the buildings less attractive as targets.

2.6.5 Other Protection Programs

Programs supporting requirements of a single service are shown in **Table 2-7** as italicized entries. A detailed description of IPE and CPE projects is presented in Annex C.

Individual Protection

Eye/Respiratory. The Army is developing the M48 protective mask to replace the M43 series masks. The M48 will be for Apache pilots. It will provide a lightweight motor blower unit, use a standard battery, and will provide increased protective capability.

In the near-term, the Army will replace the M43 mask for the general aviator (non-Apache applications) with the Aircrew Protective Mask, M45. The M45 is lighter and less expensive than the M43 and features CB protection without the aid of force ventilated air.

Clothing. The Army has approved fielding of the Self-Contained Toxic Environment Protective Outfit (STEPO). STEPO provides OSHA level A protection for Army Chemical Activity/Depot (CA/D), Explosive Ordnance Disposal (EOD), and Technical Escort Unit (TEU) personnel. The Army has also developed an Improved Toxicological Agent Protective (ITAP) ensemble that provides level B or C protection for short term operations in Immediately Dangerous to Life and Health (IDLH) toxic chemical environments (up to one hour), emergency life saving response functions, routine Chemical Activity operations, and initial entry and monitoring activities. The ITAP ensemble incorporates improvements in material and design. It includes a one-hour supplied air bottle system, which can be switched to a filtered air respirator when operators exit the area of high contamination. A Personal Ice Cooling System (PICS) has been developed for use with both the ITAP and STEPO.

Collective Protection

The Navy now includes the Collective Protection System (CPS) on selected spaces on new construction ships. Currently the DDG-51, LHD-1, AOE-6, and LSD-41 ship classes are being built with CPS. The Navy also has the capability to backfit CPS on ships already in Service. The Selected Area Collective Protective System (SACPS) has been installed on selected LHA-1 class ships. The Ship CPS Backfit program continues to backfit selected spaces critical to amphibious ships with CPS.

These spaces include hospital areas, command and control areas, and rest and relief areas. The Navy Shipboard Collective Protection Equipment (CPE) effort will increase the shipboard particulate filter life (from the current one or two years) to at least a three year service life, through the use of new particulate pre-filter materials and the use of new high efficiency particulate (HEPA) filter media. The Shipboard CPE will thus provide millions of dollars of savings in life cycle costs by reducing shipboard maintenance requirements and providing energy efficient fans. The Shipboard CPE will transition to the JCPE in FY03.

2.7 MEDICAL SYSTEMS

2.7.1 Introduction

Many countries and terrorist groups have acquired the means to produce and deliver chemical, biological, and radiological weapons. NBC proliferation increases the threat to deployed U.S. forces. Chemical warfare (CW) agents are available worldwide and include vesicants (blister agents), nerve, blood, and respiratory agents. Biological warfare (BW) agents include bacteria, viruses, rickettsiae, and toxins, many of which can be produced by any group with some basic knowledge of microbiology and access to a scientific laboratory or a pharmaceutical facility. The primary radiological/nuclear warfare (RW) threat is the use of conventional explosives to spread nuclear contamination over a limited area or strategic terrain (including use against reactors or industrial radiation sources) and potentially the use of a single or a small number of crude nuclear weapons. Exposure to multiple threats may result in synergistic effects.

Under the CBDP, and overseen by the Medical Systems Commodity Area Manager, the Medical Chemical and Biological Defense Research Program (MCBDRP) is chartered as the joint focal point for medical research efforts to counter CW and BW threats. Separate from the CBDP, the focal point for medical radiological defense research is the Armed Forces Radiobiology Research Institute (AFRRI). Taken together, these programs form a virtual Joint Medical Chemical, Biological, and Radiological Defense Research Program (JMCBRDRP). The JMCBRDRP mission is to preserve combat effectiveness by timely provision of medical countermeasures. Countermeasures are developed in accordance with joint service mission needs and requirements in response to threats of chemical, biological, or radiological contamination.

Along with individual and collective protection, medical systems forms a third area associated with the NBC defense principle of protection. *Medical Systems* include all pharmaceuticals, biologics, and devices that preserve combat effectiveness by timely identification, diagnosis, and provision of medical countermeasures in response to Joint Service chemical, biological, or radiological warfare defense requirements. Technology advances are being pursued in the creation and manufacturing of vaccines and pharmaceuticals that prevent the lethal and/or incapacitating effects of biological, chemical, or radiological warfare agents. Therapies that improve survival and lessen time for return to duty have been developed. Also being developed are rapid portable diagnostics that will facilitate a quick medical response for exposed warfighters.

The JMCBRDRP has the following goals:

(1) Provide individual level medical protection and prevention to preserve fighting strength.
(2) Maintain technological capabilities to meet present requirements and counter future threats.
(3) Provide medical management of CW, BW, and RW casualties to enhance survivability, and expedite and maximize return to duty.
(4) Sustain basic research that provides the knowledge upon which innovative diagnostics, prophylaxes, and therapies are developed.

DoD medical NBC defense research and development programs have provided numerous products to protect and treat service members. Assessment methodologies enable threat evaluation and injury prediction. Medical prophylaxis and treatment strategies reduce performance decrements, injuries, and deaths of military personnel in the field, thus enabling them to accomplish their missions, reducing the need for medical resources, and decreasing the probability of long-term health effects.

Specific initiatives programmed to improve NBC defense medical readiness include:

- Continued emphasis on NBC medical countermeasures research.
- Development and implementation of a biological defense immunization policy for U.S. forces and other-than-U.S. forces.
- Cooperative initiative with the U.S. Food and Drug Administration (FDA) for acceptance of efficacy data derived from animal studies as surrogates for large-scale human efficacy trials to license drugs and biological products that cannot be ethically tested for efficacy in humans.
- A prime systems contractor to the Joint Vaccine Acquisition Program (JVAP) continues its effort to develop, license, produce, and store biological defense vaccines.
- Enhanced medical diagnostic capability for diseases/injuries caused by all agents.
- Studies to elucidate the toxicity and mechanism of action of Fourth Generation Agents, and to determine the effectiveness of current medical countermeasures.
- Studies to evaluate the effects of exposure to low levels of chemical warfare agents (CWAs).
- Training of health care professionals for the medical management of chemical, biological, and radiological casualties.
- Identification and testing of medications and therapeutic regimens that reduce the effect of radiation on both bone marrow and the intestinal tract.
- Consequence assessment of sub-lethal radiation exposure combined with susceptibility to biological and chemical agents.

Medical NBC defense research programs discussed in this section are divided into chemical, biological, and nuclear research. **Table 2-10** provides a summary of the programs and the planned modernization strategy through the far term.

Table 2-10. Medical NBC Defense Programs and Modernization Strategy

	NEAR (FY02-03)	MID (FY04-09)	FAR (FY10-19)
Medical Chemical Defense	Licensed SERPACWA (Skin Exposure Reduction Paste against Chemical Warfare Agents) Licensed multichambered autoinjector	Licensed pyridostigmine Bromide Licensed ophthalmic ointment for vesicant ocular injury Licensed advanced anticonvulsant	Licensed active topical skin protectant Licensed advanced prophylaxis for chemical warfare nerve agents Licensed specific protection and treatment for blister agents (vesicant agent countermeasures) Licensed therapeutic lotion for burns caused by vesicant agents Licensed vesicant agent prophylaxis
Medical Biological Defense	Joint Biological Agent Identification and Diagnostic System (JBAIDS) Block I	Licensed smallpox (vaccinia virus, cell culture-derived) vaccine JBAIDS (Block II) - FDA approval for use as a diagnostic system Initiate JBAIDS Block III FDA-approval to add indications to licensed therapeutics for exposure to plague, anthrax and smallpox Licensed broad spectrum immunomodulator for biodefense against multiple threat agents including anthrax, plague and tularemia Licensed Tularemia vaccine	Licensed Next Generation Anthrax vaccine Licensed recombinant Plague vaccine Licensed multivalent Venezuelan equine encephalitis (VEE) vaccine Multiagent vaccine delivery capability JBAIDS Block III production Licensed Recombinant Multivalent (A,B) Botulinum vaccine Licensed Ricin vaccine Licensed recombinant Staphylococcal Enterotoxin (A, B) vaccine Licensed broad spectrum antibiotics and antivirals Licensed therapeutics for toxin exposure Alternative delivery methods for vaccines and immunogens
Medical Nuclear Defense	Broad spectrum, nontoxic androstene steroid protectant validated in small/large preclinical models Combination cytokine therapy for blood-forming tissue injury; safety and efficacy testing in small/large animal model Improved cytogenetic markers with automated sample processing and image analysis; reduced analysis time and increased throughput Complete assessment of prophylactic efficacy of anthrax vaccine for animals exposed to combined *B. anthracis* spores and ionizing radiation	Sustained, slow-release radioprotective drug delivery for extended-exposure protection New-generation neutraceutical and recombined biologics for prophylaxis and therapy of multiorgan radiation injuries; safety and efficacy testing in large animal model Multiplexed cytogenetic biodosimetry with better accuracy and precision; improved diagnostic predictive capability Molecular biomarker-based biodosimetry for field applications; dose/response correlation for selected expression molecular biomarkers Module for casualty prediction models (CATS/HPAC); mortality prediction from combined *B. anthracis* and radiation exposure Evaluation of therapeutic approach (genistein and *Lactobacillus reuteri*) for shigellosis and radiation exposure	Licensed products to reduce/prevent radiation-induced short- and long-term (cancer) injuries Licensed products for treating severe radiation injuries Cytogenetic-based biodosimetry system; employment in field hospitals Molecular biomarker-based biodosimetry system validation complete; small, transportable system for field environments Approved standards for medical management of combined radiation/*B. anthracis* exposure Licensed products to reduce/prevent injury and disease from combined radiation/human pathogen exposure Field-capable suite of clinical biological dosimetry tests for rapid assessment of exposure.

2.7.2 Challenges in Medical NBC Warfare Defense Programs

Medical prophylaxes, pretreatments, and therapies are necessary to protect personnel from the toxic or lethal effects of exposure to all validated threat agents, as well as other anticipated threats. DoD has fielded a number of medical countermeasures that greatly improve individual medical protection, treatment, and diagnostic capabilities.

Executive Order 13139 of September 30, 1999 makes it the policy of the United States Government to provide military personnel with safe and effective vaccines, antidotes, and treatments that will negate or minimize the effects of exposure to a range of CBR weapons as well as diseases endemic to an area of operations. This executive order establishes the procedures for the administration of investigational new drugs to members of the Armed Forces to include informed consent requirements and waiver provisions. DoD Directive 6200.2, *Use of Investigative New Drugs for Force Health Protection*, August 1, 2000, establishes policy for the use of investigational new drugs for force health protection, incorporating the requirements of 10 U.S.C. 1107, the Executive Order 13139, and the FDA interim final rule (21 CFR 50.23(d)).

The acquisition life cycle of medical products developed by DoD is normally managed in accordance with the guidelines found in DoD Regulation 5000.2-R. However, DoD also must comply with the requirements of Title 21, Food & Drugs, Code of Federal Regulations (CFR), for the manufacture, testing, and licensing of medical products.

The DoD is working closely with the FDA to amend the CFR for New Drug and Biological Products that cannot meet the efficacy studies required by the FDA for product licensure because they are either not feasible and/or cannot ethically be conducted under the FDA's regulations for adequate and well controlled studies in humans. (See 21 CFR Sec. 312.21(2)(b).) DoD presented a proposal to the FDA's Vaccines and Related Biological Products Advisory Committee to use animal efficacy data as evidence demonstrating the efficacy of the Pentavalent Botulinum Toxoid (ABCDE). The Advisory Committee recommended that the FDA accept DoD's proposed animal model for efficacy data for licensure of the Pentavalent Botulinum Toxoid (ABCDE). The FDA has proposed a rule that allows the use of animal efficacy data for those products that either cannot be tested ethically in humans or it is unfeasible to test. This proposed rule has been published in the Federal Register [Federal Register: October 5, 1999 (Volume 64, Number 192)].* As of the second quarter FY02, the proposed rule has not been finalized.

Medical NBC defense products are thoroughly tested and evaluated for their safety in accordance with FDA guidelines before administration to *any* personnel. All medical products must be safe to use and not degrade operational performance. In cases where adverse effects are known or possible, a decision must be made—and a risk accepted—of the potential effects of a medical product versus the catastrophic effects of NBC weapons. Even in those cases where efficacy could not be studied in human clinical trials, the safety profiles of the products are well delineated. In many cases, the safety is well understood because the medical products have been widely used to treat other medical conditions.

* Available at http://www.fda.gov/cber/rules.htm

While there are efforts to reduce reliance on animals as subjects of research (see Section 2.7.3.), the use of animal models remains a critical aspect in the development of some medical products. One of the challenges in the development of some medical products is a continuing and growing lack of availability of specific non-human primates, frequently used and the animal model of choice in many definitive efficacy studies of vaccines and therapeutics. DoD is currently investigating the total non-human primate requirements, and identifying alternative models, including non-human primates other than those in short supply, other animal models, and non-animal models (*e.g.*, cell cultures). This investigation is intended to preclude potential resource limitations from slowing the development of medical NBC defense products.

2.7.3 Reducing Reliance on the Use of Animals as Subjects of Research

In accordance with the FY95 National Defense Authorization Act, which directed DoD to establish aggressive programs to reduce, refine, or replace the use of animals in research, the JMCBRDRP utilizes and develops technologies that will reduce reliance on animal research. When possible, the research programs employ computerized molecular modeling, computer predictions, *in vitro* cell cultures, a cell-free reaction system, an *in vitro* model of human skin, and a lipid bilayer system to replace the use of animals. Statisticians evaluate all research proposals that use animals to ensure that the minimum number of animals required to obtain scientific validity are used. Animals lower on the phylogenetic scale (or the least sentient species) are used if the selection will permit attainment of the scientific objective. Additionally, a veterinarian with expertise in laboratory animal medicine reviews all procedures that might cause pain or distress in laboratory animals to determine the procedural modifications, analgesics and/or anesthetic regimens that could be incorporated to minimize pain or distress. Detailed protocols are comprehensively reviewed and approved by an Institutional Animal Care and Use Committee before experiments are initiated; the small percentage of protocols which specify the use of non-human primates undergo further scrutiny by the U.S. Army Medical Research and Materiel Command (USAMRMC) Animal Use Review Office. Policies and procedures of the Association for the Assessment and Accreditation of Laboratory Animal Care – International are rigorously enforced and followed. DoD policy requires that animal use be conducted in full compliance with the Animal Welfare Act and that animals are to be used in research only when scientifically acceptable alternatives are not available.

2.7.4 Joint Medical Chemical Defense Research Program

The mission of the Joint Medical Chemical Defense Research Program (JMCDRP) is preserve the health, safety, and combat effectiveness of warfighters by timely provision of medical countermeasures in response to joint service chemical warfare defense requirements.

2.7.4.1 Goals. The goals of the JMCDRP are the following:

- Maintain technological capability to meet present requirements and counter future threats:
  - Determine sites, mechanisms of action and effects of exposure to CWAs.
  - Exploit neuroscience technology and dermal pathophysiology to identify mechanism of action of CWAs.
  - Identify sites and biochemical mechanisms of action of medical countermeasures.

- Exploit molecular biology and biotechnology to develop new approaches for medical countermeasures.
- Exploit molecular modeling and quantitative structure-activity relationships supporting drug discovery and design.

- Provide individual-level prevention and protection to preserve fighting strength:
  - Develop improved prophylaxes, pretreatments, antidotes, and therapeutic countermeasures.
  - Develop skin protectants and decontaminants.
  - Identify factors that influence safety and efficacy properties of candidate countermeasures.
  - Develop and maintain preformulation, formulation, and radiolabeling capabilities.
- Provide medical management of chemical casualties to enhance survival and expedite and maximize return to duty:
  - Develop concepts and recommend therapeutic regimens and procedures for the management of chemical casualties.
  - Develop diagnostic and prognostic indicators for chemical casualties.
  - Develop safe and effective wound decontamination formulations and procedures.

2.7.4.2 Objectives. The objectives of the JMCDRP differ with the varying threats:

- For vesicant (or blister) agents, the objective is to develop a pathophysiological database on vesicant chemical agents and a working hypothesis on how damage occurs at the cellular level. Used with associated technologies, this approach will enable the formulation of definitive pretreatment and treatment strategies, and is expected to produce a realistic concept for medical prophylaxis, immediate post-exposure therapy, and topical protection. Alternatively, in dealing with liquid agent threat, active topical skin protectants (aTSPs) are being developed that will improve protection by enhancing barrier properties and will detoxify any CW agent that penetrates the protective barrier.
- For nerve agents, one objective is the fielding of a safe and effective improved anticonvulsant. The advanced anticonvulsant will be more water soluble, will terminate seizures more quickly, will reduce the likelihood of seizure recurrence, and will prevent seizure-induced brain damage and subsequent behavioral incapacitation. Another objective is to field an advanced pretreatment effective against all nerve agents based on physiological scavengers such as the human enzymes butyrylcholinesterase (BuChE) or carboxylesterase (CaE). Ideally the prophylaxis would not require any follow-on treatment, and would have no adverse side effects. These naturally occurring enzymes, as well as acetylcholinesterase, are targets for nerve agents. Through bioengineering efforts, human BuChE and CaE have been mutated to forms that are not only less susceptible to inhibition by the nerve agents, but have the added capability to catalyze nerve agent breakdown. Another potential chemical warfare agent scavenger is human paraoxonase. This enzyme also is being bioengineered to make it more effective and decrease the time it takes to destroy nerve agent.

- For blood agents, the objective is to identify safe and effective pretreatments for protection from cyanide exposure.
- For respiratory agents, the objective is to develop prophylaxes and therapies by understanding pathophysiological changes after agent exposure.

2.7.4.3 Threats, Countermeasures, Technical Barriers, and Accomplishments

The chemical warfare threats and countermeasures, as well as chemical defense research and development technical barriers and accomplishments, are outlined in Annex E (Section E.1). Countermeasures and diagnostic techniques for the effects of chemical weapons are shown in **Table 2-11**. Critical issues in medical chemical defense include the ability to protect U.S. warfighters from the very rapidly acting nerve agents and persistent vesicating agents as well as choking agents and respiratory agents. New threats are also emerging. The effectiveness of current countermeasures against Fourth Generation Agents is currently being investigated.

Table 2-11. Medical Chemical Defense Countermeasures and Diagnostic Techniques

- ***Chemical Warfare Agent (CWA) Scavengers*** – Human enzymes that have been engineered to destroy nerve agents are being developed as nerve agent scavengers.
- ***Advanced Anticonvulsant*** – Benzodiazepines that are water soluble and long acting are being evaluated for improved control of nerve agent-induced seizure activity.
- ***Active Topical Skin Protectant – Development of topical creams that contain reactive moieties that can neutralize CWA as well as act as barriers to skin contact with CWA.***
- ***Antivesicants*** – Countermeasures that provide reduction in mustard-induced blister formation, corneal opacity, dermal histopathology; and systemic effects are being evaluated.
- ***Laser debridement of vesicant burn injuries*** - Techniques and methodologies using laser technology to accelerate recovery from sulfur mustard injury are being developed.
- ***Effects of exposure to non-lethal levels of CWA*** – The probability and severity of medical effects of single and multiple low-level exposures to CWA are being evaluated.
- ***Fourth Generation Agents*** – Current medical regimens used for protection against the conventional nerve agents are being evaluated as countermeasures for Fourth Generation Agents.
- ***Cyanide Countermeasures*** – Potential pretreatment compounds (*e.g.*, methemoglobin formers and sulfide donors) and regimen are being evaluated for safety and efficacy as pretreatments.
- *Nerve agent antidotes* – New nerve agent antidote compounds that are water soluble, have a broader spectrum of efficacy, and are more effective than current antidote compounds.
- ***Chemical Casualty Management*** - Technologies to assist in the diagnosis, prognosis, and management of chemical casualties are being developed.
- ***Respiratory Agent Injury*** – Mechanisms of respiratory agent injury are being determined and medical countermeasures for respiratory agent casualties are being developed.

2.7.5 Joint Medical Biological Defense Research Program

The mission of the Joint Medical Biological Defense Research Program (JMBDRP) is to develop medical countermeasures to protect U.S. forces and thereby deter, constrain, and defeat the use of biological agents against them (DoD Directive 5160.5, May 1985). The program is directed against agents of biological origin that are validated military threats. The primary concern is the

development of vaccines, therapeutic drugs and treatment regimens, and diagnostic tools, and other medical products that are effective against agents of biological origin.

2.7.5.1 Goals. Goals of the JMBDRP include the following:

- Protecting U.S. forces warfighting capability during a biological attack.
- Reducing vulnerability to validated and emerging threats by maintaining a strong technology base.
- Providing consultation medical management of BW casualties.

2.7.5.2 Objectives. In accomplishing the goals of the JMBDRP, efforts are focused on three objectives:

- Maintaining technological capability to meet present requirements and counter future threats:
  - Determine sites, mechanisms of action, and effects of exposure to biological warfare agents with emphasis on exploitation of molecular science.
  - Identify sites and biochemical mechanisms of action of medical countermeasures.
  - Exploit genomics, proteomics, and bioinformatics to greatly expand the knowledge base necessary for advancing research leading to next generation medical countermeasures against "traditional" biological threats and genetically modified threats
  - Exploit molecular biology and biotechnology to develop new approaches for medical countermeasures.
  - Exploit molecular modeling and quantitative structure-activity relationships supporting drug and vaccine discovery and design.
- Providing individual-level prevention and protection to preserve fighting strength:
  - Develop improved vaccines, pretreatments, antidotes, and therapeutic countermeasures.
  - Identify factors that influence safety and efficacy properties of candidate countermeasures.
- Providing training in medical management of biological casualties to enhance survival and expedite and maximize return to duty:
  - Develop concepts and recommend therapeutic regimens and procedures for the management of biological casualties.

The JMBDRP responds to requirements from the DoD as identified in the Joint Service Agreement on Biological Defense, the Joint Warfighting Science and Technology Plan, the Defense Technology Area Plan, the Defense S&T Strategy, and DoD Directive 6205.3, "Biological Defense Immunization Program."

Highly sophisticated technology base efforts for medical biological defense hold the promise of yielding important new products and technologies to protect U.S. forces against a wide range of biological threat agents. These products include multi-agent vaccine delivery capabilities/systems that will reduce costs of vaccine production and simplify immunization schedules, and a common diagnostic

system that can be deployed at forward sites to rapidly analyze clinical samples for the indications of biological warfare agents as well as infectious diseases of military importance. The development of these products, as well as the complementary technology-based research and development to enhance and expand these capabilities and to identify and develop new capabilities, is also being supported by collaboration with other agencies, including the Defense Advanced Research Projects Agency (DARPA) and the Department of Energy (DOE).

Projects and technologies shared with the DOE are related to the strengths of DOE laboratories in developing advanced technologies in order to enable rapid detection of and response to a chemical or biological incident. While DOE focuses internal technology development efforts on the domestic threat, they actively support the DoD. The work spans DNA sequencing and biodetection to modeling and simulation, collaborating on projects such as x-ray crystallography and nuclear magnetic resonance imaging of BW agent antigens. The DNA sequencing efforts have led to advances in developing "lab on a chip" diagnostic technology for several BW threat agents. DOE is not involved in protection and treatment of personnel, but they are assisting DoD with drug/chemical database searches with the intent of identifying novel inhibitors of pathogens.

Since FY00, there has been an ongoing effort to transition medical research efforts in from the DARPA program to the Medical Biological Defense Research Program (MBDRP) technology base for exploitation and further development. The overall goal is development of the most promising medical technologies to a level of technology readiness that supports transition out of technology base and into advanced development. In FY00 and FY01 technology base reviews of DARPA-funded programs in Biological Warfare Defense led to selection of several DARPA research efforts in the Unconventional Pathogen Countermeasures and Advanced Medical Diagnostics programs for transition to the MBDRP technology base. The selected programs include:

- The development of broad-spectrum vaccines by molecular breeding (gene shuffling) strategies based on demonstrated success in a hepatitis B surface antigen model. This effort focuses on development of vaccines with broad cross-protection for the alphaviruses (equine encephalitis viruses).
- Broad-spectrum antimicrobial drug discovery efforts. This research effort involves the development of nucleic acid-binding compounds, which focus on highly conserved adenine-thymine rich structures in pathogens. The program focuses on therapeutics for virus threats and antibacterial targets.
- High-level plant-based expression system for vaccine antigens and epithelial transport molecules (secretory IgA) for biological threat agents. Complete human antibodies produced in plant materials (plantibodies) demonstrated neutralization against a viral target (herpes simplex virus). The focus of the effort is to utilize this technology to develop vaccines against biological threats. The technology has the potential for significantly reducing vaccine production costs by using transformed monocot (grain) tissues versus more expensive current production methods.
- The development of a proprietary B-cell sensing technology for rapid and sensitive medical diagnostics for biological threat agents and endemic diseases. The technology will be broadly applicable to clinical lab, point-of-care, field screening, and confirmatory samples from bioaerosol detectors.

- Development of *in vivo* countermeasures against biological toxin threats of the superantigen family, exemplified by staphylococcal enterotoxin B (SEB), using a peptide or peptidomimetic antagonist.

The DARPA BW defense program also funds efforts that complement MBDRP a core research program effort, DTO CB.25 Multi-agent Vaccines for Biological Threats. This DTO effort evaluates new platforms to enhance delivery and effectiveness of multi-agent vaccines. Multi-agent vaccines are similar to the measles-mumps-rubella vaccine administered to children, though the technologies being explored for producing these new vaccines are more advanced—relying on bioengineering technologies such as naked DNA and the replicon-based delivery systems. The multi-agent vaccine DTO research effort on both the naked DNA and replicon approaches is advancing rapidly with demonstration of proof-of-principle in a higher animal model of a multi-agent vaccine planned for FY03.

Bioengineering techniques are also being used to prepare a variety of recombinant vaccines against single threat agents that will be produced without the need to grow the actual threat agent during the vaccine production process. Several recombinant vaccines are scheduled for transition out of the technical base to advanced development and ultimately FDA licensure over the next ten years.

Development of a common diagnostic system is proceeding with the adoption of rapid nucleic acid analysis methods. In FY01, the research focused on three configurations of portable instruments using common polymerase chain reaction (PCR) chemistries. These have demonstrated the capability for rapidly identifying panels of biological warfare agents and naturally occurring infectious diseases. The Common Diagnostic Systems Defense Technology Objective (DTO) obtained a Milestone A decision at the beginning of FY02 and transitioned to Concept Exploration. With these tools, laboratory-based identification of infections will be made much faster (less than 30 minutes) and farther forward than is now possible.

The JMBDRP includes the following areas of research:

Pre-exposure Countermeasures: This area involves prophylactic measures undertaken to prevent illness and injury associated with exposure to bacterial, viral, and toxin threat agents. The primary focus of pre-exposure therapy is the production of effective vaccines. The roles of various factors in stimulating cellular and humoral immunity are determined through study of specific genes or properties of threat agents. This knowledge provides tools for development of second-generation recombinant or multi-agent vaccine candidates as well as pretreatment therapies, such as the use of immunomodulators, to intervene in the pathogenic effects of threat agents.

Post-exposure Countermeasures: Research efforts in this area are focused on developing safe, effective prophylaxes and treatments to alleviate disease or injury associated with exposure to bacterial, viral, or toxin threat agents. Therapeutic measures may involve administration of antimicrobials, antivirals, antitoxins or generic compounds formulated to intervene at the pathogen's site of action. The knowledge necessary to develop such products requires in-depth research in the basic pathogenesis and physiology of the BW agents. These analyses will afford researchers tools to create a universal approach in treating post-exposure casualties of a BW attack.

Diagnostics: Diagnostics research involves the investigation and evaluation of sensitive and specific methods for detection of infectious organisms, toxins, antigens and antibodies in biological materials to include the application of nucleic acid probes or synthetic antigens. Rapid identification tests and diagnostic methods for the identification of bacteria, viruses, and toxins or their antigens as well as their metabolites, and analogs in clinical specimens are major goals of this program area. Research is also being directed toward an understanding of host gene expression patterns and changes in the patterns shortly after exposure to biological agents that may provide very early markers of exposure before the sign and symptoms of infection are evident.

2.7.5.3 Threats, Countermeasures, Technical Barriers, and Accomplishments. A biological threat agent is defined as an intentionally disseminated living microorganism or toxin that can cause disease or death in humans, animals, or plants. Threat agents include a broad range of microorganisms (bacteria, rickettsiae, and viruses) and toxins of biological origin. Biological weapons are easy to make, difficult to detect, and can be very effective. Defense against this class of weapon is difficult, particularly when biological agents can produce casualties over an area of thousands of square kilometers. Biological agents could also be used with devastating effect in combination with nuclear, chemical, or conventional weapons.

Countermeasures and diagnostic techniques for biological threat agents are shown in **Table 2-12**. Details of the BW threats and countermeasures, as well as biological defense research and development technical barriers and accomplishments, are presented in Annex E (Section E.2).Critical elements of medical biological defense include the ability to protect U.S. forces from BW agents, to rapidly diagnose (in clinical specimens) infection or intoxication from agents, and to treat casualties. Currently, the most effective countermeasure is pre-deployment active immunization. Future threats, however, may involve genetically engineered biological weapons that may be easily produced, highly lethal, difficult to detect, and resistant to conventional therapies. An enemy's ability to produce genetically engineered threats on demand also exacerbates the long-lead time between research for a medical solution and obtaining FDA licensure for the medical product.

The current JMBDRP includes the following research areas for the development of medical countermeasures:

- Characterize the biochemistry, molecular biology, physiology, and morphology of BW threat agents.
- Investigate the pathogenesis and immunology of the disease.
- Determine the mechanism of action of the threat agent in animal model systems.
- Select antigen(s) for candidate vaccines.
- Develop and compare potential vaccine candidates and characterize their effects in animal models.
- Develop surrogate markers of efficacy.
- Establish safety and efficacy data for candidate vaccines.
- Develop medical diagnostics to include far forward, confirmatory, and reference labs.
- Develop chemo/immunotherapeutic agents and preparations.

Technical shortcomings in the private sector include (1) the lack of high-level biological containment (BL-3 and BL-4) laboratory facilities to support biological defense research, (2) lack of

widespread scientific expertise in biological defense, and (3) a continuing and growing lack of availability of Indian Rhesus macaques, frequently used and the animal model of choice in many definitive efficacy studies of vaccines and therapeutics. These factors restrict the depth of expertise, facilities, and support available. A recent redress of funds and authorizations over a six year period (FY02–07) will be used for DoD facility upgrades and to enhance scientific and technological expertise.

Table 2-12. Medical Biological Defense Countermeasures and Diagnostic Techniques

VACCINES

- *Killed* – killed or inactivated microorganism that is incapable of replicating but stimulates immunity.
- *Live, attenuated* – live organism, selected not to cause disease but able to stimulate immunity.
- *Toxoid* – toxin protein treated to inactivate its toxicity but retains its ability to stimulate immunity.
- *Recombinant* – gene coding for a protein that stimulates specific immunity to a BW agent is inserted into biological vector for production. Protein may be produced in high yields through bioengineering.
- *Deoxyribonucleic Acid (DNA)* – section of DNA that codes for protein that stimulates specific immunity to a BW agent. DNA produces the desired protein in recipient that stimulates immunity.
- *Polyvalent/Multivalent/Multiagent* – mixture of antigens or vaccine constructs that protect against a number of different BW agents.
- *Vectored* – carrier organism bioengineered to confer immunity against a biological agent or multiple agents.
- *Replicon* – A vectored system in which portions of pathogen genes are combined with a portion of viral DNA and introduced into cells by the normal viral infectious mechanism. A replicon replicates a single time, after which it is eliminated, and elicit a protective immune response without causing disease.

ANTIBODY (ANTISERUM, ANTITOXIN)

- *Heterologous* – antibodies collected from animals (*i.e.*, different species than the recipient) repeatedly immunized against the BW threat. These antibodies must be treated to reduce the human immune response to them (serum sickness).
- *Homologous* – antibodies of human origin (*i.e.*, same species as the recipient) that provide protective immunity against the BW threat. These antibodies are not prone to stimulating serum sickness.
- *Monoclonal* – a cell culture technique for producing highly specific antibodies against a disease agent.
- *Bioengineered* – antigen binding site on the variable portion of an antibody elicited in a nonhuman system is combined with the nonvariable portion of a human antibody to produce a "humanized" antibody.

DRUGS

- *Antibiotics* – very effective against bacteria, but are ineffective against viruses and toxins.
- *Antiviral compounds* – promising drugs in development by the pharmaceutical industry are being evaluated against biological threat viruses
- *Others* – compounds that offer new possibilities for protecting against and treating exposure to BW agents (such as drugs to treat toxins or nonspecific treatments such as immunomodulators.)

DIAGNOSTIC TECHNOLOGIES

- *Immunological technologies* – These tests rely on antibodies for detecting the presence of proteins associated with the BW agent. They are easy to use, compact, rapid (minutes), and require little logistic support. This technology is currently used in out-patient clinics and doctor's offices.
- *Nucleic acid technologies* – nucleic acid tests, specifically the polymerase chain reaction (PCR), rely on segments of genes unique to BW agents to detect the presence of those agents. These tests are extremely sensitive and specific, but currently require more support to perform.
- *DNA Microarray technologies* – Often referred to as "gene chips", this technology assesses the status of thousands of genes simultaneously for changes in level of gene expression. Events that occur immediately after exposure to a biological agent may be related to changes in gene expression.

2.7.5.4 Defense Advanced Research Projects Agency (DARPA) Programs. As one of its major program areas, DARPA is pursuing the demonstration and development of new biological warfare defense capabilities. Major thrusts include real-time (environmental) sensing; medical countermeasures (developing barriers to prevent entry of pathogens into the human body and developing pathogen countermeasures to block pathogen virulence and to modulate host immune response); and Advanced Medical Diagnostics for the most virulent pathogens and their molecular mechanisms.

Medical countermeasures research includes: (1) broad spectrum therapeutics against known, biological warfare pathogens, (2) therapeutics against virulence pathways (mechanisms of disease) shared by broad classes of pathogens and (3) stimulators of innate immunity. Specific approaches include modified red blood cells to sequester and destroy pathogens, development of broad spectrum vaccines, engineering of plants to produce human vaccines and other products, identification of virulence mechanisms shared by pathogens, development of novel therapeutics targeting these mechanisms, and efficacy testing in cell cultures and animals.

Early diagnosis is key to providing effective therapy against BW agents since many of these agents cause early nonspecific flu-like symptoms. The goal of the DARPA Advanced Medical Diagnostics thrust is to develop the capability to detect the presence of infection by biological threat agents, differentiate from other significant pathogens, and identify the pathogen, even in the absence of recognizable signs and symptoms (when the pathogen numbers are low). Specific accomplishments are listed in Annex E.

2.7.6 Medical Nuclear (Radiological) Defense Research Program

The mission of the Medical Nuclear Defense Research Program (MNDRP) is to conduct research in the field of radiobiology and related matters essential to the support of DoD and the Military Services. The sole repository of defense radiobiology expertise is the Armed Forces Radiobiological Research Institute (AFRRI).

2.7.6.1 Goals. The goals of the MNDRP are the following:

- Understand the pathological consequences of radiation injury in order to guide development of pharmacological agents for mitigating injury.
- Develop medical countermeasures for acute, delayed, and chronic radiation injury.
- Develop and test prophylactic drugs to reduce the adverse health consequences of sublethal radiation exposures.
- Identify biological markers and develop rapid assay systems to assess radiation injury under field environments and enhance medical management of radiological casualties.
- Quantify and build into casualty prediction models the morbidity and mortality due to combined exposure to ionizing radiation and infectious disease or chemical agents.
- Sustain combat capability, increase survival, and minimize short- and long-term problems associated with ionizing radiation when combined with other mass casualty weapons or battlefield stressors such as traumatic injury and endemic disease.

2.7.6.2 Objectives. The primary objective of this research group is to address the major aspects of military operational requirements for dealing with radiation injuries. A nuclear threat agent is any weapon that causes detrimental medical effects by either direct external irradiation or by internal contamination with radioactive material. These agents include radiation dispersal weapons, which scatter radioactive material with conventional explosives; deliberate area contamination; destruction of a nuclear power plant; improvised nuclear devices; and traditional nuclear weapons. Operational requirements include programs in casualty management, medical radioprotectants to diminish radiation injury, medical therapeutic regimens, biodosimetry, combined NBC injury effects and its mitigation, maintenance of performance, and radiation hazards assessment.

2.7.6.3 Threats, Countermeasures, Technical Barriers, and Accomplishments. If counter-proliferation and intelligence efforts fail to deter the use of nuclear weapons, medical remediation of casualties must be available to treat the effects of weapons use. Such a device would most likely be utilized against military, economic, or a political targets (*e.g.*, an airbase, the seat of government, large population center, or commercial port city). In such scenarios, citizens outside the immediate lethal area would be exposed to the prompt radiation of the initial explosion as well as to chronic exposures resulting from the residual radioactive fallout.

If an adversary employs a nuclear weapon, the concomitant use of biological or chemical weapons should be anticipated. Radiation dispersal events could include the destruction of a nuclear reactor, intentional contamination of a battlefield with nuclear waste, or dispersal of radiological materials in a terrorist car bomb attack involving conventional explosives. Most casualties in these scenarios would suffer non-lethal doses of external irradiation. This would complicate the management of their conventional injuries and could cause internal contamination with radionucleides. Prompt effects of moderate- to high-dose radiation injury diminish the soldier's ability to fight and survive. Effective radiation countermeasures must protect the warfighter from performance decrement and simultaneously diminish lethality and the long-term health effects of radiation injury. Prophylactic and therapeutic applications of novel pharmacological agents will increase survival and diminish morbidity of individual soldiers wounded by radiation. A research program to understand molecular and cellular damage induced by radiation is needed to determine the best medical countermeasures for the newly arising radiological threats on the modern battlefield. **Table 2-13** presents an overview of countermeasures to radiological exposure and research accomplishments during FY01.

Significant progress has been made in prophylactic and therapeutic measures that will reduce mortality and morbidity in high-dose radiation environments. During the Cold War, the number of casualties resulting from the large-scale deployment of nuclear weapons would have easily overwhelmed the medical assets of NATO forces. In the current threat environment, adequate planning for medical response to a very limited nuclear attack is mandatory. While casualty numbers from a nuclear detonation will still be large, countermeasures have been developed that will significantly limit the morbidity and the secondary mortality. These modalities will be particularly important in the likely scenario of terrorist use of radiation weapons. If the attack is limited to one or, at worst, a small number of events, the ability to provide intensive, sophisticated medical and other support is highly credible because of the availability of uncompromised treatment/research centers and medical evacuation capabilities.

Details of the radiological threats and countermeasures, as well as nuclear defense research and development technical barriers and accomplishments, are presented in Annex E (Section E.3).

Table 2-13. Medical Nuclear Defense Countermeasures

PRETREATMENTS
Single agents: Injections and/or oral administration of androstene steroid, vitamin E, genistein and/or amifostine (Ethyol®) enhance survival of acutely irradiated laboratory animals.
Multidrug combinations: Enhanced survival in animal models is possible using a two-pronged strategy of pretreatments (*e.g.*, androstene steroids, amifostine, *etc*.) followed by postexposure cytokine therapy.
MEDICAL THERAPIES
Blood Forming Cell Stimulants: Granulocyte colony stimulating factor (G-CSF, Neupogen®) granulocyte-macrophage colony stimulating factor (GM-CSF, Leukine®) have been demonstrated to be highly effective in restoring the immune competence of the bone marrow and allowing survival from radiation injuries previously considered lethal. The cytokine thrombopoietin has been developed as a therapeutic agent and is undergoing further trials as a platelet-formation stimulant. Interleukin 11 (IL-11, Neumega®) has moderate thrombopoietic activity, as well as epithelial tissue repair capacity, and is currently available for human use. Keratinocyte growth factor is a promising new recombinant cytokine for treating radiation-damaged barrier epithelium, and preliminary experiments have shown its efficacy in preventing translocation of intestinal microflora in irradiated animals.
Broad Range Cellular Recovery Stimulants: Research continues into biologically stable compounds that stimulate recovery of multiple hematopoietic cell lineages.
Susceptibility to Infectious Agents and Efficacious Therapy: Research continues into assessing susceptibility and resistance to infectious agents in individuals exposed to prompt and chronic sublethal radiation doses, and developing combined-modality therapies that attack microorganisms while enhancing innate immunity. A significant reduction in mortality was shown in animal models using a clinical support protocol based on antibiotic and platelet transfusion regimens.
DIAGNOSTIC TECHNIQUES
Biodosimetry and Dose Assessment: No dose-assessment method other than individual physical dosimeters is currently available to deployed soldiers. A novel automated chromosome aberration analytical procedure based on premature chromosome condensation was developed and could be made deployable to the Echelon-3 level of medical care. Novel analytical methods and newly identified biological markers that leverage nucleic acid amplifying technologies are being developed. These will lead to a new-generation suite of biodosimetry assays that are rapid and deployable for field use point-of-care testing and provide greater diagnostic value for medical treatment decisions.
CHEMICAL AND BIOLOGICAL WARFARE CONSEQUENCES WITH RADIATION
Increased lethality of biological weapons after low level irradiation: Ongoing studies indicate even low sublethal levels of radiation will markedly increase susceptibility to infection by agents of biological warfare. Existing data suggest synergistic consequences of mustard and nerve agents under combined exposure with ionizing radiation.

2.8 JOINT BIOLOGICAL DEFENSE PROGRAM – SPECIAL REPORT ON ANTHRAX VACCINE COSTS, ACQUISITION STRATEGY, AND RELATED ISSUES

As part of the National Defense Authorization Act for Fiscal Year 2001 - Authorization Conference Report (106-945, Section 217, Joint Biological Defense Program, page 719), Congress directed the Department to submit a special report along with the Annual Report to Congress on the Chemical and Biological Defense Program. (Related activities of the Joint Medical Biological Defense Research Program are described in Section 2.7.5 of this chapter and Annex E of this report.) The conferees directed the Department to provide information on the costs incurred by, and payments made to, each contractor or other entity engaged in the production, storage, distribution, or marketing of the anthrax vaccine administered by the Department of Defense. **Table 2-14** identifies all obligations associated with the manufacture of the Anthrax Vaccine Adsorbed (AVA) as of February 27, 2002. **Table 2-15** identifies storage costs, distribution, and marketing.

Table 2-14. Obligation of Funds for Anthrax Vaccine Adsorbed ($ in millions)

System Cost Element	FY 00 & Prior	FY 01
BioPort Corporation		
Production	54.9	0
Redundancy	4.4	0
Process Validation/BLA Supplement Approval	26.8	39.3
Testing, Labeling, Shipping, & Security	7.1	1.9
Facility Renovation	3.4	0
Camber Corporation	3.0	7.7
SAIC	1.3	0
Program Management Support	0.3	0.7
Total	**101.2**	**49.6**

Table 2-15. Storage and Marketing Costs for Anthrax Vaccine Adsorbed ($ in millions)

AVIP Costs	FY99	FY00	FY01
Contract Personnel/ Support	3.5	3.2	3.3
Vaccine Distribution	0.3	0.3	0.4
Education	0.9	1.7	1.1
Program Research and Evaluation	--	2.6	2.6
VA-DoD Force Health Protection Initiative	0.6	0.6	0.5
Total	**5.4**	**8.4**	**7.9**

The acquisition of anthrax vaccine adsorbed supports the goals and objectives of protection of U.S. forces against anthrax. Total force vaccination against anthrax is being accomplished through the Anthrax Vaccine Immunization Program, as described in **Table 2-16**.

Table 2-16. Anthrax Vaccine Immunization Program (AVIP)

The AVIP web site provides a detailed account on the nature of the threat from anthrax (*Bacillus anthracis*), description of the vaccine, explanation of U.S. DoD policies regarding biological defense vaccines, U.S. DoD policies regarding the anthrax vaccine, immunization schedule, information on adverse event reporting, and other information related to the AVIP. The AVIP may be found on the internet at http://www.anthrax.mil/.

As of January 31, 2002, 2,113,155 doses of the vaccine have been administered to 526,146 persons. Also as of this date, 75,289 service members have completed the 6-shot series.

In December of 1997, the Secretary of Defense announced plans to begin vaccinating Service personnel deployed in high-threat areas (HTAs) against the BW agent anthrax. Vaccinations for troops in Southwest Asia began in March 1998. The Secretary of Defense approved the Anthrax Vaccine Immunization Program for the Total Force in May 1998. Vaccinations for troops in Korea began in August 1998. The AVIP Agency was established in September 1998 to implement and monitor the DoD policy and Services' plans. The Services' AVIP plans call for eventual vaccination of the Total Force (active and reserve components) and emergency-essential DoD civilians and contractors. The AVIP plan included three phases. Forces at highest risk are immunized first.

Phase I began in Mar 1998, vaccinating personnel assigned or deploying to high threat areas (HTAs) of Southwest Asia. Due to an unanticipated delay in release of FDA-approved vaccine, DoD slowed its implementation of the AVIP incrementally between July and November 2000 and June 2001. DoD is currently executing a modified Phase I, vaccinating only designated special mission units and personnel involved in vaccine research. Phase II will vaccinate the early deploying forces projected to deploy in support of contingency plans into the HTAs. Phase III will vaccinate the remainder of the Total Force.

BioPort received full approval of all aspects of their Biologics License Application supplement from the FDA on January 31, 2002. On the same date, FDA released three production lots of anthrax vaccine.

Following this FDA approval of BioPort's newly renovated anthrax vaccine production facility and restoration of vaccine supply, DoD will resume its phased execution program; catching up with those people who were asked to defer doses and continuing to ensure that individuals deploying to high threat areas receive the vaccine. People who deferred doses during the slow down period will resume their vaccination series where they left off; next doses are then counted from that point.

2.9 OPERATIONAL TESTING - PROJECT O49

Increased awareness of the chemical and biological (CB) threat has resulted in increased requirements for CB defense information and operationally oriented data and analysis from the Services and the Commanders in Chiefs (CINCs) of the Unified Combatant Commands. One of DoD's most valuable assets for meeting these requirements is the *Joint/CINC Operational Testing* (Project O49) program, based at the West Desert Test Center at U.S. Army Dugway Proving Ground (WDTC at DPG), Utah. Project O49 is a joint service program funded through the CB Defense Program. Objectives are to: (1) plan, conduct, evaluate and report on laboratory analyses, field tests and technical assessments in response to user requirements; (2) serve as the DoD's Joint Contact Point for CB defense test and technical data; and (3) publish and maintain the many volumes of the CB Technical Data Source Book. Project O49 recently has upgraded the West Desert Technical Information Center (WDTIC) and coordinated with the Chemical-Biological Information Analysis Center (CBIAC) to vastly improve literature search and analysis capabilities.

Following are summaries of current Project O49 operational tests:

- *Persistent Chemical Agents and Their Reactions with Surfaces* is scheduled to be conducted during 2002 at the WDTC at DPG for the U.S. Air Force (USAF). The objectives of this test are to 1) determine the evaporation rate of five different CW agents, neat and thickened, from several warfighting surfaces, 2) determine the transfer hazard of the same CW agents and mixtures from the same surfaces at various times, 3) determine a methodology for extraction of CW agent from concrete and identify various reactions of CW agents in absorbed on or into concrete, 4) determine levels of contamination of CW agents on various surfaces that will result in a contact hazard to personnel, and 5) fully characterize the soil samples used in the previous objectives as to type and world wide incidence.
- *Processing Cargo and Troops Through an Exchange Zone* will be conducted during 2002 for the Air Mobility Command. The objective of this test is to determine if clean cargo and troops can be processed through an exchange zone without hindering transload operations. Evaluations will consist of attempting to move cargo and troops through several zones without cross contamination.
- *Large Frame Aircraft Decontamination* will be conducted during June 2002. The objective of this test is to examine decontamination technologies and tactics, techniques, and procedures (TTP) to determine the most appropriate means to decontaminate large frame aircraft.
- *Operation Southern Breeze Field Test (MTMC-Cargo)* was conducted during May 2001 at Charleston Naval Weapons Station, South Carolina for the US Transportation Command, in conjunction the Military Traffic Management Command (MTMC). The test objective was to determine how covering versus not covering cargo from a Large Medium Speed Roll On, Roll Off (LMSR) Ship affected the level of contamination and the amount of time needed to decontaminate the items.
- *Operation Southern Breeze Field Test (MSC-Ship)* will be conducted during June 2002 at Charleston Naval Weapons Station, South Carolina, for the Military Sealift Command (MSC). Test objectives are to (1) evaluate the extent of internal contamination allowed by the

ventilation system of an LMSR Ship when contaminated with a simulated chemical agent, (2) evaluate the effectiveness of current decontamination procedures and the use of portable collective protection systems (M20A1s) inside crew quarters, and (3) evaluate the feasibility of wrapping equipment/cargo in a protective cover as a means of contamination avoidance and expediting port throughput.

- *Casualty Decontamination* is scheduled in FY02 to field test the Wartime Medical Decontamination Teams Concepts of Operations.

2.10 CB DEFENSE RDA PROGRAMS REQUIREMENTS ASSESSMENT

ISSUE: **DoD does not have a current approved mechanism for licensure of chemical and biological defense medical products (*i.e.*, drugs and vaccines) because legal and ethical constraints prevent adequate full testing in humans.**

SOLUTION*:* The FDA and DoD are working together to amend the Code of Federal Regulations to allow animal efficacy data to be used in lieu of large-scale human clinical efficacy trials. FDA's Center for Biologics Evaluation and Research (CBER) proposed a rule on October 5, 1999 entitled, "New Drug and Biological Products; Evidence Needed to Demonstrate Efficacy of New Drugs for Use Against Lethal or Permanently Disabling Toxic Substances When Efficacy Studies in Humans Ethically Cannot Be Conducted," and is available at www.fda.gov/cber/rules.htm. This rule is expected to be finalized in 2002. This mechanism of licensure is vital to provide military service personnel with licensed products. This rule will also establish requirements for licensure and allow the DoD to plan and conduct the appropriate studies to obtain approval for the products planned for production and licensing. Requests for approval of each medical product will be reviewed on an individual basis. In some cases, human efficacy may be determined to some degree (*e.g.*, the Topical Skin Protectant was tested against poison ivy extract in humans.) In other cases, human efficacy data will not be available.

ISSUE: **DoD lacks FDA-licensed vaccines against some BW threat agents.**

SOLUTION: DoD currently has only one licensed vaccine for biological defense protection, the Anthrax Vaccine Adsorbed. For other biological defense vaccines, DoD awarded a prime systems contract to DynPort LLC, now called Dynport Vaccine Company (DVC). This contract establishes a single integrator to develop, license, produce, and maintain a stockpile of BD vaccines for protection against BW agents. DVC is required to obtain and maintain FDA licensure for all the vaccine products developed under this contract.

The contract was awarded in November 1997 and began with the development and licensure of three vaccines: Q fever, Tularemia, and Smallpox, and the storage of the current unlicensed BD vaccine stockpile (IND products). There are options for the development and licensure of ten other BD vaccines, which are programmed for development and licensure.

In July 2001, DoD submitted to "Report on Biological Warfare Defense Vaccine Research & Development Programs." This report addresses: 1) the implications of relying on the commercial sector to meet the DoD's biological defense vaccine requirements; 2) a design for a government-owned, contractor-operated (GOCO) vaccine production facility; 3) preliminary cost estimates and schedule for the facility; 4) consultation with the Surgeon General on the utility of such a facility for the production of vaccines for the civilian sector and the impact of civilian production on meeting Armed Forces needs and facility operating costs; and 5) the impact of international vaccine requirements and the production of vaccines to meet those requirements on meeting Armed Forces needs and facility operating costs.

As part of the DoD's vaccine initiative, DoD selected an independent panel of experts to assess the DoD acquisition of vaccine production programs and report their recommendations for improvement to the Deputy Secretary of Defense. The panel prepared a report to reflect its independent opinions for consideration by DoD. This report discusses vaccine industry constraints and concludes that the size and scope of the DoD program is too large for either DoD or industry alone. It recommends the application of a combined, integrated approach by DoD and industry, coupled with better alignment with industry best practices. DoD is working with the Department of Health and Human Services and other federal agencies to develop the requirements and plans for constructing a national biological defense vaccine production facility.

ISSUE: **Anthrax vaccination currently requires a primary series, six dose regimen spaced out over the course of 18 months, with an annual booster to maintain immunity. This protocol makes it difficult to complete before deployment of forces or to ensure that mobile forces, once deployed, are administered the proper regimen.**

SOLUTION: DoD conducted a successful pilot study evaluating a dosage regime using fewer doses of Anthrax Vaccine Adsorbed. The results of this study were presented to the Food and Drug Administration (FDA) in FY99. The results have been accepted for publication in the peer-reviewed journal *Vaccine* and will appear in a 2002 issue. Congress has funded the Department of Health and Human Services effort for expanded, pivotal studies. The Centers for Disease Control and Prevention (CDC) will conduct these congressionally funded studies in a collaborative effort to study the safety and efficacy of vaccines used against biological agents. The study will address: (1) the risk factors for adverse events including differences in rates of adverse events between men and women; (2) determining immunological correlates of protection and documenting vaccine efficacy, and (3) optimizing the vaccination schedule and administration to assure efficacy while minimizing the number of doses required and the occurrence of adverse events. These studies will be conducted at five research centers: Emory University, Mayo Clinic, Baylor College of Medicine, University of Alabama-Birmingham and Walter Reed Army Institute of Research. Enrollment of 1,560 volunteers is expected by Spring 2002. Interim results are anticipated by early 2004 with the completed study in approximately 5 years from initiation.

ISSUE: **There is no currently licensed manufacturer for the smallpox vaccine.**

***SOLUTION*:** The currently licensed smallpox vaccine, made by outdated methods and last produced over 20 years ago, is in limited supply. A more modern replacement is needed. The U.S. Army has developed a candidate vaccine. Human trials of the Army vaccine are very promising. The final report from a clinical trial of the candidate vaccine administered by scarification indicates that the candidate is safe and immunogenically similar to the licensed vaccine. The candidate vaccine continues to be developed for FDA licensure. The subcontractor selected by the JVAP prime systems contractor to manufacture the new smallpox vaccine completed process definition studies, manufactured a GMP pilot lot suitable for a phase 1 clinical trial, and validated a vaccine potency assay in FY01. A phase 1 trial of the newly manufactured GMP pilot lot is planned for start up in April 2002. FDA licensure is expected in 2005. An immune globulin product (Vaccinia Immune Globulin or VIG) is required to treat adverse reactions to vaccination with the smallpox vaccine. To ensure continued availability of previously manufactured VIG, an IND was obtained for this material, thus allowing planned clinical trials to proceed. The JVAP prime systems contractor also filed the first annual report for the IND (#9141) obtained for a new VIG product for intravenous administration. The selected subcontractor has manufactured three lots of the new VIG product. A clinical trial using this material is currently undergoing data analysis and two more lots are in the process of being manufactured. This product is in clinical testing, with licensure expected in 2004. The JVAP Program Management Office is in close coordination with the Centers for Disease Control and Prevention that has contracts for the development of a separate smallpox vaccine candidate for homeland defense. Parallel development of these vaccines is judicious risk reduction since both must undergo extensive human testing. Down selections to a single vaccine is desirable.

ISSUE: **The effects on humans resulting from the exposure to low doses of chemical agents, particularly organophosphorous (nerve) agents, are not clearly understood.**

***SOLUTION*:** Beginning in FY96, DoD, in association with the Research Working Group of the Interagency Persian Gulf Veterans' Coordinating Board, dedicated $5 million to evaluate the chronic effects of low-dose level exposure to chemical agents. Studies have been underway since 1QFY97 to develop highly specific and sensitive assays, preferably forward-deployable, to detect and potentially quantify low-level exposure to chemical agents. These ongoing studies may also identify any long-lasting and toxic metabolites of chemical agents that could account for delayed and long-term health consequences. In addition, studies to look at the impact of possible genetic polymorphisms of cholinesterase enzymes upon individual response to nerve agents are underway. Additional funds have been committed and contracts are being awarded to evaluate potential chronic health complaints resulting from exposure to nerve agents. These contracts were begun 1QFY98. In May 1999, the Department of Defense submitted a report to Congress entitled *DoD Strategy to Address Low-Level Exposures to Chemical Warfare Agents (CWAs)*. This report provided a review of the policies and doctrines of the Department of Defense on chemical warfare defense. Based on this review, DoD recommended no modifications to policies and doctrine, and

stated that existing efforts were well designed to address the need, based on current scientific information.

During FY00, DoD established the Low Level Chemical Warfare Agent Working Group, which was chartered to provide advice on the research programs to understand the health effects of exposure to low-level chemical warfare agents, to prevent unnecessary duplication of research efforts, and to focus and direct scientific investigations to address operational issues. In FY01, research efforts to understand the effects of low level chemical toxicity on the human body and to develop medical countermeasures to minimize effects of low level chemical exposure the were underway at or were sponsored by USAMRMC's U.S. Army Medical Research Institute for Chemical Defense. Accomplishments are found in Annex E.

ISSUE: **An inadequate amount of agent fate data exists to support the fundamental understanding of post attack environment. Nearly all of the pertinent data was collected during a time when test programs were focused on offensive war strategies. Little attention was given to the wider spectrum of data that pertains to post attack recovery, restoration of operations, effects at non-lethal (*e.g.*, low level) exposures, and for advanced model development and validation.**

SOLUTION: The primary objective of the ongoing DTO CB.42 Environmental Fate of Agents is to provide decision-makers information to accurately predict agent persistence and the resulting hazard from chemical agent attacks. This can be achieved through lab, field and wind tunnel testing so that different variables, such as meteorological and vapor measurements can be validated. The collection of agent fate data will support the development of a validated hazard prediction model.

ISSUE: **As a result of the terrorist attacks of September 11, 2001 and the attacks with anthrax contaminated letters, there has been increased emphasis on the need to develop capabilities to prepare for future terrorist attacks, especially potentially catastrophic attacks by terrorists using biological weapons.**

SOLUTION: In the FY03 President's Budget Request for the DoD Chemical and Biological Defense Program, the President's Office of Homeland Security (OHS), established October 8, 2001 by Executive Order 13228, provided a significant addition of funds for two key initiatives—(1) Biological Counterterrorism Research Program, and (2) Biological Defense Homeland Security Support Program. These two initiatives would be implemented by the Department of Defense in support of the OHS. Funds for these initiatives are in addition to the core programs of the CBDP. Funding is included in all acquisition activities, from basic research through procurement as described below.

BIOLOGICAL COUNTERTERRORISM RESEARCH PROGRAM

This program will establish a biological terrorism threat assessment research Center for Biological Counterterrorism at the U.S. Army Medical Research and Materiel Command, Fort Detrick, Maryland. A panel of senior scientists from DoD, federal labs, academia, industry and intelligence communities will develop concept and scope of threat assessment research. The research program

will initiate competitive extramural contracts during design and construction phase. The unique facilities at Fort Detrick will support DoD and national requirements for analysis of emerging biological threats and assessment of countermeasures against those threats. The FY03 program will:

- Conduct a technology survey and identify gaps.
- Award extramural research with emphasis on identification of virulence factors, pathogenic mechanisms and structural biology.
- Establish research programs in aerobiological research, forensic genomics and certified forensic biological threat agent capability.
- Initiate planning and concept development for dedicated facility to continue effort.
- Develop Applied Microbial Threat Assessment Research to assist in the development of the Counter Terrorism Research Program and to establish a management element for the Program; develop program policy, strategic plan, short through far term investment strategies.
- Develop environmental and access control point monitoring.
- Develop enhanced medical surveillance technologies.
- Demonstrate an enhanced signatures database and conduct baseline studies.
- Develop improved biological defense data mining, fusion, and analysis architectures.
- Conduct Baseline Self Assessment (BSA), Mission Area Assessments (MAAs), and Requirements Analysis and Process Development.

BIOLOGICAL DEFENSE HOMELAND SECURITY SUPPORT PROGRAM

This program initiates comprehensive program to build a National Biological Defense System for the Office of Homeland Security (OHS). It aims to create and deploy a national, multi-component, multi-organization defense capability targeted to urban areas, other high-value assets, and special events. It seeks to provide an integrated homeland security capability to detect, mitigate and respond to biological-related incidents. Capabilities would include:

- Enhanced biological detection capabilities and the fusion of medical surveillance systems, wide-area environmental sensors, access control points and information systems.
- Deployed systems will exploit existing technology supplemented with new capabilities resulting from accelerated development.

DOD FORCE PROTECTION AND HOMELAND SECURITY INITIATIVES

In addition to the efforts supported by the Office of Homeland Security, the Chemical and Biological Defense Program plans to establish a fully-equipped DoD test-bed, an enhanced monitoring system for the National Capitol Region and an initial capability in two urban areas in order to enhance the protection of DoD assets against terrorist attacks with chemical or biological weapons Specific research and development activities in FY03 include:

- Enhanced biological detection capabilities and the fusion of medical surveillance systems, wide-area environmental sensors, access control points and information systems.
- Requirements analysis, system integration, and program support for DoD installation and urban test beds.

- Microbial forensic genomic, confirmatory analysis, and aerobiology testing and model development.
- Environmental and access control point monitoring for the integration of point, standoff, and transportable detection technologies.
- Demonstrate initial mining, fusion, and analysis module, incorporate modeling and analysis of threat transport prediction, adopt command, control, and communications infrastructure, and integrate information networking.
- DoD test bed design, environmental testing, and test bed trials.
- Initiate the integration of point-of-care diagnostics, syndromic reporting and medical surveillance mining.
- Integration of signature source term cataloging into system of system technology architecture.
- Consequence Management in support of WMD-CSTs, including: initiate the evaluation, purchase, and testing of commercial-off-the-shelf products for the Table of Distribution & Allowances (TDA) for WMD-CSTs.
- Integration, demonstration, and testing of: (1) CB collection, detection, and identification technologies, (2) reagents and antibodies for biological detection, and (3) an automated biological agent testing laboratory.
- Initiate systems engineering studies for deployment of sensors in the National Capital Region.
- Conduct Ambient Breeze Tunnel testing and characterization of system and components .
- Conduct background aerosol and indoor building flow character and testing.
- Conduct wargames/tabletop exercises for Concepts of Operations (CONOPS) development.
- In support of Consequence Management - Initiate development of a Unified Command Suite (UCS) and Mobile Analytical Laboratory (MALS) block upgrades to support WMD-CSTs.

This program also provides resources in the DoD CBDP to complete fielding and modernization of (1) WMD-Civil Support Teams, and (2) Reserve Component Reconnaissance and Decontamination Teams. Full funding includes the following in the FY03 budget:

- Type-classified protection, detection, and training equipment.
- Development and fielding of upgraded analytical platforms for the detection, identification, and characterization of CB and radiological agents used by terrorists in a civilian environment.
- Development and fielding of communication capabilities that are interoperable with other federal, state, and local agencies.
- Testing and evaluation to ensure that the systems are safe and effective.
- Program management funds to successfully execute the CBDP Consequence Management RDA program.

Another key element of the Biological Defense Homeland Security Support Program is the *Joint Service Installation Protection Project* (JSIPP). The JSIPP is a Pilot Project designed to increase CB defense capabilities at DoD Installations. The JSIPP is intended to provide a robust

CB defense capability integrated into installation force protection and anti-terrorism plans. The project will refine concepts of operations and resource requirements for expansion across DoD. The two key components of this project are the: (1) Chemical Biological Installation Protection Program, and (2) Chemical Emergency First Response Program. The project will equip nine diverse DoD Installations with:

- State of the Art Contamination Avoidance, Protection and Decontamination Equipment Packages.
- Emergency response capability for consequence management.
- Integrated Command and Control Network.
- Comprehensive training and exercise plan.

Finally, the FY03 budget includes procurement funds to support homeland security biological defense. Procurement will support the following:

- *First Responders*- procures emergency first-response capability for consequence management—supports organizing, equipping, training and conducting exercises for first responders.
- *Installation Force Protection Equipment* – procures CBD equipment packages for nine installations; buys Dry Filter Units, Joint Portal Shield bio detectors, Automated Chemical Agent Detectors, Remote Data Relays, Ruggedized Advanced Pathogen Identification Device (RAPID), Hand Held Assays and operational fielding support.
- *WMD Civil Support Teams*- procures new equipment training support, required equipment and required Operational Assessments for 32 WMD-CSTs.
- *Homeland Security Initiative*- procures a dual-use operational capability for integrated bio-surveillance, detection, and alerting in the National Capitol Region within 12 months.

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Chapter 3

Nuclear, Biological, and Chemical (NBC) Defense Logistics Status

3.1 INTRODUCTION

The overall logistical readiness of the Department of Defense's NBC defense equipment continues to improve. The Services have increased stock of most NBC defense equipment, and the overall Service requirements have decreased as a result of a smaller force. Both factors have improved the overall DoD readiness and sustainment status. Asset visibility initiatives continue to increase the ability to manage what is becoming an increasingly joint collection of NBC defense end items and consumables. A number of items continue to pose a moderate to high risk challenge due to low inventories and continued modernization efforts.

The DoD Chemical and Biological Defense Program jointly manages the research, development, and procurement of major end items of NBC defense equipment. These items are funded through defense-wide funding accounts. Consumable NBC defense items are managed by the Services and the Defense Logistics Agency (DLA) in accordance with Title X responsibilities of the Services to manage their own operations and maintenance funds. Under the provisions of Title X of the FY95 Defense Authorization Act, Service Secretaries are responsible for, and have the authority to conduct, all affairs of their respective departments including supplying, researching, developing, maintaining equipment, and training. The existence of defense-wide (rather than Service-specific) research, development, and acquisition funding accounts has ensured the joint integration of NBC defense programs. However, no defense-wide (that is, joint) operations and maintenance funding mechanism exists for the sustainment of NBC defense items, including consumables. Because of this, the *joint* NBC defense community is limited to tracking the status of the DoD NBC defense logistics readiness and sustainment program and making recommendations to correct funding shortfalls.

The Joint Service Materiel Group (JSMG) coordinates NBC defense logistics issues. The JSMG, established by the Joint Service Agreement (JSA), works to ensure a smooth transition through the phases of NBC defense equipment life cycles. It is also charged with developing and maintaining an annual Joint Service NBC Defense Logistics Support Plan (LSP). This LSP forms the basis for the analysis found later in this chapter.

This chapter reflects logistics data to support FY01 logistics needs. In September 2001, the Quadrennial Defense Review presented a new force sizing construct that supersedes the requirement for supporting two nearly simultaneous Major Theater Wars. Logistics requirements to support the new force sizing construct will be reported in the next annual report. During the past year, increased focus by all Services and DLA on NBC defense logistics has visibly improved the overall program. Readiness shortfalls have been identified and addressed to the degree that full sustainment through a one Major Theater War (MTW) scenario is reasonably assured. The ability to sustain a second nearly simultaneous MTW scenario is in question, due to current and potential critical shortfalls of specific

program areas. Contingent upon implementation of the recommendations contained in the Secretary of Defense's Quadrennial Defense Review, the Services have programmed funds to specifically address these problem areas. Additionally, the services are formulating doctrine, tactics, techniques, and procedures for domestic response to terrorist incidents involving weapons of mass destruction.

The Joint Chemical Defense Equipment Consumption Rates (JCHEMRATES) IV study was completed in November 1998. This study was sponsored by the Joint Services Coordination Committee and executed through the U.S. Army Center for Army Analyses. The goal of the JCHEMRATES study was to define parameters of future chemical warfare scenarios and determine the consumption rates for consumable chemical defense equipment. Using the current Defense Planning Guidance, the JCHEMRATES study developed consumption rates for the two MTW scenarios. Consumption rates include both medical and non-medical chemical defense items for each Service and overall DoD roll-ups for both scenarios. They include both initial issue of chemical defense equipment and sustainment through the 120-day period. These rates form an important basis for determining future Service purchases and their readiness to go to war. The final report on the JCHEMRATES IV study was published in April 1999.

The JCHEMRATES IV study's two MTW requirement is not and should not be considered a procurement target. This study did not fully consider certain factors such as air transport into theaters of conflict or Navy fleet requirements for ships at sea but not in the theater of operations. Thus, while the Services agree with the methodology and intent of the study, the Navy and Air Force disagree with some of the findings. Future iterations of this study will require further refinement prior to becoming a fully accepted planning tool. The JCHEMRATES MTW requirement does not consider peacetime training requirements, sizing requirements, full procurement to the entire active and Reserve forces, or the increasing number of peacekeeping missions in recent years. An increasing emphasis on counterterrorism, and humanitarian and peacekeeping missions worldwide is an additional drain on NBC defense supplies and has added to planning factors since these missions exceed the requirements planning figures (that is, 2 MTWs) used for acquisition planning. Therefore, the MTW requirement denotes a *minimum planning number*, which if the total DoD inventory drops below, may represent a critical shortfall for that particular item which should be immediately addressed to avoid diminishing the force's NBC defense capability. Because of this limitation in the study, the Services have identified their total Service requirements as their procurement targets, while acknowledging JCHEMRATES as a necessary step in joint service management of the NBC defense program.

To address shortcomings of JCHEMRATES studies and to include biological defense, the Joint NBC Defense Board is sponsoring a follow-on study, the *Joint Chemical Biological—Quantitative Requirements and Equipment Consumption* study. This study began in the fourth quarter of FY01 with an identification of user needs and concerns while developing the study scenarios.

The Services continue to have issues regarding the accountability and management of NBC defense item inventories. Limited asset visibility of consumable NBC defense items below the wholesale level remains a problem due to the lack of automated tracking systems at that level (the exceptions being the Air Force and a recent Marine Corps initiative). This has the full attention of the senior NBC defense managers. The Joint Total Asset Visibility (JTAV) project is progressing toward

addressing these problems in the long term, but is initially hampered by the uneven quality of inventory reporting.

The Services still procure consumable NBC defense items through multiple, separate, and distinct funding authorizations, as discussed in Section 3.6 of this chapter. Each Service addresses secondary item procurement policies independently. There continue to be shortfalls of specific NBC defense items when measured against DoD requirements of a two MTW scenario.

However, the Services have replaced several JCHEMRATES generated 2 MTW requirements with new requirements that reflect total service requirements. These requirements are generally higher than 2 MTW requirements, and cause the risks for those items to appear greater. This disparity will be eliminated with new Defense Planning Guidance and the release of the *Joint Chemical Biological—Quantitative Requirements and Equipment Consumption* (JCB-QREC) study results, which will provide a new analytical basis for updated warfighter requirements.

The process by which the Services and DLA fund and store war reserve materiel has been hampered by differing definitions, different deployment strategies, and a lack of validated requirements for jointly managed items. The Joint Service Integration Group (JSIG) was tasked in calendar year 2000 to study Service concerns with JCHEMRATES IV. Initiation of a follow-on study, the *Joint Chemical Biological—Quantitative Requirements and Equipment Consumption* study is underway and is being tailored to address these concerns and thus will create a solid foundation for providing a basis for the common planning of future requirements.

The JSMG initiated its sixth Joint Service NBC Defense Logistics Support Plan (LSP) in August 2001. This report focuses on identifying the current on-hand stores of the Services' and DLA's NBC defense equipment, and matching these numbers against the requirements generated from the final JCHEMRATES IV study. The LSP's aim is to identify the Services' readiness and sustainment capability, maintenance requirements, and industrial base issues in the area of NBC defense. The data call conducted for the FY02 LSP was used to develop the findings in this chapter.

3.2 NBC DEFENSE LOGISTICS MANAGEMENT

NBC defense logistics management remains in transition. The Joint NBC Defense Board has begun to exercise full authority in this area, and the JSMG, which reports to the Joint NBC Defense Board, has been charged with coordinating and integrating logistics readiness. The Joint NBC Defense Board has identified the need to standardize the MTW equipment requirements among the Services. They initiated a process to collect data and define requirements to ensure consistency across all planning efforts. The JSMG's role is to identify current readiness and sustainment quantities in the logistics area, with respect to the two MTW scenario outlined in the Defense Planning Guidance. Developmental NBC defense programs that will be fielded within the POM time period are addressed to identify modernization efforts that are underway.

As currently envisioned, all Services retain "starter stocks" of NBC defense equipment that will support immediate deployments and initial operations. The length of time that these stocks will last each unit depends on the respective parent Service. Air Force units deploy with 30 days of NBC defense consumables. Army divisions use a planning figure of 45 days, while Marine Corps forces and Navy shore units use 60 days as the basis for their plans. As a matter of policy, Navy ships stock 45

days or 90 days of consumable materiel based on the units mission. However, Navy ship values are notional in that they are based on peacetime demand and/or projections of wartime demand as contained in pertinent allowance documentation. For NBC defensive materiel, and particularly in the case of individual protective equipment (IPE), the days of supply represent a minimum stockage position based on current investment guidelines for such materiel. In most cases, the Services will first redistribute any available uncommitted assets to provide sustainment before sourcing elsewhere. Once these starter stocks are depleted, the military force turns to the DoD NBC defense item managers for "swing stocks," also known as "sustainment stocks."

DLA and the Army Materiel Command (AMC) are the item managers, or National Inventory Control Points (NICP), for the vast majority of NBC defense items in all four Services. They are responsible for industrial base development, acquisition, and storage of wholesale peacetime and sustainment wartime stocks. They buy (process procurement actions) and, if requested, store NBC defense materiel (swing stocks) for the Services. However, the Services must provide funding to DLA and AMC for the procurements.

Primarily Army owned sustainment stocks are stored in DLA and AMC depots although USAF, USMC, and USN may provide funds to DLA and AMC to store their sustainment stocks. All Services are responsible for individually programming and funding sustainment stocks to provide the required support to their supporting force structure. Because of a lack of visibility of NBC defense items, unclear wartime requirements (given the post-Cold War environment), scarce Operations and Maintenance funds, and low priorities given to NBC defense stocks, the current quantity of DLA and AMC NBC defense war reserves have been reduced and will not support sustainment requirements for the entire DoD force during a full two MTW scenario. These numbers are reflected in the tables of Annex F.

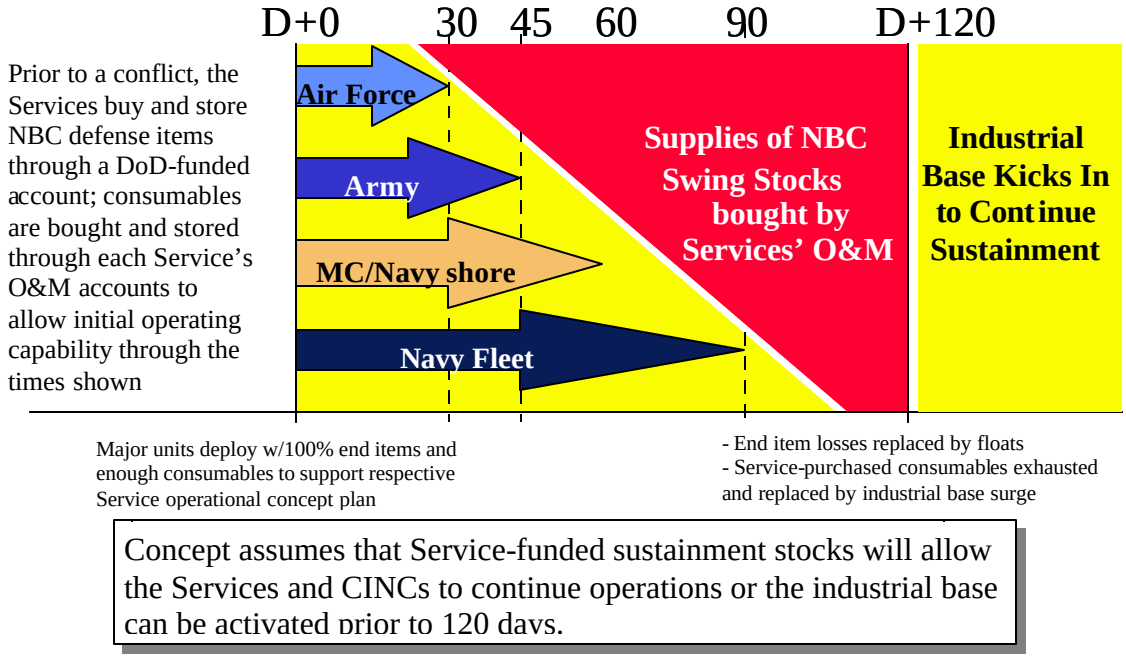

Figure 3-1. War Reserve Requirements and Planning

Service inventories of NBC defense items maintained at unit level use either manual records or a semi-automated tracking system. Stocks held at wholesale level are maintained using a separate automated system. Currently, there is little connectivity between the two systems. As a result, there is limited Service level asset visibility for NBC defense items. The Services are addressing this deficiency under the auspices of Total Asset Visibility (TAV), a long-term initiative that will link existing DoD logistics automated systems.

The Army has improved its visibility through an initiative to standardize individual issue of eleven critical NBC defense items across all major commands. Unit Status Reporting was implemented for units to report on-hand stocks *vs*. requirements on a monthly basis. In addition, plans are in place for consumable chemical defense equipment for all forces other than Force Package I and other early deploying units to be consolidated and centrally stored at Bluegrass Army Depot. This seven-year execution plan is managed by HQ AMC and will enable better visibility and rotation of NBC defense consumable items. The Air Force has a similar program that consolidates stocks of NBC defense items for deployment in support of contingency operations. These initiatives have also reduced surveillance costs and improved overall management of NBC defense stocks. The Marine Corps has been leading a joint surveillance Technical Working Group, whose initiatives have been increasing cooperative efforts in surveillance and shelf life programs. The Marine Corps has also begun an NBC stocks consolidation program and is developing an NBC Defense Equipment Management Program (DEMP) database to track the inventory, shelf life, and maintenance histories of NBC defense items.

Both DLA and AMC will remain key players in the future NBC defense logistics management system. The Joint NBC Defense Board, through the JSMG, provides coordination and integration based upon the input of all Services and Commanders-in-Chief (CINCs). DLA and AMC will continue to provide services such as raw data collection, inventory control, and a distribution infrastructure. With the results of JCHEMRATES IV, the Services and DLA can immediately begin plans to improve their readiness and sustainment status based on a common understanding of modern conflict scenario requirements.

3.3 QUANTITIES, CHARACTERISTICS, AND CAPABILITIES

The results of the data collection efforts are compiled in Tables F-1 through F-5 in Annex F, NBC Defense Logistics Readiness Data. Tables are included for each of the four Services and the Defense Logistics Agency (DLA).

3.4 LOGISTICS STATUS

During collection of FY01 data, information on the inventory status of 129 fielded NBC defense equipment items was compiled. While radiacs were not traditionally a part of this chapter, they have been retained in an effort towards continuity with other chapters and annexes of this report. NBC defense items such as spare parts and sub-components were considered a subset of the primary item for risk assessments, and were not reviewed separately. Batteries for critical systems are listed for informational purposes. Inventory tracking for batteries is difficult because of a lack of visibility and because they typically have other applications. Trainers were not included in the assessment process, since they do not reflect wartime service requirements. Quantities required for wartime needs were

then compared to quantities currently on-hand. Characteristics and capabilities of selected fielded NBC defense items are discussed in detail in Annexes A-E of this report.

Among medical consumables, sodium nitrite and sodium thiosulfate are now combined in a single Cyanide Antidote Treatment Kit. The requirements for Pyridostigmine Bromide tablets were adjusted to reflect FDA guidelines, which allows them to be administered for only 14 days, rather than 30 days. The Chemical Agent Patient Treatment Medical Equipment Set and Medical Aerosolized Nerve Agent Antidote (MANAA) Atropine Sulfate Inhalation Aerosol were added.

Beginning with the 2000 report, the two MTW requirement for consumables was adjusted to include the initial issue along with the consumption provided by JCHEMRATES. This decision was made to provide for some inventory to remain after 120 days, thus enhancing our readiness if another conflict ensues. This more closely aligns the requirements calculations with those of other commodities such as ammunition.

Two MTW Requirement for Consumables
Previous definition: equal to the greater of JCHEMRATES Initial Issue **or** Consumption
⇒ No inventory remains after 120 days

New definition: equal to JCHEMRATES Initial Issue **plus** Consumption
⇒ Some inventory remains after 120 days
Readiness for the next conflict is enhanced

Of the 129 items extensively reviewed, DoD developed risk assessments for 50 items based on data gathered as of 30 September 2001 (see **Table 3-1**). These items were singled out because of their critical role or their ability to represent the general state of their respective commodity area. While some of the items assessed changed from the previous year's report due to obsolescence, the balance of assessed items among the commodity areas remained as constant as possible to provide for continuity. These items were rated as being in a low, moderate, or high risk category. "Risk" is based on the currently available percent fill of the two MTW requirements; the lower this fill the greater the likelihood that such shortages may significantly reduce DoD's ability to respond to a contingency. Shortages for FY01 were calculated by comparing the two MTW requirements, as defined for this year, to on-hand quantities, as shown in Annex F, Tables F-1 through F-5.

RISK ASSESSMENT

Low –	Services have at least 85 percent of wartime requirement on-hand to support two nearly simultaneous major theater wars
Moderate –	Services have between 70 to 84 percent of wartime requirement on-hand to support two nearly simultaneous major theater wars
High –	Services have less than 70 percent of wartime requirement on-hand to support two nearly simultaneous major theater wars

Table 3-1 provides the results of the assessment. Programs rated as high or moderate risk are discussed in greater detail in Annex F. A seven-year comparison of data assessments is shown in **Figure 3-2**. In comparison to FY00 report data, the percentage of the FY01 report's items in the low risk category dropped from 66 percent to 62 percent. The percentage of items in moderate rose from 14 percent to 20 percent, while the percentage of items in the high risk category dropped from 20 percent to 18 percent.

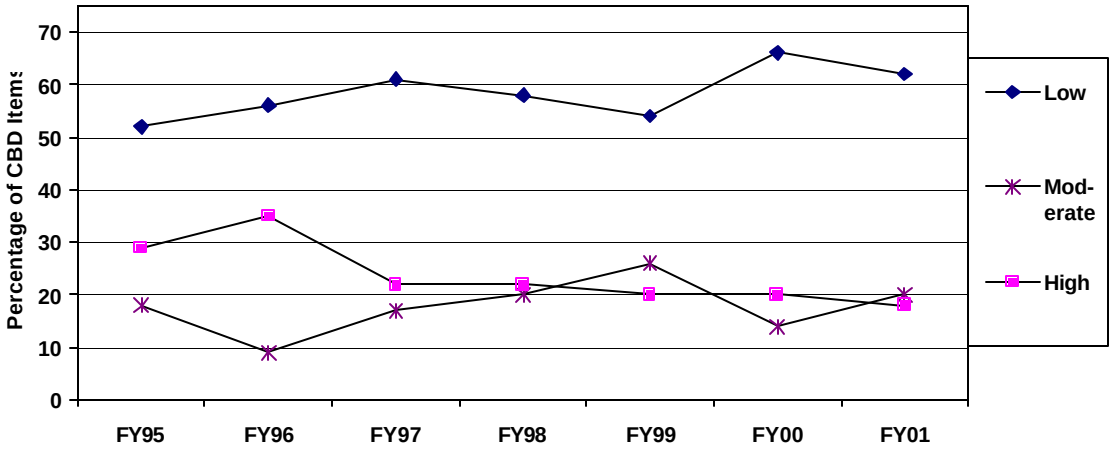

Figure 3-2. Logistic Risk Assessments: 50 NBC Defense Items

The redefinition of the two MTW requirement did not significantly affect most of the items that were assessed. Several items remain in the high to moderate risk categories while they are being fielded. These items will be monitored as continued procurement ameliorates their risk. The following items are highlighted:

- The status of M8A1 chemical agent detectors improved due to repairs while its replacement, the M22 ACADA, is being fielded.
- Collectively, 60% of the Marine Corps inventory of CAM 1.5 and CAM 2.0 have been refurbished and are currently being shipped to Marine Corps users. Funding for the remaining CAMs has been received and refurbishment action should be completed during FY02.
- Quantities of BDOs are not adequate to fill the Air Force requirement. The Air Force developed a mitigation plan in concert with procurement of the JSLIST ensembles to minimize risk. The recent plus-up of procurement funds for protective suits has aided in plans to transition to the JSLIST program. Despite the removal of quantities of BDOs from inventory because of defects the overall level of DoD War Reserve Materiel stockage of BDOs remains high, thus the immediate risk is assessed as low. Also, DLA is providing an offset to the Services, based on the value of the defective BDOs, that is being applied toward purchase of additional JSLIST suits. Other BDOs will remain in inventory until they reach maximum shelf life.
- The Air Force is relying on the CWU 66/77P to provide a protective air crew ensemble. It will replace the now obsolete Chemical Protective Undercoverall, and is assessed at moderate risk. Continued planned procurements should correct this assessment in the short term. The Joint Protective Aircrew Ensemble (JPACE), being procured in FY04, will replace this suit.
- The collective protection area continues to be assessed as high risk, in part due to the continued emphasis on contamination avoidance and individual protection, which overshadows this area. As the procurement cycle in these two latter areas matures, the risk assessment of collective protection systems will lessen slightly.
- DS2 requirements, as determined by JCHEMRATES IV, indicated a significant increase in DS2 requirements compared to JCHEMRATES III and current on-hand stocks. Because of

the magnitude of this change, DS2 is omitted from the risk assessments while the LSP Integrated Product Team considers the validity of the JCHEMRATES III requirement vice the JCHEMRATES IV calculation.

- With the expiration of M258A1 decontamination kits in FY99, the status of M291 kits becomes more critical. Present inventory and planned procurements should keep this risk low. Production of M295 kits has improved since last year to lessen their risk.
- Medical chemical defense materiel remains generally in low risk. The shortage of 2-PAM autoinjectors can be supplemented with existing supplies of atropine and Nerve Agent Antidote Kits (NAAK), reducing its risk from moderate to low. These items are gradually being replaced by the Antidote Treatment Nerve Agent Autoinjector.
- To meet JVAP requirements, the prime systems contractor (DynPort Vaccine Company) and its subcontractors have retrieved data, files, microbial stocks, and experimental lots of biological defense vaccines produced over the last 10–30 years from government laboratories and contractors in order to conduct an assessment of the suitability of these products for contingency/emergency use. A thorough and ongoing review of this information in the light of current FDA requirements for use under a contingency/ emergency use scenario has been completed. Recommended expanded testing and maintenance requirements are now being evaluated for implementation in order to make these products available for contingency/emergency use to reduce the risk of not meeting wartime requirements. This risk of not meeting wartime requirements is still high but with expanded testing and maintenance over the next year could be reduced to a low to moderate risk.

Based on the average two MTW requirements identified in the JCHEMRATES IV study as of March 1999, the Services continue to exhibit shortages in certain critical areas. Shortages of chemical and biological agent detection systems, collective protection shelters and their respective filters, and biological warfare vaccines may have a serious impact on the joint force's ability to survive and sustain combat operations under NBC warfare conditions in two nearly simultaneous MTWs. The extent of the operational impact of NBC defense equipment shortages is under review in several classified studies.

Table 3-1. Logistic Risk Assessments (as of 30 September 2001): 50 NBC Defense Items

Items	Risk Assessment	Remarks
CONTAMINATION AVOIDANCE/DETECTION EQUIPMENT		
Radiological		
AN/VDR-2 Radiac Set	Low	
AN/PDR-75 Radiac Set	Low	
AN/UDR-13 Pocket Radiac	High	Low inventory, still fielding
Biological		
Biological Integrated Detection System (BIDS)	Low	
Chemical		
M256A1 Chemical Agent Detector Kit	Low	Shelf life expiration may reduce stocks in future, but has been extended from five to six years
M8 Detection Paper	Moderate	
M8A1 Automatic Chemical Agent Alarm	Low	Being replaced by M22 ACADA
M1 Chemical Agent Monitor (CAM)/Improved CAM	High	USMC fielding in progress; 40% of USMC stock awaiting repair
Chemical Agent Point Detection System (CAPDS)	Low	
AN/KAS-1 Chemical Warfare Directional Detector	Low	
M21 Remote Sensing Chemical Agent Alarm (RSCAAL)	Low	
M22 Automatic Chemical Agent Detector/Alarm	High	Low inventory; still fielding
M93A1 NBC Reconnaissance System "Fox"	Low	
M272A1 Water Testing Kit	Low	
M274 NBC Marking Set	Low	
INDIVIDUAL PROTECTION		
Masks		
MCU-2/P-series Mask	Moderate	USAF/USN mask
M40-series General Purpose Mask	Low	USA/USMC mask
M42-series Tank Mask	Low	
M48 Apache Mask	Low	Replaces M43-series mask
MBU-19/9 Aircrew Eye/Resp. Protection (AERP)	Low	Replaces MBU-13/P; still fielding
Suits		
JSLIST protective suits*	Moderate	In process of fielding to all Services
Battle Dress Overgarment (BDO)	Low	No further production – being replaced by JSLIST
Saratoga Suit	Low	No further production – being replaced by JSLIST
CWU 66/77P	Moderate	Low inventory
Chemical Protective Undercoverall	Low	No further production - replaced by CWU 66/77P
Mark III Suit, Chemical Protection Overgarment	Moderate	No further production – being replaced by JSLIST
Aircrewman Cape	Low	
Gloves/Overboots		
Chemical Protective Gloves (7/14/25-mil)	Low	Near term DLA emergency buys lower risk
Green/Black Vinyl Overshoes (GVO/BVO)	Low	Risk low due to CPFC stocks
Chemical Protective Footwear Covers (CPFC)	Moderate	
Disposable Chemical Protective Footwear Covers	Low	Replaced by GVO/BVO

Note - Only selected Low Risk programs are displayed for information purposes.

* While the risk assessment for JSLIST suits by themselves in "moderate," it is acknowledged that the risk is higher when the entire protective ensemble (suits, gloves, boots, *etc.*) is assessed on the sum of its individual components within each Service. However, accelerated procurement of all JSLIST components in FY02 will rapidly mitigate this risk, and in the course of any military operations, the Services will take appropriate risk-reduction measures.

Table 3-1. Logistic Risk Assessments (as of 30 September 2001): 50 NBC Defense Items
(*continued*)

Items	Risk Assessment	Remarks
COLLECTIVE PROTECTION		
Chemical and Biological Protective Shelter (CBPS)	High	Limited fielding in FY02
M20A1 Simplified Collective Protective Equipment	High	Low inventory, not in production
M28 CPE HUB	High	Low inventory, still in production
M48A1 General Purpose Filter	Moderate	Low inventory
Filter For (M59, M56, Shipboard) (200 CFM)	High	Low inventory
DECONTAMINATION EQUIPMENT		
M291 Skin Decontaminating Kit	Low	Quantities cover loss of M258A1
M295 Individual Equipment Decontamination Kit	Low	
DS2, M13 Can	High	Low inventory
M11 Decontaminating Apparatus	Low	
M13 Decontaminating Apparatus, Portable	Low	
M17-series Lightweight Decontamination System (LDS) (to include the A/E32U-8 Decontamination System)	Moderate	Aging inventory partially supportable
M12A1 Power Driven Decontamination Apparatus (PDDA)	High	Repair parts only from unserviceable PDDAs
MEDICAL DEFENSE		
Mark 1 Nerve Agent Antidote Kit (NAAK)	Low	Risk lowered based on autoinjector stocks
Atropine Autoinjector	Low	
2-PAM Chloride Autoinjector	Low	
Nerve Agent Preventative Pyridostigmine (NAPP) Tablet	Low	
Convulsant Antidote Nerve Agent (CANA) Autoinjector	Low	
Biological Defense Vaccines	Moderate	Prime contract awarded for development, production, FDA licensure, and storage
Biological Warfare Agent Diagnostics	Moderate	First DoD biological diagnostic effort

Note - Only selected Low Risk programs are displayed for information purposes.

3.5 PEACETIME REQUIREMENTS

In peacetime, quantities of NBC defense equipment are necessary to train personnel in NBC defense and to build confidence among our warfighters that NBC equipment will provide the necessary protection when used correctly. The two most critical areas of peacetime stocks are individual protective equipment and medical chemical defense materiel. The Services have indicated that adequate NBC defense equipment is on-hand to conduct training.

Generally, items used in peacetime for training are drawn from wholesale stocks, requiring units to maintain both training and contingency stocks. For selected items, such as protective clothing, contingency utility is lost when the item is used (or consumed) for training. Because peacetime training requirements are met in this manner, major commands do not track training equipment in their estimates of on-hand requirements.

3.6 FUNDING

In accordance with the NBC defense management initiatives outlined in Chapter 1, funding of RDT&E and procurement was centralized in a DoD defense-wide account beginning in FY96. Operations and maintenance (O&M) funding for NBC defense materiel is not consolidated at the DoD level. Therefore, for non-major (secondary) items (*e.g.*, consumables such as decontamination kits,

detection kits, and filters), each Service continues to separately fund replenishment and sustainment of NBC defense equipment. Depot maintenance and contractor logistics support for some low density major items are also O&M funded. These appropriations are not included in the joint NBC defense program. Additionally, the Army is the only Service that currently fences funds solely for the purchase of NBC defense medical consumable items.

Funding of NBC defense items classified as war reserves secondary items (WRSI) remains a significant issue. The Services are responsible for developing the requirements and funding items in war reserve stocks. Funding of WRSI comes from Congressional appropriations made into the Working Capital Fund from the transfer of Services' O&M funds. For example, replenishment of NBC defense items in Army war reserves will require substantial funding through 2006 as some items reach their maximum extended shelf lives and require replacement. The recent plus-up of funds for protective suits is assisting in building an initial stockage and minimum sustainment (war reserve) stock to meet the current defense planning guidance.

Under current acquisition procedures and DoD guidance to minimize wholesale stockpiles, procurements are based only on funded Service requisitions. The Services remain responsible for program funding to replace NBC defense equipment wartime stocks. Procurement is usually based on economic buy quantities (a consolidation of all Service requisitions) to provide the best value to the government. Some procurements, however, suffer significant delays in delivery because of the time required to accumulate sufficient requisitions to produce economic buy quantities. This situation occurs when item managers try to plan purchases of consumable items that have a low peacetime consumption but high wartime consumption (such as decontamination kits, large collective protection filters and M256A1 detector kits). The result is a low purchasing history with a small industry production capability, which in turn causes a very low war reserve status with minimal industry surge capability. The JCHEMRATES IV study was intended to provide more accurate requirements on which the Services could base their planning.

3.7 INDUSTRIAL BASE

Since the end of the Cold War, and with a smaller DoD force, the industrial base has seen mergers and acquisitions, which have reduced the number of firms participating in defense production. The decreased number of firms has reduced competition in the sector, but the remaining firms appear to have stabilized. While the sector is stable, vulnerabilities still exist. Collective protection systems (filters in particular) continue to be the most critical subsector in the NBC defense area. Additionally, protective clothing procurement continues to receive intense scrutiny due to the possibility of industrial base shortfalls in satisfying requirements during a contingency. The limited pharmaceutical industrial base to support DoD CB defense medical programs, coupled with a lack of government vaccine production, represents a serious medical industrial base shortcoming.

Recent assessments indicate that the NBC defense industrial base sector is evolving to include firms ranging from small to large with some dedicated to producing military unique products, while others have significant commercial markets. With the growing awareness of terrorist threats, the commercial market is growing. Other companies are still dependent on Service demands and sales for their financial survival. Selected NBC defense items (JSLIST, chemical gloves, and nerve agent

autoinjectors) have been designated as critical to combat operations because of low peacetime demand, high wartime use, and the fragile supporting industrial base. As a result, DLA established, with OSD approval, a "War Stopper" program to sustain key industrial base capabilities, utilizing industrial preparedness funding under PE 07080110.

Included in the mission of the Joint Service Integrated Product Team (IPT) for the Logistic Support Plan is an assessment of the Industrial Base. This assessment is designed to assist the Services in identifying problems and issues related to production capabilities of consumable and end item Chemical and Biological Defense Equipment (CBDE). It identifies CBDE not able to fully support 2 MTW requirements due to asset shortfalls, and documents maximum production capabilities, warm and cold base, for each item. These assessments provide DoD decision-makers with accurate industrial base information and analysis.

The IPT is addressing issues from across the Services for more than 128 items/systems and spare parts critical to readiness. The IPT is conducting analyses to include industrial and technology capabilities, alternative sources of supply, and a financial and economic analysis. These analyses will provide the NBC management structure with alternatives and recommendations within the sub-sectors of NBC defense. To date, all systems were evaluated with 71 systems given in-depth analysis. Industrial preparedness measures were recommended for some of those items with others identified as having a need for re-programming to fund buy-outs that would make up the shortfalls.

3.8 NBC DEFENSE LOGISTICS SUPPORT ASSESSMENT

ISSUE: **The Department of Defense CB Defense Program has a full capability to support and sustain the first of two MTWs. Readiness shortfalls that would preclude full support of a second MTW have been identified and funded. The Services' modernization efforts and common war reserve requirements will lessen the overall risk over the near term.**

SOLUTION: The Services continue to increase their readiness and sustainment status by consolidating common stocks and increasing visibility of their wholesale stocks. In most cases, accelerated procurement of critical items into war reserves will increase readiness against the potential use of weapons of mass destruction.

During 1998, all four Services participated in the development of the JCHEMRATES IV study, which was finalized in 1999. JCHEMRATES IV provided a more accurate prediction of the initial issue and sustainment quantities required for each Service. A follow-on study, the Joint Chemical Biological – Quantitative Requirements and Equipment Consumption *is being conducted in FY02 under the auspices of the Joint NBC Defense Board.* The use of this common methodology will allow the presentation of joint service requirements in future reports and facilitate improved joint logistics management.

ISSUE: **DoD continues to lack a joint, integrated system to maintain asset visibility of NBC defense equipment below wholesale level, and lacks a standardized war reserve program for NBC defense equipment. Resourcing the procurement and sustainment of wartime stocks of consumables such as individual protective equipment, decontamination kits, and detector kits remains the responsibility of the Services.**

***SOLUTION*:** DoD established the requirement for asset visibility and reviewed existing systems and procedures, both for peacetime reporting and war time reporting. The Services and DLA are addressing the NBC defense asset visibility deficiency under the auspices of the Joint Total Asset Visibility initiative. Additionally, DLA is actively involved in a Business System Modernization (BSM) Program to replace the current legacy inventory management system by FY05. The resulting fully integrated system will interface with the individual Services. The Marine Corps have continued to improve and implement the automated NBC Defense Equipment Management Program (DEMP) which standardizes accountability by tracking inventory by NSNs, contract numbers, lot numbers, shelf lives, and related personnel data (issues, sizes, *etc.*)

ISSUE: **NBC defense industries have a limited ability to augment specific shortfalls during any future contingency, in part due to lowered DoD procurements and the inability to retain warm production lines in critical areas. Without the introduction of significant plus ups or the use of innovative business practices (such as the use of performance specifications), many of the small firms that make up this sector may choose to re-focus on the commercial market place.**

SOLUTION: DoD continues to pursue innovative strategies to maintain a responsive industrial base, especially those strategies that decrease industry reliance on DoD procurement for industrial base survival. Strategies may include tapping into independent research and development (IR&D) conducted by universities and corporations, increasing reliance on dual-use technologies, and pursuing strategies that will encourage companies to decrease dependency on DoD requirements for their survival.

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Chapter 4

Nuclear, Biological, and Chemical (NBC) Defense Readiness and Training

4.1 INTRODUCTION

The Joint NBC Defense Program builds on the successes of each Service to develop a viable Joint orientation to NBC defense capabilities, which includes Joint requirements documents; Joint doctrine and tactics, techniques, and procedures; Joint modeling, simulation, and wargaming; and Joint professional training.

4.2 NBC DEFENSE DOCTRINE

Joint Doctrine. Joint Publication 3-11, *Joint Doctrine for Operations in Nuclear, Biological, and Chemical (NBC) Environments*, 11 July 2000, provides guidelines for the planning and execution of NBC defensive operations. Its focus is on the NBC threat, national policy, and considerations peculiar to the preparation and conduct of NBC defense. These considerations include principles of theater NBC defense, logistics support, medical support, training, and readiness.

Multi-service Doctrine. The Joint Service Integration Group (JSIG) is working with the U.S. Army Chemical School (USACMLS) to lead the effort in the development of multi-service NBC defense doctrine. The JSIG is sponsoring the revision/development of a core list of multi-service NBC Defense Doctrine publications selected by the Services. This core list will provide a logical framework for NBCD multi-service tactics, techniques, and procedures (MTTP) that will integrate service's TTPs where possible and provide service unique TTPs when different. With the U.S. Army Chemical School selected as the lead service for doctrine development, two NBCD Doctrinal publications will be revised each year over a five year period. The selected core Multi-service NBCD Doctrinal list is shown below:

- MTTP for NBC Defense of Theater Fixed Sites, Ports and Airfields.
- NBC Contamination Avoidance.
- NBC Aspects of Consequence Management.
- NBC Defense Operations.
- NBC Decontamination (Restoration) MTTP.
- NBC Protection MTTP.
- Field Behavior of NBC Agents.
- Potential Military Chemical/Biological Agents and Compounds.
- NBC Vulnerability Analysis.
- MTTP for NBC Reconnaissance and Surveillance.

The FY01 effort consisted of JSIG sponsored initiatives to continue the development of NBC multi-service Doctrine. The multi-service doctrine manuals currently being revised under FY01 efforts include *NBC Protection* and *NBC Reconnaissance and Surveillance*. Multi-service doctrine manuals scheduled for revision in FY02 are *NBC Vulnerability Analysis and Potential Military Chemical/Biological Agents and Compounds.*

Multi-National Doctrine. The U.S. Army Nuclear and Chemical Agency (USANCA) has been delegated the lead DoD representative for international standardization of NBC operational matters. USANCA participates in the following North Atlantic Treaty Organization (NATO) groups:

- NBC Defense Interservice Working Party (NBCWP) under the Military Agency for Standardization,
- Land Group 7 (LG. 7)—NBC Equipment, under the NATO Army Armaments Group (NAAG),
- Working Group 2 (LG. 7)—Low Level Radiation in Military Environments,
- Challenge Subgroup (LG. 7)—Chemical/Biological Toxicity Challenge Levels,
- Technical Subgroup (LG. 7)—Nuclear Weapons Defense, and
- ATP 45 (NBCWP) NBC Warning/Reporting.
- ATP 59 (B) Doctrine for the NBC Defense of NATO Forces

USANCA also has been delegated as the representative in the American, British, Canada, Australia (ABCA) Quadripartite Alliance in the Quadripartite Working Group (QWG) for NBC Defense. In that group, USANCA also participates in the RADIAC Information Exchange Group (IEG). The USACMLS participates with USANCA to incorporate NBC group agreements in revising existing manuals.

The USACMLS has been delegated as the representative at the NATO Training Group (Joint Services Subgroup) in addition to providing representation and subject matter expertise to support USANCA at NATO/QWG meetings as required. This includes consultation to coordinate the official US position on NBC defense issues prior to international meetings.

4.2.1 Joint NBC Defense Doctrine Program Management

The NBC defense program management strategy described in Chapter 1 provides the mechanism to assist the Joint Staff in the further development of the Joint NBC defense doctrine program. The JSIG coordinates with the Services to ensure the program is realistic and meets the needs of the Joint community.

4.2.2 Joint NBC Defense Doctrine Development Program

The JSIG has implemented a program to ensure NBC/WMD is appropriately addressed in Joint doctrinal materials. Through this process, selected joint publications, either in development or in revision, are reviewed and NBC/WMD related recommendations are provided to the developers.

The U.S. Army Medical Department Center and School (USAMEDDC&S) is the lead agency for the revision of Joint Publication 4-02, *Doctrine for Health Service in Joint Operations*.

The publication was approved 30 July 2001. The revision contains additional information on the medical aspects of NBC defense.

The Air Force was tasked by the Joint Staff to draft Joint Pub 3-40, *Joint Doctrine for Counterproliferation Operations*. Once published, the document will set forth the principles to plan for and conduct military activities of counterproliferation operations. One of the key activities of counterproliferation is passive defense. JP 3-40 will complement joint doctrine promulgated in JP 3-11, *Joint Doctrine for Operations in NBC Environments*, 11 July 2000.

4.2.3 Army Medical Doctrine Development Program

Multi-Service Doctrine. The FY01 effort consisted of initiatives to develop new Army Medical Department (AMEDD) NBC defense doctrine products, provide AMEDD input to other service NBC doctrine publications, and provide input to multinational medical NBC procedures. FM 4-02.283 (NTRP 4-02.21; AFMAN 44-161(I); MCRP 4-11.1B) *Treatment of Nuclear Warfare Casualties and Low-Level Radiation Exposure* was printed and distributed in Dec 00 as a multi-service publication. FM 4-02.7 (FM 8-10-7), *Health Service Support in a Nuclear, Biological, and Chemical Environment* is being revised and developed as a multi-service publication. Doctrine for medical aspect of toxic industrial material (radiological biological, and chemical) will be developed and incorporated into current and new manuals as the technology allows. Available material on medical aspects of toxic industrial material will be included in the revision of FM 4-02.7.

Multi-National Doctrine. The Office of The Surgeon General, Department of the Army – Health Care Operations (OTSG, DASG-HCO) has been designated the head of Delegation for the NBC Medical Working Group for standardization of NBC medical operational matters. OTSG, DASG-HCO participates in or coordinates with the following NATO groups:

- NBC Defense Working Group
- NBC Medical Working Group—Head of Delegation
- Land Group 7 (LG.7)—Joint NBC Defense
- Working Group 2 (LG.7)—Low Level Radiation in Military Environments
- Challenge Subgroup (LG.7)—Chemical/Biological Toxicity Challenge Levels
- General Medical Working Party, Aeromedical Working Group
- Research Technology Area/Human Factors Medical Panel NBC Medical Subgroups.

The AMEDD participated in numerous NATO medical NBC procedural product reviews, resulting in several NATO Standardization Agreements (STANAGs) being updated. Further, the AMEDD participated in a QWG to develop and update additional Quadripartite Standardization Agreements (QSTAGs), which are medical NBC procedural products. STANAGs and QSTAGs are reviewed for integration of these agreements into Army-specific doctrine literature products as well as multi-service medical doctrine products for which the AMEDD is the proponent.

The USAMEDDC&S has been designated as the lead agency to revise the "NATO Emergency War Surgery Handbook." The initial draft for the revision is currently being developed. This draft is projected for completion during FY03.

4.2.4 Air Force Doctrine Program

HQ USAF/XONP has built upon AFDD 2-1.8, *Counter-Nuclear, Biological and Chemical Operations*. It has promulgated an Air Force policy directive, AFPD 10-26, *Counter-NBC Operational Preparedness*. The policy directive establishes the Air Force's program to plan, organize, train and equip personnel to survive and fight under threat or attack of NBC weapons.

Pursuant to the policy directive, the Air Force is undertaking a number of activities. It is developing measurable operational and enabling standards in order to determine the equipment, training, manpower, and resources needed to conduct and sustain counter-NBC operations. Its concept of operation (CONOP) and other procedural guidance are incorporating counter-NBC considerations, where appropriate. Military, DoD civilian, DoD dependents and contractor personnel are receiving counter-NBC training. The Air Force is also planning, programming and budgeting for counter-NBC preparedness in the areas of training, exercises, evaluations, manpower, and equipment, including medical requirements (in accordance with Title XVII of Public Law 103-160, dated 1994); and, it is improving counter-NBC preparedness in expeditionary operations to take the fight to the enemy.

In order to implement the policy directive, the Air Force is drafting pertinent instructions. AFI 10-2501, Full Spectrum Threat Response Planning Operations, will provide policy and guidance to commanders so they may confront the full spectrum of threats and provide for the protection of installation resources. AFI 10-2601, *Counter-Nuclear, Biological and Chemical (NBC) Operations*, Passive Defense will define the passive defense component of counter-NBC operations and will direct the integration of passive defense planning and operations.

The Air Force Surgeon General (HQ USAF/SGXR) has been participating with the Army in development of joint and multi-service medical doctrine and guidance (see paragraph 4.2.3 above). Medical NBC doctrine was included in AFDD 2-1.8, *Counter-Nuclear, Biological and Chemical Operations*.

4.2.5. Navy Doctrine

The Navy actively participated in all phases of Joint, Multi-service and Service-unique Chemical Biological Defense. The Navy Warfare Development Command (NWDC) serves as the lead Navy organization participating in efforts to revise and update multi-service Chemical-Biological Defense publications. Publications under current revision include NWP 3-11 *Multiservice NBC Operations*, NTTP 3-11.24 *Multiservice Tactics Techniques and Procedures for NBC Aspects of Consequence Management* and NTTP 3-11.25 *NBC Contamination Avoidance*. Updates are planned for the Navy publications NWP 3-20.31 *Surface Ship Survivability* and NSTM 470 *Shipboard BW/CW Defense and Countermeasures* to improve interoperability with the USMC during amphibious operations and to revise biological defense procedures.

The Navy Warfare Development Command participates in the following North Atlantic Treaty Organization (NATO) Groups:

- NBC Defense Interservice Working Party (NBCWP) under the Military Agency for Standardization,

- Land Group 7 (LG. 7)—NBC Equipment, under the NATO Army Armaments Group (NAAG),
- Working Group 2 (LG. 7)—Low Level Radiation in Military Environments,
- ATP 45 Panel (NBCWP) NBC Warning/Reporting,
- ATP 59 (B) Doctrine for the NBC Defense of NATO Forces.

The Surgeon General of the Navy (OPNAV 093) represents the Navy at the NATO Medical NBC-D Working Group and related medical working groups on behave of NWDC.

4.2.6 Marine Corps Doctrine

The Marine Corps is fully participating in all multi-service doctrine working groups to produce and update jointly funded multi-service NBC defense doctrinal publications. The NBC Operational Advisory Group met for one week to assess the Marine Corps' capstone doctrinal manual for NBC Defense, Marine Corps Warfighting Publication (MCWP) 3-37, Marine Air Ground Task Force NBC Defense Operations. The MCWP will be revised and updated during FY02. This revision and update will better address NBC defense tactics, techniques and procedures in amphibious operations.

In November 1998, the Deputy Secretary of Defense directed the Navy and Marine Corps to assess its ability to conduct amphibious assaults in a chemical and biological environment. The studies that were conducted resulted in the identification of several doctrinal deficiencies in this area. During November 2001, Navy and Marine Corps representatives met in Quantico to discuss current doctrinal deficiencies with respect to chemical biological defense during amphibious operations. Two Naval publications were considered for possible modification to correct these deficiencies—NWP 3-20.1, "Surface Ship Survivability," and NSTM 470, "Shipboard BW/CW Defense and Countermeasures." Any changes to current Marine Corps Doctrine will also be addressed or annotated in the revised/updated MCWP 3-37, MAGTF NBC Defense Operations.

4.2.7 United States Special Operations Command Doctrine

The United States Special Operations Command (USSOCOM) – Center for Operations, Plans and Policy (SOOP) with its components developed USSOCOM Pub 3-11, "Multi-service Techniques, and Procedures for Special Operations Forces in Nuclear, Biological, and Chemical Environments," dated 6 April 2001. This publication is multi-service designated (Army FM 3-05.105, Navy NTTP 3-11.30, Air Force AFTTP(I) 3-2.35.

This publication was prepared at the direction of the Commander in Chief, United States Special Operations Command who recognized the need to share the TTPs developed by individual components within the Special Operations Forces (SOF) community. This publication compiles existing Joint Doctrine, principles, and known Multi-Service/component TTPs for NBC defense preparedness. It establishes a single "How To" guide for use by individual SOF personnel and SOF components supporting Joint Task Force/Joint Special Operations Task Force (JTF/JSOTF) operations. It is a guide intended to enhance SOF force protection, survivability, and readiness in NBC environments.

USSOCOM is a participating member in multi-service doctrine working groups to produce and update multi-service NBC defense doctrinal publications.

4.3 STANDARDS OF PROFICIENCY AND CURRENCY

Each service establishes standards of proficiency and currency for NBC defense training. The following sections describe each Service's activities for NBC defense training.

4.3.1 Army

Army Regulation 350-41, *Training in Units*, establishes Army standards for proficiency for NBC defense training. NBC defense training is conducted at schools and in units. The USACMLS is responsible to train and sustain Chemical Corps soldiers and leaders and provide task/condition/standard limits, suggested training products, and oversight in the areas of NBC matters. Although the USACMLS is neither designated nor resourced to be the DoD Executive Agent for joint NBC defense training, it is pursuing the following initiatives to the extent available resources allow:

(1) assisting CINCs, Major Commands, and their staffs in assessing and providing reference materials regarding the NBC threat and recommending actions to reduce the NBC threat in their areas of operations;
(2) providing broad-based joint NBC defense doctrine and joint doctrine development support;
(3) introducing and upgrading instructional aids and training support material for War Colleges and Command and Staff Colleges for all Services;
(4) developing, evaluating, and fielding advanced instructional capabilities for both resident and nonresident instruction; and
(5) conducting the Joint Senior Leader Training Course – A Focus on Weapons of Mass Destruction, intended to provide leaders from all Services with an understanding of joint NBC defense operations, training, readiness, threat, doctrine, and capabilities.

Individual Training.

- At the initial training level, NBC defense tasks are taught to students wearing Mission Oriented Protective Posture (MOPP) during Basic Soldier Training and Warrant Officer Candidate Training to satisfy Initial Entry Training Requirements.
- Common core qualification is achieved from NBC tasks training during Officer (basic and career) and Warrant Officer (basic) training.
- NCOs train on leader NBC skills during their NCO development courses.
- Other Officer and NCO courses require training in NBC as a condition that effects the performance of branch specific tasks.
- At the company level most units have an NBC NCO specialist, and at the battalion or higher level most units have an NBC Officer and Senior NCO.

Unit Training.

- The Army is constantly challenged to improve its training of NBC battlefield hazards by integrating such training into unit mission training as well as individual and leader training.
- NBC Defense emphasis in the FY01 Common Task Test. The Army has taken steps to address this issue by making the task: "Maintain Your Assigned Protective Mask" an element of the Common Task Test for FY01. Soldiers will practice this task until they can meet the test standards.
- NBC collective tasks are published in Army Training Evaluation Program (ARTEP) Mission Training Plans. The highest level of NBC training recognizes NBC as a battlefield condition and units train to execute their Mission Essential Task List (METL) while under NBC conditions.

Medical Training. The Army funds medical NBC training oriented towards patient care, leader development and medical force health protection. Patient care training provides medical professionals with the clinical skills necessary to diagnose and treat individuals exposed to NBC agents. Leader development prepares Army medical unit leaders to manage NBC casualties on the battlefield. Medical force health protection training provides preventive medicine personnel with the skills necessary to support Force Health Protection Programs across the full spectrum of military operations.

Army funded medical NBC training is conducted at the U.S. Army Medical Department Center and School (AMEDDC&S), the U.S. Army Medical Research Institute of Chemical Defense (USAMRICD), the U.S. Army Medical Research Institute of Infectious Diseases (USAMRIID), the Armed Forces Radiobiology Research Institute (AFRRI) and the US Army Center for Health Promotion and Preventive Medicine (USACHPPM). Training modalities include training presented at the training commands (In-House training), training conducted at the requesting unit's site (On-Site training), and training achieved via the different types of distance learning programs (Distance Learning training).

Each training modality offers unique advantages. In-house training enables students to use laboratory and field training facilities while maximizing student-instructor interactions. On-site training, *i.e.*, courses taken "on the road" and presented at military installations worldwide, minimizes student travel costs while preserving direct student-instructor interactions. Distance learning programs minimize training costs and support increased audience sizes, but at the cost of direct student-instructor interactions. A summary of Army sponsored medical NBC training is provided in **Table 4-1**.

The AMEDDC&S trains all U.S. Army Medical Department (AMEDD) personnel and selected personnel from all three armed services, including the active, reserve and National Guard components. The primary focus of the AMEDDC&S's medical NBC training has historically been basic soldier skills, leader development, and training to preparing AMEDD leaders to meet the challenges of supporting Medical Force Health Protection Programs in the face of NBC threats.

AMEDDC&S medical NBC leader development training begins when new AMEDD officers receive 39 hours of NBC classroom instruction and 12 hours of NBC field training during their Officer Basic Course (OBC). The OBC teaches new AMEDD officers basic soldier skills and the

fundamental knowledge necessary to conduct medical operations in NBC environments, control NBC contamination in medical units, and understand the medical implication of NBC exposures. In FY01, 1649 students completed OBC.

Table 4-1. Summary of Army Medical NBC Training (FY2001)

Training Command	Type of Training	Training Method	Number of Students
AMEDDC&S	Leader Development	In House	2686
	Leader-Development	Distance Learning	388
	Force Health Protection	In House	71
USAMRICD	Patient Care	In House	361
	Patient Care	Distance Learning	4477
	Patient Care	On-Site	520
	Leader-Development	In House	331
USAMRIID	Patient Care	In House	361
	Patient Care	Distance Learning	500
	Patient Care	On-Site	520
	Leader-Development	In House	323
AFRRI	Patient Care	In House	81
	Patient Care	On-Site	408

The Army Medical Department (AMEDD) Officer Advanced Course (OAC) includes 10 hours of medical NBC correspondence courses. The foreign officers from Allied armies attending the AMEDD OAC received an additional 40 hours of Medical NBC training. In FY01, 388 students completed OAC.

Prior to promotion to the rank of staff sergeant, Army combat medics attend the AMEDDC&S Basic NCO Course (BNCOC). BNCOC incorporates classes and practical exercises in battlefield medical operations in an NBC environment, decontaminating, managing and treating contaminated casualties, and training non-medical soldiers in casualty decontamination procedures. In FY01, 578 NCOs completed the BNCOC.

USAMRICD's "Field Management of Chemical and Biological Casualties Course" (FCBC) provides detailed training in the first echelon management of chemical and biological agent casualties. This leadership development course, presented as a five-day in-house course at Aberdeen Proving Grounds, is also offered as a three-day on-site course. The FCBC's classroom discussions include: the current global threat of chemical and biological agent use, the characteristics and effects of threat agents, recognition and emergency treatment of agent exposure, principles of triage and decontamination of chemical and biological agent casualties. During FY01, USAMRICD presented the FCBC to 331 AMEDD officers and NCOs in the in-house courses.

The Principles of Preventive Medicine Course prepare future preventive medicine officers to support medical force health protection programs in NBC environments. In FY01, 71 students completed the Principles of Military Preventive Medicine Course. The Preventive Medicine Specialist Course was revised to incorporate Low Level Radiological (LLR) training. LLR training has been expanded in the Health Physics Specialists course and in training provided Army Nuclear Medical Science Officers (NMSOs) during attendance of the OBC, OAC and Principles of Preventive Medicine Courses. LLR training enables NMSOs and Health Physics Specialists, with the support of

Preventive Medicine Specialists, to provide medical force health protection to deploy forces supporting incidents involving potential radiation exposures, including Radiological Dispersal Device (RDDs) attacks or releases of radioactive materials from nuclear facilities.

Patient care training of physicians, physician assistants, and nurses is primarily accomplished by the specialized Army and DoD research laboratories. The laboratories' courses, taught by physicians and scientists from all three armed services, are presented to the medical professionals of all armed services. The courses are also generally available to non-DoD agencies and have made significant contribution to Homeland Security initiatives.

USAMRICD and USAMRIID trained 331 medical professionals with the in-house version of the "Medical Management of Chemical and Biological Casualties Course" (MCBC). Sponsored by the AMEDDC&S, the students attending the in-house MCBC divide their time between USAMRIID at Ft. Detrick, Maryland and USAMRICD at Aberdeen Proving Grounds, Maryland. The MCBC provides DoD personnel, primarily physicians, physician assistants, and nurses, with a working knowledge of the potential threat of chemical and biological weapons and the status and scope of medical defense strategies. It combines classroom instruction and field experience to establish essential skills, instill confidence, and define limitations in therapeutic modalities with each type of medical setting. The course also provides instruction on the use of specialized equipment and skills required for safe, long distance evacuation. First-hand experience in triage, decontamination, and medical operations on the integrated battlefield is stressed.

AFRRI, a DoD agency, trained 489 DoD and non-DoD students with the "Medical Effects of Ionizing Radiation" (MEIR) Course. The MEIR course, funded by the Army Office of the Surgeon General, provides up-to-date information concerning the biomedical consequences of radiation exposure, how the effects can be reduced, and the medical management of radiological casualties. The MEIR course, sponsored by the AMEDDC&S, is presented in-house at Bethesda, Maryland, on-site at US military installations worldwide, and via videotape as a distance-learning course. The course has been expanded to include non-nuclear weapon radiological hazards, such as LLR hazards, which could be encountered on the battlefield or during non-combat military operations.

The Army Office of the Surgeon General (OTSG) continued funding for USAMRIID and USAMRICD initiatives to exploit the potential of medical NBC distance learning courses. Distance learning courses, using VTC, satellite broadcasting, videotape series and computer based training programs, offers an alternative for those otherwise unable to attend training. The convenience of distance learning also enables large numbers of medical professionals to attend training.

In FY01, USAMRICD presented the interactive satellite distance learning course "Medical Response to Chemical Warfare and Terrorism". This course trained military and civilian health care professionals in the proper medical response in the event of an intentional or accidental chemical agent exposure. World-renowned experts from the U.S. Army Medical Research Institute of Chemical Defense (USAMRICD) and the Chemical Casualty Care Division (CCCD) presented this program at no charge to 4,137 participants. The program was taped and is now offered as a video tape program.

The Army Office of the Surgeon General sponsored a 5-day Medical NBC Readiness workshop at the AMEDDC&S for 32 AMEDD leaders with operational medical planning

responsibilities. The workshop increased the participants understanding of the impact of NBC threats on military operations and enabled participants to conduct Medical NBC exercises. Attendees learned to design and conduct Medical NBC exercises using the NBC Casualty Training System (NBC CTS).

The Army Office of the Surgeon General maintains the Medical NBC Online Information Server, an Internet web site at: http://www.nbc-med.org/. This searchable web site, visited over 400 times per day, presents medical NBC related news articles, case studies, congressional testimony, information papers, medical NBC references, training materials, and the schedule for related conferences and courses. Links are provided to AMEDDC&S, USAMRICD, USAMRIID, AFRRI, and other NBC related Internet sites offering training documents and software packages. Many references and documents can be downloaded directly from the OTSG site, including the Medical Management of Biological Casualties Handbook and Medical Management of Chemical Casualties Handbook

The Field Preventive Medicine and Training Divisions of USACHPPM are currently working with U.S. Army Forces Command to assist field preventive medicine units in assessment of their existing environmental sampling and analysis capabilities and provide technical training on toxic industrial material risk assessment and radiological hazard risk assessment. This training includes orientation and training on existing Table of Organization and Equipment as well as USACHPPM provided equipment and support.

The AMEDD and OTSG since 1996 have conducted a series of medical Chemical Biological Awareness Training (CBAT) seminar wargames for U.S. Pacific Command, U.S. European Command, and U.S. Central Command and two for U.S. Forces Korea. These seminars, for senior and executive level officials, were highly successful and have led to an increase in demand for this type of training. The CBAT games were a predecessor to the current series of Command and Staff Awareness Training (CSAT) seminar games programmed for FY 2000 through 2004. The purpose of these games is to provide an open forum for commanders and staffs to increase their awareness and explore contemporary issues, concepts, doctrine and policies relating to the medical aspects of chemical and biological defense. Most recent exercises include “Crimson Cross” CSAT for Third Medical Command and “Orbit Comet ‘00” CSAT for XVIII Airborne Corps & Fort Bragg. “Orbit Comet” involved Pope Air Force Base as well as the communities of Spring Lake and Fayetteville, NC. This seminar wargame considered the operational and medical implications of a terrorist WMD attack on Fort Bragg and the impact on the XVIII Airborne Corps to sustain force projection operations during the response. Subsequent CSAT seminars are currently scheduled for I Corps and III Corps.

The AMEDD and OTSG since 1996 have conducted a series of medical chemical biological exercises including Chemical Biological Awareness Training (CBAT) seminar war games for U.S. Forces in Korea, USPACOM, USEUCOM and USCENTCOM. These seminars, for senior and executive level officials, were highly successful and have led to an increase in demand for this type of training. The CBAT games were a predecessor to the current series of Command and Staff Awareness Training (CSAT) seminar games. The purpose of these games is to provide an open forum for commanders and staffs to increase their awareness and explore contemporary issues, concepts, doctrine and policies relating to the medical aspects of chemical and biological defense. The AMEDD,

besides sponsoring the exercises listed below, has participated in numerous other WMD/NBC exercises.

- "Exercise Terminal Breeze 96" - Provided an opportunity for law enforcement, health and medical, fire, environmental and emergency management agencies of Virginia, Maryland, and Washington, D.C. to work with the military community in examining plans, policies and procedures for crisis and consequence management in response to a WMD terrorist attack.
- "Chem Bio Awareness Training (CBAT) PACOM Aug 96" - U.S. assesses readiness of current forces to engage in CBD operations against North Korea and formulate reinforcement package options to enhance capabilities of in-theater forces to survive in a CB environment.
- "Exercise Coral Breeze" CBAT-Korea, Mar 97 - Assessment of impact of North Korean use of CB weapons on Us forces during deployments and Reception, Staging, Onward Movement and Integration (RSOI), conduct of non-combat evacuation operations and warfighting.
- "Exercise Azure Haze" CBAT EUCOM, Nov 97 - Provided awareness training to EUCOM, USAREUR & 7th Army, community and appropriate agencies on consequence management responses to a casualty-producing chemical substance incident on a US installation
- "Exercise Crimson Shield" Joint Medical Planners Workshop, Korea, Feb 98 - Assessed salient issues and identified actions that US and ROK commands need to consider when faced with NBC attacks during the conduct of a Major Theater War in Korea. Allowed development of action plans to improve theater medical readiness, capabilities and mitigate risks. Provided data and a conceptual framework for modifications to existing doctrine, policies, programs and OPLANs. Identify intersections between combatant commanders' and medical operations and commanders' needs and identified medical considerations for NEO in WMD environment.
- "Exercise CBAT-CENTCOM", Feb 99 - Seminar game that corresponds to OPLAN 1003-96. The scenario was a major contingency in Gulf in 99–00 requiring US and coalition deployments and health service support operations under CB conditions. Provided commanders and staffs a conceptual baseline for framing options to CB threats and attacks. Enhanced planning for operations in a CB environment and identified areas requiring further coordinated research, analysis & program development.
- "Exercise Crimson Cross", Command and Staff Awareness Training (CSAT), 3rd MEDCOM, Sep 00 - Identify HSS vertical integration problems in a theater land component with respect to: C4I; logistics; preventive medicine; patient movement and regulation; Joint connectivity and integration during a WMD event. Capture insights for Army efforts such as: continued evolution of medical organizations; doctrinal development and harmonization; and medical elements of the Army Transformation Strategy.
- "Exercise Orbit Comet", CSAT XVIII ABN Corps, Oct 00 - Exercise considered the operational and medical implications of a mass casualty incident resulting from a terrorist attack involving a chemical agent on Ft Bragg and the impact of the terrorist attack on XVIII ABN Corps' ability to sustain force projection operations during the response. The exercise also involved the local communities and the USAF. It involved WMD consequence management operations including medical and mass casualty management, antiterrorism and

force protection and maintaining the capability to deploy forces as directed by appropriate authority, during and immediately following a natural or manmade catastrophic event on Ft Bragg.

- "Exercise Urgent Response" CSAT I Corps - Medical NBC AC/RC Conference, Apr 01 - Provided the forum to improve the NBC awareness of attendees and their organizations. The exercise centered around the deployment of an I Corps Joint Task Force for Consequence Management (JTF-CM), including 2d Medical Brigade and subordinate units, deploying to Thailand to provide medical assistance in response to the use of a biological weapon (smallpox).

4.3.2 Air Force

Air Force policy is to provide initial and annual refresher training to military personnel and emergency essential civilians in or deployable to chemical-biological threat areas, especially personnel in NBC medium and high threat areas (HTAs). The Air Force standards of proficiency are based on two international standardization agreements: NATO Standardization Agreement 2150 (NATO Standards of Proficiency for NBC Defense) and Air Standardization Coordinating Committee (ASCC) Air Standard 84/8 (Initial, Continuation and Unit NBC Standards). Both agreements are currently implemented through Air Force Instruction 32-4001, *Disaster Preparedness Planning and Operations and will move to AFI 10-2501, Full Spectrum Threat Response Planning and Operations in March 2002*. The Air Force ensures proficiencies and currency of NBC warfare defense training through classroom training, unit level training, and exercises. NBC Defense Training (NBCDT) is required only for military personnel and emergency essential civilians in or deployable to NBC threat areas. Major Commands (MAJCOMs), the Air Reserve Component, and Direct Reporting Units may tailor their NBCDT programs to meet their specific mission requirements. The subjects presented in the classroom follow the three principles of NBC defense (avoidance, protection, and decontamination) as identified in Joint Pub 3-11. Unit level training follows the classroom training on wartime mission critical tasks. Supervisors train personnel to complete mission critical tasks while the workers are wearing their full complement of individual protective equipment. Exercises are used for training and evaluation purposes. NBC Defense training instructors at base level receive their professional training through Air Force Apprentice and Advanced courses at Fort Leonard Wood, Missouri.

Individual Training. There are two types of individual training. The first is general equipment and procedures training that enables personnel to recognize and protect themselves and others from NBC hazards. The second is individual proficiency training that enables personnel to perform their wartime tasks in an NBC-contaminated environment. Detailed training comes with assignment to a threat area or to a deployable unit. NBC Defense training is required for military personnel and emergency essential civilians who are in or identified as "tasked to deploy" or "identified to deploy" to a medium or high threat area, as well as any conventional threat areas. Individuals graduating from Air Force Basic Military Training will receive credit for NBC Defense Initial training. Personnel receive NBC defense training courses, as shown in **Table 4-2**. (Requirement changes per draft AFI 10-2501 are included in parenthesis)

Table 4-2. Air Force NBC Defense Individual Training

AUDIENCE[1,2]	TYPICAL INITIAL INSTRUCTION TIME	INITIAL (FREQUENCY)	REFRESHER (FREQUENCY)	REMARKS
Low threat	6 hours (8 hours)	Within 90 days of assignment to mobility positions or 90 days prior to permanent change of station (PCS) to a CB high threat area. (Within 60 days of arrival to the installation)	Annual show of competency or as directed by MAJCOM. (Within 15 months thereafter) (4 hours)	Allow extra time for quantitative fit testing (QNFT)/ confidence exercise and CCA training.
Medium threat	6 hours (8 hours)	Within 90 days of arrival (Within 30 days of arrival)	Within 90 days of arrival (Within 15 months thereafter) (4 hours)	See Note 2
High threat	6 hours (8 hours)	Within 90 days prior to PCS to high threat area. (Within 60 days prior to arrival)	Within 30 days of arrival - topics should only include theater specific procedures and QNFT. (Same as above) (Annually Thereafter)	See Note 2

1. NBC Defense Training is required for military personnel and emergency essential civilians in or deployable to chemical-biological medium and high threat areas.
2. Initial training is required if there has been a break of 36 months or more in NBC defense training.

NBC refresher training is at the discretion of the MAJCOMs, with the majority opting for annual refresher training through classroom training and exercise participation. Individual NBC proficiency training occurs through on-the-job-training and exercise participation. In addition, aircrews are required to conduct a one-time flight while wearing chemical defensive equipment.

Air Force major commands have reported significant increases over the last three years in the number of people receiving equipment and procedures training as well as the number of hours spent for that training.

Unit Training. Units in or deployable to NBC threat areas must conduct the following training:

Table 4-3. Air Force NBC Defense Unit Training

CB Threat Area	Minimum Exercise Requirements
Low	**Annually** - Conduct attack response exercise implementing the base OPlan 32-1 and other contingency plans (*i.e.*, NBC, terrorist, or conventional attack). - Conduct an attack response exercise for units' mobility commitments based upon the threat at deployment locations.
Medium	**Semiannually** - Conduct attack response exercise implementing the base OPlan 32-1, BSP, and other contingency plans (*i.e.*, NBC, terrorist, or conventional attack). One exercise may be satisfied by a tabletop exercise. - Conduct attack response exercise for unit mobility commitments based on the threat at deployment locations. One exercise can be satisfied by a tabletop exercise.
High	**Semiannually** - Conduct attack response exercises implementing the base OPlan 32-1, BSP, and other contingency plans.

Medical Training Initiatives. Following the Air Force Medical Service (AFMS) NBC Warfare Defense Training Workshop in 1998, eleven training initiatives were prepared to meet gaps in Air Force chemical and biological medical defense training. Training tools for the AFMS re-engineered unit type codes, such as: (1) Patient Decontamination Teams, (2) Chemically Hardened Air Transportable Hospital, (3) Preventive and Aerospace Medicine (PAM) team training, (4) Bioenvironmental Engineering NBC team training, (5) PACAF AFMEDPAC 2000, (6) Continuing Medical Readiness NBC training, (7) NBC CD-ROM Toolboxes, (8) ACC/ Force Protection Battle Lab Initiative – Bio Agent detection training, and (9) NBC Defense Leadership Skills training were identified for contractor development. The Army (funded by the AF) is the office of primary responsibility for the final initiatives: (10) Medical Management of Chemical Casualties,(11) Medical Management of Biological Casualties, and (12) NBC CD-ROMs. The AFMS is participating in satellite provided Medical Management of Chemical Casualties hosted by USAMRICD/USAMRIID respectively. Additionally, the NBC CD-ROMs were distributed to every AFMS medical treatment facility in FY00. The AF IERA trained four students per AEF rotation cycle on PCR based clinical pathogen diagnosis supporting the Biological Augmentation Team UTC. Care providers who have not been afforded the opportunity to attend the Army MCBC Course will receive an instructor-based course on medical management of chemical and biological casualties training at their units. Overseas locations have priority over CONUS bases for this initiative. In addition, identified medical UTC teams will receive medical reference materials developed by the US Army and civilian contractors for training.

4.3.3 Navy

Navy Chemical, Biological and Radiological Defense (CBR-D) training is conducted in two phases: individual and unit training. Individual training consists of attendance at formal school courses and completion of Basic and Advanced CBR Defense Personnel Qualification Standard (PQS) training. Navy personnel also conduct periodic unit CBR Defense training and pre-deployment unit training exercises.

Individual Training. The Navy provides initial entry-level CBR defense training to all officers and enlisted personnel in the accession programs. Enlisted personnel receive three hours of training (two hours in the classroom; one hour in the lab) focused on the use of personal protection equipment and survival skills, including a CBR-D "confidence" chamber exposure. Officers receive two hours of class time focused on personal protection equipment and survival skills.

Officer and Enlisted Personnel assigned to ship and shore billets requiring CBR-D expertise receive additional CBR-D related courses. These courses include the Disaster Preparedness Specialist Course and the CBR-D Operations and Training Specialist Course conducted at the U.S. Army Chemical School. Additional CBR-D training is covered in the Repair Party Leader Courses conducted at various Fleet Training Centers. Officers receive additional CBR-D related training at the Damage Control Assistant Course, the Shipboard Department Head Course, the Prospective Executive Officer Course, and the Prospective Commanding Officer Course held at the Surface Warfare Officer School, Newport, RI.

Navy medical providers attend the Management of Chemical and Biological Casualties Course at the U.S. Army Medical Research Institute for Chemical Defense and the U.S. Army Medical Research Institute of Infectious Diseases. The Navy Environmental Health Center (NEHC) sponsors a three-day course for providers, and a one-day familiarization/awareness course. Additionally, NEHC is actively developing a "distance-learning", CNET web-based, provider course expected to be on-line by June 2002.

After reporting to designated units, Navy personnel are required to complete basic and advanced CBR-D Personnel Qualification Standards (PQS) training. PQS is a compilation of the minimum knowledge and skills that an individual must demonstrate in order to qualify to stand watches or perform other specific duties necessary for the safety, security or proper operation of a ship, aircraft or support system. The objective of PQS is to standardize and facilitate these qualifications. Basic and Advanced level Chemical, Biological, Radiological (CBR) Defense PQS are contained in NAVEDTRA 43119-H. Basic level CBR PQS, which is required for all personnel assigned to a command, and consists of "CBRD Fundamentals-Watchstation 106" and "Basic CBR Defense-Watchstation 306." (See **Table 4-4**) Advanced level CBR PQS is required for personnel assigned to CBR teams, including Detection Teams, Decon Station Teams, Internal/External Monitoring Teams, Decontamination Teams and Team Leaders. Advanced level PQS consists of "CBR Detection Equipment Systems-Watchstation 215" and "Advanced CBR Defense Person- Watchstation 309."

Table 4-4. Navy Basic CBR Defense Standards

- Complete Chemical, Biological, Radiological Defense (CBRD) Fundamentals PQS
- Locate and transit Decontamination station/ CCA stations
- Locate Casualty Collection stations and Deep Shelter Stations
- Don and doff Chemical Protective Ensemble
- Change protective mask canister
- Use the M-291 skin decon kit
- Demonstrate self and buddy aid for nerve agent exposure
- Identify CBR markers
- Use M8 and M9 paper
- Pass through CPS air lock/pressure lock
- Decontaminate internal and external areas
- Satisfactorily perform or simulate immediate actions for the following emergencies: nuclear attack, chemical attack, biological attack, nuclear radiation exposure, chemical agent exposure, and biological agent exposure.

Unit Training. Proficiency training is conducted at the unit level by Navy instructors, who are graduates of the CBR-D Operations and Training Specialist Course conducted at the U.S. Army Chemical School. Navy units conduct Basic, Intermediate, and Advanced training exercises as part of the Inter-Deployment Training Cycle . During the Basic training phase, CBR-D training exercises may involve additional unit training by CBR-D specialists from an Afloat Training Group (ATG).

Early in the Basic training phase, a ship is required to conduct a Command Assessment of Readiness and Training (CART) which is a performance based assessment of a unit's readiness in each mission area. CART assesses material, administrative, and training proficiency. By the end of the Basic Training Phase, ships are required to be proficient in all missions areas and have demonstrated

the ability to sustain readiness through their internal training team organization. Internal CBR training is conducted by the ship's Damage Control Training Team (DCTT).

A Final Evaluated Problem (FEP) is the culmination of the Basic training phase and demonstrates the ship's ability to conduct multiple simultaneous combat missions and support functions and to survive complex casualty control situations under stressful conditions. The conduct of the FEP is dependent upon the ship's previously demonstrated proficiency and may require the ship to progress through all mission oriented protective postures (MOPP) levels as part of a chemical defense exercise. After completion of the Basic training phase, the completion of a Chemical Defense Drill is a repetitive requirement, conducted every six months.

The Intermediate and Advanced training phases consist of multi-ship and battle group training directed by a numbered fleet commander. Emphasis is placed on integrated watch section training in a fully coordinated multi-threat environment. During the intermediate and advanced phases of the training cycle, combat readiness is reinforced through Composite Training Unit Exercises (COMPTUEXs) and Fleet Exercises (FLEETEXs).

4.3.4 Marine Corps

The Marine Corps' NBC training focuses on the ability to conduct operations throughout the battlespace with particular emphasis on amphibious deployment, littoral, and air/ground operations. The Marine Corps views NBC as an environment, similar to daylight/darkness and cold/heat, yet with its own unique challenges.

Training requirements are derived from the Force Commander's Mission Essential Task Lists, Joint Universal Lessons Learned, Marine Corps Lessons Learned, Mission Need Statements, and Universal Needs Statements. Once validated, the training requirements are introduced into the Systems Approach to Training (SAT) Process. One of the results of the SAT process is the development of training tasks and standards that will fulfill the training requirements. These task lists and standards are incorporated into Individual Training Standards (ITSs) for individual Marines and Mission Performance Standards (MPS) for Marine units. These ITSs and MPSs are published as Marine Corps Orders for standardization and compliance throughout the Marine Corps. During FY02, ITSs and MPSs related to NBC defense training will be updated and begin transition to a newer, more effective Training & Readiness (T&R) Manual format. The T&R Manuals provides greater specificity in standards and will enhance commanders' abilities to determine readiness based on training accomplishments.

The Marine Corps conducts training in two categories: Individual Training based on ITSs and Collective (unit) Training based on MPSs. **Figure 4-1** shows the individual NBC training provided to all Marines.

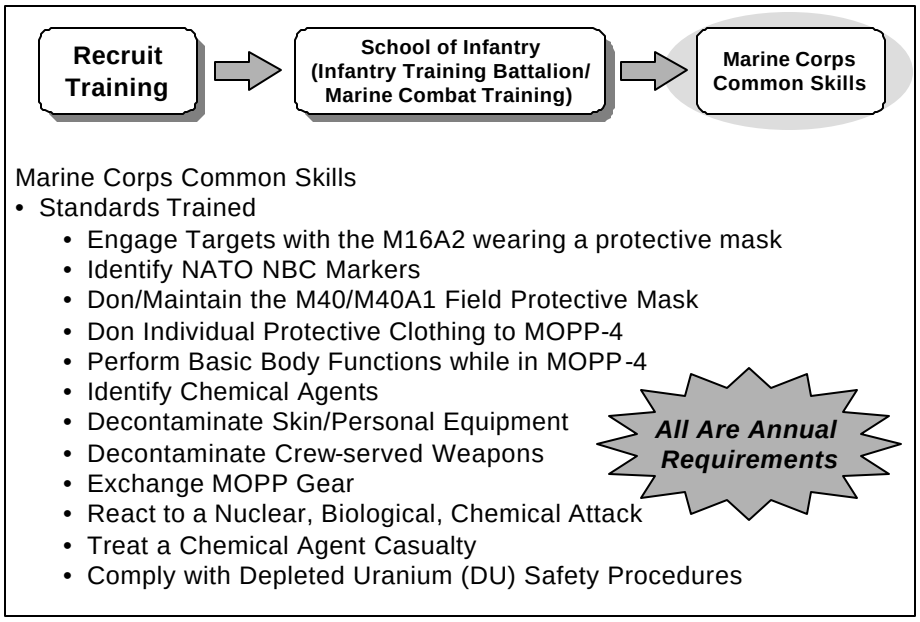

Figure 4-1. USMC Individual NBC Training

Individual Training. Marine entry-level training begins at recruit training or at Officers Candidate School (OCS) where Marines are introduced to the field protective mask and the CS chamber exercise. All enlisted Marines then proceed either to Marine Combat Training (MCT) or the School of Infantry (SOI) and, upon completion of OCS, all Officers proceed to The Basic School (TBS). The NBC portion of this training focus is surviving and functioning in an NBC environment. Training transitions from a classroom/academic environment to practical application/field environment in order to provide students more hands-on experience.

Once Marines reach their units they begin the Marine Corps Common Skills (MCCS) and Marine Battle Skills Training (MBST) program. MCCS and MBST tasks are individual training standards that all Marines are required to be proficient in and are evaluated on annually. Marine Battle Skills NBC training focuses on providing Marines with the capability to survive as well as function in an NBC environment. Senior Field grade and General Grade Officers attend the "United States Army Chemical School Joint Senior Leaders Course." These courses will round out the phases that the Marine Corps go through in the development of Marines and Leaders to operate in an NBC environment

Unit Training. Unit level (or collective) training includes classroom and field training identified in unit training exercises and plans. (See **figure 4-2**.) Many units are also required to meet specific training standards. These requirements take the form of Mission Performance Standards (MPSs) for specific types of units such as infantry, artillery or tank units. These MPSs are published in the 3500 Series of Marine Corps Orders.

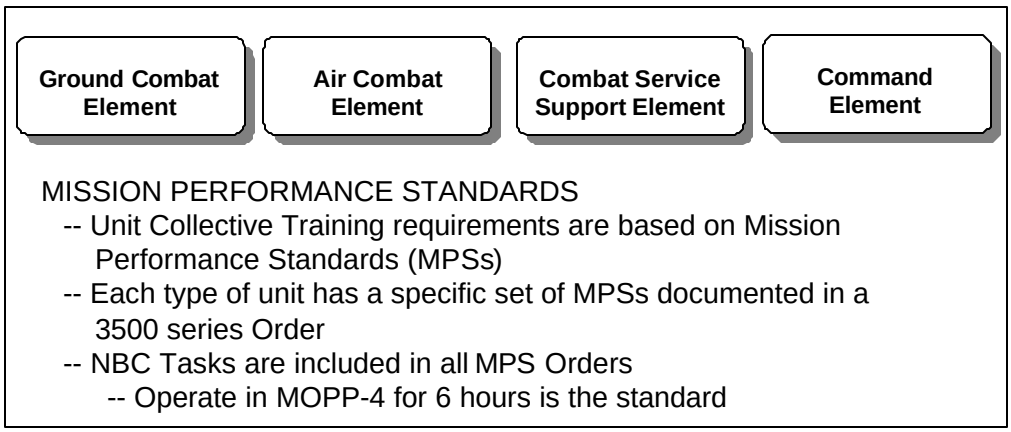

Figure 4-2. USMC Collective Training, NBC Requirements

Each MPS Order includes NBC Tasks that the unit must accomplish. However, each set of requirements varies from unit to unit. For example, a Tank Battalion must be able to utilize the vehicle's NBC filtration system, decontaminate tanks, and operate tanks under NBC conditions. An Infantry Battalion on the other hand has no requirement to decontaminate tanks, but does have to decontaminate crew served weapons. NBC training is validated through the Marine Corps' inspection program. Those units that are part of the Marine Corps' Unit Deployment Program (UDP) and designated Marine Expeditionary Units (MEUs) are required to undergo an NBC evaluation prior to deployment. Units that do not have specific NBC defense MPSs are evaluated in NBC defense as part of routine Commanding Generals' Inspection Programs, normally conducted at least biennially.

4.4 NBC DEFENSE PROFESSIONAL TRAINING

Public Law 103-160 requires all Services to conduct NBC defense professional training at the same location. Currently, all Service training, except for medical NBC courses (as described in sections 4.3.1 and 4.3.2 above), is co-located at the United States Army Chemical School. Each Service conducts their training with their own Service instructors. The experts who graduate from the Service's technical training and the Army's Chemical Defense Training Facility become instructors for their Service's unit training. The Defense Nuclear Weapons School (DNWS), as part of the Defense Threat Reduction Agency (DTRA) Albuquerque Operations Office at Kirtland AFB, New Mexico, conducts a Radiological Emergency Team Operations Course; Radiological Emergency Medical Response Course; Radiological Accident Command, Control and Coordination Course; and Weapons of Mass Destruction Command, Control, and Coordination Course.

4.4.1 Joint NBC Defense Professional Training

The JSIG has established a Joint Training Sub-panel (JTSP) comprised of designated Service training representatives to:

- Promote Joint NBC Defense training.
- Monitor Joint NBC Defense training.
- Assess Joint NBC Defense training.
- Report on assessments and recommend solutions.

- Develop Joint Training Road Map.
- Produce a Joint NBC Defense Training Development guide.
- Enhance Joint War Fighting Operations.

Information exchanges between the Services were facilitated by the JSIG and plans put in place to review future doctrine and new equipment training plans.

Joint Professional Military Education, Phases I and II, currently contains a limited degree of NBC defense considerations and requirements. It is essential that officers of all Services assigned to joint staffs understand the NBC threat, are familiar with U.S. capabilities to detect and mitigate the threat, and comprehend their staff roles and responsibilities in dealing with NBC issues. Section 4.7.1 details an ongoing JSIG initiative that addresses these shortfalls. The JSIG also sponsors the Joint Senior Leaders Course at the USACMLS. This course is targeted at leaders from all services with the intent of increasing their awareness and understanding regarding NBC defense issues.

Within the joint medical arena, the U.S. Army Medical Department sponsors the Medical Management of Chemical and Biological Casualties (MCBC) course, which provides training to DoD personnel. All Medical Nuclear Casualty Training has been consolidated under the Armed Forces Radiobiology Research Institute in Bethesda, Maryland, where radiobiology education is made available in a Tri-Service format.

4.4.2 Army NBC Defense Professional Training

- U.S. Army NBC Defense Professional Training presently takes place at Fort Leonard Wood, Missouri.
- Training consists of three enlisted/non-commissioned officer courses and two officer courses.
- At initial entry One Station Unit Training, enlisted soldiers receive training in chemical and biological agent characteristics and hazards, smoke and decontamination operations, chemical and radiological survey procedures, and individual protective clothing and equipment. This program provides 19 weeks of intensive training, culminating in live/toxic agent training in the Chemical Defense Training Facility. Toxic agent training is an integral, mandatory component of all Chemical Corps initial entry and professional courses.

Standards Trained:	**Initial Entry Training 19 Weeks**
– Radiological Survey	– Decontamination Operations
– Radiological Defense	– Smoke Operations
– Chemical and Biological Agent Characteristics and Hazards	– Individual NBC Protection
– Chemical and Biological Defense	– Chemical Defense Training Facility

Figure 4-3. U.S. Army Initial Entry Training

- Chemical Corps sergeants attend the 9 week, 3 day Chemical Basic Non-commissioned Officer Course (BNCOC), where they are trained to be an NBC company squad leader and a non-chemical company or battalion NBC NCO.

- Chemical BNCOC provides the NCO with the technical and tactical skills needed to advise company/battalion commanders in NBC operations and procedures:
    - to train non-chemical soldiers in NBC avoidance
    - decontamination
    - protective measures
    - lead smoke/decontamination squads.
- Chemical Corps staff sergeants and sergeants first class attend the 7 week, 2 day Chemical Advanced NCO Course (ANCOC), where they are trained to be an NBC platoon sergeant, an NBC NCO at brigade level, and an NBC NCO in a division or Corps level NBC element.
    - advanced technical operations
    - hazard estimates
    - logistics and maintenance management
    - combined arms operations
    - smoke and flame support
    - training management.
- Chemical Corps lieutenants attend a 19-week officer basic course, 10-weeks during mobilization. Reserve Component officers must attend the resident course.
- The Maneuver Support Center (MANSCEN), instructs the 3-weeks of common lieutenant training from the Chemical, Engineer, and Military Police schools. The Chemical Officer Basic Course (COBC) prepares lieutenants to serve as a Chemical Corps platoon leader or as a non-chemical battalion chemical staff officer/assistant operations officer. This course provides them with a fundamental knowledge of:
    - NBC agent characteristics and hazards
    - NBC recon (non-FOX), decon, and smoke operations
    - NBC staff functions
    - NBC defensive planning
    - individual and unit tactical operations
    - biological detection operations
    - Completion of live/toxic agent training is a prerequisite for graduation.
- Chemical Corps captains attend the Captain's Career Course, an 18-week officer advanced course. Extensive use is made of computer simulations to reinforce the application of NBC assets in support of tactical operations. In the MANSCEN configuration, the Chemical Officer shares training with Military Police and Engineer Officers in Common Training, Shared Tactical Training, and Brigade Battle Simulation Exercise (BBS), in which they are trained:
    - to serve as the commander of a Chemical Company
    - serve as NBC staff officers at the brigade and division level.
- Instruction focuses on:
    - leadership
    - Army operations
    - smoke and flame operations in support of maneuver units
    - biological detection operations
    - NBC defensive planning to include: hazard prediction, NBC reconnaissance and decontamination operations

- nuclear, biological and chemical vulnerability analysis
- operational radiological safety
- environmental management

Standards Trained:	**Chemical Captains Career Training** (18 Weeks)
– Leadership – Army Operations – Plan and Conduct NBC Reconnaissance – Decontamination Operations – Chemical and Biological Agent Detection Operations	– Smoke and Flame Operations – Nuclear, Biological, and Chemical Vulnerability Analysis – Operational Radiation Safety – Environmental Management – Chemical Defense Training Facility

Figure 4-4. U.S. Army Captain's Career Course Officer Advanced Training

Specialized professional training is conducted in stand-alone courses attended by DoD, Allied, and international students. These courses include:

NBC Reconnaissance Operations (FOX)	(5 weeks)
Radiological Safety (Installation level)	(3 weeks)
Operational Radiation Safety	(1 week)
Decon Procedures (Non-US) (GE, UK, NE)	(1 week)
RADIAC Calibrator Custodian	(1 week)
Biological Detection Specialist (BIDS)	(5 weeks)
Master Fox Scout	(2 weeks)
Installation Emergency Responders Course	(1 week)

4.4.3 Air Force NBC Defense Professional Training

The Air Force training detachment at Fort Leonard Wood, Missouri offers five separate in-residence courses designed to enhance the NBC proficiency of primary-duty AF Civil Engineer Readiness Flight personnel. These courses fulfill the differing needs of the total force, including Active Duty, Air National Guard, and Air Force Reserve. Further, the Air Force administers a career development correspondence course and two mobile courses in airbase operability and NBC cell operations. The AF courses range from 53 days for the Apprentice course; 10 days for the Craftsman and Readiness Flight Officer Courses; Five days for the NBC Cell Advanced and Mobile Air Base Operations and Advanced Readiness courses. The Air Force also offers computer based Qualification Training Packages (QTPs) that have been developed for most NBC Defense Equipment items, and are included as part of professional upgrade training.

Each course contains a wide range of materials covering critical aspects of Readiness Flight operations in situations ranging from peacetime, military operations other than war, through wartime. The following is a synopsis of the NBC aspects of these courses.

Training for personnel being assigned primary readiness duties includes comprehensive coverage of agent characteristics and hazards (to include determination of incapacitation/ lethality levels); nuclear weapons effects and other specific hazards associated with ionizing radiation; NBC

detection and contamination control and contamination avoidance techniques; plotting and reporting procedures; detailed NBC persistency and duration of hazard calculations to provide advice on MOPP variations; the inter-relationship between NBC defense and other passive defense activities (*e.g.*, camouflage, concealment, and deception, (CCD), dispersal, and hardening, *etc.*); and systematic analysis procedures for assessing hazards identification, vulnerability assessment, and risk assessment and providing credible mission continuation (sortie generation) and force survivability advice to commanders.

Air Force learning theory emphasizes hands-on training, and the school makes extensive use of available training ranges and equipment. The school includes Chemical Defense Training Facility (CDTF) toxic agent training in four of five in-residence courses. Training is provided on every major piece of NBC detection and decontamination equipment available in the field today, including state-of-the-art items currently being fielded.

The Civil Engineer (CE) Readiness Flight Officer and 7-level Craftsman courses provide flight leaders and mid-level NCOs with the background and technical information that is necessary for effective management of the CE Readiness Flight and contingency response operations.

Readiness is the key to successful Air Force operations. Consequently, the various aspects of CE Readiness Flight operations, including NBC defense, are also topics of instruction at briefings for Air War College, Air Force Institute of Technology, and the Joint Senior Leaders Course. Readiness personnel receive additional training on wartime and contingency aspects of NBC defense at one of three Silver Flag Exercise sites. These sites are located at Tyndall AFB, FL, Kadena AB, Japan, and Ramstein AB, Germany. Personnel deploy with their complete complement of personal NBC protective equipment and receive comprehensive training that builds upon their baseline knowledge in the areas of NBC detection, NBC reconnaissance, decontamination, warning and reporting and equipment use and inspection. Silver Flag also trains Readiness personnel on newly fielded equipment items, new techniques and procedures, and equipment that is not available at all installations.

The School of Aerospace Medicine at Brooks AFB trains over 7,000 students per year in a variety of AFMS readiness specialties. These courses are tailored to the approved and registered medical deployable NBC related unit type code assemblies. Bioenvironmental Engineering NBC Operations provide specialized medical detection, surveillance, and risk assessment training to 88 officers and 7-level NCOs per year. Critical Care Air Transport Team training includes movement of CB casualties at 250 students per year. Contingency Public Health Operations focuses on early recognition, evaluation and control of disease (including CB casualties) through expeditionary preventive medicine. Other specialty courses include NBC Battlefield Nursing, Preventive and Aerospace Medicine contingency training, Global Medicine, Military Tropical medicine and Medical Survival training. The AF Institute for Environment, Safety, and Occupational Health Risk Analysis, also at Brooks AFB, teaches PCR-based biological agent clinical diagnosis for members of the AF biological augmentation team.

4.4.4 Navy CBR Defense Professional Training

The Navy Construction Training Center Detachment at the U.S. Army Chemical School, Fort Leonard Wood, Missouri, offers two courses of instruction for Navy CBR-D specialists. The courses

are open to Navy, Coast Guard, Military Sealift Command, and select foreign military personnel, E-5 and above. Courses are designed to provide both afloat and ashore commands with individuals who can successfully perform their requisite duties in a CBR contaminated environment. In addition, the training enables CBR-D specialists to act as the primary CBR-D trainers for their respective commands.

The training, conducted at Fort Leonard Wood, capitalizes on the unique capabilities of the Army Chemical School and makes extensive use of the Chemical Defense Training Facility (CDTF). Approximately 200 students graduate annually from the Detachment's courses. In addition to being fully qualified to conduct training using the Army's facilities, the Navy Detachment actively participates as part of the JAWG.

In addition to CBR-D Specialist courses conducted at the US Army Chemical School, the Navy has incorporated CBR-D readiness training into courses that are attended by personnel at all levels of professional development.

Course Name	**Course Location**
Recruit Training CBR-D	Naval Training Center Great Lakes, IL
Damage Control "A" School	
Senior Enlisted Damage Control	Fleet Training Center San Diego, CA
Hospital Corpsman "A" School	Naval Training Center Great Lakes, IL
Independent Duty Corpsman	Naval School of Health Sciences San Diego, CA and Naval School of Health Sciences Portsmouth, VA
Management of Chemical Casualties	U.S. Army Medical Research Institute for Chemical Defense, Aberdeen Proving Ground, MD
Medical Affects of Ionizing Radiation	Armed Forces Radiobiology Research Institute Bethesda, MD
Radiation Health Indoctrination	Naval Undersea Medical Institute Groton, CT
Radiation Health Officer	
CBR-D Command Center	Naval Construction Training Center Gulfport, MS
CBR-D Personnel Protection	
CBR-D Team Training	Naval Construction Training Center Gulfport, MS and Naval Construction Training Center Port Hueneme, CA
MSC CBR-D Course	Military Sealift Command Training Center Earle, NJ
Repair Party Leader	Fleet Training Center San Diego, CA Norfolk, VA; Mayport, FL Ingleside, TX Pearl Harbor HI; Yokosuka, Japan
Repair Party Officer Short Course	Surface Warfare Officers School Newport, RI
Division Officer	
Damage Control Assistant	
Department Head	
Executive Officer	
Commanding Officer	

4.4.5 Marine Corps NBC Defense Professional Training

The Marine Corps NBC Defense School at Fort Leonard Wood consists of an Enlisted Basic NBC Defense Course, and an Officer Basic NBC Defense Course. In addition to courses conducted by the Marine Corps NBC Defense School, Marines attend four other functional courses (Chemical Captain's Career Course, Radiological Safety Officer Course, NBC Reconnaissance Course, and the Master FOX Scout) conducted by the U.S. Army Chemical School at Fort Leonard Wood.

The USMC Enlisted Basic NBC Defense Course trains approximately 220 NBC Defense Specialists in a comprehensive 10-week program covering all the ITSs specified in MCO 1510.71. The course not only trains Marines to perform their wartime duties but also provides them with the tools they will need on a daily basis to perform their primary peacetime mission of conducting NBC Defense training for their assigned units. The course is divided into eight blocks of instruction as shown in **Figure 4-5**.

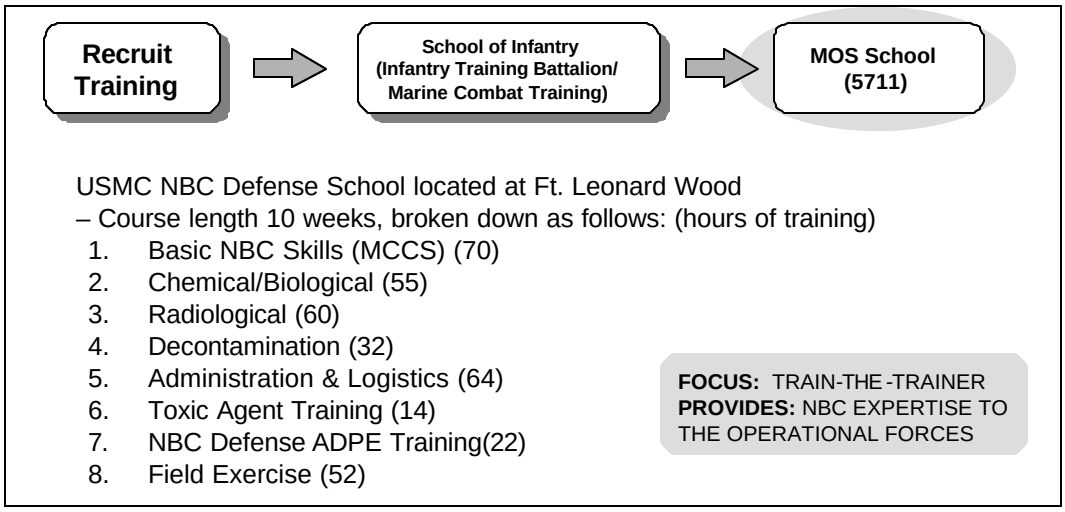

Figure 4-5. USMC Individual Training (Enlisted NBC Specialists)

All Marine NBC Officers are Warrant Officers. As Warrant Officers, they focus entirely on technical expertise, NBC defense operations, training, and supervision of enlisted NBC defense specialists. Many of the Marine Corps' NBC Defense Officers also attend the U.S. Army's Chemical Captains Career Course and other Joint NBC courses as part of advanced Military Occupational Specialist (MOS) training. The NBC Warrant Officer's course is divided into eight blocks as outlined in **Figure 4-6**.

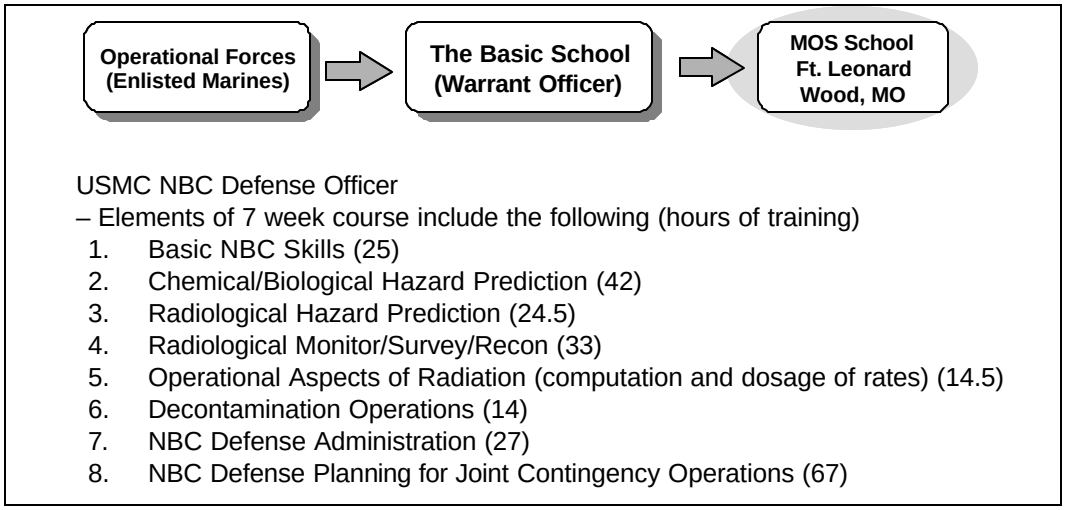

Figure 4-6. USMC Individual Training (Training for NBC Officers)

4.5 TRAINING IN A TOXIC CHEMICAL ENVIRONMENT

In 1987 the Army established the Chemical Defense Training Facility (CDTF) at Fort McClellan, Alabama. In October 1999, the Chemical School started training students at its new facility at Fort Leonard Wood, Missouri. The CDTF trains military and civilian personnel in a toxic chemical environment. Since its opening, the Army has used this valuable resource to train over 58,000 U.S. and Allied military personnel as well as selected DoD civilians. The CDTF promotes readiness by providing realistic training in the areas of detection, identification, and decontamination of chemical agents. The training develops confidence in chemical defense tactics, techniques, procedures, and chemical defense equipment. Instructors ensure that trainees can adequately perform selected tasks on a chemically contaminated battlefield. To date, the CDTF has maintained a perfect safety and environmental record.

Enrollment at the Joint Senior Leaders Course and the Toxic Agent Leader Training Course at Ft. Leonard Wood, Missouri continues to be in demand. Over 2,000 active and reserve commanders, service leaders, and toxic agent handlers from each of the services have attended. These personnel become very familiar with NBC considerations. Additionally, toxic chemical environment training provides senior officers, commanders, and future NBC defense specialists confidence in their doctrine, warfighting techniques, and the equipment they fight with in the face of challenges presented by NBC contamination.

The Weapons of Mass Destruction Civil Support Teams (WMD-CST) are trained at the Fort Leonard Wood facility. The facility has the flexibility to design toxic chemical agent training to prepare the WMD-CST for this unique mission — assisting civil authorities facing the threat of domestic terrorism involving weapons of mass destruction.

There is continued international interest in CDTF training. Germany and the Netherlands use the CDTF, Denmark and the United Kingdom have expressed interest.

Finally, Federal and state law enforcement agencies and other first responder-type agencies have also participated in the training. The Chemical School continues to support requests from civil authorities for toxic chemical agent training.

4.6 INTEGRATION OF REALISM/WARFIGHTER EXERCISES

4.6.1 Simulations and Warfighter Exercises

There are three types of simulations: live, constructive and virtual. Simulations may also be sub-grouped as training or analytic simulations.

Live simulations involve real people operating real systems. Such simulations are also known as exercises and are discussed further in the next section.

Constructive simulations allow battles to be waged on a synthetic battlefield. They are designed to give commanders and their staffs the opportunity to make decisions during a course of a battle, adjust plans to react to enemy movements, synchronize all available assets and learn, through the After Action Review (AAR) process.

Virtual simulations are designed for training and analysis primarily at the tactical level of war. These simulations are "mock-ups" of actual vehicles and give units an opportunity to train on necessary individual, crew and collective tasks without having to maneuver actual equipment in the field. While the crews maneuver their equipment around the battlefield, the rest of the environment is generated through the use of Semi-Automated Forces (SAF). SAF are computer representations of adjacent elements, the enemy, and the environments upon which the battle is waged. SAF elements not only look like other units they can be programmed to perform tasks/missions autonomously, thus adding to the realism of the training.

There are over 750 virtual and constructive models and simulations in the Army community alone. **Table 4-5** lists the primary battle command simulations in current use throughout the Army and their baseline ability to use NBC events in their scenarios. However, characterization of NBC effects in these models and simulations is limited. Very few combat simulations incorporate the effects of NBC, and none incorporate all aspects.

Table 4-5. Nuclear (N), Biological (B), Chemical (C), or Radiological (R) Capability In Current Constructive Simulations

NAME	USE	FIDELITY	N	B	C	R
Corps Battle Simulation (CBS)	Training	Operational	X		X	X
SPECTRUM	Training	Operational				
Brigade Battle Simulation (BBS)	Training	Tactical	X		X	X
Conflict Evaluation Model (CEM)	Analytic	Joint/Strategic	X	X	X	
TACWAR	Analytic	Joint/Strategic	X	X	X	
Vector In Command (VIC)	Analytic	Operational			X	
Computer Assisted Map Exercise (CAMEX)	Analytic	Operational				
EAGLE	Training	Operational				
Combined Arms and Support Task Force Evaluation Model (CASTFOREM)	Analytic	Tactical	X		X	
JANUS	Training/Analytic	Tactical			X	

Current training exercise warfighting simulations have not received sufficient priority and/or funding to adequately portray NBC effects and challenge commanders and staffs to apply NBC defense doctrine and leader-development training strategies to prepare their forces to maintain operational continuity and achieve mission success in an NBC environment. To be an effective training mechanism, these simulations must challenge training audiences to understand adversaries' NBC intent and capabilities. Simulations must also allow players to visualize how NBC capabilities affect the battle space, friendly courses of action, tactics, techniques and procedures, and operation plans to allow players to apply NBC defense principles and capabilities to set conditions for mission success against NBC threats. Warfighting simulations—Joint Warfare System (JWARS), Joint Simulation (JSIMS), and Joint Conflict and Tactical Simulation (JCATS)—are in development to accurately replicate the NBC hazards of future battlefields and their effects on friendly systems. These warfighting simulations will enable commanders staffs, and soldiers, airmen, and sailors to train and develop required high-order battlefield cognitive skills that will allow for full integration of enemy intent and capabilities, NBC environment effects, and friendly force capabilities while planning and executing operations.

There is currently no standardized Instrumentation System that can realistically portray all facets of NBC effects during field training. The U.S. Army Chemical School has developed NBC

Recon training interface devices allowing Multi Integrated Chemical Agent Detector (MICADS) to link the FOX Reconnaissance Vehicle into the Combat Training Center (CTC) instrumentation for the detection and tracking of simulated NBC contamination at CTCs and home station training areas. Resourcing will be pursued to upgrade the fielded training device interfaces at CTCs and other locations. The upgraded MICADS interface to the Instrumentation System will retrieve, process, and calculate digital contamination data for maneuver units and will also include AAR feedback in the areas of NBC casualties, change of custody, and reaction procedures during NBC attacks and operations. This Instrumentation System will provide a realistic replication of NBC contamination as portrayed on the battlefield.

The requirement to establish a baseline capability within the emerging OneSAF Test Bed version B simulation was completed. This baseline capability is interoperable with high level architecture and works as an NBC environment and effects model in both constructive and virtual simulations. Further development of the capability awaits funding.

The virtual simulation for the M93A1 NBC Reconnaissance System is operational at Fort Leonard Wood, Missouri. Future systems are planned for Fort Hood, Texas (installed in FY02) and Fort Polk, Louisiana (installed in FY03).

A virtual simulation for the P3I BIDS system has been installed at Fort Leonard Wood, Missouri. A portable unit has been installed with the 7th Chemical Company, stationed at Fort Polk, Louisiana. The Fort Polk system will be tested in FY02.

4.6.2 Joint NBC Training/Joint and Combined Exercises

Chairman of the Joint Chiefs of Staff (CJCS) Exercise Program. Joint Vision 2020 provides the operational based templates for the evolution of our Armed Forces to meet challenges posed by an adversary's use of weapons of mass destruction. JV 2020 serves as the Doctrine, Training, Leader-development, Organization, and Material (DTLOM) requirements benchmark for Service and Unified Command visions. The NBC defense cornerstone resource for this vision of future warfighting embodies three required operational imperatives:

First, and most importantly, CJCS and Service leaders should recognize that NBC strategic and operational level of war expertise is an essential resource requirement in the Joint Warfighter Center (JWFC) and USJFCOM Joint Training and Analysis Center (JTASC). Success for Joint Vision 2020, a strategy centered on capabilities-based forces, requires these organizations to successfully accomplish their respective joint NBC defense doctrine, training, and leader development roles, and for USJFCOM to accomplish its NBC defense mission as force provider, force trainer, and force integrator. NBC expertise at all levels and from all Services is paramount.

Second, Unified Commands should staff their organization appropriately with the right expertise to meet current and future requirements to shape and respond to NBC challenges.

Third, doctrine, training, and leader-development training strategies should facilitate sophisticated battlefield visualization and situational awareness proficiency, allowing commanders and staffs to conduct service, joint, and combined operations in an NBC environment.

The Chairman of Joint Chiefs of Staff published Master Plan Exercise Guidance in May 1998. This guidance provides exercise objectives to the CINCs. This guidance provided specific counterproliferation objectives. NBC Defense and Force Protection were identified as the Chairman's top training issues. This guidance influenced and guided development of CINC exercises and training conducted in Fiscal Year 2001.

As examples of Joint training and exercises, U.S. Pacific Command (USPACOM) training includes the following Joint Mission Essential Tasks (JMETs):

- Strategic Theatre (ST) 6.2 - Provide Protection for Theater Strategic Forces and Means - safeguarding friendly strategic and operational centers of gravity and force potential by reducing or avoiding the effects of enemy and unintentional friendly actions.
- Operational (OP) 6.2.8 - Establish CBW Protection in Theater of Operations/Joint Operating Area (JOA) - ensure we can detect, warn and report CBW events and protect against CBW threats in the operational area.
- Lessons learned from exercises on operational concepts, doctrine and readiness, have resulted in innovation and adaptation for USPACOM counter-CBW operations. Areas of innovation include contaminated aircraft Concept of Operations (CONOPS), decontamination standards, and in-theater capabilities for detection and testing for Bio hazards/agents.

USPACOM has made training and exercising for warfare in a CBW environment more routine, by executing a logical and progressive Consequence Management (CoM) program. The program has evolved through workshops, exercises, and seminars. USPACOM's Joint Task Force (JTF) for CoM will exercise a foreign CoM Command Post Exercise during TEMPO BRAVE 01.

Army. The Army emphasizes integration of NBC defense training in unit rotations at the Combat Training Centers (CTCs). These centers include the National Training Center (NTC), Joint Readiness Training Center (JRTC), the Combat Maneuver Training Center (CMTC), and the Battle Command Training Program (BCTP).

At the CTCs, the Army continues to see units at the company, battalion, and brigade levels unable to perform all NBC tasks to standard. Less than satisfactory performance at the CTCs is directly attributable to lack of homestation NBC training. These results clearly indicate a need for increased emphasis in educating senior leaders on how to leverage homestation training. Units that (1) have the necessary command support and equipment, (2) balance NBC within their overall training requirements, and (3) execute according to approved training plans, are able to survive and continuously operate in a simulated NBC environment. However, increasingly constrained training resources limit NBC training to fundamentals. This often means training consists only of NBC survival and not training for continuous operations in an NBC environment.

Air Force. NBC warfare defense preparedness is an integral part of periodic Operational Readiness Inspections conducted by MAJCOM Inspectors General. Realism is injected into these scenarios using a simulated wartime environment including the use of bomb simulators, smoke, and attacking aircraft. Personnel are tasked to perform war skills while in their full complement of protective equipment. Additionally, Air Force units participate in major joint and combined exercises that

incorporate realistic NBC situations. Following are examples that describe exercises incorporating NBC situations:

- ULCHI FOCUS LENS - PACAF Joint/combined command and control exercise conducted in conjunction with the Republic of Korea's national mobilization exercise "ULCHI."
- FOAL EAGLE - PACAF Joint/combined rear area battle and special operations field training exercise.

Navy. Due to the unique nature of Naval force deployments, CBR defense training may be conducted whether platforms are operating independently or in a group. During scheduled CBR defense training periods, realism is stressed and CBR defense equipment is used extensively.

Naval units conduct basic, intermediate, and advanced training CBR-D exercises prior to deployment. During the basic training phase, CBR-D training exercises may involve additional unit training by CBR-D specialists from Afloat Training Groups (ATG).

The exercises conducted by deploying Battle Groups and Amphibious Ready Groups during pre-deployment Composite Training Unit Exercises and Fleet Exercises are designed to meet CINC training requirements for forces in the deployment area of responsibility.

These CINC requirements are also tested during exercises with deployed forces. Chemical – Biological Defense scenarios have been incorporated into major Joint/Combined Exercises and Fleet Exercises for deployed units. Some of these exercises and experiments include:

- Exercise NEON FALCON.
- Exercise DESERT SAILOR.
- Ulchi FOCUS LENS.
- Fleet Battle Experiments.

Marine Corps. The Marine Corps provides the opportunity for units to incorporate NBC training into combined arms exercises (CAX) at the Marine Corps Air Ground Combat Center in Twenty Nine Palms, California. Battalion level unit exercises are also conducted during Korea and Thailand Incremental Training Programs where units deploy and exercise various tasks. Like the Air Force and Army, the Marine Corps also participated in major joint/combined exercises. The mission, threat, and task organization determines the level of training allowed. During FY01, the Marine Corps incorporated NBC defense training into the following exercises:

- JTF Exercise United Endeavor
- Ulchi Focus Lens
- Foal Eagle
- IMEFEX
- Keystone
- Desert Knight
- Azure Haze
- Urban Warrior
- ChemWar 2000
- Brave Knight
- Agile Lion
- Restoration of Operations (RestOps)

All Marine Corps units conduct annual NBC evaluations. Evaluations include operational, administrative, and logistical functional areas. These evaluations incorporate realistic NBC defense training into an operational scenario that supports the units combat mission.

4.7 INITIATIVES

This section provides details on a variety of joint and Service-unique initiative in support of defense readiness and training.

4.7.1 Joint

Doctrine/Training. The JSIG has continued a multi-year strategy to address WMD/NBC in Joint Doctrine and education at Mid/Senior-level, Joint and Service Colleges as recommended in the 1999 JSIG NBC Defense Training and Doctrine assessment. This effort is designed to improve awareness across the entire spectrum of WMD/NBC defense; including doctrine, training, war-games, exercises, and studies. It provides resources to assist in the Joint Doctrinal review process by providing WMD/NBC input where appropriate. It also provides resources to assist Mid/Senior-level, Joint and Service Colleges in reviewing their curriculum for the purpose of incorporating WMD/NBC defense material and providing WMD/NBC expert guest speakers.

During the year the JSIG provided assistance to four Service mid and senior level colleges with curriculum reviews and recommended NBC/WMD enhancements. The JSIG conducted a workshop with the colleges to facilitate the coordination of NBC/WMD education across the PME system. The JSIG provided assistance at two service colleges with wargame enhancements and also at the Joint Land, Aerospace, and Sea Simulation (JLASS) exercise. The JSIG is nearing completion of a one day exportable NBC/WMD awareness course targeted at O4–O5 level CINC Staff Officers. This course is planned for piloting by Mobile Training Team (MTT) during 3QFY02 and will later be converted into a form of Distance Learning.

The Chairman, Joint Chiefs of Staff designated WMD/NBC Defense his top priority in his Joint Training Master Plan 2002 Chairman's Commended Training Issues (CCTI) for immediate action. CCTIs are special interest items developed from all-source lessons learned, readiness reports and operational assessments. These issues are incorporated into the Chairman's Master Training Plan to ensure appropriate visibility by the combatant commands, combat support agencies and the Services in developing their Joint Training Plans. Commands are instructed to assess prescribed CCTIs in relation to their theater conditions as a key joint training readiness indicator.

USJFCOM is currently reviewing the Universal Joint Task List (UJTL) version 4.0 for adequacy in addressing CBD-related tasks, and has requested input from the CINCs and Combat Support Agencies. USJFCOM is partnering with DTRA in the preparation of lists associated with CBD-related tasks. Additionally, USJFCOMs Joint Training System Support Teams will offer to the combatant commands, during their assistance visits to the CINCs in FY 01-02, to assist with the preparation/validation of CINC JMETLs associated with CBD. Measures of performance associated with CBD-related tasks will be addressed with the development of UJTL version 5.0, during FY 02-03, with the assistance of the Defense Data Manpower Center.

Under the 1999 Unified Command Plan, the Secretary of Defense directed the formation of the Joint Task Force for Civil Support (JTF-CS) within JFCOM to act as the military command and

control unit to coordinate the military response in support of the Lead Federal Agency for Domestic CBRNE consequence management response.

Modeling. On 1 Nov 00 the DepSecDef signed a memo that delegated authority for accrediting all common use chemical and biological modeling and simulations with the Department to USD(AT&L), who in turn has delegated this responsibility to DATSD(CBD).

JCATS, JWARS and JSIMS are the future joint models for constructive and virtual combat simulation for training and analysis applications. Plans to incorporate CB defense effects into these models were initiated in FY98. VLSTRACK has been loosely coupled to JCATS to demonstrate the ability to add high resolution CW effects. JWARS will incorporate a chemical defense capability in release 1.1.

Training.

4.7.2 Army

Over the past several years, the Army has developed domestic response capabilities within the Chemical Biological – Rapid Response Team (CB-RRT) and the Weapons of Mass Destruction Civil Support Teams (WMD CSTs).

The CB-RRT provides a technical support package specifically tailored for response requirements and is composed of a variety of existing DoD elements. Upon arrival at an incident site, the CB-RRT command element quickly established initial coordination with the Lead Federal Agency (LFA), and prepares to deploy an advisory team to the federal, state, and local command and control organizations as required or directed by the designated operational commander. It also coordinates and plans assistance to local authorities and first responders for consequence management operations. The CB-RRT organizes, based on the situation, to provide the appropriate level of graduated response and technical expertise necessary to assist in mitigating a chemical or biological incident.

The WMD CSTs are Army National Guard teams of 22 persons, organized and held on active duty to respond to a validated request for military support from the civil authority, and rapidly deploy in support of the Incident Commander to assess the type of chemical, biological, or radiological contamination that may be present, advise on how to handle the effects, and facilitate State and Federal military support.

4.7.3 Air Force

The Air Force currently has three training and readiness initiatives underway and continues to improve its professional training.

The Civil Engineer (CE) Readiness Technical School implemented an advanced scenario-driven exercise in the CDTF revolving around a terrorism incident involving chemical munitions. This training is provided to advanced students and differs from the lock step training provided to Apprentice-level students. The scenario will be reviewed/revised annually during the respective course reviews. Air Force instructors are qualified to conduct joint classes at the CDTF and are fully integrated into CDTF operations. Readiness instructors lead Air Force students in four of five resident

courses through the training and also assist the other services with their training requirements. Additionally, they provide an orientation of NBC defense concepts and toxic-agent training in the CDTF for key Air Force personnel during the semi-annual Joint Senior Leaders Course. The CE Readiness Career Field Education and Training Plan's Specialty Training Standard requires readiness students and personnel to be highly qualified in chemical biological defense operations, including conducting and advising leaders on hazards analysis and the use of emerging detection and plotting technologies.

Air Force Readiness personnel enrolled in correspondence courses for upgrade training to the five skill level will eventually be able to complete a hybrid course, which includes both paper-based and interactive CD-ROM containing full motion-video and sound. The course is presently available only in a paperback version, which will continue to remain available. Interactive courseware development began in FY97 with the goal of developing the entire course on CD-ROM. This initiative was revised in FY00 in favor of the hybrid course. A CE Correspondence course writer at Sheppard AFB, Texas began CD-ROM development in FY01. This product will set the standard for all other CE specialties.

The Air Force has established the Counter Proliferation Integrated Process Team (CP IPT) as the Air Staff focal point for counter-proliferation issues. The CP IPT will also commission working groups as necessary, including a Passive Defense Working Group. The Passive Defense Working Group will:

- Define the end state for future AF NBC operations.
- Focus on near, mid, and far term actions.
- Transform force while maintaining ability to go to war.
- Identify existing CONOPS for sustaining mission essential tasks under biological and chemical warfare conditions.
- Identify gaps in existing chemical-biological defense (CBD) CONOPS.
- Recommend steps for developing comprehensive and effective CBD CONOPS.
- Identify specific issues and recommend corrective actions.

Additionally, the AF Medical Service has developed, or is in the process of developing, NBC Defense Training contract statements of work for eleven initiatives, which are listed in section 4.3.2. All are being managed by HQ AETC/SGP and HQ USAF/SGX.

4.7.4 Navy

Navy initiatives focused on improving CB Defense Readiness, Training, Doctrine and Readiness Reporting across the fleet and also improving coordination of defense actions with other services and agencies. In addition the Navy has focused on the long term integration of CBR Defense, Afloat Anti-terrorism Force Protection, and Homeland Defense initiatives. As a result of an internal re-organization, Navy requirements in these areas are now managed by a single Chief Of Naval Operations office.

The Navy maintains a response capability at the Naval Medical Research Center (NMRC). NMRC is primarily a research institute, however, its Biological Defense Research Directorate has

developed a capability that consists of a transportable biological field laboratory, expressly for the identification of biological warfare agents. This capability has been utilized extensively by DOD and other government agencies to provide a rapid analysis of biological samples.

To improve Navy readiness to respond to Chemical, Biological, and Radiological events the Navy has conducted an extensive series of CBRD studies. These studies includes:

- "The NBC Warfight" which analyzes operational decision-making within the concept of the a Joint CBR Battle Management Cell.
- "Biological Attack on a Pier" which analyzes the consequence management and interagency response to a biological attack on a pier adjacent to a naval base.
- "Shipboard Biological Hoax" which examines the tactical and operational implications of an internal contamination event on a ship.
- "Preparing a Fixed Site for CBR Defense" which analyzes basic naval base CBR defensive responses and command and control systems.
- "A Framework for Navy Forward Fixed Site CBR Defense Requirements" which examines CBR defense requirements for small, remote facilities, large fixed sites and large fixed administrative sites in peacetime and wartime.
- "Improving CB Defense for Domestic Naval Bases" which focuses on preparedness, point detection requirements, and medical responses to a biological attack at a US Navy base.

To improve Fleet participation in the Joint NBC Defense Program a successful series of Type Commander (TYCOM) CBRD Conferences have recently been convened. These recurring conferences have allowed personnel from the Naval Surface Force, Aviation Force, and Submarine Force Commanders and also personnel from operational units throughout the fleet to actively participate in improving Navy CBRD readiness. The results of these meetings have been used to shape CBRD equipment, doctrine, and training requirements.

To support warfighting and force protection missions, the Navy is assisting the United States Coast Guard (USCG) in evaluating requirements and improving capabilities for CBR Defense. The ultimate goal is the integration of the USCG into the Joint Service Chemical and Biological Defense Program to ensure full interoperability with the DoD services. The Coast Guard is in the process of upgrading their Naval Operational Capabilities and raising Survivability Standards to include enhanced CBR defense capability for future "Deepwater" assets (new ships and aircraft) and also improving the readiness of current USCG assets.

To improve unit CBRD readiness reporting the Navy has instituted changes to the Status of Resources and Training System (SORTS) reporting process. These changes will improve unit CBR equipment readiness and training readiness reporting procedures. These changes are designed to improve the visibility of CBR readiness issues throughout a naval units entire chain of command.

4.7.5 Marine Corps

During FY01 the Marine Corps Chemical Biological Incident Response Force (CBIRF) continued to refine its tactics, techniques, and procedures to respond to the growing biological and chemical terrorist threat.

National Asset Activated 1 April 1996

— Provides an operational force to rapidly respond to WMD incidents
— Tests New Equipment, Procedures, and Techniques required to support their mission
— Provides Consequence Management training to Marine Forces through Mobile Training Teams
— Assists in the assessment of Unit/Facility Vulnerabilities to Enhance Force Protection Planning
— Works with other Emergency Response Agencies

Figure 4-7. Chemical/Biological Incident Response Force (CBIRF) Role in Training

The CBIRF's mission focuses on consequence management to terrorist-initiated NBC incidents. The CBIRF is a national asset, to be globally sourced to CINCs and the National Command Authority for duties as the President may direct. The CBIRF consists of 360 highly skilled and trained Navy and Marine Corps personnel, organized into three elements: Command Element, Headquarters & Service Company and a Reaction Force Company with three Reaction Platoons. The CBIRF has state-of-the-art detection, monitoring, medical and decontamination equipment and is prepared for operations in a wide range of military-civilian contingencies. In addition to the CBIRF's capabilities to respond to CB incidents, it also serves as a training asset to the operational forces. The CBIRF can provide mobile training teams to various units to provide advanced consequence management training. This can provide operational forces with the most up-to-date techniques, tactics, and procedures developed by the CBIRF. CBIRF also assists in Unit/Facilities Vulnerability Assessments to enhance force protection. The bottom line is that the CBIRF serves as a force multiplier to the MAGTF.

Marine Corps FY01 Accomplishments:

- The Marine Corps NBC Defense School provided exercise and training support for the staff of Commander, United States Naval Forces Central Command and Commander, United States Fifth Fleet in support of Joint/Combined Exercise Neon Falcon 01.
- Began fielding, training and deployment of the "Enhanced NBC" Force Protection sets for the Marine Expeditionary Units (MEUs) that are forward deployed with the Navy.
- The Marine Corps participated in the Operational Testing (OT) for the Sorbent Decontamination System, which will help continue the process of replacing DS-2 with a waterless decontaminant.
- Participated in the Portable Biological Agent Sampler test demonstration conducted by the U.S. Army Chemical School at Fort Leonard Wood, MO during June 2001.
- The Marine Corps participated in the decontamination performance demonstration exercise conducted by the U.S. Army chemical School at Fort Leonard wood, MO during July 2001.
- Conducted the Annual NBC Conference in Dumfries, Virginia on 17–21 September 2001. The Marine Corps Conference gathered Marine Corps NBC Subject Matter Experts for the

purpose of refining and defining doctrine, reviewing current NBC Requirements, and distributing information on programs currently in material development.

- Participated in CINCCENT's Desert Breeze and CINCUNC/CFC's Coral Breeze WMD Wargame Seminars. The primary purpose of these seminars was to educate the CINC and Component commanders and staffs on implications of the current and emerging WMD threat (MARFORPAC).
- Conducted a comprehensive assessment of USMC vulnerability to WMD within the context of major OPLANs that included gauging adequacy of individual and unit level training (MARFORPAC).
- Provided forces and equipment in support of the Restoration of Operations (RESTOPS) Advanced Concept Technology Demonstration (ACTD). These forces performed various missions, including training and evaluation, toward ACTD objectives (MARFORPAC).
- Marine Forces Reserve (MarForRes) NBC Defense Single Site Storage Facility (SSSF) became fully operational. This site is located on the Fort Worth Federal Center, Fort Worth, Texas. The SSSF is designed to house, inspect, and maintain all NBC equipment for MarForRes except for the field protective mask.

Marine Corps FY01 Initiatives:

- Continued development of a joint Navy/Marine Corps web-based distance learning-course for NBC Defense Individual Survival Measures co-sponsored by the Marine Corps Institute and the Marine Corps NBC Defense School for use by all Marines, throughout the Marine Corps.
- The Marine Corps NBC Defense School is actively involved in the JSIG Joint Training Sub-Panel activities regarding assistance with identification of training requirements for all joint NBC defense equipment development programs.
- The Marine Corps Combat Development Command (MCCDC) formed the USMC NBC Defense Operational Advisory Group (OAG) that is comprised of representation from all Marine Component Commands and their Major Subordinate Commands (MSC). Per the OAG's charter, the purpose of the OAG is to provide a USMC NBCD decision making and guidance forum among the USMC NBCD Specialist Community. The first OAG meeting was conducted between 10-14 Sep 01 with subsequent meetings scheduled biannually thereafter.
- Marine Forces Pacific is actively involved in a Plan of Action and Milestones (POA&M) for internal improvements and for engaging external agencies more effectively to reach long-term improvement. CG, I MEF held the initial POA&M working group on 10-13 Oct 2000. Sixty-five military and civilians attended. Attendees represented a cross-section of intelligence analysts, operators, planners, logisticians, and NBC Defense subject matter experts. The working group was organized into five mission analysis teams: Standards & Peacetime Requirements, Contamination Avoidance, Protection, Restoration, and Battle Management. Each mission analysis team identified NBC Defense requirements and deficiencies based on a Korean theater scenario using the Doctrine, Organization, Training, Equipment, and Support/ Sustainment (DOTES) model as an analytical methodology. Three major OPLAN operational scenarios were used to generate requirements: Maritime Propositioned Force operations,

amphibious assault, and subsequent combat operations ashore. The current NBC threat and ongoing Marine Corps/Department of Defense (DoD) NBC Defense programs were considered in the analysis. The working group validated the vulnerabilities revealed during MARFORPAC's NBC Defense readiness assessment. It identified internal and external deficiencies across a wide-ranging spectrum: standards, doctrine, training, evaluations, readiness assessment and reporting, and resources (both personnel and equipment). Working group recommendations for improvement were then developed into a draft POA&M per guidance from the Commander of Marine Force Pacific. The POA&M was approved in Dec 2000 and contains 138 complex tasks, phased over a three-year period, similar to a campaign plan.

- In a support role, Marine Force Pacific continues its participation in RestOps. The RestOps Advanced Concept Technology Demonstration (ACTD) is a USCINCPAC-USCINCCENT co-sponsored experiment designed to improve the before, during and after attack actions to protect against and immediately react to the consequences of a chem-bio attack. These actions aim to restore operating tempo (OPTEMPO) in wartime mission execution and the movement of individuals and materiel to support combat operations at a fixed site. The ACTD will: identify effective means of pre-attack protection of personnel and critical equipment while maintaining operational agility; identify chem-bio collection, detection, identification and warning that is achievable to reduce vulnerabilities; identify expedient methods of post-attack decontamination of personnel and personal equipment; provide for enhanced decontamination of critical equipment and facilities necessary to restore and sustain operations; provide enhanced ability to determine the extent and location of contamination; and provide for improved post-attack medical treatment to exposed personnel. MARFORPAC participates in this ACTD as a component of both sponsoring CINCs and sits on two of its oversight committees. Also MARFORPAC provides forces and equipment for operational tests and evaluations conducted in support of ACTD objectives. The primary ACTD demonstration site is Osan Air Base, Republic of Korea. Locations for testing and evaluating specific technologies, tactics, techniques, and procedures include the West Desert Test Center, Dugway, Utah, Marine Corps Base Kaneohe Bay, Hawaii, Brooks Air Force Base, Texas, Nellis Air Force Base, Nevada, and Kirtland Air Force Base, New Mexico.MARFORPAC sponsored a force protection initiative funded by DTRA. DTRA will conduct an independent assessment of USMC operations in a Weapons of Mass Destruction (WMD) environment which encompasses chemical/biological/nuclear attacks.

4.7.6 Emergency Response: Army Medical Response

The AMEDD continues to be involved in supporting DoD and federal counterterrorism initiatives and contingency operations related to NBC threat agents, mainly with elements of the Medical Research and Materiel Command (MRMC). The following offices and agencies have required AMEDD assistance: DoD SO/LIC, J4 Medical Readiness, U.S. Army Technical Escort Unit, US Department of State, Federal Bureau of Investigation, Department of Health and Human Services, Office of Emergency Preparedness, and the U.S. Marine Corps CBIRF.

The U.S. Army published AR 525-13, *Antiterrorism Force Protection (AT/FP): Security of Personnel, Information, and Critical Resources from Asymmetric Attacks*, dated 10 September 1998. From this regulation it is assumed that U.S. Army medical treatment facilities and clinics will be called upon to provide assistant to civilian first responders if a WMD terrorist act occurs and to provide emergency room and inpatient treatment for both eligible DoD beneficiaries and civilian casualties. This regulation specifically states that the Surgeon General will:

- Establish policy and guidance on the management and treatment of conventional and nuclear, biological, and chemical (NBC) casualties.
- Coordinate emergency medical NBC response capabilities worldwide with other DoD, Joint, Federal, state, local and HN agencies.
- Maintain medical NBC response teams to address nuclear, biological/emerging infection, chemical accidents/incidents worldwide.
- Provide chemical and biological analysis of biomedical samples from patients/decease to assist in the identification of agent(s) used against U.S. personnel.
- Provide guidance on the vaccination and prophylaxis against biological warfare agents.

During 2002, MEDCOM will publish Regulation 525-xx, *Medical Emergency Management Planning* , which includes all medical teams and systems that could potentially be available to support civil authorities in the event of a Chemical, Nuclear, Biological, Radiological-Explosive (CNBR-E) event or a terrorist attack with Weapons of Mass Destruction. The regulation also includes the Army policy for fixed facility medical treatment facilities in support of local domestic First Responders.

The AMEDD has formed Specialty Response Teams (SRTs), which in some instances may be designated Special Medical Augmentation Response Teams (SMART). These teams provide a rapidly available asset to complement the need to cover the full spectrum of military medical response—locally, nationally, and internationally. These teams are organized by the U.S. Army Medical Command (USAMEDCOM) subordinate commands; they are not intended to supplant TOE units assigned to Forces Command or other major commands. The regional medical commands (RMCs), the United States Army Center for Health Promotion and Preventive Medicine (USACHPPM), and the US Army Medical Research and Materiel Command (USAMRMC) commanders organize SRTs using their table of distribution and allowances (TDA) assets. These teams enable the commander to field standardized modules in each of the SRT areas to meet the requirements of the mission. Members of the US Army Reserve (USAR) may be relied upon to provide a variety of functions in support of the various SRT missions. The two SRTs that can most likely to support NBC are the Special Medical Augmentation Response Team – Preventive Medicine (SMART-PM) and the Special Medical Augmentation Response Team – Nuclear/Biological/Chemical (SMART-NBC). The following paragraphs describe activities/programs within the Army Medical Command (MEDCOM) that support civil authorities, consequence management, and domestic preparedness.

Medical Capabilities. The U.S. Army Medical Command (MEDCOM) has organized, trained and equipped Special Medical Augmentation Response Teams. Designated MEDCOM Subordinate Commands will deploy SMARTs in CONUS or OCONUS to provide short duration, medical augmentation to Local, State, Federal and Defense Agencies or Medical Teams responding to

disasters, civil-military cooperative actions, humanitarian assistance, Weapons of Mass Destruction and emergencies within 12 hours of notification. Reaction time to and length of OCONUS missions will vary based on the situation.

SMART Areas. There are a total of 43 SMARTs in ten functional areas that are capable of responding.

(1) Trauma/Critical Care (SMART-TCC).
(2) Nuclear/Biological/Chemical (SMART-NBC).
(3) Stress Management (SMART-SM).
(4) Medical Command, Control, Communications, Tele-medicine (SMART-MC3T).
(5) Pastoral Care (clinical) (SMART-PC).
(6) Preventive Medicine (SMART-PM).
(7) Burn (SMART-B).
(8) Veterinary (SMART-V).
(9) Two Health Systems Assessment and Assistance (SMART-HS).
(10) Aero-Medical Isolation (SMART-AIT).

SMART Composition. The teams are composed of military officers, warrant officers, enlisted soldiers, civilian employees and appropriate contractors of the Department of Defense assigned to MEDCOM by name and capable of deploying to augment local, state and federal response assets in domestic support, civil-military cooperative assistance, disaster relief and humanitarian assistance operations in CONUS. There are approximately 287 MEDCOM Personnel designated to respond as SMART members. These teams are trained and equipped and can be alerted and sent out within 12 hours of notification.

The National Medical Chemical and Biological Advisory Team (MCBAT) is comprised of USAMRMC elements from USAMRIID and USAMRICD. These assets are Tier 1 elements of the DoD Chemical Biological Rapid Response Team (C/B-RRT) and are ready to deploy worldwide within 4 hours after receiving their orders. The RMC Chemical/Biological SMARTs are trained medical teams located at the RMCs that can deploy in response to a chemical, biological, or radiological incident. Examples of incidents that may require a rapid response include:

- An accident involving the transport or storage of NBC weapons,
- The release of CW or BW agents or radiological material,
- A leak of an industrial chemical, infectious material, or radioactive material.

The MCBAT is the principal DoD medical advisor to the Commander, C/B-RRT and the Interagency Response Task Force. Both the MCBAT and regional Chemical/Biological SMARTs can provide medical advice and consultation to commanders or local medical and political authorities for preparation of a response to a threat or actual incident. They can also provide medical advice to commanders or local authorities on protection of first responders and other health care personnel, casualty decontamination procedures, first aid (for non-medical personnel) and initial medical treatment, and casualty handling. The initial advice includes identifying signs and symptoms of NBC exposure, first aid (self-aid, buddy aid, and combat lifesaver aid for military personnel), and initial treatment when an incident has occurred. The MCBAT also assists in facilitating the procurement of

needed resources. The RMC Chemical/ Biological SMART may, after initial assessment of the situation, elect to use telemedicine reach back.

USAMRICD has developed a Chemical Casualty Site Team (CSST) with the capability of rapid deployment in support of DoD or the MCBAT as part of the Foreign Emergency Response Team (FEST), or the Domestic Emergency Response Team (DEST). The team is tasked to support each specific mission. Personnel available for deployment consist of physicians, a nurse, toxicologists, veterinarians, and laboratory specialists. These personnel, when coupled with their supporting capabilities, are knowledgeable in the medical effects of a specific chemical warfare agent, identification of chemical agents or their metabolites in biological samples, determination of blood cholinesterase levels, technical and biomedical expertise required to enable protection of personnel responding to chemical incidents or to guide decontamination of personnel and causalities, and technical expertise to accomplish mission planning.

USAMRIID has developed the capability to deploy an Aeromedical Isolation Team (AIT) consisting of physicians, nurses, medical assistants, and laboratory technicians who are specially trained to provide care to and transport patients with disease caused by biological warfare agents or by infectious diseases requiring high containment. The AIT is a highly specialized medical evacuation asset for the evacuation of limited numbers of contagious casualties, with lethal infectious diseases, or for consultation on appropriate management of such casualties in the event of a mass casualty situation. USAMRIID's teams are deployable worldwide on a 12-hour notice using USAF transportation assets.

Another asset that USAMRIID has is the Biological Threat Response Cell (BTRC). The BTRC is designed to respond to any CONUS or OCONUS biological warfare or biological terrorist event. The cell is composed of the Deputy Commander as OIC/POC, the Operational Medicine physicians and the AIT, selected scientists and clinicians, a Biological Safety Officer, a logistician and an engineer. USAMRIID also provides consultants to the Chem-Bio Rapid Response Team as members of the MCBAT.

As a supporting capability, USAMRIID has a 16-bed ward with the capability of isolating (up to Biosafety Level 3) patients with infectious diseases in a contingency situation. USAMRIID also has a special Biosafety Level 4 (highest level of containment) patient care area designed for a maximum of 4 patients requiring this level of containment. These patient care areas are capable of providing intensive care for critically ill patients with specialized personnel and equipment augmentation from Walter Reed Army Medical Center. An additional supporting capability at USAMRIID is its capacity for medical diagnostic assays for recognized biological agents.

MEDCOM has also taken the initiative to provide a standardized decontamination equipment, documentation, and personnel training package for the command's fixed medical treatment facilities. This equipment and training will provide a decontamination capability at all Army fixed medical treatment facilities for a CBRNE event. The intent is to standardize a minimum level of decontamination capability by providing the same decontamination equipment and training to each medical treatment facility. The execution phase began with the first shipment of equipment in December 2000 and will end with the final equipment delivery and personnel training on 30 April 2001.

4.7.7 Medical Countermeasures and Surveillance against NBC and other Battlefield Toxicants and Occupational Health Hazards

Historically, most veterans' health and benefit issues are related to service in combat operations. U.S. forces are now more likely to deploy into non-combat environments such as peace-keeping, peacemaking, humanitarian assistance, or training. Presidential Review Directive (PRD)/National Science and Technology Council (NSTC)-5 directs DoD, the Department of Veterans Affairs, and the Department of Health and Human Services to review policies and programs and develop a plan that may be implemented by the Federal government to better safeguard those individuals who may risk their lives to defend our Nation's interests. An NSTC Interagency Working Group oversaw the work of four task forces that focused on (1) deployment health, (2) record keeping, (3) research, and (4) health risk communication.

DoD policy that requires pre- and post-deployment health assessments, screenings, and briefings shall be performed active and reserve component personnel deployed as a resulting of a Joint Chiefs of Staff/Unified Command deployment order for 30 continuous days or greater to a land-based location outside of the United States that does not have a permanent U.S. military treatment facility. Routine shipboard operations that do not involve field operations ashore for over 30 days are exempt from this policy. The details for completing these assessments are found in JCS Policy Memorandum MCM-251-98, 4 December 1998, subject: Deployment Health Surveillance and Readiness; ASD(HA) Policy Memorandum, 6 October 1999, subject: Policy for Pre- and Post-Deployment Health Assessment and Blood Samples; and DoD Instruction 6490.3, "Implementation and Application of Joint Medical Surveillance for Deployments," August 7, 1997.

Deployment can encompass a wide range of missions in which additional operations in NBC environments may expose a Joint Task Force to other toxic chemicals, radiological contamination, and environmental contamination from industrial operations within the host nation. Standard U.S. occupational health and environmental standards are not enforceable in a host nation scenario. As a result, the JFC has been confronted with toxic industrial chemicals, radiological hazards, and long-term environmental contamination from industrial operations within the host nation. The Joint Force Commander must utilize organic NBC reconnaissance and preventive medicine medical surveillance assets to identify host nation occupational and environmental hazards and to determine troop deployment locations that will minimize the short- and long-term health risk during occupation by U.S. forces. This type of information, if not provided by the host nation, is available from the Armed Forces Medical Intelligence Center (AFMIC) and the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM). Joint medical surveillance within the theater of operations can identify NBC related occupation, industrial, and environmental health hazards. Factors to be considered will include the type of contamination and the prevailing wind direction. Proposed planning factors for downwind hazard distances for some commonly known industrial chemicals are provided in the USACHPPM Technical Guide 230A, "Short-Term Chemical Exposure Guidelines for Deployed Military Personnel". The technical guide is to be used as a tool to assess potential adverse health impacts resulting from exposure to harmful chemicals as a result of uncontrolled industrial release, sabotage, or from the intentional or unintentional actions of enemy or friendly forces. Preventive med-icine assets within the theater can be employed to conduct joint medical surveillance and to provide

recommendations to the Joint Force Commander for risk communication to minimize the short-term and long-term health effects of toxic exposures to deployed military personnel. DoD Directives (6055.1 and 6490.2) and Instruction (6490.3) apply to joint medical surveillance and safety and occupational health in an NBC or otherwise contaminated environment.

The Joint Publication 3-11, *Doctrine for Nuclear, Biological, and Chemical Defense Operations* sets forth principles to assist commanders and staffs to plan for and conduct joint, multinational and interagency operations in which their forces may encounter the employment or threat of NBC weapons and other toxic materials. It has taken into account new DoD and JCS policies, directives, and instructions for joint medical surveillance and risk communication. New DoD standards and guidelines are being developed for accurate risk communication. The Assistant Secretary of the Army for Installations and Environment, ASA(I&E), is the DoD Executive Agent for developing these new DoD nuclear, biological, chemical, and environmental (NBC-E) force protection policies. ASA(I&E) is staffing a new Army policy entitled "Medical Force Protection: Environmental and Occupational Health Threats Policy." The need for this new policy was identified during the 1999 Medical Functional Area Assessment and was validated by the Deputy Chief of Staff for Operations, Headquarters, Department of the Army, in a 23 July 1999 memo to the ASA(I&E). This new policy for force health protection is urgently needed to permit the development of appropriate U.S. Army doctrine, detection standards, and risk communication guidelines for use by commanders to protect soldiers from battlefield toxicants and occupational health hazards during deployments.

4.7.8 Air Force Medical NBC Teams

The Air Force Medical Readiness Re-engineering efforts have created eight specialty teams for NBC Medical Defense. These teams include (1) Theater Epidemiology Team, (2) Radiological Assessment Team, (3) Wartime Patient Decon Team, (4) Bioenvironmental Engineering NBC Team, (5) Infectious Diseases Team, (6) Preventative Aerospace Medicine Team, (7) Biological Augmentation Team, and (8) In-place Patient Decon Team (USAFE). Following is a brief description of the capabilities provided by these teams.

The *Theater Epidemiology Team* (TET) provides (1) theater medical and environmental threat assessments, (2) theater disease surveillance and disease outbreak investigation, and (3) baseline environmental monitoring. The TET is a theater-level medical asset.

The *Radiological Assessment Team* (AFRAT) is composed of two Nuclear Incident Response Force (NIRF) Teams and one Radio analytical Augmentation Team. The NIRF Teams include health physicists, industrial hygienists, equipment technicians, and bioenvironmental technicians. The AFRAT provides comprehensive radiological monitoring, hazard evaluation, and health physics support in a radiological response operation. The AFRAT is a service-level asset.

The *Wartime Patient Decon Team* (WMDT) is deployed in direct support of medical treatment facilities operating in NBC threat environments. They construct and operate decontamination sites and facilities in the vicinity of the supported medical treatment facilities. The WMDT is deployed at the unit level to support a medical treatment facility. Currently, there are 33 complete teams (2 personnel packages and 1 equipment package each) in the Air Force inventory.

The *Bioenvironmental Engineering NBC Team* provides the following capabilities in support of CE Readiness NBC personnel: (1) NBC agent surveillance, detection and abatement, (2) reconnaissance teams for NBC agent detection, (3) advice on health effects and human performance due to extended wear of the ground crew ensemble, and (4) information on other NBC related health risks to deployed forces.

The *Infectious Diseases Team* provides personnel that augment the capability to identify, control, report, and provide treatment for infectious diseases and biological warfare agents in the deployed theater. The Team is designed to be deployed to facilities with greater than 100 beds where a significant threat for biological warfare casualties or infectious disease exists.

The *Preventative Aerospace Medicine Team*: (PAM) (1) identifies, monitors and prevents disease and non-battle injury (DNBI), (2) performs health threat and risk assessment, such as communicable disease tracking, (3) performs health hazard surveillance, (4) controls health hazards through food, water and field sanitation inspections, and, (5) mitigates the effects and prevents DNBI. PAM teams are an integral to all deployed AIR Force medical treatment facilities. There presently are 35 teams in the inventory, and can deploy in increments of 2 to 9 personnel. PAM teams operate at the unit level, while the TET serves as a theater medical asset.

The *Biological Augmentation Team* (BAT) is a three to two-person team of skilled medical laboratory officer and enlisted personnel that provides rapid pathogen identification using nucleic acid-based identification diagnostic capability. The team is modular so that it may augment other teams, capabilities, and facilities. The BAT Team can analyze clinical samples

Such as food and water for pathogens of operational concern. There are currently 8 complete BAT teams in the Air Force, and more are planned.

The *In-place Patient Decon Team* supports five U.S. Air Forces in Europe (USAFE) medical treatment facilities (MTF).

4.8 READINESS REPORTING SYSTEM

CJCSI 3401.02, the policy document for the Status of Resources and Training System (SORTS) requires units from all Services to independently assess their equipment on hand and training status for operations in a chemical and biological environment. This is a change to previous SORTS reporting requirements and provides more visibility to NBC defense related issues.

The Services individually monitor their SORTS data to determine the type of equipment and training needing attention. Units routinely report their equipment on hand and training status for operations in a chemical or biological environment. Commanders combine this information with other factors, including wartime mission, to provide an overall assessment of a unit's readiness to go to war.

Additionally, the Commanders-in-Chief (CINCs) of the Unified Commands submit readiness assessments at each Joint Monthly Readiness Review (JMRR). In the JMRR, CINCs assess the readiness and capabilities of their command to integrate and synchronize forces in executing assigned missions. As needed, CINCs address NBC defense readiness and deficiencies as part of the JMRR.

USMC CBD Readiness Reporting. The Marine Corps has developed the Chemical and Biological Defense (CBD) Calculator (automated program) that can be used by Commanders to assist in assessing their unit's CBD readiness. The CBD Calculator provides a measurable standard that commanders can use to base their assessment on. Unit NBC personnel enter training and equipment data into the calculator and automatically generate a recommended CBD readiness status formatted for input to the SORTS report. The Marine Corps SORTS order is being revised to recommend that all Commanders use the CBD Calculator when determining their CBD status for SORTS reporting.

4.9 CB DEFENSE READINESS AND TRAINING ASSESSMENT

ISSUE: **The Government Accounting Office (GAO) published a report, *CHEMICAL AND BIOLOGICAL DEFENSE: DOD Needs to Clarify Expectations for Medical Readiness*, GAO-02-38, October 2002. A summary of the GAO recommendations and the DOD response are listed below. In response, the Assistant Secretary of Defense for Health Affairs (HA) has established a Task Force to address the medical issues. The HA Task Force and Service programs will described in next year's report.**

RECOMMENDATION 1: The GAO recommended that the SECDEF address the gap between the stated CB threat and the current level of medical readiness by clarifying the Department's expectations regarding medical preparation for CB contingencies and, as appropriate, by directing the Joint Staff to integrate biological medical readiness in DPG.

DOD RESPONSE: Concur. As the coordinating body with the Services and the CINCs on issues of this nature, the Joint Staff will be requested to conduct a re-examination of CB medical training issues and provide suggested adjustments to enhance the DoD's medical readiness posture.

RECOMMENDATION 2: The GAO recommended that the Services and Joint Staff support completion of the Common User Database (CUD) by concluding an agreement regarding which personnel are required to provide specific treatments. This database should eventually be validated by proficiency testing of the identified personnel to help further refine training & specialty mix requirements.

DOD RESPONSE: Concur. The Joint Staff will be requested to coordinate this effort with the Services. The elements and scope of the Medical CUD must be widely disseminated and agreed on by the Services and the Joint Staff so that general treatment of NBC casualties can be jointly accomplished and trained to. The CUD must be comprehensive, include all echelons of care, and consider Service specific environments. Additionally, the requirement to train physicians to treat CB casualties must be accomplished in the Services and with standardized protocols defined by the Joint Medical NBC Defense Readiness Working Group.

RECOMMENDATION 3: In furtherance of a tri-service approach to medial planning, the GAO recommended that the Services and Joint Staff use enhanced modeling capabilities to develop defensible and transparent risk assessments associated with various evacuation rates. The Services and Joint Staff develop and approve joint models and tools to support more timely, flexible and integrated planning for these threats and enable effective updating of both long-term

specialty mix evaluations and short-term combat medical requirements.

DOD RESPONSE: Concur. As noted in the GAO report, the sole DoD-approved tool for the development of Health Service Support (HSS) predictive requirements to support theater operations is the Medial Analysis Tool (MAT). The MAT is capable of providing requirements (and subsequently adequate modeling of those requirements through its Course of Action Analysis function) for the WMD environment, once casualty rates are determined.

The many variables and the absence of historical data have, to date, precluded arrival at any one set of conclusions that would be more logically defensible than another set as jointly accepted planning factors. The Services will move forward in the development of CBRNE associated *casualty rate's* that would enable MAT to provide requirements data for the WMD environment. This would give the Unified CINC's a more tangible grasp of the casualty expectations and the HSS assets subsequently required in an asymmetrical environment. Having said this, the US has ratified the NATO Standardization Agreements [2475, 2476 & 2477] "Allied Medical Publication P-8, Medical Planning Guide of NBC Casualties (NBC)" on 25 Aug 00, which establishes a methodology for assessing NBC casualties and could serve as a basis for casualty rate determination. The evacuation issue is greatly exacerbated by the BW threat; it must be addressed as a joint issue and incorporated into medical modeling. Additionally, if the GAO recommendation pertains to the percentage of patients that will require evacuation, DoD concurs. However, if the GAO recommendation pertains to the evacuation (EVAC) policy, DoD non-concurs. EVAC policy only places patients into the EVAC system, not into beds thereby generating bed and personnel requirements. Bed generation is a function of the EVAC delay and is determined by the average length of stay (ALOS) or stay time. Finally, the report attributes inter-service disagreement as a major reason for the lack of standard CB casualty/evacuation planning factors. This is an over-simplification of a very real problem, which the report acknowledges. The Joint Staff be requested to establish a joint CB casualty rates working group with representatives from the Services to determine rates for use in MAT modeling.

RECOMMENDATION 4: The GAO recommended that the Services develop CB medical training requirements and assess the effectiveness of the training with rigorous proficiency metrics and standards.

DOD RESPONSE: Concur. During the FY01 Joint Medical NBC Readiness Conference, a working group began to identify and quantify the medical NBC training requirements for all Services to follow. The results of their work and plan will be briefed to the Joint NBC Board for approval. The Joint Staff will be requested to take the lead in this effort and provide a written proposal to establish the formation of a Joint, Services, and DoD medical NBC oversight group.

RECOMMENDATION 5: The GAO recommended that the Services develop and maintain information management systems to monitor completion of required CB training and track the proficiency of medical personnel, at least for the first responders and key personnel in high risk areas of operations.

DOD RESPONSE: Concur. DoD suggests that the recommendation be worded as "…track the proficiency of medical personnel, at least for those personnel identified as essential in the medical response to an NBC event." Rationale: the diverse nature of the NBC threat suggests that the current wording is too narrow. Currently numerous stove-piped systems exist within the Services to track training. The TRICARE Management Activity (TMA) will be tasked to

develop a joint tracking system to monitor training and proficiency of personnel identified to function in a CB environment.

RECOMMENDATION 6: The GAO recommended that the Joint Staff, CINCs and Services increase the realistic exercise of medical support to a level commensurate with the current CB threat assessments. To the extent there is a threat of mass casualties, exercises should explore the limits of medical capabilities and the full consequences of the scenarios that overwhelm them.

DOD RESPONSE: Concur. Historic "across-the-board" decreases in exercise funding for medical participation have directly impacted upon the level and frequency of exercise involvement. To maximize future medical participation, the Assistant Secretary of Defense for Health Affairs [ASD(HA)] will request that the Joint Staff, working with the CINCs, emphasize heightened medical participation in all relevant exercises. This would include participation in pre-planning activities with J2, J3, J4, J7, and other directorates in order to develop realistic scenarios that test our skills and capabilities in CBW environments.

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Chapter 5

Status of DoD Efforts to Implement the Chemical Weapons Convention (CWC)

5.1 INTRODUCTION

The CWC was opened for signature on January 13, 1993. The Convention entered into force on April 29, 1997. As of January 1, 2002, 145 countries, including the United States, had signed and ratified or acceded to the CWC. Another 29 countries have signed but not ratified.

5.2 DEPARTMENT OF DEFENSE IMPLEMENTATION OF THE CWC

Since the CWC entered into force, DoD has hosted more than 340 visits and inspections at chemical weapons (CW) storage, former production, and destruction facilities. The Army (the Service most directly impacted by CWC implementation activities) and DoD's Defense Threat Reduction Agency (DTRA) continue to host and escort inspectors from the Organisation for the Prohibition of Chemical Weapons (OPCW) Technical Secretariat (TS). The OPCW is charged with overseeing worldwide implementation of the CWC. TS inspectors conduct both continuous and non-continuous monitoring at DoD CW destruction facilities and systematic inspections at DoD CW storage, former production and Schedule 1 facilities. DTRA provides CWC Orientation Training to United States Government (USG) national escorts and other treaty compliance personnel and to date has provided training to over 700 USG personnel.

In addition to supporting inspections at DoD facilities, DTRA assists the Department of Commerce (DOC) with CWC inspections at U.S. chemical industry sites pursuant to a Memorandum of Agreement. The DOC is the lead agency for chemical industry inspections. DTRA supports DOC with training, escort, and logistic support on a non-interference, cost reimbursable basis. U.S. chemical industry inspections began in May 2000 and, as of January 1, 2002, the OPCW had conducted 28 inspections.

DoD conducts a Chemical Weapons Agreements Implementation Working Group (CWIWG) to implement the CWC. Through regularly recurring meetings, representatives of the Office of the Secretary of Defense (OSD), the Joint Staff, the Military Departments, the Military Services, and DoD agencies and activities coordinate planning efforts to ensure proper implementation of the CWC. Formal meetings of the CWIWG are scheduled approximately monthly and small group meetings are held as needed to address specific requirements in support of the CWIWG. A Compliance Review Group (CRG) was established within DoD to address, as needed, CWC compliance concerns. OSD, the Joint Staff, the Military Services, and DTRA provide technical experts to support activity at the U.S. Delegation to the OPCW in The Hague, The Netherlands.

The Army was tasked to destroy all chemical warfare materiel under the Program Manager for Chemical Demilitarization (PMCD). PMCD includes programs for unitary stockpile destruction, destruction of bulk agent by alternative technologies (non-incineration), destruction of other chemical warfare materiel and the destruction of former CW production

facilities. There is a separate Army program to demonstrate alternative technologies to destroy assembled CW munitions. The Army coordinates closely with the OSD to ensure that these programs are compliant with CWC provisions.

5.3 SAFETY ORIENTATION FOR INSPECTORS

All OPCW inspectors who conduct continuous monitoring at U.S. chemical weapons demilitarization facilities are required to attend a 32-hour safety orientation, which is broken down into two sections and is presented by the Army. One section is a 24-hour hazardous waste operations and emergency response (HAZWOPER) course which is a USG requirement of all personnel who must be present on a more than short-term basis at U.S. chemical demilitarization facilities. The second section is an 8-hour Ammunition Safety Course. A 48-hour demilitarization protective ensemble (DPE) procedures course is required only for those inspectors designated by the OPCW TS, whose responsibilities would include the use of such protective equipment. Approximately 211 currently assigned OPCW TS inspectors have attended HAZWOPER training; 90 of the 211 inspectors have taken the 48-hour DPE class. The orientation is conducted at the Chemical Demilitarization Training Facility in Edgewood, Maryland. Annual 8-hour HAZWOPER refresher classes are also required, and are being accomplished by the Army in The Hague. DTRA provides USG national escorts for OPCW inspectors while attending required training at US facilities. DTRA insures that all inspectors and escorts receive required training.

5.4 PREPARATION OF DEFENSE INSTALLATIONS

The Military Services and DTRA have developed individual implementation and compliance plans to provide guidance for their commands and activities under the CWC. The Military Services have individually established implementation support offices which participate actively at the DoD CWIWG, provide Service policy direction, and conduct ongoing liaison with their major commands to ensure that all military elements are fully prepared for inspections under the CWC.

The Military Services continue to coordinate actively with DTRA to prepare DoD installations for inspections under the CWC. All defense installations which are subject to declarations under the requirements of the CWC, and many which are subject to challenge inspections even though not declared, have been visited by Military Service representatives and DTRA technical experts. DTRA will continue to support site assistance visits and Army treaty implementation and compliance meetings.

All of the Military Services have held exercises to test their preparedness for short-notice CWC challenge inspections. Such exercises involve the active participation of Service, DTRA, and other DoD representatives in the roles they would assume during a challenge inspection. DoD and the Services have exercised written DoD guidance and procedures to test the operational readiness of personnel and facilities. Commonly, the lead Service responsible for developing an exercise also produces comprehensive Lessons Learned report to ensure DoD readiness for possible challenge inspections. The Services have initiated efforts to ensure that in the case of a challenge inspection affected commands take timely and appropriate measures, based on lessons-learned, to demonstrate compliance while protecting security concerns.

DoD organized both a tabletop and a mock challenge inspection exercise in 2001 at a DoD facility and the TS participated by providing an inspection team. DoD's objective in including the TS was to better understand the challenges DoD would face in demonstrating compliance and protecting national security and gauge TS readiness to conduct a challenge inspection.

5.5 DEFENSE TREATY INSPECTION READINESS PROGRAM

The Defense Treaty Inspection Readiness Program (DTIRP), for which DTRA is the executive agent, has implemented an extensive outreach program to provide information about the CWC, security countermeasures, and facility preparation, to both government and DoD industry. DTIRP provides training and awareness services through such fora as seminars, site assistance visits, mock inspections, mobile training teams, industry associations, national conventions and symposia. DTIRP also publishes various educational products (electronic media and print) and administers electronic bulletin boards to provide information concerning the CWC to government and industry. DTIRP, in close coordination with the Naval Surface Warfare Center at Indian Head, MD, has produced and conducted the Chemical Technology Security Course, to train USG personnel from the Departments of Defense, Commerce, and Justice.

The DTIRP has provided, and will continue to provide, arms control vulnerability assessment teams in support of any requirement to assess risks to national security and United States industry and research institutions such as those required under Public Law 106-113, §1124.

In October 2001, Joint Staff and DTIRP co-sponsored a seminar to provide the CINC CWC Supervisors a seminar formatted program updating them on DoD plans for executing challenge inspections if one should occur in the CINC Area of Responsibility.

5.6 TECHNICAL EQUIPMENT INSPECTION PROGRAM

The Technical Equipment Inspection (TEI) Program ensures OPCW TS verification equipment meets U.S safety, environmental and security requirements through a familiarization process authorized by Conference of States Parties Decision 71. The familiarization results are documented in the "Certification Report of Chemical Weapons Convention Organisation for the Prohibition of Chemical Weapons Technical Secretariat Equipment." In addition, TEI performs chemical agent monitoring of inbound equipment at the Point of Entry to protect U.S. personnel and to prevent inaccurate findings as a result of pre-existing contaminants on the verification equipment.

5.7 ARTICLE X ASSISTANCE AND OTHER ASSISTANCE

Under Article X of the CWC, a State Party to the treaty may make an appeal for assistance through the Director-General of the TS. In accordance with a condition established in the U.S. Senate's Advise and Consent to the Ratification of the CWC, the United States will provide "no assistance…other than medical antidotes and treatment," which the USG deems are necessary, to those CWC States Parties that have requested assistance under Article X of the CWC.

Under the CWC, DoD has not provided any chemical weapons detection equipment or assistance in the safe transportation, storage, and destruction of chemical weapons to other

States Parties. Such assistance, however, is being provided to Russia under DoD's Cooperative Threat Reduction (CTR) program.

5.8 ARMS CONTROL TECHNOLOGY

DTRA conducts research, development, test and evaluation (RDT&E) to support U.S. roles in global CW arms control and nonproliferation initiatives. The primary goal of the program is to protect DoD equities and minimize the threat to national security interests posed by U.S. involvement in CW arms control activities. Related objectives are to assist the U.S. in meeting legal obligations imposed by treaty provisions, support development of U.S. policy, minimize implementation costs, enhance the safety of inspections and conduct research and development (R&D) on enabling technologies for future treaties or nonproliferation initiatives. Current emphasis is on technologies and procedures for on-site analysis under the CWC, development of advanced non-destructive evaluation, and environmental characterization of the emerging CW threat.

DTRA developments to date include analytical software for use in chemical analysis by gas chromatography/mass spectrometry (GC-MS). This software satisfied a critical requirement to prevent the release of potential sensitive or confidential business data during CWC inspections. Additionally DTRA has developed and fielded non-destructive analysis technologies that have been employed as confidence building measures under the CWC. These technologies have also demonstrated their multi-functional role in other nonproliferation related efforts such as United Nations Special Commission (UNSCOM) inspections in Iraq and more recently, support to law enforcement agencies at events such as the Democratic National Convention and the Olympics in Atlanta. DTRA, in cooperation with Finland, also continues to develop and validate procedures for GC-MS sample preparation and is currently finalizing Version 3.0 of these procedures in support of Senate ratification condition 18 of the CWC. Finally, DTRA is cooperating with the intelligence community in the evaluation of new threat agents and their degradation pathways.

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Annex A

Contamination Avoidance Programs

Table A-1. Contamination Avoidance RDA Efforts

Category	Nomenclature	Status	USA	USAF	USMC	USN
Automatic Detectors and Monitors	- M22 Automatic Chem Agent Detection Alarm (ACADA)	Production	Joint	Joint	Joint	Rqmt
	- Improved Point Detection System (IPDS)	Production				Rqmt
	- Improved CAM (ICAM)	Production	Rqmt	Interest	Rqmt	Rqmt
	- Joint Chemical Biological Agent Water Monitor (JCBAWM)	RDTE	Joint*	Joint*	Joint*	Interest
	- Joint Chemical Agent Detector (JCAD)	RDTE	Joint*	Joint*	Joint*	Joint*
	- Biological Point Detection					
	--Interim Biological Agent Detector (IBAD)	Fielded				*Rqmt*
	--Biological Integrated Detection System (BIDS NDI)	Fielded	*Rqmt*			
	--BIDS P3I	Fielded	*Rqmt*			
	--DOD Biological Sampling Kit	Fielded	Joint	Joint	Joint	Joint
	- Detection System, Biological Agent: Joint Portal Shield	Production	Joint	Joint		Joint
	- Joint Bio Point Detection System (JBPDS), Block I	RDTE	Joint	Joint	Joint	
Remote/ Early Warning	- Joint Service Lightweight Stand-off Chemical Agent Detector (JSLSCAD)	RDTE	Joint	Joint	Joint	Joint
	- Joint Service Warning and Identification LIDAR Detector (JSWILD/Artemis)	RDTE	Interest	Interest	Interest	Interest
	- Joint Bio Stand-off Detection System (JBSDS)	RDTE	Joint	Joint	Joint	Joint
NBC Recon	- Joint Service NBC Reconnaissance System (JSNBCRS)	RDTE				
	--NBCRS/CB Mass spectrometer	*	*Rqmt*		*Rqmt*	
	--Joint Service Light NBCRS/Lightweight Recon System (JSLNBCRS)	*	Joint	Joint	Joint	*Interest*
	- Interim Armored Vehicle-NBC Recon Vehicle (NBCRV Block II)	RDTE	Joint			
Warning and Reporting	- Joint Warning and Reporting Network (JWARN)	RDTE/Prod	Joint	Joint	Joint	Joint
	-- Multipurpose Integrated Chemical Agent Detector (MICAD)	*	*Rqmt*		*Rqmt*	
Radiation Detection	- AN/UDR-13 Pocket Radiac	Production	Rqmt	Interest		
	- AN/PDR-75 Radiac	Fielded	Rqmt		Rqmt	
	- AN/PDR-77 Radiac	Fielded	Rqmt			
	- AN/VDR-2 Radiac	Fielded	Rqmt		Rqmt	
	- Multi-Function Radiac	Fielded	Rqmt			
	- ADM-300A	Fielded		Rqmt		

Joint= Joint Service requirement
Rqmt= Service requirement
Rqmt, Interest= sub-product requirement or interest
LRIP= Low Rate Initial Production
Joint*=Draft Joint Service requirement
Int-NIR= Service interest, no imminent requirement
*= Sub-product(s) of a Joint project

DETECTORS AND MONITORS

FIELDED AND PRODUCTION ITEMS

Chemical Agent Monitor (CAM) and Improved Chemical Agent Monitor (ICAM)

The CAM is a hand held instrument capable of detecting, identifying, and providing relative vapor hazard readouts for G and V type nerve agents and H type blister agents. The CAM uses ion mobility spectrometry (IMS) to detect and identify agents within one minute of agent exposure. A weak radioactive source ionizes air drawn into the system, and the

CAM then measures the speed of the ions' movement. Agent identification is based on characteristic ion mobility and relative concentrations based on the number of ions detected. The ICAM has the same chemical agent detection capability as the CAM; improvements are that it is 300% more reliable, starts up 10 times faster, and the modular design is much less expensive to repair. The ICAM has the additional features of an RS-232 data communications interface, and the ability to be programmed for new/different threat agents. The four pound, 15" long ICAM can be powered either by an internal battery or by an external source through the ICAM's combination power/fault diagnosis/RS-232 plug. The ICAM may be used for a variety of missions, to include area reconnaissance and area surveillance, monitoring of decontamination operations, and medical triage operations. The ICAM significantly reduces the level and frequency of maintenance *vs*. CAM without affecting performance. The ICAM sieve pack has double the capacity of the two CAM sieve packs, which results in twice the operational life of the ICAM over the CAM. When fielded, the ICAM will significantly reduce operating and sustainment costs associated with the CAM by $135 million over its life cycle in present day dollars. This savings is based on the total planned procurement of the ICAM, and would be greater if all CAMs were replaced by ICAMs.

M31 Biological Integrated Detection System (BIDS)
Non-Developmental Item (NDI) & Pre-Planned Product Improvement (P3I)

BIDS uses a multiple technology approach, both developmental and off-the-shelf materiel, to detect biological agents with maximum accuracy. BIDS is a vehicle-mounted, fully integrated biological detection system. The system, which is a collectively-protected, HMMWV-mounted S788 shelter, is modular to allow component replacement and exploitation of "leap ahead" technologies. The NDI variant is capable of detecting and presumptively identifying four BW agents simultaneously in less than 45 minutes. Thirty-eight BIDS NDI (*version shown*) were fielded to the 310th Chemical Company (U.S. Reserve) during FY96. This gave DoD its first credible, rapidly deployable biological detection capability. The BIDS is a Corps level asset. The P3I BIDS is capable of detecting and presumptively identifying 8 BW agents simultaneously in 30 minutes. The suite is semi-automated and contains next generation technologies such as the Ultraviolet Aerosol Particle Sizer (UVAPS), Chemical Biological Mass Spectrometer (CBMS), Mini-Flow Cytometer, and the Biological Detector (BD). Fielding of 38 systems to the 7th Chemical Company was completed in October 1999. In 4QFY03, the third BIDS company, 13th Chemical (P3I), will be fielded at Ft. Hood, Texas.

Interim Biological Agent Detector (IBAD)

IBAD provides shipboard detection of biological warfare agents. IBAD consists of a particle sizer/counter, wet wall cyclone particle sampler, and hand held assays (HHAs) for the presumptive identification of suspect aerosol particles. IBAD is capable of detecting an increase in the particulate background, which may indicate a man-made biological attack is underway, and sampling the air for identification analysis. IBAD can detect a change in background within 15 minutes and can identify biological agents within an additional 30 minutes, utilizing the HHAs. It is an interim rapid prototype system that started service with the fleet in FY96. Twenty IBAD

systems have been fielded. These systems will be among ship platforms as dictated by fleet priorities.

Detection System, Biological Agent: Joint Portal Shield

The Joint Portal Shield (JPS) is DoD's first networked biological detection system. Portal Shield is a Joint Service capability for biological detection at high value fixed assets. The system uses an innovative network of sensors to increase probability of detecting a biological warfare attack while decreasing false alarms and consumables. The JPS system consists of a variable number of biological sensors forming a network under the command and control of a centralized command post computer (CPC). The CPC communicates with and monitors the operation of each sensor. The sensor is modular in design and can detect and presumptively identify up to eight BW agents simultaneously in less than 25 minutes. Currently, nine overseas sites are fielded and outfitted with JPS networks. Twelve additional sites are being fielding with scheduled completion by 4QFY02. In addition the systems have a chemical sensor interface (M22, M21, M90), which provides an integrated chemical and biological sensor network capability.

The JPS program was initiated in FY96 as an Advanced Concept Technology Demonstration (Air Base/Port Biological Detection ACTD). With a successful Military Utility Assessment (MUA) in FY97, a fielding in FY98 in support of Operation Desert Thunder and a Directed Procurement memorandum from The Office of the Joint Chiefs of Staff, a Milestone III review was held and approved in Jan FY99. The MS III transitioned the program from an ACTD into production and the system was approved for the fabrication, installation, and support at high value CINC fixed sites overseas. The fielding (237 sensors) when completed will provide coverage at 21 fixed sites.

Production is ongoing with 97 sensors scheduled for delivery in FY02. Currently 52 of the 97 are in transit for additional CENTCOM sites located in Oman, the Kingdom of Saudi Arabia, United Arab Emirates, Qatar and Bahrain.

The Commanders-In-Chiefs from the United States Central Command (CENTCOM) and the Pacific Command (PACOM) are the operational sponsors of the JPS program. Contractor Logistics Support (CLS) personnel are on-site at fielded locations in the CENTCOM and PACOM theaters of operation to maintain and repair the Joint Portal Shield equipment. In FY02 the Service sites began transition of operations and sustainment (O&S) support from the Joint Program Office of Biological Defense to a Service responsibility. In FY03 all O&S support will become a Service responsibility.

Joint Biological Point Detection System (JBPDS)

JBPDS provides point biological detection capabilities for all four services and throughout the battlespace. The system, which complements Joint Portal Shield and P3I BIDS and replaces the NDI-BIDS and IBAD, is both more reliable and sensitive than all predecessor systems. The sensor's highly maintainable and modular design detects and presumptively identifies ten BW agents simultaneously in less than 20 minutes. Its detection suite is common across multiple configurations (*i.e.*, the XM96 Man Portable, the XM97 Shelter, the XM98 Shipboard, and the XM102 Trailer Mounted for airbase, vehicle, surface combatant and marine expeditionary applications). The system may be operated locally or remotely, and fully automates the functions of: *collection* (capturing samples of the suspect aerosol for systems and confirmatory analysis), *detection* (interrogating and broadly categorizing the contents of the aerosol), *identification* (providing presumptive identification of the suspect BW agent), and *warning* (providing visual and audible alert to local and remote control units). This acquisition strategy allows for significant economies throughout the RDA process, eliminating duplicative efforts among the Services, and greater logistic supportability in joint operations. The current strategy also offers the fastest possible fielding of these urgently required systems, as well as the flexibility needed to continuously improve the system (by virtue of a parallel Block II Spiral Development effort) with the latest advances in the biological detection/identification, information processing and engineering sciences.

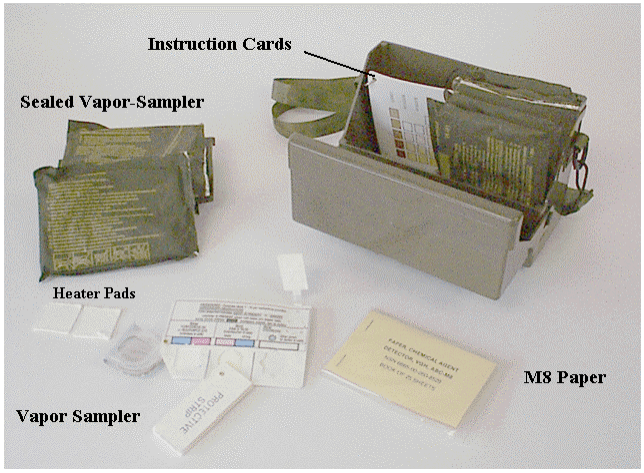
Hand Held immunochromatographic Assay (HHA)

The HHA is a simple, antibody-based test used as a quick screen to presumptively identify BW agents from environmental samples. HHAs are inexpensive, easy to use, very reliable, and provide presumptive identification in 15 minutes. HHAs are designed to presumptively identify one agent per HHA and can currently identify ten different BW threat and four simulant agents. Training HHAs are also available. HHAs are read at 15 minutes and can either be read by eye or incorporated into automated detection device (*e.g.*, XM-99 Joint Portal Shield, Joint Biological Point Detection System (JBPDS), *etc*.). HHAs should not be used for the analysis of soil samples and are not for diagnostic use. HHAs must be stored at 4°C, but cannot be frozen. Shelf life at refrigeration temperatures (4°C) is 2 years. The HHA has a one-time use only capability, cannot be reused once fluid is applied, and must be disposed of as medical waste. All HHA results must be confirmed by a "Gold Standard" laboratory.

DoD Biological Sampling Kit

The DoD Biological Sampling Kit, with its associated HHAs, provides a presumptive identification capability for BW agents in environmental samples and are employed for: field screening suspect munitions or munitions fragments for presence of biological warfare (BW) agents; screening envelopes or packages that display suspicious liquids, powders or suspensions; screening suspect terrorist laboratory or weapons materials that might be associated with the manufacture or delivery of BW agents; or as a contamination identification kit for indoor areas where it is suspected a BW agent has been released in fairly high concentrations. The DoD Biological Sampling Kit contains a panel of 8 HHAs, a blue-capped tube containing a bottle of buffer solution and cotton tipped swabs, and a basic instruction card. Training DoD Biological Sampling Kits are also available as well as an interactive, multimedia training CD-ROM. The DoD Biological Sampling Kit must be stored at 4ºC, has a one-time use only capability, and is not for diagnostic use. All components of the DoD Biological Sampling Kit must be disposed of as medical waste. All HHA results must be confirmed by a "Gold Standard" laboratory.

M256A1 Chemical Agent Detector Kit



The M256A1 kit can detect and identify field concentrations of nerve agents (sarin, tabun, soman, GF, and VX), blister agents (mustard, phosgene oxime, mustard-lewisite, and lewisite), and blood agents (hydrogen cyanide and cyanogen chloride) in both vapor and liquid form in about 15–20 minutes. The kit consists of a carrying case containing twelve chemistry sets individually sealed in a plastic laminated foil envelope, a book of M8 chemical agent detector paper, and a set of instructions. Each detector ticket has pretreated test spots and glass ampoules containing chemical reagents. In use, the glass ampoules are crushed to release a reagent, which runs down pre-formed channels to the appropriate test spots. The presence or absence of chemical agents is indicated through specific color changes on the test spots. The kit may be used to determine when it is safe to unmask, to locate and identify chemical hazards (reconnaissance), and to monitor decontamination effectiveness.

ABC-M8 VGH, and M9 Chemical Agent Detector Paper

M8 and M9 paper are dye impregnated papers that change color when exposed to liquid chemical agents or aerosols. These papers cannot detect chemical agents in vapor form. M8 paper (*shown*) comes in 4" by 2 $^{1}/_{2}$" booklets. Each booklet contains 25 sheets of detector paper that are capable

of detecting G series nerve agents (sarin, tabun, soman, and GF), V type nerve agents, and H (mustard) type blister agents. M8 paper can identify agents through distinctive color changes from its original off-white: yellow-orange for G, blue-green for V, and red for H. M8 paper is typically used to identify unknown liquid droplets during chemical reconnaissance/surveillance missions. M9 (SR119) detector paper (*shown right*) is rolled into 2-inch wide by 30-feet long rolls on a 1.25-inch diameter core. M9 paper can detect G and V nerve agents, H agents, and L agents but it cannot distinguish the identity of agents. It turns pink or a shade of red when in contact with liquid chemical nerve and blister agents. M9 paper is typically placed on the BDO, equipment, and vehicle exteriors to warn personnel of the presence of a liquid chemical agent.

M18A3 Chemical Agent Detector Kit

The M18A3 can detect and identify dangerous concentrations of nerve agents (sarin, tabun, soman, GF, and VX), blister agents (mustards, phosgene oxime, mustard-lewisite mixture, phenyl dichloroarsine (PD), ethyl dichloroarsine (ED), and methyl dichloroarsine (MD)), blood agents (hydrogen cyanide and cyanogen chloride), and choking agents (phosgene) in about 1–4 minutes. The kit is also used to confirm results of the M256A1 kit. The M18A3 kit contains a squeeze bulb and enough detector tubes, detector tickets, and chemical reagents needed to conduct 25 tests for each agent vapor. The kit also contains a booklet of M8 chemical agent detector paper to detect liquid agents. Agent vapor detection is indicated by the production of a specific color change in the detector tubes. The M18A3 kit is only used by special teams such as surety teams or technical escort personnel.

M272 Water Test Kit

The M272 kit can detect and identify hazardous levels of nerve, blister, and blood agents in treated or untreated water resources in about 20 minutes. The kit contains enough detector tubes, detector tickets, a test bottle, and pre-packed, pre-measured test reagents to conduct 25 tests for each agent. The kit also contains simulants used for training. Agent detection in water is indicated by the production of a specific color change in the detector tubes or in the ticket. The M272 was fielded in 1984 and does not meet current lower level detection requirements.

M8A1 Automatic Chemical Agent Alarm (ACAA)

The M8A1 ACAA is a system that continuously samples the air to detect the presence of dangerous concentrations of G and V type nerve agent vapors. This system is currently being replaced by the ACADA in many Army units. Displaced M8A1 systems are being cascaded to lower priority units throughout the Army. The M8A1 ACAA may be employed in a number of configurations, but all configurations are built around the M43A1 detector unit and the M42 alarm unit. The configurations differ primarily in their mountings and power supplies: ground mounted and battery operated, or mounted on a vehicle and powered by the vehicle's electrical system. The M43A1 detector unit measures 7 1/2" x 5 1/2" x 11". Using the battery in ground mounted operations adds another 7 3/4" to the height. The M43A1 detector unit uses a radio-isotope to ionize molecules in

the air that is pumped through the system, then detects electrical current changes that occur in the presence of nerve agents. The M43A1 detector unit will alarm within about 1-2 minutes from exposure to agent. The M42 alarm unit is a remote visual and audible alarm that measures 7" x 4" x 2 1/3". The M42 alarm unit may be placed up to 400 meters from the M43A1 detector unit to give users warning of an approaching agent cloud.

M90 Automatic Agent Detector (AMAD)

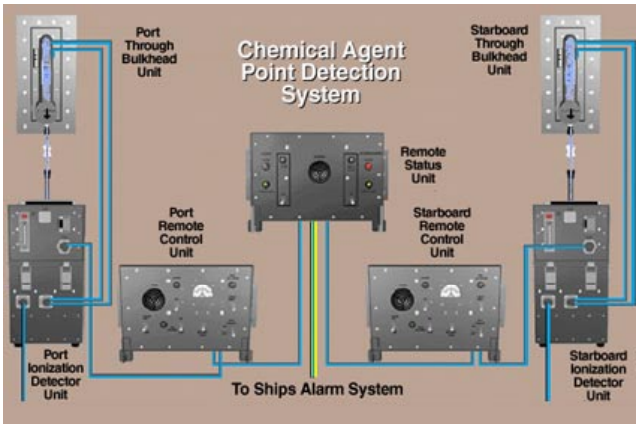
The AMAD is an automatic nerve and mustard agent detector that detects agents in vapor form. This system is currently in use by the Air Force. It transmits an alarm by radio to a central alarm unit.

Automatic Liquid Agent Detector (ALAD)

The ALAD is a liquid agent detector that can detect droplets of GD, VX, HD, and L as well as thickened agents. It transmits its alarm by field wire to a central alarm unit. Although the remote transmission is useful, the device only detects droplets of liquid agents. It must be used in conjunction with other point or standoff vapor agent detectors to afford a complete detection capability.

Chemical Agent Point Detection System (CAPDS), MK21, MOD1

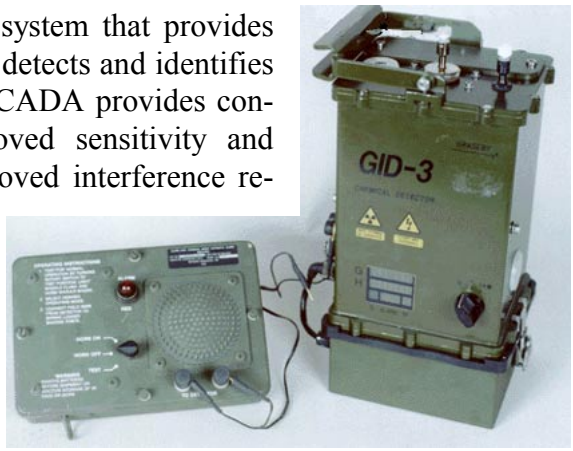
CAPDS is a fixed system capable of detecting nerve agents in vapor form, using a simple baffle tube ionization spectrometer. Installed in a ship's upper superstructure level, CAPDS obtains a sample of external air, ionizes airborne vapor molecules, and collects them on a charged plate after eliminating lighter molecules via the baffle structure. When a sufficient mass of ions is collected, a pre-set potential is achieved, and an alarm signal is generated and sent to both Damage Control Central and the bridge. The system has been installed on almost all surface ships.



Improved (Chemical Agent) Point Detection System (IPDS)

The IPDS is a new shipboard point detector and alarm that replaces the existing shipboard CAPDS. IPDS uses special elongated ion mobility cells to achieve the resolution necessary to counter false alarms caused by interferent vapors. IPDS can detect nerve and blister agent vapors at low levels, and automatically provide an alarm to the ship. The unit is built to survive the harsh sea environment and the extreme electromagnetic effects found on Navy ships.

M22 Automatic Chemical Agent Detection Alarm (ACADA)



ACADA is a man-portable, point sampling alarm system that provides significant improvement over current capabilities; it detects and identifies all nerve agents, mustard, and lewisite, by class. ACADA provides concurrent nerve and blister agent detection, improved sensitivity and response time, agent identification capability, improved interference rejection, extensive built-in test, a data communications interface, and the capability to be programmed for new threat agents. It replaces the M8A1 Alarm as an automatic point detector and augments the CAM as a survey instrument. The ACADA consists of an off-the-shelf non-developmental item (NDI)—the GID-3 chemical agent alarm. A shipboard version of the ACADA is being built to address the unique interferents found aboard Navy ships that cause false alarms on the NDI ACADA. The shipboard version of ACADA will serve to cover the Navy's emergency requirements until the Joint Chemical Agent Detector can be fielded.

DETECTORS AND MONITORS

RDTE ITEMS

Agent Water Monitors

The Joint Service Chemical Biological Agent Water Monitor is a cooperative RDTE effort, chartered to develop a detection system which will detect chemical and biological agents in water. The detector will feature multi-agent capabilities, and operate automatically, improving both ease and response time of existing system. The project will accommodate the four services' requirements.

Rationale:

- Joint Army, Air Force, and Marine Corps requirement
- Navy interest

Key Requirements:

- Detect and identify chemical agents and agents of biological origin in water
- Perform monitoring automatically with continuous and batch sampling capabilities
- Easy to operate and support in forward areas, austere environments, and limited lighting

Description:

The Agent Water system will improve current water monitoring and purifying capabilities. It will automatically detect CB agents at or below harmful levels in water and not false alarm to common interferents. The system will be compact, man-portable and easy to use, and be decontaminated to a negligible risk level.

Joint Chemical Agent Detector (JCAD)

The JCAD is a fully cooperative RDTE effort, chartered to develop a chemical agent detector for a variety of mission requirements and service platforms. The detector will provide warfighters near-real time information on the presence of chemical agents so that miosis or more severe effects can be avoided and not subvert the mission. The project will accommodate the four services' requirements.

Rationale:

- Joint Army, Navy, Air Force, and Marine Corps requirement

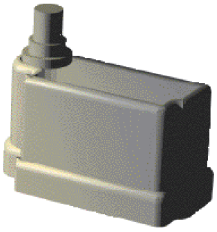
Key Requirements:

- Small, lightweight detector capable of detecting presence of chemical agent vapors
- Capable of de-warning, allowing for rapid reduction of protective postures
- Detect, identify, quantify, and warn of
  presence of even low levels of nerve, blister,
  and blood agents in vapor form in aircraft and shipboard interiors
- Operated/maintained by ship's force;
  operate in a shipboard environment

Description:

JCAD will provide a detector or a network of detectors capable of automatically detecting, identifying, and quantifying chemical agents (nerve, blister, and blood) inside aircraft and shipboard interiors. The device must be sufficiently sensitive to warn aircrews before accumulation, over the entire mission, of levels of agent that may cause miosis or more severe effects. JCAD will also provide hand-held monitoring capabilities, protecting the individual soldier, sailor, airman, and marine through the use of pocket-sized detection and alarm.

Real-Time Monitor



Pre-Concentrator - to Meet Low Level Detection Limits

Post-Attack Monitor

Force Medical Protection/Dosimeter ACTD

Rationale:

- Supports Joint Forces Command (JFCOM)

Key Requirements:

- Develop an individually worn sampler that can continuously measure and archive exposure levels of chemical and biological warfare agents using passive sampling methodology (Phase I)
- Include real-time analysis, an alarm to warn the wearer of an immediate chemical hazard, and a trap for biological agents for later analysis (Phase II)
- Develop extensive concepts of operations (CONOPS) encompassing diverse operational forces and scenarios

Description:

The Force Medical Protection Dosimeter ACTD seeks to develop an individually worn sampler that can continuously measure and archive exposure levels of chemical and biological warfare agents. The Phase I of the development emphasizes collection and archiving of exposure to chemical agents using passive sampling methodology. Phase II includes real-time analysis, an alarm to warn the wearer of an immediate chemical hazard, and will trap biological pathogens for later analysis.

Improved detection and identification capabilities will provide greater awareness of immediate chemical exposure risk, more precise identification of exposure, and amount of individual or multiple doses, which will result in improved situational awareness, treatment, and record keeping. Additional payoffs will include the ability to perform real-time analysis of agents, communication of exposure information to command centers, and increased battlefield awareness and intelligence.

Specific challenges include developing technologies to collect, analyze, and differentiate between agents, interferents, and naturally occurring compounds; improving selectivity and sensitivity to agents. Providing communications capabilities and real-time alarm while reducing size and weight will require advances in sampling methods, chemical analysis techniques, and electronics. Developing CONOPS for use of a sampler will require modeling, experimentation, field testing to improve capabilities and increase utility, and analysis to determine value of information of exposure data collected, especially if exposure levels are below threshold clinical effects levels.

BIOLOGICAL LONG LINE SOURCE RELEASE AND POINT DETECTION

RDTE ITEMS

Biological Point Detection is a fully cooperative acquisition effort chartered to develop new biological point detectors and detection systems for the four services. The BIDS effort encompasses development of an integrated system as well as several stand-alone biological detectors. In addition, a Joint Biological Point Detection System (JBPDS) is under development. JBPDS will be a system that can stand alone, or be used in a suite of systems.

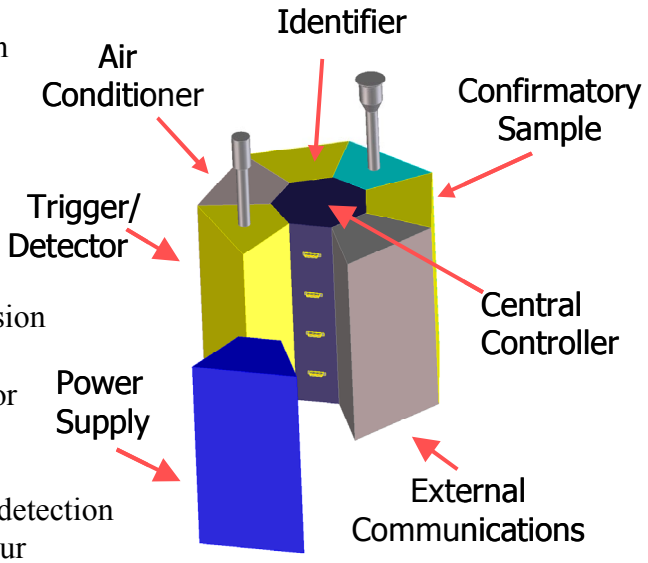
Joint Biological Point Detection System (JBPDS) Block II

Rationale:

- Joint Army, Navy, Air Force, and Marine Corps requirement

Key Requirements:

- Automatically detect, identify and warn of the presence of biological warfare and produce a sample for transport to and further analysis by designated laboratories.
- Simultaneously identify eight to ten agents with and interchangeable library of assays for all ITF-6 agents.
- Detect cloud concentrations better than Block I and/or militarily significant levels of BW agents at a detection probability of 90% in less than five minutes.
- Reliability of 0.92.
- Availability of 0.90.
- Mean Time Between Operational Mission Failure of 288 hours
- Mean Corrective Maintenance Time for Operational Mission Failure Repair of 5 hours or less.
- Provide a common suite of biological detection equipment that can be applied to all four services' designated platforms



Potential JBPDS Block II Configuration

Description:

This developmental system will replace all existing biological detection systems (BIDS, IBAD and the Joint Portal Shield Network System), and complement the JBPDS Block I in the field. It will provide biological detection capabilities for all four services and throughout the battlespace. The Block II JBPDS program will undertake a spiral development process to exploit rapid advances taking place in the biological detection and identification, information processing and engineering sciences. The Block II Development effort will yield technology advancements and insertions into the Block I Production

effort and provide for the fastest possible fielding and upgrade of joint biological detection capabilities. The PM, JBPDS plans to award a Development contract in FY03 for the design, integration and fabrication of Block II JBPDS. Block II Low Rate Initial Production is anticipated to start in FY06, with first unit equipped in FY07.

Critical Reagents Program (CRP)

Rationale:

- Supports all Services, DoD first responders, Federal Agency's, and NATO countries' biological detection programs

Key Requirements:

- Provide Total Life Cycle Management for the critical reagents (antibodies, antigens, and gene probes and primers), Hand Held Assays (HHAs), and DoD Biological Sampling Kits necessary to the operation of all DoD biological detection systems.
- Ensure best quality reagents and HHAs are available in time and in adequate quantities.
- Ensure adequate security and surge capability of critical reagents and HHAs.
- Produce Hand Held Assays (HHAs) and DoD Biological Sampling Kits that are critical to all DoD biological detection programs.

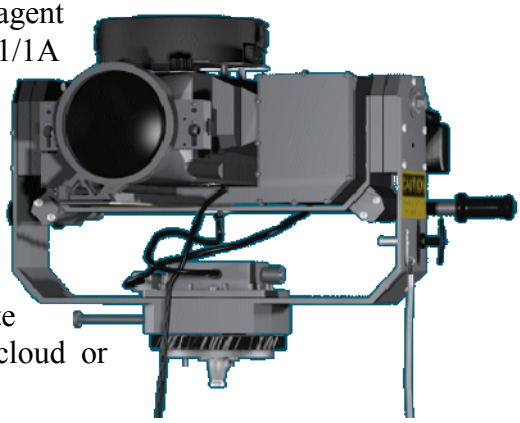
Description:

The Critical Reagents Program (CRP) ensures the quality, availability, and security of BW reagents, Hand Held Assays (HHAs) and DoD Biological Sampling Kits, which are critical to the successful development, test, and operation of DoD biological warfare detection systems and medical biological products. The program maintains an R&D effort to ensure the best possible reagents are available for use against both current and emerging threats and to include analysis of commercially available reagents and technologies. The CRP has instituted a program-wide quality assurance program and addresses relevant security issues. The CRP consolidates all DoD antibody, antigen, gene probe/primer, HHA, and DoD Biological Sampling Kit developments and requirements. The CRP currently has reagents and HHAs to detect 10 BW threat agents from the ITF-6A threat list. The CRP provides required reagents and HHAs to support fielded DoD BW detection systems (BIDS NDI and P3I, XM-99 Joint Portal Shield, IBAD, and DoD Biological Sampling Kits) and developmental systems (JBPDS), as well as other Federal Agencies and NATO allies. The near future requires the development of 12 additional reagents to support the development and fielding of JBPDS Block II and the development of environmental and diagnostic molecular reagents for the JBAIDS. Outlying years will focus on the development of reagents to identify new and emerging threats and the procurement of improved reagents to replace older stocks.

STAND-OFF DETECTION AND REMOTE/EARLY WARNING

FIELDED AND PRODUCTION ITEMS

AN/KAS-1/1A Chemical Warfare Directional Detector (CWDD)



This is a semi-portable system designed to detect nerve agent vapor clouds at ranges up to five kilometers. The AN/KAS-1/1A must be removed from its stowage case and set up on a pre-installed pedestal for operation. A trained, diligent operator must manually aim the detector at the suspect cloud and interpret its infrared images to determine whether or not the cloud contains nerve agent vapors. The AN/KAS-1A provides a remote video display, an enhanced capability for vapor cloud analysis, and a remote relative bearing indicator useful for avoiding the agent cloud or other surface target with a thermal signature.

M21 Remote Sensing Chemical Agent Alarm (RSCAAL)

The M21 RSCAAL is an automatic scanning, passive infrared sensor that detects nerve (GA, GB, and GD) and blister (H and L) agent vapor clouds based on changes on the infrared spectrum caused by the agent cloud. It is effective at line-of-sight distances of up to five kilometers. The alarm is used for surveillance and reconnaissance missions in both vehicle-mounted and tripod-mounted modes.

STAND-OFF DETECTION AND REMOTE/EARLY WARNING

RDTE ITEMS

Joint Service Lightweight Standoff Chemical Agent Detector (JSLSCAD)

Rationale:

- Joint Army, Navy, Air Force, and Marine Corps requirement. (Army is lead Service)

Key Requirements:

- Automatically detect nerve, blister, and blood agents at a distance up to 5 km
- Lightweight and employed from manned and unmanned systems
- Capable of being data-linked with centralized hazard information data collection center
- Capable of remote operations; aerial and on-the-move operation

Description:

JSLSCAD will be capable of scanning 360° x 60°, and automatically detecting nerve or blister agents at a distance up to 5 km. The system will be light, compact and operate from a stationary position or on-the-move. The JSLSCAD Michelson interferometer employs a passive infrared system that will detect presence of chemical agents by completing a spectral analysis of target vapor agent chemical clouds. JSLSCAD is envisioned for employment on various platforms and in various roles, including fixed site defense, unmanned aerial vehicles, tanks and other vehicles, and on board ships. Among the vehicle platforms will be the JSLNBCRS (both HMMWV and LAV variants).

Joint Service Warning and Identification LIDAR Detector (JSWILD/Artemis)

JSWILD is a joint effort chartered to develop a chemical warning and identification system for each of the Services. JSWILD will utilize an active LIDAR sensor to perform rapid agent identification and ranging to satisfy requirement for all four services.

Rationale:

- Army, Navy, and Air Force interest

Key Requirements:

- Automatically detect, range, and map CW agents at distances of up to 20 km
- Scan atmosphere and terrain to detect chemical vapors and airborne liquids and particles
- Provide stand-off capability for both fixed site and reconnaissance
- Provide rapid agent concentration mapping

Description:

JSWILD/Artemis will be a vehicle-mountable (*concept shown*), contamination monitoring system, which detects and quantifies all types of chemical agent contamination (including agent rain, vapors, and aerosols) in a stand-off mode from a distance of 20 kilometers (km). The JSWILD/Artemis will operate from fixed sites ground vehicles, or shipboard. The system has distance-ranging and contamination-mapping capabilities and transmits this information to a battlefield information network.

Biological Remote/Early Warning

The Joint Biological Remote Standoff Detection System (JBSDS) program is intended to give the warfighting commander a significantly shortened decision cycle regarding biological attacks; that is, the commander will see and be able to react to a biological attack much faster, thereby allowing many more personnel to take protective measures before they become exposed to the biological warfare agents. This means that fewer people will become casualties, and fewer people will have to take post-attack medical treatments.

Joint Biological Standoff Detection System (JBSDS)

Rationale:

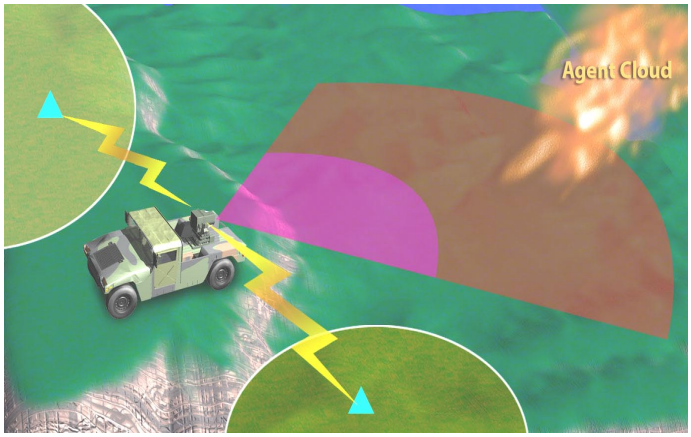
- Joint Requirement

Key Requirements:

- Detect and track aerosol clouds out to 15 km
- Discriminate biological particles from non-biological particles in aerosol clouds out to 3 km
- Operate at fixed site or in stationary mode from mobile platform
- Operate in conjunction with bio point detectors
- Operationally skin and eye safe

Description:

The JBSDS will be a standoff early warning biological detection system. The system will be capable of providing near real time, on-the-move detection of biological attacks/ incidents and standoff early detection/ warning of BW agents at fixed sites or when mounted on multiple platforms, including NBC reconnaissance platforms. JBSDS will be employed to provide detection of biological hazards employed by various means and will provide early warning via the Joint Warning and Reporting Network (JWARN). JBSDS will augment and integrate with existing biological detection systems to provide a biological detection network capable of near real time detection and warning theater-wide to limit the effects of biological agent hazards against U.S. forces at the tactical and operational level of war. JBSDS will have the flexibility to warn automatically or to allow for human intervention in the detection-to-alarm process. JBSDS will be employed in support of various areas of interest (*e.g.*, fixed sites, air/sea ports of debarkation, amphibious landing



sites, *etc*.), remotely, in unattended configurations, or on platforms to include vehicles, aircraft, and ships. JBSDS will pass detection information and warnings through existing and planned communications networks (*e.g.*, JWARN). Commanders may integrate JBSDS outputs with information from intelligence, meteorological and oceanographic, radar, medical surveillance, local area operations, and other available assets to increase force protection, mitigate the consequence of biological hazards, and maximize combat effectiveness.

NBC RECONNAISSANCE

FIELDED AND PRODUCTION ITEMS

M93 NBC Reconnaissance System (NBCRS)

The M93 NBC Reconnaissance System, known as the FOX, is a high mobility armored vehicle capable of performing NBC reconnaissance on primary, secondary, and cross country routes throughout the battlefield. The NBCRS was procured as a Non-Developmental Item and is capable of detection, warning and sampling the effects of NBC weapons and is used as a reconnaissance vehicle to locate, identify and mark chemical and nuclear contamination on the battlefield. The M93 FOX usually accompanies the scouts or motorized reconnaissance forces when performing its NBC mission. The NBCRS has an overpressure filtration system that permits the crew to operate the system in a shirt sleeve environment which is fully protected from the effects of NBC agents and contamination. It utilizes a secure communications system to warn follow-on forces. Samples gathered are forwarded to the Theater Area Medical Laboratory for further analysis and verification. The mobility platform is a six wheeled all wheel drive, armored combat vehicle capable of cross-country operation at speeds up to 65 MPH. The Fox System is fully amphibious and is capable of swimming speeds up to 6 MPH. The M93 NBCRS has been fielded worldwide to the Army and Marine Corps forces.

M93A1 – FOX NBC Reconnaissance System (NBCRS)

The Block I Modification–M93A1 NBCRS contains an enhanced and fully integrated NBC sensor suite consisting of the M21 RSCAAL, MM1 Mobile Mass Spectrometer, CAM/ICAM, AN/VDR-2, and M22 ACADA. The NBC sensor suite has been digitally linked together with the communications and navigation subsystems by a dual-purpose central processor system known as MICAD. The MICAD processor fully automates NBC Warning and Reporting functions and provides the crew commander full situational awareness of the Fox's NBC sensors, navigation, and communications systems. The M93A1 FOX is also equipped with

an advanced position navigation system (GPS & ANAV) that enables the system to accurately locate and report agent contamination. The NDI mobility platform is a six wheeled, all wheel drive armored vehicle capable of cross-country operation at speeds up to 65 MPH. The Fox System is also fully amphibious and is capable of swimming at speeds up to 6 MPH. It is used as a reconnaissance vehicle to locate, identify, and mark chemical and biological agents on the battlefield. The FOX usually accompanies the scouts or motorized reconnaissance forces when performing its NBC mission.

NBC RECONNAISSANCE

RDTE ITEMS

NBC Reconnaissance System (NBCRS) Block II

Rationale:

- U.S. Army and U.S. Marine Corps Requirements

Description:

The Block II modification will incorporate enhanced chemical and biological detectors that will allow on-the-move standoff chemical agent vapor detection (*i.e.*, JSLSCAD). Biological agent detection capability is added for the first time through the Chemical Biological Mass Spectrometer (CBMS). The CBMS also improves the detection and identification of liquid agents. Integration of common NBC technical architecture will facilitate low-cost expansion/upgrading of on-board computers. The NBCRS Block II Program will provide CB Sensor Suites to the Army's Nuclear, Biological and Chemical Reconnaissance Vehicle (NBCRV) Program, which will be used to equip the Army's future Brigade Combat Teams.

Joint Service Light NBC Reconnaissance System (JSLNBCRS)

Rationale:

- Joint U.S. Army, U.S. Air Force, and Marine Corps Requirements

Key Requirements:

- Stand-off and point detection from vehicle mounted or dismounted operations
- Chemical standoff detection
- Detection while on-the-move capability from speeds of 0–45 kph
- Biological point detection and identification
- A dismountable, handheld, self-contained chemical point detection capability
- Radiological detection capability (vehicle mounted or dismounted operations)
- Collective protection

- Environmental Conditioning Unit capable of providing climate conditioning for the crew and equipment
- Overpressure protection from all known agents

Description:

The JSLNBCRS will provide a premiere vehicle for accurate, rapid NBC combat hazard information by verifying the absence of, finding, mapping, and marking radiological, biological, and chemical hazards. The JSLNBCRS will be an integration of advanced NBC detection and analysis equipment suited for Marine Air-Ground Task Forces (MAGTFs), U.S. Air Force tactical forces, and U.S. Army Light Contingency Forces. Two variants, the High Mobility Multipurpose Wheeled Vehicle (HMMWV) (*variant shown*) and the Light Armored Vehicle (LAV) are planned and will house the same equipment.

WARNING AND REPORTING

FIELDED AND PRODUCTION ITEMS

Joint Service Warning and Reporting Network (JWARN) (FUE FY 99)

Rationale:

- Army, Navy, Air Force, and Marine Corps requirement

Key Requirements:

- Capable of interfacing with all NBC detectors and sensors
- Capable of interoperability with all service command and control systems
- Capable of generating NBC reports
- Capable of automatic transmission of NBC alarm and data
- Capable of vehicle operation

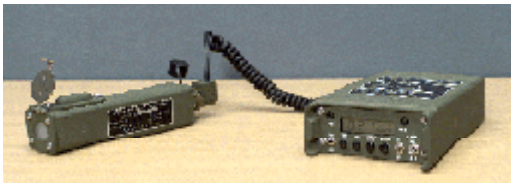
Description:

JWARN is an automated Nuclear, Biological, and Chemical (NBC) Information System. JWARN will be essential for integrating the data from NBC detectors and sensors into the Joint Service Command, Control, Communication, Computers, Information and Intelligence (C^4I^2) systems and networks in the digitized battlefield. JWARN will provide the Joint Force a comprehensive analysis and response capability to minimize the effects of hostile NBC attacks or accidents/incidents. JWARN will also provide the Joint Forces with the operational capability to employ NBC warning technology that will collect, analyze, identify, locate, report and disseminate NBC threat and hazard information. JWARN will be located in command and control centers at the appropriate level defined in Service-specific annexes and employed by NBC defense specialists and other designated personnel. It will transfer data automatically from and to the actual detector/sensor/network node and provide commanders with analyzed data for decisions for disseminating warnings to the lowest echelons on the battlefield. It will provide additional data processing, production of plans and reports, and access to specific NBC information to improve the efficiency of NBC personnel assets. A Block I upgrade is planned to automate NBC warning and reporting tools and to standardize NBC warning and reporting requirements across the Service boundaries.

RADIACS

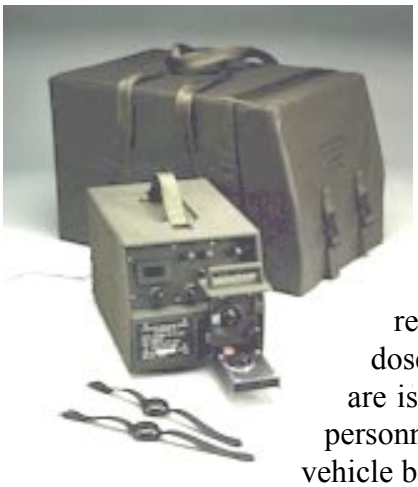
FIELDED AND PRODUCTION ITEMS

AN/VDR-2



The AN/VDR-2 measures gamma dose rates from 0.01 µGy/hr (micro-Grays per hour) to 100 Gy/hr and beta dose rates from 0.01 µGy/hr to 5 cGy/hr. The unit functions simultaneously as a dose rate meter and dose meter with independent adjustable alarms that can be set at any level over the entire range. Dosage data is independently stored in non-destructive memory for display on command and may be retained when the unit is turned off. The unit is powered by three 9 volt batteries.

AN/PDR-75 Radiac Set



The AN/PDR-75 measures dose from 0 to 999 cGy (centi-Gray). The Radiac Set consists of a dosimeter and a reader. It provides the capability to monitor and record the exposure of individual personnel to gamma and neutron radiation. Each individual will be issued a DT-236/PDR-75 dosimeter. This device, worn on the wrist, contains a neutron diode and a phosphate glass gamma detector. When a determination of exposure is required, the dosimeter is inserted into a CP-696/PDR-75 reader, which then displays the cumulative neutron and gamma dose. The reader is issued at the company level and the dosimeters are issued to all combat, combat support, and combat service support personnel. The reader can be powered by a BA-5590 lithium battery, vehicle battery, or external power supply via adapter cables provided.

AN/PDR-77 Radiac Set

The AN/PDR-77 Radiac Set is a set of portable radiation detection equipment for detecting alpha, beta, gamma, and x-ray radiation. The set consists of a radiacmeter to which one of three radiation probes can be attached for measuring particular types of radiation. The probes are part of the set. The set includes accessories and basic test and repair parts for unit maintenance including a carrying pouch with shoulder straps capable of holding the radiacmeter, alpha probe, and beta/gamma probe for field use. The entire set is contained in a carrying case (large briefcase) for easy portability and storage.

AN/UDR-13 Pocket RADIAC - Production (FUE FY99)

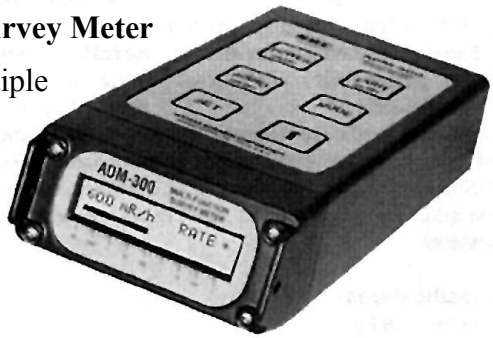
The AN/UDR-13 Pocket RADIAC is a compact, hand-held, tactical device capable of measuring the gamma dose-rate and gamma and neutron cumulative dose in a battlefield environment. Its pocket size permits convenient use by troops on foot. Alarm presets are provided for both the dose-rate and total dose modes. A push-button pad enables mode selection and functional control. Data readout is by liquid crystal display. It will replace the obsolete IM-93 quartz fiber dosimeter and the PP-1578 Dosimeter Charger.

Multi-Function Radiation (MFR) Detector -Production

This program improves radiation detection equipment by replacing the current suite of logistically unsupportable assets. Present detectors (PAC-1S, AN/PDR-43 and AN/PDR-56F) have exceeded maintainability standards. Original manufacturers have either discontinued production or are no longer in business. An improved capability is required to support both wartime and peacetime nuclear accident response operations. A production contract was awarded in March 1995. First deliveries were made in 1997.

ADM-300A Multifunction Survey Meter

The ADM-300A is a battery-operated, self-diagnostic, multiple functional instrument. It is used alone to locate and measure low and high intensity radioactivity in the form of gamma rays or beta particles. It is used with external probes to locate and measure alpha, beta, gamma, and x-rays, and neutron radiation.



DARPA Programs

Tissue-Based Biosensors Program

Accomplishments:

- B-cell sensor prototype system fabricated and tested. Simulant detection down to 200 particles in solution reported.
- Engineered liver and vascular endothelial cells into chip format. Genetically induced fluorescent reporter elements for cell stress into liver cells for detector system.
- Used green fluorescent protein to optically tag transcriptional upregulation cellular events (NFkB) for FLUORO-tox prototype high throughput cell sensor system
- Initiated fluorotox database for data mining cell responses to unknown pathogens.
- Demonstrated 4 order magnitude increase in cell survival by introducing extremophile genes into labile cells.

- Defined mechanism of action of operational neurotoxicants from engine lubricant in neuronal based hand held biosensors.

Description:

DARPA is exploring the use of biological cells and tissues as detector components for sensor devices that will report on chemical and biological toxins. Cells and tissues can be used to report on the functional consequences of exposure (mechanism and activity) to a wide spectrum of chemical and or biological toxins, whether they are living or dead, or whether they have been bioengineered and are currently undetectable by other means (antibodies, nucleic acid sequencing). Technical issues that are being addressed in the program include, (1) the fabrication of biocompatible matrices and interfaces for the long-term retention of cell and tissue function, (2) pattern recognition from critical pathways responsible for the interfaces for the long-term retention of cell and tissue function, (2) pattern recognition from critical pathways responsible for the processing of toxins, (3) sampling strategies to accurately extract and present the toxin from air, liquid, or solid samples, and (4) systems integration into a functional device. The current focus of the program is on the use of neuronal and immunological cells and tissues as detectors for such devices. Engineering of cells and tissues of these origins, including stem cells, is proceeding in order to optimize sensor performance requirements and fabricate prototype devices for testing evaluation.

Microfluidic Molecular Systems Program

Accomplishments:

- Demonstrated discrimination of 0.4% differences in cell impedance using micromachined dielectrophoreses system.
- Demonstrated on-chip circulation—controlled transport of target liquids through combination of integrated fluidic channels and reaction components.
- Demonstrated microscale enabled immunoassay with enzyme labelers to replace conventional optical label.
- Demonstrated microfan and filter system to capture airborne particulates into liquid for input to detection system.
- Demonstrated efficient transport of DNA over cm distances using electrophoretic confinement and transport through electrophoretic vias.
- Demonstrated a multi-channel device that is able to carry out six independent assays simultaneously using a single point detector.

Description:

Micro total analysis systems are being developed through focused research on micro-fluidic, chip-scale technologies. Automated sample collection and sample preparation are key front-end processes for early biological agent detection, whether it is by immuno-assays, DNA assays, or tissue-based assays. To scale down these processes into miniaturized, multiplexed detection systems, microfluidic chip-scale components need to be developed. Microfluidic components/devices currently being developed by DARPA include chip-scale micropumps/valves, particle separation filters, fluidic interconnects, fluidic manipulation of hybridized microbeads, controlled mixing/dosing, etc. Several

demonstrable handheld prototypes, such as a programmable microfluidic system for remote sensors, are currently being tested.

Pathogen Genome Sequencing Program

Accomplishments:

- Sequencing and analysis of the pathogenic bacteria *Brucella suis*, *Coxiella burnetti*, *Burkholderia mallei*, *Rickettsia typhi*, and several orthopoxvirus variants is nearing completion.
- Random phase sequencing via low-level coverage of Ochrobactrum anthrop, a near neighbor of *Brucella suis* was completed.
- Random phase sequencing with high level coverage of *Bacillus cereus* and *Bacillus thuringiensis*, near neighbors of *Bacillus anthracis* was completed.
- Re-initiated sequencing of *Franciscella tularensis* in FY01 with completion anticipated in 3Q FY02. Sequence information is available via National Library of Medicine for all but *O. anthropi* (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?db=Genome).

Description:

DARPA has made a commitment to sequencing the genomes of one representative strain for each of the high threat biowarfare agents identified by the Chairman of the Joint Chief of Staff threat list. This effort, undertaken with broad community interaction, supports Biological Warfare Defense research activities sponsored by DARPA and is intended to satisfy the needs of Department of Defense components, the Intelligence Community, and other governmental organizations. Interest is focused on BWD pathogens, and non-pathogenic near neighbors thought to be important to establish a basis for low false alarm detection and identification via genotype analysis. The work also contributes to the development of advanced unconventional pathogen countermeasures.

Protection Program

Accomplishments:

- Built first prototype of water disinfection pen (size of a thick fountain pen) based on an eletrochemical cell. The pen was able to create a mixed oxidant solution that is more potent than tablets used nowadays by the forces: the mixed oxidant pen was able to destroy many waterborne pathogens to at least 3 to 4 log removal.
- Demonstrated that harmonic pulsing of a reverse osmosis membrane increases water flux through the membrane and decreases the total dissolved solids.
- Built first prototype water distillation unit the size of a coffee mug that distills water. The distillation unit was able to desalt seawater without clogging. Tests on water-borne bugs show at least a 4 log removal. The water generation rate was measured to be approximately 0.3 liters in 5 minutes.
- Built first generation air purification unit to destroy airborne pathogens by thermocatalytic destruction. The destruction efficiencies for various air pathogens and simulants in the high 90% range. The goal is to get towards at least 99.999% removal rates.
- Began work on advanced carbon surface treatments to improve adsorption capacity and kinetics.

Description:

There are two related programs currently ongoing within DARPA that further enable the individual warfighter by providing significantly more mobile and flexible water purification and desalinization systems and better air filtration media. The intent is to demonstrate highly efficient, smaller, lighter, high water through-put technologies for water purification and desalinization, and to explore pioneering air filtration schemes that have an acutely high utility for the DoD enabling new mission scenarios that are critical to the changing battlefield environment. The water desalinization and purification systems would meet Army Operational Requirements (*i.e.*, effectively treat salt/brackish water and nuclear, biological and chemical contaminated water, purify 0.2 liter water per minute, weigh less than 2 lbs., *etc*.) The proposed man-portable water units will be multifunctional in that they can be used for several functions, such as water purification, power generation and camp stoves. Work in air purification develops simple air filtration and purification systems for the individual that provide significant improvements over the current charcoal filter gas mask technology (which have remained virtually unchanged for over 20 years). The intention is to develop air purification systems for collective protection that will require much less maintenance and greater personal safety than current based-carbon recirculating filters.

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Annex B

Modeling and Simulation Programs

Table B-1. Modeling and Simulation RDA Efforts

Category	Nomenclature	Status	USA	USAF	USMC	USN
Hazards Analysis Systems	- VLSTRACK	RDTE/Fielded	Joint*	Joint*	Joint*	Joint*
	- CWNAVSIM	RDTE				Rqmt
	- MESO	RDTE	Joint*	Joint*	Joint*	Joint*
	- CBW-CFX	RDTE	Joint*	Joint*	Joint*	Joint*
	- HPAC	Fielded	Joint*	Joint*	Joint*	Joint*
	- D2PC/D2Puff	Fielded	Joint*	Joint*	Joint*	Joint*
	- JEM	RDTE	Joint*	Joint*	Joint*	Joint*
Operational Effects Analysis Systems	- STAFFS	RDTE	Joint*	*Rqmt*	Joint*	Joint*
	- JOEF	RDTE	Joint*	Joint*	Joint*	Joint*
	- JMNBCDST	RDTE	Joint*	Joint*	Joint*	Joint*
Simulation Based Acquisition Systems	- NCBR Simulator	RDTE	Joint*	Joint*	Joint*	Joint*
	- VPS	RDTE	Joint*	Joint*	Joint*	Joint*
Training Simulation Systems	- VERTS	RDTE	Joint*	Joint*	Joint*	Joint*
	- TSC	RDTE	Joint*	Joint*	Joint*	Joint*

Joint= Joint Service requirement
Joint*=Draft Joint Service requirement
Rqmt= Service requirement
Rqmt = sub-product requirement or interest

HAZARDS ANALYSIS

FIELDED AND PRODUCTION

Vapor, Liquid and Solid Tracking (VLSTRACK)

VLSTRACK is a chemical and biological agent hazard assessment model *that predicts the behavior of agents and the resulting hazards from a chemical or biological weapons attack.* This model has been specifically verified and validated against all known data concerning passive defense against biological and chemical weapons and is the only model accredited by the Department of Defense for this purpose. As such, it supports operational decisions, operational contingency planning, threat assessment doctrine, acquisition program studies, and requirements generation. VLSTRACK Version 3.1 is currently available and fielded directly from the science and technology program. Limited training is also available from the developer.

Hazard Prediction and Assessment Capability (HPAC)

HPAC is a nuclear, chemical and biological hazard prediction system *that predicts hazards resulting from the use of our forces on opposition facilities or assets.* It is the only model accredited by the Department of Defense for this purpose. HPAC Version 4.0 is a modular system of capabilities using a Gaussian puff methodology Transport and Dispersion engine called SCIPUFF to drive specific nuclear, biological or chemical event applications. It has a

broad data base system and is able to use various weather data inputs. HPAC supports operational decisions, operational contingency planning, threat assessment doctrine, acquisition program studies, and requirements generation. HPAC Version 4.0 is currently available and fielded directly from the Technology development program conducted by the Defense Threat Reduction Agency (DTRA). Training is also available from the developer.

D2PC

D2PC is a Gaussian plume transport and diffusion model that predicts potential hazards involving accidental releases of chemical warfare agents in the U.S. Army's stockpile and non-stockpile programs. The model is used in the planning and response phases of potential accidents. D2 is used to support funding decisions by the Army and Federal Emergency Management Agency (FEMA) to enhance safety in the local civilian communities, including location of planning zones, sirens, tone alert radios, and collective protection facilities. Automated links allow direct input of on-site meteorological data, continuous updating of projected hazard areas, and rapid communication of model results to County and State Emergency Management Agencies. D2 is currently being phased-out and replaced with the D2-Puff model. D2-Puff version 4.0 is a kinematic gaussian puff model that accounts for spatial and temporal variability in a wind field over complex terrain. D2-Puff is currently installed at five stockpile sites and is scheduled for installation at the three remaining sites in CY02. The U.S. Army Safety Office has accredited the D2 model for all applications; D2-Puff has full accreditation at three sites and partial accreditation at two other sites. An Independent Verification & Validation was performed on both models in 1999. Training is provided on-site periodically. Model development is funded by the U.S. Army SBCCOM Program Manager for the Chemical Stockpile Emergency Preparedness Program.

HAZARDS ANALYSIS

RDTE ITEMS

CWNAVSIM

Rationale:

- Navy requirement

Key Requirements:

- Predict ship system degradation resulting from a chemical attack.
- Predict Mission Oriented Protective Posture (MOPP) requirements resulting from a chemical attack.
- Predict shipboard chemical agent detection system effectiveness.

Description:

CWNAVSIM was developed to address specific Naval acquisition program decisions regarding Chemical weapons defensive systems, specifically, the needed Tactics, Techniques and Procedures (TTPs) needed to defend the ship and the need for and placement

of detection devices. CWNAVSIM makes use of VLSTRACK, two ship-specific models (VENM and NURA), gridded ship representations and other ship specific databases to predict hazard levels throughout the ship as well as shipboard casualties and mission degradation. It has been accredited by specific Chief of Naval Operation offices to support acquisition program decisions. CWNAVSIM is only available from the CBD science and technology program. Training is not available.

MESO

Rationale:

- Joint requirement

Key Requirements:

- Advance the state-of-the-art in use of Lagrangian particle transport and diffusion (T&D)
- Advance the state-of-the-art in characterization of the planetary boundary layer
- Address physical processes and hazard assessment capabilities of current standard models for CBD

Description:

MESO is developed by ITT to provide a T&D capability which is more accurate and theoretically sound than Gaussian puff methodology but does not require the time and computer resources of a full Navier-Stokes Computational Fluid Dynamics (CFD) code. The development effort for the Department of Defense is also intended to provide advances in modeling important physical processes relevant to hazard assessment. MESO is currently not in distribution.

Computational Fluid Dynamics for Chemical and Biological Defense (CBW-CFX)

Rationale:

- Joint requirement

Key Requirements:

- Track threat from vapor, liquid, and solid CB agents around or within complex structures, *e.g.*, ships and buildings

Description:

Interface with other models as needed, *e.g.*, VLSTRACK and VENM. CBW-CFX uses CFD code to model the transport, diffusion, deposition, and surface evaporation of chemical and biological agents in and around 3-D structures. CFX is a commercial code developed by AEA Technologies which allows licensed users to develop subroutines which can be used within the code. CBW-CFX adds methodology for physical processes unique to chemical and biological agents. CBW-CFX is intended for use by the developers.

Joint Effects Model (JEM)

Rationale:

- Joint Army, Navy, Air Force, and Marine Corps requirement

Key Requirements:

- Predict hazard areas and contamination effects from nuclear, chemical or biological attack
- Predict hazard areas and contamination effects from nuclear, chemical or biological agent releases and releases of toxic industrial materials

Description:

JEM is the acquisition program of record that will transition the Science and Technology capabilities of VLSTRACK, HPAC, and D2PC. Once fielded, JEM will be the standard DoD Nuclear, Biological and Chemical (NBC) hazard prediction model. JEM will be capable of modeling hazards in a variety of scenarios including: counterforce, passive defense, accident and/or incidents, high altitude releases, urban NBC environments, building interiors, and human performance degradation; some of these capabilities will be included following release of Block 1. JEM will support defense against NBC and Toxic Industrial Chemical (TIC)/Toxic Industrial Material (TIM) weapons, devices, and incidents. JEM will be verified, validated, and accredited (VV&A) according to an approved process that adheres to the DoD VV&A directives. When used operationally, JEM will reside on and interface with command, control, communications, computers, and intelligence (C4I) systems. Warning systems on those C4I systems will use JEM to predict hazard areas and provide warning to U.S. forces within those areas. When used analytically, JEM will assist DoD components to train jointly, develop doctrine and tactics, and assess warfighting, technology, and materiel development proposals, and force structuring. JEM (unclassified version) will also support homeland defense through use by Civil Authorities and Allies.

OPERATIONAL EFFECTS ANALYSIS

RDTE ITEMS

Simulation Training and Analysis For Fixed Sites (STAFFS)

Rationale:

- Joint Army, Navy, Air Force, and Marine Corps requirement

Key Requirements:

- Determines operational effects of CB warfare environment on military fixed site operations
- Interfaces with key NBC models, simulations, and data bases

Description:

STAFFS is a general-purpose simulation model which represents the operations of large fixed-site facilities such as air bases, aerial ports of debarkation (APODs) and seaports of debarkation (SPODs), with the capability to represent chemical and biological warfare (CBW) attacks and their effects on operations. No other capability currently exists within DoD to assess the operational impact of CBW attacks on critical fixed-site targets. Due to their fixed location and essential combat support roles to forces in the theater of operation, these rear-area facilities can be expected to be high priority targets to aggressor forces and thus one of the most likely targets to encounter CB weapons and their effects. These sites may be particularly susceptible to repeated CBW attacks, which could significantly degrade logistical throughput and hamper combat operations. STAFFS is currently in use and being further developed in two major functional areas: 1) support of wargaming and operational exercises including distributed interactive environments, and, 2) support of operational and requirements analysis. Wargame applications run interactively with STAFFS accepting input and providing output to other model applications running as a system. Man-in-the-loop games and simulations may be performed. Analysis applications typically involve the examination of many different simulation/analysis cases (a case matrix) often involving parametric representation of unknown system data. Different user interfaces are provided specific to the application. STAFFS wargaming applications utilize an interactive graphic user/system interface while analysis applications typically utilize file base batch processing.

STAFFS utilizes spatial and temporal CB challenge data calculated by other standard CB hazard assessment models including VLSTRACK and HPAC. CB equipment and agent effects represented in high resolution include detectors, protective gear, decontamination, toxic and infective agent effects, collective protection, medical treatment, equipment induced thermal effects, equipment induced encumbrance, and doctrinal procedures such as work-rest cycles. These effects are represented by engineering level sub-models which can be easily changed to represent different equipment capabilities and levels of availability. Basic operational tasks are modeled using a task-network approach that is adaptable to any desired level of resolution. STAFFS is developed by AFRL. Limited training is available.

Joint Operational Effects Federation (JOEF)

Rationale:

- Joint Army, Navy, Air Force, and Marine Corps requirement

Key Requirements:

- Analyzes operational issues and doctrine through the interrelation and effects of various elements within the overall system.
- Evaluates the performance of particular equipment based on material characteristics.
- Assesses individual Warfighter ability to perform mission essential tasks.
- Integrates existing transport/diffusion models for CB agent hazards.

Description:

The JOEF will provide the operational community with the federated models and simulations specific to their operational environment required to predict or immediately respond to the need for operational effects information relative to any nuclear, radiological, chemical, or biological event. JOEF will include both fixed site and mobile forces simulation capabilities that, when married to specific data bases, will completely simulate all nuclear, radiological, chemical and biological defense processes, forces, and battlespace environments. In addition, the Federation will address both personnel degradation and medical processes and resources. JOEF will be used by both the operational commander and operational analyst to make rapid course of action analysis effects- based operational decisions, logistics decisions, CBD asset location decisions, and develop TTPs for CBD operations. The JOEF will be utilized by: 1) operational planners and decision makers in support of course of action assessment and plan evaluation; 2) the analysis community in support of high level concept assessments and system effectiveness studies and 3) Joint exercises and experiments in support of planning, execution, and analysis. The JOEF vision is of a set of validated low-to-medium fidelity warfare entity models, certified data, appropriate simulation services, and related user support tools in a framework suitable for modeling multi-warfare scenarios.

Joint Medical NBC Decision Support Tool (JMNBCDST)

Rationale:

- Joint Army, Navy, Air Force, and Marine Corps requirement

Key Requirements:

- Provide the capability to support deliberate planning, crisis action planning, exercises/training, and execution of operational missions, both on the battlefield and in urban environments.
- Interface with current and co-developmental medical planning tools such as the Medical Analysis Tool (MAT), Command and Control systems, medical informatics including the Defense Medical Surveillance System (DMSS) database, and Joint Warning and Reporting Network (JWARN) for discretionary transmission of data.

Description:

The Joint Medical NBC Decision Support Tool will enable the Service/medical planner/operator to model and analyze the NBC battlefield both to identify Service/Joint Force agent exposures on military and civilian populations and to estimate NBC casualties. It will also relate treatment protocols (time, task, treater files) to these casualties to determine: medical materiel requirements, medical personnel requirements, medical evacuation requirements and for hospital bed requirements at Level 3-5. As such, it supports operational decisions, operational contingency planning, threat assessment doctrine, acquisition program studies, and requirements generation.

SIMULATION BASED ACQUISITION SYSTEMS

RDTE ITEMS

Nuclear, Chemical, Biological and Radiological (NCBR) Simulator

Rationale:

- Army requirement, and Navy, Air Force and Marine Corps interest.

Key Requirements:

- Simulation of fielded and developmental CB defense systems to evaluate performance in operational situations.
- Integration of a CB environment into a distributed simulation environment involving mobile forces.

Description:

The NCBR Simulator provides the capability to utilize existing hazard transport and dispersion codes within the context of detailed materiel evaluations. NCBR enables high fidelity simulations of CB defense equipment (CBDE) such as detectors and protective gear to "see" and react to CB hazards within a detailed synthetic environment. In real time, the NCBR calculates a high fidelity, three-dimensional (3D) hazard environment as a function of hazard delivery system (source term), meteorological conditions and complex (3D) terrain. The DTRA SCIPUFF and the Naval Surface Warfare Center's VLSTRACK Gaussian puff models provide the means for the NCBR to calculate CBR hazard environments. The NCBR makes the data available to other simulations via full 3D representations of the environments (instantaneous air concentration), 2D grids (dose, deposition, and air concentration contours), and at a point via a subscription process. SBCCOM serves as the proponent for configuration control and release of the NCBR, and DTRA WMD Analysis and Assessment Center supported the migration of the tool to the DoD's High Level Architecture (HLA) standard for distributed simulation. NCBR is a key enabling technology for the more inclusive Virtual Prototyping System and will provide the mobile forces capability to JOEF.

To address nuclear environments, the NCBR uses DTRA's External Blast (XBLAST) and Version 6 of Atmospheric Transport of Radiation (ATRv6) as the means for calculating the blast and prompt radiation environments resulting from tactical nuclear warheads. The NCBR publishes axis-symmetric 2D grids and 1D (line) arrays that the receiving simulation rotates about the origin of symmetry to obtain a full 2D or 3D environment.

Virtual Prototyping System (VPS)

Rationale:

- Joint Army, Navy, Air Force, and Marine Corps requirement

Key Requirements:

- Represent standoff and point detection systems on stationary and mobile platforms in urban, rural, and littoral terrains.
- Detector representations will be reconfigurable and responsive to design and operations changes.
- Immersive simulation capability will allow evaluation of operator interfaces.
- Represent individual and collective protection systems in operational environments.

Description:

The VPS will provide the immersive capability to evaluate how the operating characteristics of proposed or developmental CBDE will affect the performance of the overall system. VPS will enable materiel developers to assess how proposed CB defense systems will provide increased capabilities. At a more detailed level it will allow system designers to assess the impact that design changes have on the overall system performance. The virtual immersive capability will enable human factors evaluations of operator interfaces long before the first prototype units of the developmental CBDE are built in hardware. All of these capabilities address the basic SBA tenet of enabling early and sustained user feedback throughout the system design process.

Performance assessments and evaluation will be enabled at the engagement and engineering levels of simulations. The trade space for evaluating technical options for system and component alternatives will be expanded. That evaluation will take place in a realistic synthetic or virtual operating environment. Human and live system in-the-loop capability will exist. Development will be based on current proof-of-concepts simulation used to support developmental, analysis, training and testing efforts. The envisioned simulation system will be able to operate at specific sites for focused evaluations or distributed to many sites for robust Joint Task Force (JTF) engagement assessments of engineering alternatives.

TRAINING SIMULATION SYSTEMS

RDTE ITEMS

Virtual Emergency Response Training System (VERTS)

Rationale:

- Joint Army, Navy, Air Force, and Marine Corps requirement.

Key Requirements:

- Visually immersive training environment for specialized missions of the US Army National Guard Weapons of Mass Destruction Civil Support Teams- (WMD CST).
- Must represent not only the deploying military units' personnel and equipment, but also the civil first responders and their equipment with which the CSTs will work..
- Detailed visual and structural databases required for each city/site.

Description:

The VERTS is being developed to enhance the training of WMD CSTs. WMD response requires significant training demands for individual and collective tasks. Soldiers and airmen must be proficient on a wide array of government and commercial equipment for NBC protection, detection and medical response. The WMD CSTs, in particular, are required to master a variety of equipment and procedures. The VERTS is required to support both individual and collective training. VERTS supports training in all tasks for the CST. It allows training on procedures for response to dangerous NBC agents, procedures that are difficult if not impossible to recreate in a live training environment. VERTS also allows mission rehearsals in actual and realistic urban settings. Training in the virtual cities of VERTS allows these teams to learn to navigate in actual cities, in actual buildings and to do so without the threat of being observed by adversaries, criminals and terrorists. VERTS, by being distributable over a network, allows teams to train together without having to travel long distances. Once validated for CSTs, VERTS offers the promise to train other DoD response elements and first responders as well.

The simulation system will consist of a network of PC-based modules that will serve as Survey Team Stations (Desk-Top), a Chief Trainer/Battlemaster Station, Immersive Station, Medical Station, Network Server Station, AAR Station, and Data Logger Station.

Training Simulation Capability (TSC)

Rationale:

- Joint Army, Navy, Air Force, and Marine Corps requirement

Key Requirements:

- Integration with and have access to current and planned individual service C^4I^2RS systems

- Provide ability to gather and store lessons learned and identified failure/error incidents in order to provide after action review
- Provide capability to use NBC effects models and mission data to perform mission rehearsals using a simulation federation.

Description:

The TSC will provide the ability to simulate NBC attacks using NBC defense assets and Command, Control, Communications, Computers, Intelligence, Information, Reconnaissance, and Surveillance (C^4I^2RS) systems for training and exercises. It will allow for exercise planning, execution, and capturing lessons learned for after action review (AAR). It will provide the capability to use or simulate the use of NBC sensors, Tactical Engagement Simulation (TES) gear, and simulators for training and exercises. The TSC will provide the capability to simulate NBC environments and effects under live, virtual, and constructive simulations. It will provide the capability to use training and simulations in both Command Post Exercise (CPX) and Field Training Exercise (FTX) environments. It will operate in conjunction with the Joint Warning and Reporting Network (JWARN), future Joint NBC Battle Management systems, and the other Model and Simulation capabilities developed to support NBC defense requirements.

The TSC will be used at all levels of NBC defense decision-making to train for and simulate NBC attacks against friendly forces. It will provide for the training and use of simulation capability by all NBC defense personnel and commanders related to NBC threats and scenarios. When fully fielded the TSC will run the gamut from individual/team trainers up through large unit battle staff training capabilities.

Annex C

Non-Medical Protection Programs

Table C-1. Protection RDA Efforts

Category	Nomenclature	Status	USA	USAF	USMC	USN
	INDIVIDUAL PROTECTION:					
Eye/	- MBU-19/P Aircrew Eye/Respiratory Protection (AERP)	Production	Interest	Rqmt	Interest	
Respiratory	- M48 Aircraft Mask	Production	Rqmt			
Protective Masks	- CB Respiratory System (A/P22P-14(V))	Production			Rqmt	Rqmt
	- M45 Aircrew Protective Mask (ACPM)	Production	Rqmt		Interest	
	- M40A1/M42A2	Fielded	Rqmt		Rqmt	Rqmt
	- MCU-2A/P	Production		Rqmt		Rqmt
	- Joint Service Aircrew Mask (JSAM)	RDTE	Rqmt	Rqmt	Rqmt	Rqmt
	- Joint Service General Purpose Mask (JSGPM)	RDTE	Rqmt	Rqmt	Rqmt	Rqmt
Ancillary	- Protection Assessment Test System (PATS)	Production	Rqmt	Rqmt	Rqmt	Interest
Equipment	- Voice Communication Adapter	Production	Rqmt	Rqmt	Rqmt	Rqmt
	- Joint Service Mask Leakage Tester	RDTE	Interest	Rqmt	Rqmt	Rqmt
Battlefield	- CB Protective Overgarment Saratoga	Fielded	Interest		Rqmt	Interest
Protective	- Chemical Protective Undergarment (CPU)	Fielded	Rqmt		Int-NIR	
Suits	- Modified CPU (mCPU)	RDTE	Rqmt			
	- Joint Service Lightweight Integrated Suit Technology, Additional Source Qualification (JASQ)					
	-- Overgarment	Prod.*	Rqmt	Rqmt	Rqmt	Rqmt
	-- Boots (MULO)	MS III*	Rqmt	Rqmt	Rqmt	
	-Battledress Overgarment (BDO)	Fielded	Rqmt	Rqmt		
Specialty	- STEPO	Fielding	Rqmt			
Suits	- EOD Ensemble	Production		Rqmt		
	- Improved Toxicological Agent Protective (ITAP)	MS III	Rqmt		Interest	Interest
	- Joint Firefighter Integrated Response Ensemble (JFIRE)	Production	Rqmt	Rqmt		
	- Suit Contamination Avoidance Liquid Protective (SCALP)	Fielded	Rqmt			
	COLLECTIVE PROTECTION:					
Tentage and	- M20A1/M28 Simplified CP Equipment (CPE)	Fielded	Rqmt	Rqmt		Rqmt
Shelter Systems	- CB Protective Shelter (CBPS) (Medical)	Production	Rqmt		Interest	Interest
	- CP Deployable Medical System–Chemically/ Biologically Hardened Air Transportable Hospital (DEPMEDS/CHATH)	Production	Rqmt	Rqmt		
	- Joint Transportable CP System (JTCOPS)	RDTE	Rqmt	Rqmt	Rqmt	Rqmt
Collective	- Shipboard Collective Protection System (CPS)	Production	Interest	Interest		Rqmt
Protection (CP)	- Modular Collective Protection System (MCPE)	Fielded	Rqmt	Interest		Interest
Systems	- M8A3 GPFU	Fielded	Rqmt			
	- M13A1 GPFU	Fielded	Rqmt	Rqmt		Rqmt
	Joint Collective Protection Equipment (JCPE)	RDTE	Rqmt	Rqmt	Rqmt	Rqmt
Generic Filters	- M48/M48A1 (100 cfm)	Fielded	Rqmt		Rqmt	Rqmt
	- M56 (200 cfm)	Fielded	Rqmt	Rqmt	Interest	Rqmt
	- Fixed Installation Filters	Fielded	Rqmt	Rqmt		

Rqmt = Product requirement
Interest = Product Interest
Int-NIR = Product Interest, No Imminent Requirement

* - Sub-Product(s) of a Consolidated Joint Service Project
Rqmt, Interest = Sub-Product requirement or Interest

INDIVIDUAL PROTECTION EQUIPMENT

RESPIRATORY

FIELDED AND PRODUCTION ITEMS

M17A2 Protective Mask

The M17A2 Protective Mask consists of a natural blend rubber face piece; two activated charcoal filters mounted within cheek pouches; a voicemitter to facilitate communications, a drinking tube; eyelens outserts to protect the mask's integral eyelens and reduce cold weather fogging; an impermeable hood; and a carrier for the mask, its components, and medical items (such as the Nerve Agent Antidote Kit). The Army and Marine Corps are replacing this mask with the M40 series protective masks. The Navy has replaced the M17A2 protective mask with the MCU-2/P. The Air Force replaced it with the MCU-2A/P, but retained limited quantities of extra small M17A2s for those situations where the MCU-2A/P small size is too large.

MCU-2A/P Protective Mask

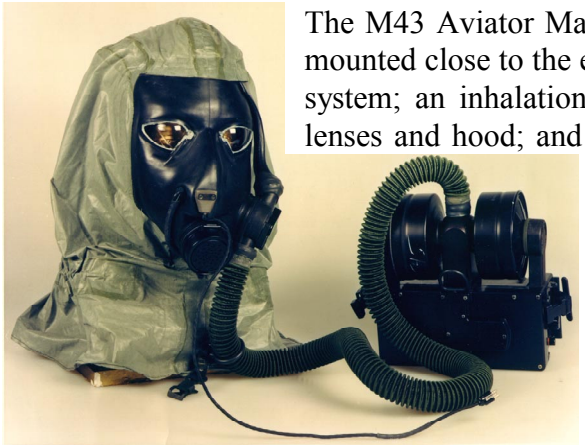
The MCU-2A/P provides eye and respiratory protection from all chemical and biological agents as well as radioactive particulate material. The mask uses a replaceable, standard NATO filter canister which is mounted on either side of a wide-view optical quality visor. The mask provides improved fit, comfort, and visibility relative to earlier masks, and includes a drinking tube for attachment to the standard canteen, and electronic voicemitter connections for improved communications.

M40/42 Series Protective Mask

The M40/42 series protective masks provide eye-respiratory face protection from tactical concentrations of CB warfare agents, toxins and radioactive fallout particles. Each mask consists of a silicone rubber face piece with an in-turned peripheral face seal and binocular rigid lens system. The facepiece is covered with a chlorobutyl/EPDM second skin to provide optimum liquid agent protection for the masks. It accommodates NATO standard canisters, which can be worn on either cheek of the mask. The M40 series (*left*) is designed for the individual dismounted ground warrior, while the M42 series (*right*) is designed for combat vehicle crewmen. Recent improvements

include a universal second skin, making the mask compatible with JSLIST and Saratoga overgarments, and ballistic/laser protective eye lens outserts. The mask facepiece has been made a spare part, which has resulted in a significant operation and support cost savings. Use of modular parts permits the M40 series facepiece to be used in both the M40 and M42 configuration. This has resulted in significant operational and support cost savings.

M43 Protective Mask



The M43 Aviator Mask consists of a form-fitting face piece with lenses mounted close to the eyes; an integral CB hood and skull-type suspension system; an inhalation air distribution assembly for air flow regulation, lenses and hood; and a portable motor/blower filter assembly that operates on either battery or aircraft power. The M43 Type I was developed for the AH-64 aviator and is compatible with the AH-64 Integrated Helmet and Display Sight System and the Optical Relay Tube. The M43 Type II is intended for the general aviator. The M43 Type I (Apache version) will be replaced by the M48. The M43 Type II general aviation version is being replaced by the M45.

M45 Aircrew Protective Mask (ACPM) (FUE FY98)

The M45 Air Crew Protective Mask is specially designed to meet the requirements of Army helicopter pilots and crews (except for the Apache helicopter). It does not require power or forced air to provide CB protection; it provides compatibility with helicopter optical systems, aircraft displays and night vision devices; and has reduced weight, cost and logistical burden when compared to the M43 series of mask. The ACPM has close fitting eyelenses mounted in a silicone rubber facepiece with an in-turned peripheral seal, a detachable hood system, and utilizes the standard NATO canister. The M45 will replace the M43 (Type II) and the M24 aviators mask. The M45 is also being used as a mask for personnel who do not get an adequate face seal in the M40 or MCU-2A/P masks. The M45 comes in four sizes, versus the three sizes for the M40 and MCU-2A/P, and fits a higher percentage of the extra small and extra large population. It will be used to phase out the extra small M17 masks currently being used for some of these hard-to-fit personnel. The M45 is also used for specific ground force applications where close eye compatibility is required for unique equipment such as for the Land Warrior system.

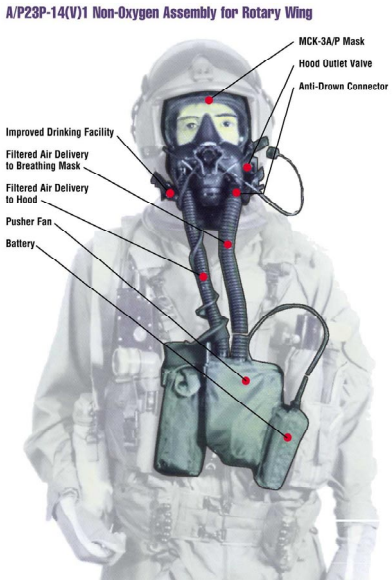
M48 Protective Mask - Production

The M48 is the third generation M43 series masks. The M48 mask replaces the M43 Type I mask and will be the only mask for the Apache aviator for the foreseeable future. The M48 mask consist of a lightweight motor blower, a new hose assembly, a web belt, the mask carrier, facepiece carrier, eyelens cushions, and facepiece. The motor blower is aircraft mounted with a quick disconnect bracket on the pilot's seat during flight operations.

Aircrew Eye/Respiratory Protection (AERP)

The AERP (replaces the MBU-13/P system for aircrews) is a protective mask which enables aircrews to conduct mission operations in a chemical-biological environment. The AERP system includes a protective hood assembly with a standard MBU-12/P mask, an intercom for ground communication, and a blower assembly that provides de-misting. The blower is stowed during flight operations on a bracket that is mounted inside the aircraft.

CB Respiratory System (A/P22P-14(V) 1, 2, 3, & 4) NDI



The CB Respiratory System is a self-contained protective ensemble designed for all forward deployed rotary wing (Version 1 for USN) and fixed wing (Version 2–4 for USN and USMC) aircrew. The design incorporates a CB filter, dual air/oxygen supply and a cross-over manifold with ground flight selector switch to provide filtered air for hood ventilation, and filtered air for oxygen for breathing. The system provides enhanced protection and offer anti-drown features.

RESPIRATORY

RDTE ITEMS

Joint Service General Purpose Mask (JSGPM)

Rationale:

- Joint Army, Navy, Air Force, and Marine Corps requirement

Key Requirements:

- 24-hour CB protection
- Lower breathing resistance
- Reduced weight and bulk

Description:

The JSGPM will be a lightweight protective mask system—consisting of mask, carrier, and accessories—incorporating state-of-the-art technology to protect U.S. forces from all future threats. The mask components will be designed to minimize the impact on the wearer's performance and to maximize the ability to interface with future Service equipment and protective clothing.

Joint Service Aircrew Mask (JSAM)

Rationale:

- Joint Army, Navy, Air Force, and Marine Corps requirement

Key Requirements:

- Continuous CB protection
- Improved anti-G protection

Description:

JSAM will be a lightweight CB protective mask that can be worn as CB protection for all aircrew. With the addition of anti-G features, it can be worn as combined CB and anti-G protection for aircrews in high performance aircraft. It will be compatible with existing CB ensembles, provide flame and thermal protection, provide hypoxia protection to 60,000 feet, and the CB portion will be capable of being donned in flight. JSAM will also be compatible with existing aircrew life support equipment.

Joint Service Chemical Environment Survivability Mask (JSCESM)

Rationale:

- Joint Army (SOCOM), Air Force, Marine Corps, Navy (potential) requirement

Key Requirements:

- One size fits all
- For low threat area usage
- Limited protection
  (6 hours, limited agent concentrations)
- Small, lightweight
- Drinking capability

Description:

The JSCESM (*concept illustration shown*) is intended to be a lightweight complement to the JSGPM. It will provide commanders at all levels with greater options for protection, especially in Operations Other Than War (OOTW). The JSCESM will provide an inexpensive/disposable, emergency mask for use in NBC situations confronting the Services operating in low NBC threat conditions and military medical care providers and patients in certain instances when using the standard service mask is not practical. Warfighters in special operations or other combat/non-combat roles will carry JSCESM (in the uniform cargo pocket) or while in civilian clothing (concealable) during deployment when an NBC threat is possible, but unlikely. Additionally, other missions exist for the JSCESM such as use in collective protection shelters (CPS) if the shelter filtration system fails or emergency evacuation of a shelter is required when contamination is present.

ANCILLARY MASK EQUIPMENT

FIELDED AND PRODUCTION ITEMS

M41 Protection Assessment Test System

The M41 Protection Assessment Test System (PATS) enhances operational capability by validating proper fit of the mask to the face of the individual. PATS provides a simple, rapid, and accurate means of validating the face piece fit and function of protective masks.

Voice Communication Adapter

The Voice Communication Adapter (VCA) is a low risk program providing additional capability to the M40/42 mask. The VCA is a joint program between the USMC and US Army.

Universal Second Skin

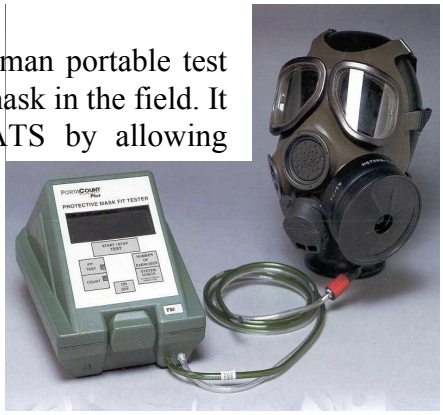
The Universal Second Skin is one of the components of a pre-planned product improvement (P3I) in the M40/M42 series mask. The Universal second skin provides liquid agent protection for the mask faceblank material. This program is a Joint U.S. Army/U.S. Marine Corps effort. Both Services developed prototype designs and, after field user and human engineer testing, the Marine Corps design was selected. The Air Force is developing a second skin for the MCU-2A/P.

ANCILLARY MASK EQUIPMENT

RDTE ITEMS

Joint Service Mask Leakage Tester

The Joint Service Mask Leakage Tester (JSMLT) will be a man portable test system capable of checking the serviceability of a protective mask in the field. It will have expanded capability compared to the M41 PATS by allowing component level testing of the mask as well as system level testing with added components. It will provide a capability for an overall mask serviceability and fit factor validation of protective masks in the field.



BATTLEFIELD PROTECTIVE SUITS

FIELDED AND PRODUCTION ITEMS

Battle Dress Overgarment (BDO)

The BDO is a camouflage patterned (desert or woodland), two piece, air permeable overgarment typically worn over the duty uniform. The overgarment material consists of an outer layer of nylon cotton, and an inner layer of activated charcoal impregnated polyurethane foam. The BDO provides protection against chemical agent vapors and liquid droplets, biological agents (to include toxins), and radioactive alpha and beta particles. The BDO is issued in a sealed vapor-barrier bag that protects the garment from rain, moisture and sunlight. The BDO provides 24 hours of chemical agent protection once contaminated and has a field durability of 22 days (extendable to 30 days at the discretion of Field Commanders).

Joint Service Lightweight Integrated Suit Technology (JSLIST) Overgarment

The JSLIST Overgarment will provide 24 hour protection after 45 days of wear and 6 launderings. The liner currently is based upon activated carbon bead technology, replacing the bulky activated carbon foam technology in previous garments. The JSLIST Overgarment is a two-piece jacket and trouser design with an integrated hood compatible with respective Service masks and second skins. It will be worn as an overgarment for the duty uniform or as a primary garment over underwear depending upon the environment and mission. The JSLIST Additional Source Qualification (JASQ) effort will test and evaluate suits of different materials manufactured in the JSLIST design in an attempt to increase competition and lower cost by qualifying additional materials for JSLIST suit production

CP Suit, Saratoga (USMC)

Like the BDO, the SARATOGA CP Suit is an air permeable, camouflage patterned overgarment. Instead of carbon impregnated foam, SARATOGA uses spherical, activated carbon adsorbers immobilized in the liner fabric. This system allows for a lighter, cooler garment, which is launderable. The Saratoga provides a 24 hour protection period and has a durability of 30 days continuous wear.

CWU-66/P Aircrew Ensemble - Production (FUE FY96)

The CWU-66/P, a one-piece flightsuit configuration, provides 24-hour protection against standard NATO threats. It is made with Von Blucher carbon spheres, and is less bulky than prior ensembles. It offers a reduced thermal load burden and is compatible with aircrew life support equipment.

Chemical Protective Undergarment (CPU)

The CPU is a one-time launderable two-piece lightweight undergarment made of a non-woven fabric containing activated charcoal. When worn under a new combat vehicle crewman (CVC) coverall, battle dress uniform (BDU), or aviation battle dress uniform (ABDU), the CPU provides 12 hours of both vapor and liquid protection and is durable for 15 days.

BATTLEFIELD PROTECTIVE SUITS

RDTE ITEMS

Joint Service Lightweight Integrated Suit Technology (JSLIST)

The JSLIST program is a fully cooperative Joint Service RDTE effort chartered to develop new CB protective clothing for all Services. The program will yield a family of garments and ensembles, developed for Joint Service mission needs and tested to Joint Service standards. The JSLIST will provide enhanced CB protective ensembles with reduced physiological heat burden and will be generally lightweight and launderable. JSLIST is the first of a 3 phase program and supports a variety of Service suit and accessories. Previous chemical protective requirements from all Services are incorporated within the Joint ORD for JSLIST. There are five JSLIST clothing item requirements: 1) overgarment, 2) undergarment, 3) duty uniform, 4) boots and 5) gloves. Each of the Services' requirements are incorporated by these five JSLIST requirements.

In April 1997, the JSLIST program type classified the JSLIST Overgarment and Multi-purpose Overboot (MULO).

The JSLIST Additional Source Qualification (JASQ) was initiated to qualify additional sources of JSLIST materials and to conduct field wear tests and laboratory chemical tests on commercial JSLIST suit candidates. The JASQ candidates that perform as well as, or better than the current JSLIST garment will be considered for placement on a JSLIST qualified products list and may be authorized as additional JSLIST material sources.

Joint Protective Aircrew Ensemble (JPACE)

Rationale:

- Joint Army, Navy, Air Force, and Marine Corps Requirement (Navy lead)

Key Requirements:

- Provides Below-the-Neck (BTN) protection for rotary and fixed wing aircrew
- 30 day wear time
- Launderable
- Compatible with aircrew mounted aviation life support systems
- Ejection safe and water survivable

Description:

JPACE (*concept shown*) will be a chemical biological (CB) protective ensemble for all services' aviation communities. It will be a replacement for the Navy/Marine Corps MK-1 undergarment, Army ABDU-BDO and/or CPU system and AF CWU-66/P overgarment. Due to mission constraints and threat analysis, a separate garment may be considered for fixed wing versus

rotary wing aircrew. JPACE started as a spin-off from JSLIST to address aviation specific CB requirements. Therefore, JSLIST and JSLIST P3I materials, designs, and documentation will be used to the maximum extent possible. This ensemble will be jointly tested and fielded with JSAM (Joint Service Aircrew Mask) and will be used as a technical insertion to the Army Air Warrior program. JPACE will provide the fixed and rotary wing aviator with BTN protection against CB threats.

Modified Chemical Protective Undergarment (mCPU)

A modified CPU (mCPU) is being developed to include a pass-through for microclimate cooling unit tubing. The mCPU worn with the Aviation Battledress Uniform will be used as interim chemical protection for Army aviators until the development and fielding of the Joint Protective Aircrew Ensemble (JPACE).

PROTECTIVE ACCESSORIES

FIELDED AND PRODUCTION ITEMS

Chemical Protective Footwear Covers

The CPFC are unsupported, impermeable, butyl rubber overshoes that can be stored flat. They are a loose fitting butyl rubber upper vulcanized to a non-slip molded butyl rubber sole with five holes to allow lacing around the foot. They are worn over the combat boot. They have the ability to resist acid, jet fuel, oil and fire. They were manufactured in two sizes, small and large, but are no longer being procured.

Chemical Protective Sock

This sock is the first generation Air Crew Chemical Defense Equipment. It is plastic and disposable. The sock comes in one size as 500 ea per roll, 21 inch long, 4 mils thick and 8 in wide flat extruded tubing with 1/8 in wide heat-seal closure. This sock is to be worn over regular sock.

Disposable Footwear Cover

Plastic over-boots are worn over the flyer's boot. They protect the user from chemical contamination en-route from the shelter and the aircraft. They come in one size and are removed before entering the aircraft or shelter.

Green Vinyl Overboots /Black Vinyl Overboots (GVO/BVO)

The GVO/BVO are fitted vinyl overshoes that are worn over the combat boots to provide chemical agent protection and/or moisture vapor protection during wet weather. The impermeable GVO/BVO provide protection against chemical agents for 24 hours and are durable for up to 60 days.

Multipurpose Overboot (MULO) *(JSLIST Boots)*

The MULO is a joint service program under the auspices of the JSLIST program and will replace the GVO/BVO. It is made of an elastomer blend and will be produced by injection molding. It is designed for wear over the combat boot, jungle boot, and intermediate cold/wet boot, and provides 24 hours of protection chemical agents with a wear life of 60 days. The MULO provides more durability, improved traction, resistance to POLs and flame, and better donning and doffing characteristics over standard footwear.

Chemical Protective (CP) Gloves

The CP glove set consists of a butyl-rubber outer glove for protection from chemical agents, and a cotton inner glove (25 mil glove only) for perspiration absorption. CP outer gloves come in three thicknesses: 7, 14, and 25 mil. The 7 mil glove is used by personnel who require a high degree of tactility, such as medical and personnel engaged in electronic equipment repair. The 14 mil glove is used by personnel like aviators and mechanics, in cases when good tactility is necessary and stress to the glove is not too harsh. The 25 mil glove is used by personnel who require a durable glove to perform close combat tasks and heavy labor. The 14 and 25 mil glove sets provide protection for at least 24 hours. The 7 mil glove set should be replaced within 6 hours of exposure to a chemical agent.

Glove Inserts

These gauntlet cotton inserts are worn under the chemical protective (CP) butyl rubber gloves. They provide perspiration absorption. They can be worn in either hand and are available in three sizes (small, medium and large).

Chemical Protective Helmet Cover

The Chemical Protective Helmet Cover is intended to provide any standard helmet with protection from chemical and biological contamination. It is a one-piece configuration made of butyl coated nylon cloth and gathered at the opening by an elastic webbing enclosed in the hem. The covers come in one size and are of olive green color.

Aircrewman Cape

This disposable cape is a one size fits all plastic bag (74 in x 23 in) worn over the entire body to provide additional protection against liquid contamination. The over-cape should be worn if aircrews have to walk around liquid contaminated areas and if aircraft are not sheltered. If worn, the over-cape is removed before entering the aircraft.

SPECIALTY SUITS

FIELDED AND PRODUCTION ITEMS

Joint Firefighter Integrated Response Ensemble (JFIRE)

JFIRE is a joint effort between the Air Force (lead agency) and the Army. The JFIRE Program has developed an ensemble that will protect the military firefighters IAW National Fire Protection Association (NFPA) standards and provide CB protection during firefighting operations in a CB environment. JFIRE leverages the JSLIST overgarment for chemical protection, to be worn under aluminized proximity firefighting outergear and with a switchable filtered/supplied air mask with chemical warfare kit. A Commercial Off-the-Shelf (COTS) glove that can be used for both fire and CB protection has replaced the need for CB gloves to be worn under standard proximity gloves. JFIRE meets several key requirements, including (1) providing 24 hours of CB agent protection against 10 g/m^2 liquid agent, (2) providing firefighters CB protection in both structural and crash fire fighting/rescue operation, (3) allowing firefighters to use mission essential tools and equipment in a CB environment, (4) providing resistance to water and all standard fire fighting chemicals (foam, CO_2, aircraft POL), and (5) is capable of being donned in 8 minutes.

Suit Contamination Avoidance Liquid Protection (SCALP)

The SCALP can be worn over standard chemical protective garments to provide 1 hour of protection from gross liquid contamination. The SCALP, which consists of a jacket with hood, trouser and booties, is made from a polyethylene-coated Tyvek™ impermeable material.

Self-Contained Toxic Environment Protective Outfit (STEPO)

STEPO (*shown left*) provides OSHA level A protection for Army Chemical Activity/Depot (CA/D), Explosive Ordnance Disposal (EOD) and Technical Escort Unit (TEU) personnel. The STEPO is currently being fielded to CA/D, TEU and EOD. The STEPO is a totally encapsulating protective ensemble for protection against CB agents, missile/rocket fuels, POL, and industrial chemicals for periods up to four hours. The ensemble incorporates two types of NIOSH approved self-contained breathing systems (one hour and four hour configurations) and a tether/emergency breathing apparatus option, a battery powered Personal Ice Cooling System (PICS) (*shown to right*), a hands-free communications system, and standard M3 Toxicological Agent Protective (TAP) boots and gloves. The suit is capable of being decontaminated for reuse up to 5 times after chemical vapor exposures. STEPO shares common, modular components with the ITAP and JFIRE ensembles simplifying logistics and reducing costs.

EOD M3 Toxicological Agent Protective (TAP) Ensemble

One-piece coverall for the protection of personnel engaged in extreme hazardous decontamination work or other special operations involving danger from spillage or splashing of chemical agents including toxic industrial material. The coverall is constructed from butyl rubber coated plain weave nylon cloth and comes in four sizes (small, medium, large and extra large). The design consists of snap-type button front and protective flap. This is a special purpose Life Support Clothing and Equipment (LSC&E) item.

Improved Toxicological Agent Protective (ITAP)

ITAP replaces the M3 TAP ensemble. ITAP enhances existing capabilities by increasing personal protection and reducing the thermal burden on the wearer. ITAP also provides skin and respiratory protection both during peacetime and wartime for short term operations in Immediately Dangerous to Life and Health (IDLH) toxic chemical environments (up to 1 hour), emergency life saving response, routine Chemical Activity operations and initial entry and monitoring. ITAP shares common, modular components with the STEPO and JFIRE ensembles, simplifying logistics and reducing costs.

ITAP provides splash and vapor protection against potential exposure to liquid agent when worn as a system—requirements: 10g/m^2 HD, VX, GB, L agent challenge for 1 hour. It provides an optional Personal Ice Cooling System (PICS), and is functional as a system where temperatures range from 0° to 100°F when used with the cooling system. The ITAP suit and overhood are capable of being decontaminated for a minimum of 5 reuses, 2 hours per use (1 hour at IDLH), after vapor and particulate contamination. After liquid contamination ITAP suit will be decontaminated and held for disposal.

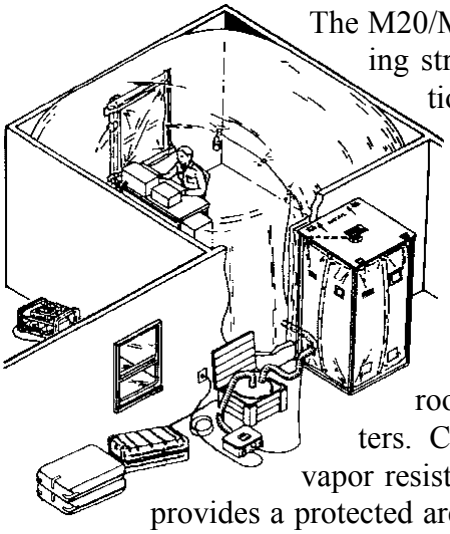
The ITAP fabric is self-extinguishing meeting NFPA 1991. The fabric is also static dissipative and does not hold a charge sufficient to set off munitions and explosives in accordance with current Explosive Safety Board requirements. The fabric is light in color to reduce operator solar heat load, and is capable of being stored within the temperature range of 0° to 120°F. ITAP has a minimum shelf life of 5 years.

COLLECTIVE PROTECTION EQUIPMENT

TENTAGE AND SHELTERS

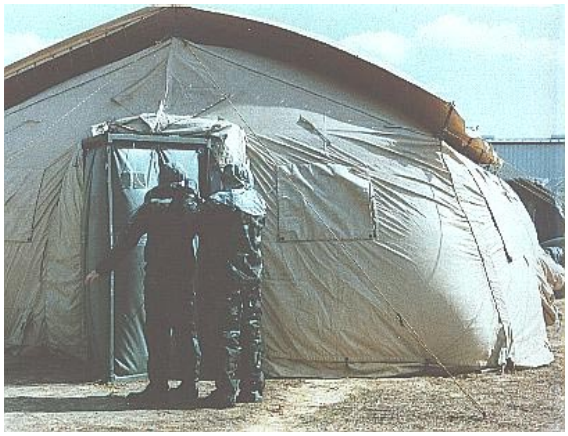
FIELDED AND PRODUCTION ITEMS

M20/ M20A1 Simplified Collective Protective Equipment



The M20/M20A1 SCPE is used to convert an interior room of an existing structure into a positive overpressure, NBC collective protection shelter where individuals can perform assigned missions without wearing the protective mask and overgarment. The system consists of a liner, protective entrance, filter canister, and support kit. The SCPE is a low cost method of transforming a room in an existing structure into an NBC collective protection shelter for command, control and communication (C^3), medical treatment, and soldier relief functions. M20A1 is a room liner for existing shelters. Components include a CB vapor resistant polyethylene liner that provides a protected area in an existing structure; a collapsible, protective entrance that allows entry to/exit from the protected area; a hermetically sealed filter canister, which provides filtered air to both the liner and the protective entrance; and a support kit, which contains ducting, lighting, sealing and repair material and an electronically powered blower.

M28 Simplified CPE (SCPE)



The M28 SCPE is a low cost method of transforming a room of an existing structure into an NBC collective protection shelter for command, control and communication (C^3), medical treatment, and soldier relief functions. M28 is a liner for the TEMPER tent. Components include a CB vapor resistant polyethylene liner that provides a protected area in an existing structure; a collapsible, protective entrance that allows entry to/exit from the protected area; a hermetically sealed filter canister, which provides filtered air to both the liner and the protective entrance; and a support kit, which contains ducting, lighting, sealing and repair material and an electronically powered blower. A pre-planned product improvement (P^3I) program to the M28 SCPE provides liquid agent resistant liners, protective liners for tents, interconnectors, and an interface with environmental control units. The improved SCPE also allows more people to enter at one time, and protects hospitals under tents.

Chemically Protected Deployable Medical System (CP DEPMEDS) - Development/Production

The Army's CP DEPMEDS program is a joint effort with the Air Force to insert environmentally controlled collective protection into currently fielded hospital shelters. The requirement is to be able to sustain medical operation for 72 hours in a chemical contaminated environment. Environmentally-controlled collective protection is provided through the integration of M28 CPE, chemically protected air conditioners, heaters, water distribution and latrines, and alarms systems. M28 CPE provides protection to existing TEMPER Tents and passageways within the hospital. DEPMEDS ISO shelters are protected through the replacement of existing shelter seals with those that are CB protected. The Field Deployable Environmental Control Unit provides CB protective air conditioning and the Army Space Heater provides CB protective heating. Both environmental control units are chemically protected through the addition of a CB kit. To sustain approximately 500 patients and staff, chemically protected latrines and water distribution systems have been developed.

Chemically/Biologically Hardened Air Transportable Hospital (CHATH) – Production

The Air Force's CHATH program is a joint effort with the Army to enable medical personnel to deploy and setup in chemical and biological threat areas and operate in chemically and biologically active environments. CHATH allows personnel to perform their hospital duties in a Toxic Free Area. CHATH upgrades TEMPER-based Air Transportable Hospitals (ATHs) retaining the same medical equipment and personnel. CHATH uses existing and modified U.S. Army equipment to line the current ATH tents providing an airtight shelter. The Human Systems Program Office (HSC/YA) developed a Chemically/biologically Hardened Air Management Plant (CHAMP). The CHAMP filters chemically and biologically contaminated air, and recirculates and filters interior air to maintain a clean hospital standard, provides heating, cooling, and over-pressurization to the hospital. The CHAMP can be operated from standard electrical sources or from its own internal generator. The CHAMP comes equipped with an Automatic Transfer Switch (ATS) to maintain power after Base power is shut off. The ATS starts the Diesel generator after three seconds of power interruption. The CHAMP allows the CHATH to be staged near warfighters in the field in a bare base environment. The CHATH can be deployed in increments of 10, 25, and 50 beds. This flexibility of the CHATH system helps ensure the best medical care is as near to the crisis area as possible.

CB Protected Shelter (CBPS)

CBPS is a highly mobile, rapidly deployable shelter system designed to be used for Level I and II forward area medical treatment facilities and forward surgical teams. CBPS also replaces the M51. The system is self-contained and self-sustaining. The CBPS consists of a dedicated M1113 Expanded Capacity Vehicle (ECV), a Lightweight Multipurpose Shelter (LMS) mounted onto the vehicle, a 300 square foot airbeam supported CB protected shelter, and a High Mobility Trailer with a towed 10kw tactical Quiet Generator Set. The ECV and LMS transports a crew of four and their gear. All medical equipment required for the shelter is transported in the LMS or on the trailer. The CB shelter is rolled and carried on the rear of the LMS during transport. The CBPS is operational within 20 minutes with a crew of four. All power required to support operations is provided by the ECV engine or with the 10kw generator for limited power. The system is environmentally condi-

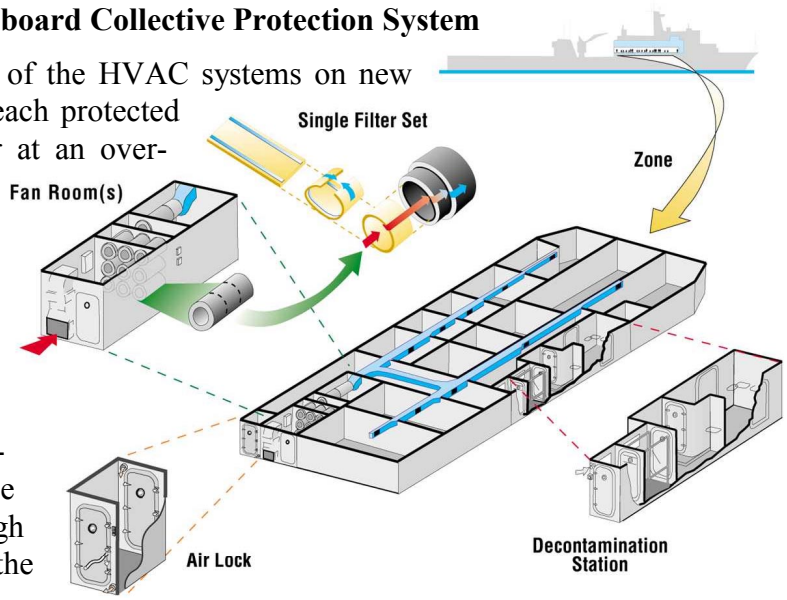
tioned by a hydraulically powered environmental support system, which provides filtered air, heating, air conditioning, and electrical power. The system is presently in limited production.

COLLECTIVE PROTECTION SYSTEMS

FIELDED AND PRODUCTION ITEMS

Shipboard Collective Protection System

Shipboard CPS is an integral part of the HVAC systems on new construction ships. CPS provides each protected zone on the ship with filtered air at an over-pressure of 2.0 inches water gauge. CPS is modular and is based on a Navy-improved version of the 200 cfm M56 filter. CPS includes filters, filter housings, high pressure fans, airlocks, pressure control valves, low pressure alarm system, and personnel decontamination stations. These systems are being installed through both new ship construction and the CPS Backfit program.



COLLECTIVE PROTECTION SYSTEMS

RDTE ITEMS

Shipboard Collective Protection Equipment

Rationale:

- Navy Service-Unique requirement

Key Requirements:

- Provide protection against chemical and biological threat agents
- Provide a minimum of three year continuous operational life
- Provide more efficient, long life filters
- Provide quieter, more efficient supply fans
- Develop methods to counter new and novel threat agents

Description:

Shipboard Collective Protection Equipment (CPE) provides a contamination-free environment within specified zone boundaries such that mission essential operations

and life sustaining functions can be performed during or after a CB attack. The objective of this program is to provide Pre-Planned Product Improvements (P3I) to the current Shipboard CPS to decrease logistic costs by extending particulate filter life, reducing shipboard maintenance requirements, and providing energy-efficient fans. The program develops improvements to existing shipboard HEPA and gas adsorber filters, supports long term shipboard testing of filter improvements to develop filter life database, and provides plans for backfitting existing non-CPS ships. Shipboard CPE is being installed on selected new construction ships. The Shipboard CPE program will transition to the JCPE program in FY03.

Joint Collective Protection Equipment (JCPE)

Rationale:

- Joint Service requirement

Key Requirements:

- Rapid insertion of technology improvements to existing equipment
- Increased number of shelters for command/control, medical, and rest/relief areas
- Improved shipboard systems
- Standardization of equipment

Description:

JCPE provides needed improvements and cost saving standardization to currently fielded collective protection systems by using the latest technologies in filtration, shelter materials, and environmental controls to provide affordable, lightweight, easy to operate and maintain equipment. Inserting improved technology into currently fielded systems will result in improved performance with reduced operating costs. Standardization of individual system components across Joint Service mission areas will reduce logistics burden while maintaining the industrial base. Taken both individually and collectively, these tasks will improve NBC defense readiness for Joint Services by providing state-of-the-art, off-the-shelf solutions for currently fielded equipment deficiencies.

Joint Transportable Collective Protection System (JTCOPS)

Rationale:

- Joint Service requirement

Key Requirements:

- Protection against chemical and biological agents, toxic industrial materials, and radiological particulate matter
- Use as a stand-alone structure or within existing structures
- Ability to process personnel through a contamination control area to a contamination-free area

Description:

The JTCOPS program is a new start program that will use new technology to provide relief from psychological and physiological stresses during sustained operations in a contaminated environment due to wearing full Individual Protection Equipment.

JTCOPS will be a modular shelter system that will provide the ability to process contaminated personnel through a Contamination Control Area into a Toxic Free Area, and will be expandable to meet changing mission needs. It will allow collective protected vehicles/vans to be connected for safe personnel ingress/egress. The system will include air filtration, environmental control, and power generation elements. JTCOPS will be used for a variety of mission scenarios to include command and control, rest and relief, billeting and medical treatment.

GENERIC NBC FILTERS AND COLLECTIVE PROTECTION FILTRATION SYSTEMS

FIELDED AND PRODUCTION ITEMS

Generic, high volume air flow NBC filters, and CP filtration systems exist that are currently installed on a wide variety of applications. These CP systems are modular and have been applied to numerous vehicles, vans, mobile shelters, and fixed sites.

GENERIC NBC FILTERS

NBC filters are used to remove Nuclear and Biological particulates and Chemical aerosols and vapors from the air supplied to collective protection systems.

M48/M48A1

The 100 cubic foot per minute (cfm) filter is used in the M1A1/A2 Abrams tank, M93 Modular Collective Protection Equipment (MCPE), CB Protected Shelter, and Paladin Self Propelled Howitzer.

M56

The 200 cfm filter is used as the basic filter set in the MCPE and in Naval applications. It can be stacked to obtain filtration of higher air flow rates.

600 cfm and 1200 cfm Stainless Steel Fixed Installation Gas Filters

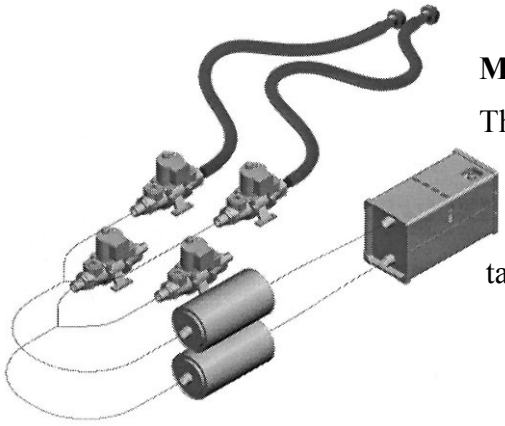
These filters are used in fixed site applications where high volumes of air flow are required. They can be stacked to provide higher NBC filtered air flow rates. Particulate filter would be procured separately.

GENERIC NBC CP FILTRATION SYSTEMS

The following are modular NBC CP filtration systems which are applied to a wide variety of applications. They consist of an NBC filter, motor/blower unit, housings, and integration housings/ductwork. Some can be integrated into environmental control equipment.

M8A3 Gas Particulate Filter Unit (GPFU)

The 12 cfm system provides air to armored vehicle crewman ventilated facemasks, *i.e.*, M42A1/A2. Used in M113 Armored Personnel Carrier variants and USMC AAVP7A1 amphibious vehicle.



M13A1 GPFU

The 20 cfm system provides air to armored vehicle crewmen ventilated facemasks, *i.e.*, M42A1/A2. Used on the M1A1/A2 Abrams tanks, Bradley Fighting Vehicles, Multiple Launch Rocket System (MLRS), tank transporter, and other vehicles.

Modular Collective Protection Equipment (100, 200, 400, 600 cfm Systems)

Modular Collective Protection Equipment (MCPE) consists of a family of related end items from which modules can be chosen and combined to meet the unique demands of individual systems. These end items employ common parts and mountings and interchangeable connections and accessories to the greatest extent possible. MCPE provides collective overpressure to a wide variety of mobile shelters and vans. It uses the M48 NBC filter in the 100 cfm system and the M56 NBC filter in the others.

Annex D

Decontamination Programs

Table D-1. Decontamination RDA Efforts

Category	Nomenclature	Status	USA	USAF	USMC	USN
Personnel	- M295 Individual Equipment Decontaminating Kit	Production	Rqmt	Rqmt	Interest	Rqmt
	- M291 Skin Decontaminating Kit	Production		Rqmt	Rqmt	Rqmt
Combat Equipment, Vehicles, and Aircraft	- M17A2/A3 Lightweight Decontamination System	Production	Rqmt	Rqmt	Rqmt	Rqmt
	- M17 MCHF Lightweight Decontamination System	Production		Int-NIR	Rqmt	Rqmt
	- M21/M22 Modular Decontamination System (MDS)	Production	Rqmt	Int-NIR	Int-NIR	Int-NIR
	- Joint Service Sensitive Equipment Decon	RDTE	Rqmt	Rqmt	Rqmt	Rqmt
	- Joint Service Fixed Site Decon	RDTE		Rqmt	Rqmt	
Decontaminant Solutions and Coatings	- M100 Sorbent Decontamination System and Solution Decontaminants	Production	Rqmt	Interest	Rqmt	Interest

Rqmt = Product Requirement
Interest = Product Interest
Int-NIR = Product Interest, No Imminent Requirement

* = sub-Product(s) of a Consolidated Joint Service Project
Rqmt, Interest = Sub-Product Requirement or Interest

PERSONNEL

FIELDED AND PRODUCTION ITEMS

M291 Skin Decontamination Kit

The M291 (shown in use) consists of a wallet-like flexible carrying pouch containing six individually sealed foil packets. Each packet contains a folded non-woven fiber applicator pad with an attached strap handle on one side. The pad contains a reactive and sorptive resin polymer mixture. The kit enables warfighters to remove, neutralize, and destroy chemical and biological warfare agents on contaminated skin. The kit is carried in a pocket of the Battle Dress Overgarment (BDO).

M295 Equipment Decontamination Kit

The M295 (shown in use) consists of four individual wipedown mitts, each enclosed in a soft, protective packet. The packet assembly is designed to fit comfortably within the pocket of a BDO. Each wipedown mitt in the kit is comprised of a decontaminating sorbent powder contained within a non-woven polyester material and a polyethylene film backing. In use, sorbent powder from the mitt is allowed to flow freely through the non-woven polyester pad material. Decontamination is accomplished through sorption of contamination by both the non-woven polyester pad and by the decontaminating sorbent powder. The M295 enables the warfighter to perform basic decontamination to remove, neutralize, or destroy CB warfare agents and toxins on contaminated personal and load bearing equipment.

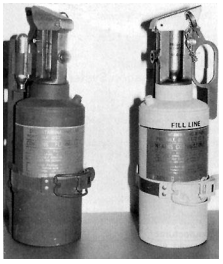
COMBAT EQUIPMENT, VEHICLES, AND AIRCRAFT

FIELDED AND PRODUCTION ITEMS

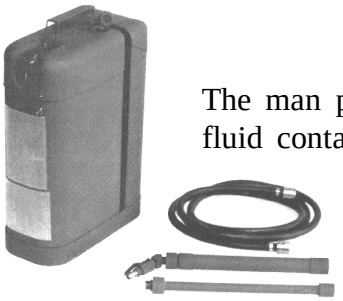
M100 Sorbent Decontamination System

The reactive sorbent decontamination system provides a simple, rapid, and efficient system to decontaminate small and individual issue items of equipment. It is effective in all environments, is less corrosive, and presents a lowered logistics burden through improved shelf life and reduced special handling and storage needs. The M100 system uses a catalytic component that reacts with the chemical agents being adsorbed; this eliminates the potential hazard created by the off-gassing of agents from used adsorbents.

ABC-M11 Portable Decontaminating Apparatus



The 1-1/3 quart capacity M11 is used to spray DS2 decontaminating solution onto critical areas (*i.e.*, frequently used parts) of vehicles and crew served weapons. The M11 consists of a steel cylinder, a spray head assembly, and a small nitrogen cylinder (about 3" long). The refillable M11 can produce a spray 6 to 8 feet long, and cover an area of about 135 square feet. The M11 is currently used on tanks and other systems where the larger M13 Decontaminating Apparatus, Portable cannot be effectively stowed.



M13 Decontaminating Apparatus, Portable (DAP)

The man portable M13 consists of a vehicle mounting bracket, a pre-filled fluid container containing 14 liters of DS2 decontaminating solution, and a brush-tipped pumping handle connected to the fluid container by a hose. The fluid container and brush head are both disposable. The M13 can decontaminate 1,200 square feet per fluid container. The combination of spray pump and brush allows personnel to decontaminate hard to reach surfaces, and remove thickened agent, mud, grease and other material.

ABC-M12A1 Power Driven Decontamination Apparatus (PDDA); Skid-Mounted

The M12A1 consists of three main components: a pump unit, a 500 gallon tank unit, and a 600 gallon per hour liquid fuel water heater. The M12A1 is a flexible system that can be used for purposes such as de-icing, fire fighting with water or foam, water pumping and transport, and personnel showering in addition to equipment and area decontamination. The M12A1 can pump 50 gallons of decontaminating solution per minute through both of its hoses. The integral shower assembly provides 25 shower heads. The M12A1 is typically mounted on a 5 ton truck for tactical mobility, but can be dismounted to facilitate air transport. The USMC has replaced the M12A1 PDDA with the M17 MCHF Lightweight Decontamination Apparatus.

M17 Series Lightweight Decontamination System (LDS)

The M17 series Lightweight Decontamination System (LDS) is a portable, lightweight, compact engine driven pump and water heating system. The system is used during decontamination operations. The LDS is capable of drawing water from any source and delivering it at moderate pressure and controlled temperatures. The system has an accessory kit with hoses, spray wands, and personnel shower hardware. It also includes a collapsible water bladder.

M17 MCHF Lightweight Decontamination System

The M17 Marine Corps Heavy Fuel (MCHF) LDS is a portable, lightweight, compact, engine-driven pump and multifuel-fired water heating system. The system is capable of performing the same hasty and deliberate decontamination procedures as required of the M17 series LDS. All components can be moved by a four-man crew, and can be operated using Military Standard Fuels (diesel fuel, JP-8, *etc*.) It can decontaminate both sides of a vehicle or aircraft simultaneously, and can decontaminate personnel, equipment, and other materiel without an external power source and in coordination with a watertank or natural water resource.

M21/M22 Modular Decontamination System (MDS)

The MDS provides the warfighter an improved capability to perform detailed equipment decontamination on the battlefield. The system replaces current methods of decontamination application (*i.e.*, mops and brooms or with the portable M13 Decontamination Apparatus), which are time consuming and labor intensive. The MDS improves effectiveness, reduces water usage, reduces equipment processing time, and is less labor intensive. The MDS consists of an M21 decontaminant Pumper/Scrubber module, and M22 High Pressure/Hot Water module. The M22 delivers DS2 or liquid field expedient decontaminants and is capable of drawing the decontaminant directly from a container on the ground while mounted on a trailer. The M22 provides hot water up to 3000 psi at a rate of 5 gpm with the capability of high volume cold water and detergent injector. It is also capable of drawing water from natural and urban water sources (such as fire hydrants) and delivering it at variable and adjustable pressures, temperatures, and flow rates. Each module (M21 or M22) may be transported or operated from a 3/4-ton trailer towed by a M1037 High Mobility Multipurpose Wheeled Vehicle (HMMWV).

COMBAT EQUIPMENT, VEHICLES, AND AIRCRAFT

RDTE ITEMS

Joint Service Sensitive Equipment Decontamination (JSSED)

Rationale:

- Joint Service requirement

Key Requirements:

- Non-aqueous based decontamination systems for sensitive equipment and vehicle interiors
- Capable of being used in both mobile and fixed-sites

Description:

Provide a first ever capability to decontaminate chemical and biological warfare agents and toxins from sensitive electronic, avionics, electro-optic equipment, and vehicle interiors. Its use must be compatible with and not degrade sensitive materials or equipment. It must be operator safe and offer protection from off-gassing and direct liquid exposure during decontamination.

Joint Service Fixed Site Decontamination System

Rationale:

- Army, Air Force, and Marine Corps requirement

Key Requirements:

- Provide restoration capability at fixed site locations
- Provide improved/state-of-the-art NBC decontamination equipment
- Provide non-hazardous and environmentally safe NBC decontaminants

Description:

The Joint Service Fixed Site Decontamination program is a joint effort. The system will provide a family of decontaminants and applicators to provide the capability to decontaminate ports, airfield, and rear-area supply depots, and includes personnel and casualties with open wounds. In FY02 the program name will officially change to the Joint Service Family of Decontamination Systems (JSFDS) to better reflect the approach to meeting the program requirements.

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Annex E

Joint Medical Chemical, Biological, and Radiological Defense Research Programs

The Joint Medical Chemical, Biological, and Radiological Defense Research Programs are addressed in three sections of this annex. Section E.1 addresses medical chemical defense research, section E.2 addresses medical biological defense research, and section E.3 addresses medical radiological defense research.

Table E-1. Medical Chemical and Biological Defense RDA Efforts

Category	Nomenclature	Status	USA	USAF	USMC	USN
Medical Chemical Defense	- Antidote Treatment – Nerve Agent Autoinjector	Fielded	Joint	Joint	Joint	Joint
	- Convulsant Antidote for Nerve Agents	Fielded	Joint	Joint	Joint	Joint
	- Skin Advanced Anticonvulsant System	RDTE	Joint	Joint	Joint	Joint
	- Cyanide Pretreatment	RDTE	Joint	Joint	Joint	Joint
	- Medical Aerosolized Nerve Agent Antidote	Fielded	Joint	Joint	Joint	Joint
	- Nerve Agent Pretreatment, Pyridostigmine	Fielded	Joint	Joint	Joint	Joint
	- Skin Exposure Reduction Paste Against Chemical Warfare Agents (SERPACWA)	Production	Joint	Joint	Joint	Joint
	- Active Topical Skin Protectant	RDTE	Joint*	Joint*	Joint*	Joint*
	- Chemical Agent Prophylaxes	RDTE	Joint*	Joint*	Joint*	Joint*
Medical Biological Defense	- Anthrax Vaccine Adsorbed	Production	Joint	Joint	Joint	Joint
	- Clostridium Botulinum Toxins Medical Defense System	RDTE	Joint*	Joint*	Joint*	Joint*
	- Next Generation Anthrax Vaccine	RDTE	Joint*	Joint*	Joint*	Joint*
	- Improved Plague vaccine	RDTE	Joint*	Joint*	Joint*	Joint*
	- Ricin Vaccine	RDTE	Joint	Joint	Joint	Joint
	- Smallpox Vaccine (cell cultured derived)	RDTE	Joint*	Joint*	Joint*	Joint*
	- Staphylococcus Enterotoxin Vaccine	RDTE	Joint	Joint	Joint	Joint
	- Tularemia Live Vaccine	RDTE	Joint	Joint	Joint	Joint
	- Venezuelan Equine Encephalitis Vaccine	RDTE	Joint*	Joint*	Joint*	Joint*
	- Joint Biological Agent Identification and Diagnostic System	RDTE	Joint	Joint	Joint	Joint

Joint= Joint Service requirement Joint*=Draft Joint Service requirement

E.1 MEDICAL CHEMICAL DEFENSE RESEARCH PROGRAM

E.1.1 Fielded Products

Advances in medical research and development (R&D) significantly improve the war-fighting mission by sustaining unit effectiveness through conserving the fighting strength of our forces and supporting the nation's global military strategy, which requires the ability to effectively deploy and operate. Medical R&D products (materiel and non-materiel solutions) provide the foundation that ensures the fielding of a flexible, sustainable, modernized force across the spectrum of conflict and in the full breadth and depth of the battlefield. Overcoming medical threats and extending human performance have provided a significant increase in military effectiveness in the past and present the potential for future enhancement of military operational effectiveness. Following are fielded medical chemical defense items, including pharmaceuticals, materiel, and technical information and guidance (with initial fielding date shown.)

Pharmaceuticals:

- Nerve Agent Antidote Kit (Mark I), 1983
- Skin Decontamination Kit (M291), 1990
- Nerve Agent Pretreatment (Pyridostigmine), 1987
- Convulsant Antidote for Nerve Agent (CANA), 1991
- Medical Aerosolized Nerve Agent Antidote (MANAA), 1994

MARK I, M291, Nerve Agent Pretreatment, and CANA

Materiel:

- Test Mate® ChE (Cholinesterase) Kit, 1997 (*shown*).
- Resuscitation Device, Individual, Chemical, 1990.
- Decontaminable Patient Litter (NSN 6530-01-380-7309), 1991.
- Chemical Warfare (CW) Protective Patient Wrap (NSN 8415-01-311-7711), 1991.
- Computer-Based Performance Assessment Battery, 1993.
- M40 Protective Mask Vision Correction (optical inserts).

Decontaminable Patient Litter and CW Protective Patient Wrap

Technical Information and Guidance:

- Taxonomic Work Station, 1985.
- U.S. Army Medical Research Institute of Chemical Defense (USAMRICD) Technical Memoranda on Chemical Casualty Care, 1990.
- Field Manual (FM) 8-285, *Treatment of Chemical Agent Casualties and Conventional Military Chemical Injuries*, 1995.
- *Field Management of Chemical Casualties Handbook*, Second Edition, July 2000
- Technical Bulletin (TB) Medical (MED) 296, 1996: *Assay Techniques for Detection of Exposure to Sulfur Mustard, Cholinesterase Inhibitors, Sarin, Soman, GF, and Cyanide*.
- Compact Disk - Read-Only Memory (CD-ROM) on "Management of Chemical Warfare Injuries," 1996.
- *Medical Management of Chemical Casualties Handbook*, Third Edition, July 2000.

E.1.2 Medical Chemical Defense R&D Accomplishments

The medical chemical defense R&D technical barriers and accomplishments during FY01 are grouped by medical chemical defense strategies, which include:

- *Pretreatments.*
- *Therapeutics.*
- *Diagnostics.*

Today's chemical threat, however, is not restricted to commonly accepted classical agents, such as vesicants [sulfur mustard (HD)], nerve agents (soman, sarin, tabun, and VX), respiratory agents (phosgene), or blood agents (cyanide). Potential adversaries may develop novel threat agents. Additionally, the potential for transient or sustained systemic toxicity from low dose exposure(s) to chemical warfare agents must be thoroughly investigated to determine the potential effect on Service members. The ability to provide timely and effective medical countermeasures to new threats depends upon maintaining a high level of technological capability. Sustaining and enhancing this technological capability is dependent upon the continued support of a robust program investigating basic pathophysiological mechanisms which, in turn, contributes to the knowledge and database upon which new, innovative, and improved diagnostics, pretreatments, and therapies are based.

Countermeasure strategies to the classic and novel threats include pharmaceuticals, medical equipment, specialized materiel or medical procedures, and concepts for training, doctrine, and organization. Medical countermeasures are designed not only to prevent lethality but also to preserve and sustain combat effectiveness in the face of combined threats from chemical and conventional munitions on the integrated battlefield by:

- Rapid diagnosis of chemical agent exposure.
- Prevention of the effects of chemical agents (*e.g.*, prophylaxes or pretreatment).
- Far-forward treatment upon exposure to chemical warfare threats (*e.g.*, antidotes).
- Chemical casualty care (*e.g.*, therapy and management).

Medical chemical defense research directly conducted or sponsored by the United States Army Medical Research and Materiel Command (USAMRMC) laboratories yielded the following accomplishments in FY01:

Research Category: Pretreatments/Prophylaxes

The countermeasures, technical barriers, and accomplishments in the medical chemical defense research category of pretreatments are outlined below.

Countermeasures:

- Improved Skin Exposure Reduction Paste against Chemical Warfare Agents (SERPACWA) by incorporation of active moieties that detoxify the chemical agents.
- Pretreatment regimen that protects against rapid action and incapacitating effect of nerve agents and fourth generation nerve agents.

- Pharmaceutical and biological pretreatments, treatments, antidotes, decontaminants and protectants.

Technical Barriers:

- Lack of pretreatments and/or antidotes that are quick acting, long lasting, easy to carry and use on the battlefield.
- Lack of appropriate experimental model systems to predict pretreatment or treatment efficacy and safety in humans.
- Lack of detailed molecular model of all threat agents to understand the mechanism of their unique chemical properties and their effects.
- Potential performance decrement with pretreatment is being investigated.
- Lack of a capability to provide forensic diagnostics for chemical threats.

Accomplishments:

The detailed accomplishments that follow are drawn from the basic research, applied research, and concept exploration related to the development of pretreatments.

- Modified several modules in the active Topical Skin Protectant (aTSP) Decision Tree Network (DTN) to allow more effective efficacy evaluation comparisons with SERPACWA.
- Investigated 158 candidate active moieties in over 350 formulations as part of the aTSP effort.
- Demonstrated significantly improved efficacy over SERPACWA by 17 active moieties against sulfur mustard (HD) and 15 active moieties against soman.
- Identified a formulation containing a polyamine as the lead aTSP candidate with demonstrated efficacy against sulfur mustard and soman in both *in vitro* and *in vivo* models.
- Filed 9 patents describing aTSP development.
- Identified several candidate active moieties that would be useful in a multiple layer protective system as part of the aTSP research effort.
- Determined that Oltrapraz, a stimulator of glutathione-S-transferase, had no protective effect against HD cytotoxicity in human epidermal keratinocyte (HEK) cells.
- Demonstrated protective efficacy of heparin management test (HMT), mesna and olvanil against HD-induced biochemical changes in lung lavage fluids
- Initiated studies of liposome encapsulated drug delivery.
- Identified Cohn Fraction IV from blood as a good source for obtaining large quantities of purified human butyrylcholinesterase (huBuChE) suitable for use as a bioscavenger for organophosphate (OP) poisoning.
- Inititiated the purification of huBuChE from 100 Kg of Cohn fraction IV paste containing ~12-15 g of enzyme, resulting in 5 g of purified enzyme.
- Five hundred milligrams of purified huBuChE was provided to the Netherlands Organization (TNO) labs for toxicokinetic and toxicodynamic studies. Of this, 200 mg was committed for neutron scattering studies and approximately 300 mg will be used for testing safety, toxicity, and efficacy as a bioscavenger in mice and non-human primates.

- Determined the effectiveness of huBuChE as a single pretreatment drug against OP nerve agents in non-human primates and observed no performance decrement. Continued to develop joint program comprising WRAIR, USAMRICD, MedImmune Inc., and the National Institute for Drug Abuse (NIDA) to prepare ~1000 doses of huBuChE from Cohn Fraction IV in compliance with current Good Manufacturing Practices (cGMP).
- Investigated the role of amino acid residues in the reactivation of DEPQ- and MEPQ-inhibited mouse acetylcholinesterase (AchE) and huBuChE by TMB_4, Toxogonin, 2-PAM, and HI-6.
- Demonstrated that phosphoryl oxime inhibition occurs during reactivation of DEPQ- and MEPQ-inhibited AChE by TMB_4 and Toxogonin, but not HI-6. Reactivation of both DEPQ- and MEPQ-inhibited AChE was accelerated in the presence of organophosphorus hydrolase (OPH) and the AchE was able to hydrolyze phosphoryl oximes formed during reactivation.
- A full-length cDNA clone for the mature tetrameric subunit of bovine brain AChE was expressed in Chinese Hamster ovary cells (CHO) as well as HEK 293 cells to generate the tetrameric form of bovine brain AChE.
- Truncated the full-length cDNA clone for the mature tetrameric subunit of bovine brain AChE at the C-terminus to obtain a 1745 base pair cDNA clone for the monomeric subunit of bovine brain AChE.
- Determined carbohydrate structures of eight of nine site-specific glycopeptides derived from human butyrylcholinesterase; three of four site-specific carbohydrate structures of bovine serum AChE; and three of eight site-specific carbohydrate structures of equine BuChE. This is an important step to elucidating the requirements for prolonged circulatory time of cholinesterases.
- Initiated investigations on the use of a liposome-mediated delivery system for the transfection of huBuChE gene into lungs.
- Developed High Performance Liquid Chromatography (HPLC) techniques to purify the custom peptides designed for targeting and aiding penetration of liposomes with BuChE gene to mouse lung cells.
- Elucidated the amino acid residues that control the binding of anti-Alzheimer's drug, galanthamine to cholinesterases (ChEs) and demonstrated that galanthamine interacts with the active site of ChEs.
- Synthesized and evaluated eight tacrine-related hetero- and homo-bivalent ligands as candidate pretreatment drugs for protection against OP toxicity (in collaboration with Sienna University, Italy).
- Synthesized and evaluated the anti-cholinesterase properties of the hybrid analog of AChE inhibitors, huperzine A and huperzine B (in collaboration with Georgetown University, Washington, DC).
- Demonstrated that huperzine A provides neuroprotection against oxidative stress in rodent cerebella and forebrain neurons.
- Determined that sodium channel blockers and huperzine A provide differential neuroprotection against hypoxia or glutamate mediated neurotoxicity in primary cultures of rat cerebella neurons.

- Showed that huperzine A modulated and decreased the neurotoxicity induced by b-amyloid in primary neurons.
- Initiated telemetry study of animals to evaluate neuroprotective compound efficacy by measuring EEG, ECQ, heart rates, blood pressure and respiratory rates.
- Quantified and correlated huperzine A effects on cholinesterase levels in brain, blood and other tissues in rats after low, medium and near lethal doses of huperzine A.
- Determined that huperzine A protects against NMDA-induced lethality in rats.
- Determined pharmacokinetic parameters for (-) huperzine A in rat serum. Isolated and structurally characterized the major huperzine A metabolite from rat liver and serum.
- Developed isolation methods and sensitive HPLC-based assay for pyridostigmine bromide measurements from human plasma in support of the Pyridostigmine Bromide Integrated Project Team FDA submission effort.
- Designed and synthesized a new series of compounds named pyridophens to achieve binary prodrugs to preferentially inhibit AChE over BuChE, while still retaining the muscarinic receptor antagonism of aprophen.
- Developed the use of a viability assay (ProCheck™; Intergen, Inc.), containing no hazardous components that can detect 2-chloroethyl ethyl sulfide (CEES; half mustard) - induced viability changes in as few as 1000-3000 leukocytes/ml.
- Determined that human whole blood exposure to CEES vapor (1.5 mg/L/min) for only 15 minutes (total CEES dose of 22.5 mg) significantly decreased total leukocyte viability compared to controls.
- Demonstrated human whole blood exposure to CEES vapor (1.5 mg/L/min) from 15-60 minutes (total CEES dose of 22.5-90 mg) resulted in similar total leukocyte cell counts relative to controls, even when viability was significantly reduced.
- Identified reductions in the number of human whole blood lymphocytes with cell surface markers CD3, CD5 or CD45 as an indicator of CEES (30 min; 1.5 mg/L/min; total CEES dose of 45 mg)-induced damage.
- Established a cooperative research and development agreement with Emory University to test the leukocyte-protective effect of polyoxometalates in the presence or absence of other potential vesicant antidotes following exposure of human whole blood to CEES.
- Initiated a non-human primate (Rhesus monkey) model study to assess the effects of huBuChE on complex cognitive tasks (serial probe recognition and targeting) as part of the OP prophylactic countermeasure research effort. As part of this same effort, developed a mouse behavioral and reflex assay to evaluate novel esterase compounds in normal and genetically modified (knockout and transgenic) animals.
- Developed a rodent model to assess the effects of low dose (sub-clinical) exposure to OP nerve agents that evaluates general behavioral performance and cognitive ability with emphasis on acquisition of new tasks.
- Determined in rats that AChE inhibition following repeated low-dose VX exposure was highly correlated between different brain regions but less so between brain and red blood cells. Found that measures indicative of general CNS energy systems (*e.g.*, cortical Na, K-ATPase) were not significantly affected.

Research Category: Therapeutics/Diagnostics

The countermeasures, technical barriers, and accomplishments in the medical chemical defense research category of therapeutics/diagnostics are outlined below.

Countermeasures:

- Products that moderate or improve healing of vesicant injury.
- Medical countermeasures to minimize lethality, morbidity, and incapacitation caused by chemical warfare agents (CWAs).
- Specific casualty management techniques to improve survival and minimize lost duty time.
- Pharmaceutical/biological antidotes, or decontaminants/protectants.
- Diagnostics for the effects of exposure to rapidly acting nerve agents, vesicants, cyanide, and Fourth Generation Agents.

Technical Barriers:

- Need for quick-acting and long-lasting antidotes that are deployable.
- Lack of appropriate experimental model systems for treatment efficacy and safety in humans.
- Need for detailed molecular model of Fourth Generation Agents to understand the origin of their unique chemical properties.
- Lack of simple and sensitive field-portable diagnostic assays for CWA exposure.

Accomplishments:

- Evaluated the release of lung immune products in response to *in vivo* mustard exposure to better define lung injury and the potential for therapeutic agents to prevent cellular damage. Observed that, for peroxidase reactions, reduced glutathione (GSH) demonstrated a greater response. Regarding cytokines, the inflammatory mediator MIP2 was released more than interleukins 4 and 6.
- Completed testing of colony stimulating factor (CSF) in African Green Monkeys and showed efficacy by CSF against HD-induced leukopenia.
- Studies were conducted on IL-6 expression and secretion and structural changes following HD exposure of HEK. While ELISA data show an HD-induced increased secretion over 24 h, mRNA data present wave –like patterns. NMR data clearly show the unfolding of the IL-6 glycoprotein. This is related to disappearance of one of the two disulfide bonds in IL-6.
- Modified the mouse ear drug screen model by lowering the dose of HD to produce a model with increased sensitivity.
- Several procedures for inhibiting apoptosis resulted in reduction of cytotoxicity following HD exposure of cells in culture. These include the calmodulin antagonist W7, an antibody against the Fas receptor (CD95) and a general caspase inhibitor Z-VAD.
- Identified treatments (2-deoxyglucose, fructose +/- CysA, and elevated glucose) that can increase mitochondrial metabolism but not necessarily prevent loss of viable cells caused by HD exposure.

- Demonstrated concentration dependent inhibition of α1-antitrypsin, the primary protease inhibitor at the epidermal-dermal junction.
- Demonstrated, using inhibitors and antisense RNA, no involvement of PLA2 in HD-induced arachidonic acid release. PLD does seem to be involved
- Demonstrated increased expression of caspase 3, CD95 (Fas receptor), and intracellular IL-8 in HEK following HD exposure.
- Suppressed (dose dependent) HD-induced IL-8 and improved cellular morphology in HEK using the synthetic analogue of tetrahydrocannabinol (THC), CT3.
- Identified several apoptosis inhibitors (dithiocarbamates, aurintricarboxylic acid and caspase inhibitors) that protect against HD cytotoxicity in HEK with best protection applied 3h post-HD exposure, using combinations. The 48 and 96 hour toxicities were identified as more significant than at 24 hours.
- Demonstrated various micro-pathological changes resulting from exposure to HD.
- Identified in HEK that a substantial reorganization and 25% decrease in a6b4 and laminin-5 at 1 hour post exposure to 400uM HD.
- Demonstrated that HD and nitrogen mustard (HN2) degrades laminin-5 in HEK.
- Identified alterations in actin, tubulin, and keratin and high molecular weight aggregates involving k-14 as a result of HD exposure.
- Identified SAPK/JNK, p38, and NF-kB 3 to be important signaling pathways and that pharmacological inhibition of p38 or NF-kB pathways significantly reduced the HD-induced cytokine response.
- Demonstrated that HD-induced cell death may occur through down-regulation of a specific regulatory pathway controlled by the gene Akt or PDK1, its upstream effector.
- Developed a method for removal of GD (soman) from blood in order to quantify the pyridostigmine-spared cholinesterases.
- Developed methods to determine coefficients of distribution of acetyl and butyryl cholinesterases in guinea pigs, mice, and other species of animals in blood, brain, and other tissues.
- Filed a patent defining a microassay method to measure cholinesterase entitled “Assay for detecting, measuring, and monitoring the activities and concentration of proteins and methods of use thereof”.
- Demonstrated that pyridostigmine inhibited binding to the muscle ACh receptor (mAChR) but not to the nerve ACh receptor (nAChR). Also showed that DEET, an insecticide, did not affect mAChR binding but that it did non-competitively inhibit nerve AChR binding. Co-exposure of mAChR and nAChR to the compounds yielded no enhancement of inhibition.
- Demonstrated that pyridostigmine inhibited purified acetylcholinesterase (AChE) more potently than butyrylcholinesterase, while DEET partially blocked the inhibition of both enzymes by pyridostigmine. Permethrin (an insecticide) emulsion did not perturb binding at either receptors nor inhibit ChEs. Therefore, it appears that there should be no correlation between cholinergic functions and the exposure to DEET, permethrin, and pyridostigmine bromide.
- Demonstrated a protective ratio of 15.7 for polyurethane sponges (combination of HI-6 and extracting additives) to decontaminate soma-exposed guinea pigs (LD_{50}, 155

mg/kg). A protective ratio of almost 25 was obtained in VX contaminated guinea pigs (LD_{50}, 3.37 mg/kg).

- Initiated the development of enzyme-coupled assays to rapidly detect mustargen (generic name mechlorethamine, MSD, mustine, or nitrogen mustard) and HD using a visible or fluorescent indicator. The enzymes, choline oxidase and horseradish peroxidase, have been successfully immobilized on polyurethane prepolymers, making the reaction suitable for long-term monitoring of this CWA.
- Demonstrated a dose-dependent reversible coupling of soluble AChE to the macroaffinity sponge polymer for purification of the AchE using a new scheme to synthesize a spacer-ligand.
- Determined the enzymatic rate constants (kcat and K_M) for soluble OPH and OPH immobilized on polyallylamine cotton for both paraoxon and demeton-S. This represents a more stable form of cotton (SBIR, Phase II).
- Demonstrated the ability of polyurethane immobilized OPH and OPH-AE, a modified OPH, to detoxify a wide variety of pesticides (OP surrogates). (SBIR, Phase II).
- Determined that magnesium sulfate and the nitrone PBN (N-tert-butyl-α-phenylnitrone) were ineffective in reducing neuronal damage subsequent to soman-induced status epilepticus.
- Initiated a modified model study for investigating less severe neuronal damage that may be more amenable to neuroprotectant drug treatment while increasing survivability and reducing morbidity of animals.
- Determined that the scavenger dihydrolipoic acid protects cultured neurons from oxidative stress *in vitro*, but the addition of the nitrone free radical spin trap PBN (N-tert-butyl-α-phenylnitrone) substantially enhanced neuroprotection.
- Determined that increasing endogenous stores of naturally occurring lipoates followed by supplementing with spin trapping nitrones may constitute an effective neuroprotective strategy based upon *in vitro* and *in vivo* studies.
- Initiated pilot studies in rats to determine whether the neuroprotection offered by dexanabinol (HU-211) will reduce behavioral deficits reducing from soman-induced status epilepticus as measured using the active avoidance paradigm.
- Determined that HU-211 protects against soman-induced excitotoxicity but appears to have no effect on the vasogenic-related damage seen in the thalamus.
- Determined a relationship between lesion volume and certain frequency bands of the electroencephalographic recording device at specific time intervals that can confidently predict impending brain damage following soman-induced seizure activity.
- Developed a one-compartment mathematical model to describe the level of protection provided by stoichiometric scavengers against nerve agents.
- Medical countermeasures that improved survival against fourth generation agents (FGAs).
- Developed a new *in vitro* model to screen for better oximes using human AChE. Determined that steroidal eye drops (prednisolone acetate) applied for up to 2 hours to sulfur mustard exposed eyes, followed by subtenon injection of triamcinolone/cefazolin combination significantly reduced ocular damage in the rabbit. In addition, determined

that matrix metalloproteases inhibitor (Ilomastat) droplets applied to sulfur mustard exposed eyes showed promising therapeutic results.

- Determined maximum doses of the nerve agents sarin (GB), cyclosarin (GF), soman (GD), VX, and VR that can be absorbed daily in male and female guinea pigs without lethal effects or clinical signs of toxicity, thus establishing an upper limit for chronic low-dose chemical nerve agent studies.
- Identified an enhanced sensitivity to low-dose nerve agents in animals on food-restricted diets, suggesting an interaction between food intake and maximum tolerated dose.
- Determined the doses of sarin (GB), soman (GD) and VX that abnormally enhance startle responses in animals exposed to low-level chemical warfare nerve agents.
- Identified specific gene products that are either enhanced or depressed in the brain following low-level chemical warfare nerve agent exposures to GB and GD.
- Observed changes in brain electrical activity (EEG) suggesting cumulative and slowly reversing sleep disruption with low-dose sarin (GB) exposures.
- Measured cumulative and regionally selective inhibition of brain acetylcholinesterase activity with low-dose VX exposure.
- Developed a computer model of electrical flow in the heart to predict nerve agent induced cardiac arrhythmias.
- Verified that sarin (GB), soman (GD) and VX have no direct effect on electrical excitability and resting membrane potentials in single neurons at low-doses.
- Identified functional changes in synaptic connections between brain neurons following acute exposure to low-dose VX and sarin (GB) and investigated allosteric drugs such as galanthamine as a method to reverse these synaptic changes.
- Observed a loss of electrical excitability resulting from direct interaction between sulfur mustard (HD) and neuron membranes in cell culture.
- Continued developing a swine model to test treatment of sulfur mustard induced dermal injury similar to third degree burns.
- Determined in the swine model that full thickness laser debridement or surgical excision followed by skin grafting significantly improved wound healing. Initiated development of the model to mimic superficial and second degree burns.
- Continued to develop a mouse inhalation model to test phosgene injury.
- Found that bronchoalveolar lavage fluid in these animals had greater amounts of total Ca++ and K+ than non-phosgene exposed animals, as early as one hour after exposure. This model may be an early indicator of phosgene exposure, providing the medical staff with ample time to properly treat for injury. This model was used to determine that N-acetylcysteine given intraperitoneally increased survival rates in mice.
- Developed a fixed site cholinesterase assay to analyze cholinesterase activity in whole blood, red blood cells and tissue as an indicator of nerve agent poisoning. This assay is automated, uses small sample size (10 microliters), and is very accurate.
- Developed polyurethane sponges for skin and wound decontamination of chemical warfare agents. The wetting solution of oxime (HI-6) and tetraglyme provides greater than ten-fold and one hundred-fold increase in survival when used to decontaminate soman and VX, respectively, applied to the guinea pig skin.

Research Category: Reducing Reliance on the use of Animals as Subjects of Research

- Initiated development of an *in vitro* human whole blood model to rapidly screen for potential antidote combinations that effectively protect cells from the damage associated with vesicant exposure.

E.1.3 Advanced Development Products

In advanced development, the goals are proof-of-principle and the conduct of studies necessary to obtain FDA approval/licensure of drugs, vaccines, and devices. The medical R&D process links the materiel developer (U.S. Army Medical Research and Materiel Command, USAMRMC) with the combat and training developer (U.S. Army Medical Department Center and School, AMEDD C&S) and the logistician (U.S. Army Medical Materiel Agency, USAMMA) in addressing the threat and JMCDRP requirements. Medical chemical defense products now in the advanced development phase are the following:

Product: Skin Exposure Reduction Paste Against Chemical Warfare Agents (SERPACWA) [formerly Topical Skin Protectant (TSP)]

Concept:

- Use perfluorinated formulations.
- Form non-toxic, nonirritating barrier film layer on skin.
- Augments Mission Oriented Protective Posture (MOPP).
- Protection against vesicant and nerve agents.

Accomplishments:

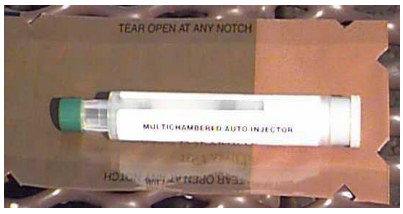
- FDA required Phase IV studies are completed or ongoing

Product: Antidote Treatment, Nerve Agent, Autoinjector (Formerly Multi-chambered Autoinjector)

Concept:

- Speed administration of life-saving antidotes against nerve agents.
- Replace two-Injector Mark I Nerve Agent Antidote Kit with single autoinjector.

Accomplishments:



- Production line upgrade underway with a custom-built high- speed autoinjector filling machine to increase capacity
- The FDA issued an approval letter for the New Drug Application (NDA) on 17 January 2002.
- A Transition Planning and Tracking Group formed

Product: Advanced Anticonvulsant System

Concept:

- A buddy-aid administered anticonvulsant to protect against convulsions after CWA exposure.

- Replace the currently fielded Convulsant Antidote Nerve Agent (CANA) with a faster acting and more effective anticonvulsant.

Accomplishments:

- Laboratory efforts to develop information required to down select one candidate for human trials continued.

E.2 MEDICAL BIOLOGICAL DEFENSE RESEARCH PROGRAM

E.2.1 Biological Defense Products

Advances in DoD medical R&D significantly impact the warfighting mission by sustaining unit effectiveness through conserving the fighting strength of our forces and supporting the nation's global military strategy, which requires the ability to effectively deploy and operate in all environments. Medical R&D products (materiel and non-materiel solutions) provide the foundation that ensures the fielding of a flexible, sustainable, modernized force across the spectrum of conflict and in the full breadth and depth of the battlefield. Overcoming medical threats and extending human performance have provided a significant increase in military effectiveness in the past and present the potential for future enhancement of military operational effectiveness. Only one medical materiel solution (Anthrax Vaccine Adsorbed) is fully licensed by the Food and Drug Administration (FDA) and available for use. Currently, however, access to the vaccine is limited until the FDA approves the manufacturer's Biologics License Application. Others are in investigational new drug (IND) status, which may only be used consistent with Executive Order 13139. A Prime Systems Contract, which supports the Joint Vaccine Acquisition Program (JVAP), is responsible for moving mature solutions from the technology base through advanced development to FDA licensure and procurement of baseline stockpiles. Currently licensed and IND solutions for use in medical biological defense R&D include the following:

Vaccines and Antisera:

- Anthrax Vaccine Adsorbed (licensed)
- Smallpox Vaccine (limited stockpile of licensed vaccine)
- Botulinum Toxoid, Absorbed
- Botulinum Pentavalent Vaccine (IND #3723)
- Botulinum Type F Toxoid Vaccine (IND #5077)
- Equine Heptavalent F(ab')2 Botulinum Antitoxin (Types A, B, C, D, E, F, and G) (IND #3703)
- Botulism Immune Globulin, Human (IND #1332)
- Botulism Antitoxin Heptavalent Equine, Types A, B, C, D, E, F, and G (IND #7451)
- Q Fever Vaccine, Formalin inactivated, CM Extract, Gamma Irradiated (Henzerling Strain) (IND #3516)
- Tularemia Vaccine (IND #157)
- New smallpox vaccine (Vaccinia Virus, Cell Culture-derived) (IND #4984)
- Venezuelan Equine Encephalitis Virus Vaccine (attenuated), TC-83 (IND #142)
- Venezuelan Equine Encephalitis Virus Vaccine (inactivated), C-84 (IND #914)
- Eastern Equine Encephalitis Virus Vaccine (IND #266)
- Western Equine Encephalitis Virus Vaccine (IND #2013)

The status of medical materiel solutions being managed by the Joint Program Office for Biological Defense (JPO-BD) and JVAP are reported in Section E.2.3.

Technical Information and Guidance:

- *Medical Management of Biological Casualties Handbook*, fourth edition, February 2001.
- CD-ROM on "Management of Biological Warfare Casualties," 1999.
- NATO Handbook "Medical Aspects of NBC Defensive Operations, AMedP-6(B), Part II (Biological)," 1998.

E.2.2 Biological Defense Research and Development Accomplishments

The biological defense research and development technical barriers and accomplishments during FY01 are grouped by the following medical defense strategies against biological threats (bacteria, viruses, and toxins):

- Vaccines against bacterial agents.
- Therapeutics for bacterial agents.
- Vaccines against viral agents.
- Therapeutics for viral agents.
- Vaccines against toxin agents.
- Therapeutics for toxin agents.
- Diagnostics.

Several projects and technologies are shared with other agencies, including the Department of Energy (DOE) and the Defense Advanced Research Projects Agency (DARPA). DARPA technology transition and cooperative efforts with the Medical Chemical and Biological Defense Research Program are described in Chapter 2 of this report (section 2.7.5.2). The DOE projects tie into the strengths of the DOE laboratories in developing advanced technologies in order to enable rapid detection of and response to a chemical or biological agent incident. DOE is not involved directly in protection and treatment of personnel, but actively assists DoD with drug/chemical database searches, DNA sequencing, advanced protein chemistry, and modeling/simulation projects. Successful sequencing of plasmids found in the causative agents of plague and anthrax helped create the "lab on a chip". The extensive knowledge and databases available to DOE allow application of computational tools to predict sites of intervention by novel therapies against threat agents.

Medical biological defense research conducted or sponsored by the United States Army Medical Research and Materiel Command (USAMRMC) laboratories yielded the following accomplishments in FY01:

Bacterial Agents

The countermeasures, technical barriers, and accomplishments in the biological threat category of bacterial agents are outlined below.

Countermeasures:

- Vaccines for immunity against bacterial threat agents.
- Therapeutics for treatment of bacterial diseases.

Technical Barriers:

- Incomplete genetic information for all of the bacterial threat agents.
- Lack of appropriate animal model systems for investigation of some bacterial threats and countermeasures.

- Lack of suitable epidemiological situations in which to perform human clinical trials to evaluate efficacy of vaccines.
- Difficulty in field testing rapid identification kits under natural conditions.
- Difficulty in defining surrogate markers of protection.
- Necessity to enhance the otherwise limited data on which to base rational drug and antibody therapies for bacterial agents of interest.
- Necessity to establish and maintain capabilities to assess threats and provide countermeasures for new, emerging, and genetically engineered bacterial threats.

Vaccines Accomplishments:

- Completed a dose-seeking experiment in mice (two vaccine doses) challenged parenterally with *Yersinia pestis* and generated data for calculating the effective dose required to protect mice against a parenteral challenge (*i.e.*, ED_{50} 0.6 μg/dose or ED_{95} 10 μg/dose).
- Performed a single-vaccine dose experiment in mice challenged by aerosol with *Y. pestis*. This experiment established the optimal effective single vaccine dose (10 μg) in the mouse for aerosolized plague..
- Performed a preliminary experiment comparing immunogenicity and efficacy versus route of administration (subcutaneous (sc) and intramuscular (im)) of a single dose of the F1-V fusion antigen recombinant plague vaccine candidate and found a dose dependent advantage in F1-V-dependent antibody production the sc route. This was less apparent at higher vaccine doses and, in the mouse, did not appear to have a significant effect on vaccine efficacy.
- Completed two anti-F1-V passive transfer experiments in mice challenged by aerosols of *Y. pestis* and found that mice can be protected from challenge with aerosolized plague with passively transferred antibody. Establishing that protection from plague can be mediated by antibody has important implications in that antibody levels may be used as a surrogate marker of immunity and antibody therapy may be useful for plague prophylaxis and or treatment.
- Compared a nose-only versus whole-body exposure to determine the lethal aerosol dose of *Y. pestis* in mice and found that F1-V induced statistically significant protection from aerosolized plague challenge in non-human primates (NHPs).
- Conducted an immunogenicity/efficacy study of the F1-V vaccine candidate in NHPs challenged with capsulated and non-encapsulated *Y. pestis*. The overall survival rate (11 of 28) against aerosol challenge was statistically significant when compared to unvaccinated NHPs (0 of 10) and NHPs receiving the licensed plague vaccine (0 of 8).
- Completed a preclinical plague vaccine (F1-V fusion antigen) stability and formulation study.
- Completed an independent contractor study for F1-V vaccine safety.
- Defined the research base process for purifying the F1-V antigen, making it amenable to scale-up production in compliance with current Good Manufacturing Processes (cGMP) and transferred the technology package to the JVAP.
- Showed that five research-grade lots of F1-V candidate vaccine were nearly identical in composition and purity through a combination of novel applications of light-scattering methods and traditional protein assays.

- Determined the long-term stability and efficacy of F1-V bulk protein and Alhydrogel™-formulated vaccine. Protein retained biophysical integrity for 1 month at 4°C and the vaccine retained its immunogenicity for up to 9 months at 4°C.
- Compiled all research data into a "Technical Data Packet for Milestone 0 Exit" in preparation for a Component Advanced Development decision review.
- Devised a research project management approach to answer issues and difficulties specific to F1-V.
- Conducted a study to determine the effectiveness of the plague vaccine candidate in non-human primates. Twenty African green monkeys were immunized via intramuscularly with the recombinant F1-V candidate vaccine formulated with Alhydrogel. Results indicated that 30 % of the animals were protected against an aerosol challenge as compared to 0 % protection with the previously licensed plague vaccine.
- Created and screened anti-V monoclonal antibodies in passive protection studies against parenteral plague challenge.
- Established a cooperative research agreement with the National Institutes of Health to evaluate the F1-V vaccine candidate in the flea-bite model of plague infection
- Performed preliminary experiments on the protective efficacy of alternative recombinant proteins (YopD combined with V antigen) in mice challenged with aerosolized plague and in macrophages to determine the ability of antibody to YopD to block cytotoxicity and apoptosis.
- Established a contract for a scaled-up production and purification of recombinant YopD protein for use in follow up studies.
- Recloned important plague virulence genes SycD, YopB, YopD, YscC and TyeA for testing as alternative plague vaccines.
- Screened 300 genetic mutants of *Y. pestis* to identify essential virulence genes. Two possible essential genes were identified for additional study.
- Found that extracellular *Y. pestis* (KIM5) bacteria expressing certain virulence factors (Yops) can significantly inhibit the host cellular immune response.
- Determined that the DNA sequences of *Y. pestis* strains Angola, Pestoides A and Pestoides F *asd* and *galE* genes have single nucleotide polymorphisms. Using pulse field gel electrophoresis, genetically typed 47 different strains of *Y. pestis.*
- Defined genetic mutations in *Y. pestis* were created through a cooperative research agreement. The pools of mutants (96 mutants/pool) will be studied to identify genes that are turned on inside the infected host.
- Established that *Y. pestis* grown at 37°C had decreased aerosol virulence.
- Constructed a panel of insertion mutations in the *Y. pestis* virulence plasmid (pFra). This plasmid contains genes for known virulence factors such as the bacterial capsule and other gene sequences of undefined function that may be important in pathogenesis.
- Established an effective dose (ED_{50}) for rabbit polyclonal anti-F1 antibody in the mouse.
- Constructed V-antigen alleles to study virulence regulation and cross-protective immunity among *Yersinia sp.*
- Characterized a new phage-resistant mutant strain of the plague bacteria.

- Constructed *Y. pestis* strains that express a bioluminescent operon for use in pulmonary deposition and pathogenesis studies.
- Through a collaborative study, established the ability of multi-locus variable tandem repeat analysis to define genetic relatedness among strains of *Y. pestis*. Also, through two other collaborative studies, established the genetic relatedness of *Y. pestis* strains using insertion sequences and subtractive hybridization techniques.
- Discovered a novel virulence plasmid (pJars), which confers resistance to arsenic.
- Identified putative host protein targets of the *Y. pestis* V antigen.
- Tested the safety and efficacy of attenuated *Y. pestis* live vaccine candidates in non-human primates (NHPs).
- Tested the efficacy of DNA-based F1, V, and F1-V candidate vaccines in the mouse and found that F1-V provided protection against both parenteral and aerosol plague challenges, that V alone is less effective than F1-V, and that F1 alone does not appear to confer significant protection.
- Identified several possible adherence factors within the genome of *Bacillus anthracis*.
- Discovered that anthrax spores adhere to lung cells *in vitro*.
- Tested 24 different anthrax strains in vaccinated guinea pigs. Nine strains were identified as equally virulent, compared to the Ames strain.
- Purified virulent and avirulent anthrax spores to be used to vaccinate and challenge rabbits.
- Developed procedures to produce highly purified anthrax capsule protein to be evaluated as a vaccine candidate.
- Identified 19 novel virulence genes from the available *B. anthracis* preliminary DNA sequence database.
- Developed protocols to mutate the *B. anthracis* Ames strain to a non-lethal form to identify the role of certain virulence genes in the disease.
- Determined that *B. anthracis* produces an enterotoxin component of *B. cereus*, a gastrointestinal pathogen.
- Determined lethal dose-50% values for challenge and attenuated vaccine strains of *B. anthracis* in outbred mice.
- Inactivated the hemolysin gene in two attenuated strains of *B. anthracis*. These strains retained some hemolytic capability, suggesting that other factors are involved in this property of the pathogen.
- Evaluated the recombinant PA (rPA) component of a next-generation anthrax vaccine with and without formaldehyde added as a stabilizer in the rabbit model.
- Prepared a large volume of high-titer immune ascites fluid in mice injected with rPA in Freund's adjuvant or rPA in Alhydrogel™. The anti-rPA immune globulin G (IgG) was used to develop a quantitative mouse anti-PA antibody assay.
- Utilized the quantitative anti-PA antibody assay to analyze serum samples on a routine basis.
- Completed experiments testing various amounts of rPA in a single dose vaccine in rabbits. and found an excellent correlation between vaccine dose, immunogenicity, and survival (protection).

- Found that IL-12 was inferior to meningococcal outer membrane protein as an adjuvant for induction of anti-Brucella lipopolysaccharide antibody responses in mice.
- Developed IgG1 anti-Brucella lipopolysaccharide monoclonal antibody for use as a potential diagnostic reagent.
- Prepared protocol for a comparative analysis of Canadian O-polysaccharide and U.S. live, attenuated vaccine candidate against 3 species of Brucella.
- Established fermentation conditions for a live, attenuated Brucella vaccine candidate.
- Found that Brucella lipopolysaccharide-induced secretion of α-interferon by murine macrophage cell lines, suggesting that modulation of this process might be used to enhance protective immune responses to Brucella infection.
- Constructed model plasmid expressing both green fluorescent protein and non-antibiotic selectable marker in candidate Brucella vaccine strain for plasmid maintenance.
- Cloned reporter genes and tetanus toxin C fragment under the control of a Brucella promoter for use in heterologous antigen expression for multiagent vaccine development.
- Found that monocyte and monocyte-derived macrophages use toll-like receptor 4 to produce TNF-α in response to both *E. coli* and Brucella lipopolysaccharide.
- Found that uptake of rough and smooth *B. melitensis* by macrophages and dendritic cells is greatly increased by addition of human serum. Smooth *B. melitensis* inhibits apoptosis of infected monocyte while rough Brucella accelerates this process. These data support observations that smooth strains survive longer in macrophages *in vivo* and provide more prolonged stimulation of immune response.
- Found that transfection of human monocyte-derived macrophages with a gene for human heat shock protein-70 inhibited *B. melitensis* lipopolysaccharide-induced production of TNFα, IL-1α, IL-10 and IL-12 but not IL-6 and protected macrophages from killing by lipopolysaccharide. These studies suggest that strategies to increase intracellular heat shock protein-70 may be useful for modulating host defense against Brucella.
- Evaluated a heat-killed, irradiation-inactivated, capsule negative mutant of Burkholderia mallei, the causative agent of glanders, as a potential candidate vaccine.
- Determined that certain killed *B. mallei* cell preparations were not able to protect mice when challenged with *B. mallei.*
- Determined that vaccinated mice challenged with a low dose of *B. mallei* had greatly enlarged, still-infected spleens, demonstrating in the laboratory a chronic state of the disease.
- Found that administration of CpG oligodeoxynucleotides just before respiratory challenge of mice with virulent *B. mallei* improved survival and delayed death.

Therapeutics Accomplishments:

- Determined the minimum inhibitory concentration (MIC) levels for 45 antibiotics against 16 different strains of *B. anthracis*.
- Developed a screening system for polyamide inhibition of *B. anthracis*.
- Test 20 polyamides in *B. anthracis* for activity and identified several promising compounds.

- Completed the determination of LD_{50} for anthrax (Ames strain) by aerosol in a mouse model for lethal inhalation anthrax.
- Tested doxycycline, ceftazadime, imipenem, ciprofloxacin, azithromycin, and tobramycin for efficacy in the mouse model for glanders.
- Explored methods for direct assay of adenosine triphosphate (ATP) levels in bacterial cells to assess feasibility as a rapid and accurate bioenergetic metric for *in vitro* antibiotic activity.
- Evaluated antibiotics to identify candidates for laboratory prophylaxis (pre-treatment protection) of plague and found that ciprofloxacin and levofloxacin provided the lowest minimum inhibitory concentrations (MIC).
- Experimentally demonstrated that kanamycin resistance in *Y. pestis* does not cross protect the bacteria from gentamicin and streptomycin, thereby reducing potential concerns over the use of the kanamycin resistance marker in making laboratory manipulations in the plague bacterial genome.

Toxin Agents

The countermeasures, technical barriers, and accomplishments in the biological threat category of toxins are outlined below.

Countermeasures:

- Vaccines that produce long-term protective immunity against toxin agents.
- Drugs that can be administered prior to toxin exposure to protect against toxic effects of the agent.
- Therapeutics for treatment of diseases/symptoms caused by toxin agents.

*Technical Barrier*s:

- Develop appropriate model systems that emulate human aerosol exposure and intoxication.
- Methods for induction of respiratory and mucosal immune responses that produce long term protective immunity at the agent's port of entry.
- Development of markers of pulmonary inflammation in animal models.
- Identification and development of appropriate animal models for investigation of surrogate endpoints of human clinical efficacy.
- Retention of toxin antigenicity without toxic properties for vaccine candidate.
- Insertion of stable genetic alteration of toxin biological targets to produce toxin-resistant biological targets.
- Generic protection from families of toxins with subtle alterations in toxic modes of action.
- Necessity to enhance the otherwise limited data on which to base rational drug and antibody therapies for toxin agents of interest.
- Necessity to establish and maintain capabilities to assess threats and provides countermeasures for new and emerging toxin threats.

Vaccine Accomplishments:

- Provided technical assistance to Joint Vaccine Acquisition Program in support of the botulinum neurotoxin serotypes A, B, C, and F vaccine candidates that previously transitioned to advanced development.
- Demonstrated that mice inoculated with botulinum B and F recombinant vaccine candidates were completely protected from lethal challenge with botulinum neurotoxin type F at a concentration of 10^5 median LD_{50}.
- Demonstrated that mice vaccinated with the recombinant botulinum toxin type E heavy chain [rBoNTE(H_c)] were protected from lethal challenge with botulinum neurotoxin type E.
- Redesigned and created a recombinant botulinum type A heavy chain [rBoNTA(H_c)] clone by site-directed mutagenesis, during which three amino acid residues downstream from the initiation codon were removed.
- Expressed and purified rBoNTE(H_c) from the Pichia pastoris yeast expression system.
- Established assays for analyzing the stability of clinical grade recombinant staphylococcal enterotoxin B (rSEB) vaccine candidate under various storage times. Stability data has been collected for 12 months to date.
- Established SEB toxicity assays based on non-potentiated lethality and cytokine-release from inhalation challenge.
- Completed vialing of the cGMP lot of the rSEB vaccine candidate.
- Completed assays to generate a Certificate of Analysis (CoA) for the cGMP lot of the rSEB vaccine candidate.
- Reviewed and revised documentation package prepared for the cGMP lot of the rSEB vaccine candidate.
- Initiated a contract for preclinical purification of the recombinant staphylococcal enterotoxin A (rSEA) vaccine standard.
- Established the aerosol LD_{50} of SEB and protective efficacy of the rSEB vaccine candidate in HLA transgenic mice.
- Determined immunological, toxicological, and histopathological parameters in BALB/c and transgenic mouse strains.
- Established safety and efficacy of the novel mucosal adjuvant, CpG oligodeoxynucleotides, in mice.
- Evaluated the efficacy of inhaled rSEB vaccine candidate in transgenic and BALB/c mice.
- Inserted and tested a new promoter gene from lactobacilli to improve expression of SEB mutant genes.
- Expressed (using an *E. coli* expression system), purified, and partly characterized four novel mutants of the ricin toxin A chain as potential vaccine candidates to replace the chemically-derived deglycosylated ricin A chain candidate, which had manufacturing and other issues of concern regarding transition to advanced development.
- Demonstrated that two of the novel mutant ricin vaccine candidates were not toxic *in vitro* since they did not inhibit protein synthesis in a cell-free assay system.

- Demonstrated that two of the novel mutant ricin vaccine candidates with increased protein stability also could elicit significant protective immunity in mice challenged by intraperitoneal and aerosol administration of ricin toxin.
- Developed a liposomal ricin A subunit vaccine that could be administered by an intramuscular or intranasal route. The vaccine protected 100% of the mice from an intranasal ricin challenge with $5LD_{99}$ dose of ricin toxin.
- Demonstrated that immunization with *Ricinus communis* agglutinin protected 100% of mice from an intranasal ricin challenge of $5LD_{99}$ doses.
- Demonstrated that skin patch immunization of mice with a sulfhydryl-blocked ricin A subunit induced antibodies to ricin.
- Initiated project to develop a skin patch vaccine that protects against anthrax

Therapeutics Accomplishments:

- Generated an oligoclonal antitoxin comprising three separate antibodies (two human monoclonal antibodies and one chimeric monoclonal antibody) and demonstrated that it is capable of neutralizing over 800,000 median LD_{50} of botulinum neurotoxin type A/mg antibody.
- Developed the first practical high performance liquid chromatography (HPLC)-based activity assays for botulinum neurotoxins types D and F, enabling the first thorough characterization of these two toxins.
- Developed high-throughput (96 well microtiter plate) assays for four of the seven botulinum neurotoxin serotypes and filed a patent application for the assay.
- Evaluated several hundred pseudo-tripeptides as inhibitors of botulinum neurotoxin type A using non-toxic recombinant light chain and a high-throughput activity assay.
- Identified two structurally analogous isocoumarin compounds with substitutions in the 7-N position of the isocoumarin ring as inhibitors of botulinum neurotoxin.
- Characterized buforin II and various analogs as inhibitors of botulinum neurotoxin type B and produced novel buforin II mutants for use in ongoing structural studies.
- Synthesized fluorescent derivatives of buforin compounds for site-specific studies on botulinum B light chain.
- Completed synthesis of botulinum neurotoxin light chain genes types A, B, C, E, F, and G and expressed recombinant light chain A, B, and E.
- Purified recombinant light chain for botulinum types A, B, and E and demonstrated that these are proteolytic. The light chains are being produced for *in vitro* assays to screen compounds for their ability to inhibit the activity of the toxin.
- Cloned and expressed genes in *E. coli* encoding botulinum toxin substrates (SNAP-25, VAMP, and syntaxin) for use in inhibitor screening assays.
- Used X-ray crystallography to determine the structure of the catalytic domain of botulinum neurotoxin type B in a state where it was free from the holotoxin
- Used X-ray crystallography to determine the structure of a complex of an inhibitor (BABIM) bound to the active site of botulinum type B.
- Crystallized botulinum neurotoxin type E with gangliosides and their bound fragments and collected complete X-ray diffraction datasets.

- Use X-ray crystallography to determine the structure of the tetanus toxin C fragment with the drug doxorubicin bound to the putative ganglioside binding site.
- Demonstrated proof-of-concept for use of the heavy chain of botulinum type A as a delivery vehicle in primary spinal cord cells.
- Produced a non-toxic, proteolytically-inactive, triple mutant of botulinum toxin light chain for use in transporting therapeutic drugs into cholinergic nerve cells.
- Expressed the non-cleavable SNAP-25 mutant as a GST fusion protein in BL21(DE3)pLysS bacteria.
- Found that over-expression of RhoB, a signal transduction protein involved in modulation of the actin cytoskeleton, prevents the inhibitory effects of botulinum toxin on actin reorganization and LPA/KCl-stimulated Acetylcholine release.
- Initiated dose efficacy testing of pentoxyfylline in non-human primates to aid in determining its potential as a possible therapeutic for SEB intoxication.
- Identified two additional drugs, baicalin and chlorogenic acid, which blocked SEB-induced cytokine proliferation.
- Demonstrated that the drug candidates D609 and baicalin inhibited SEB-induced cytokines and chemokines at the transcriptional level.
- Found that D609, a phospholipase C (PLC) inhibitor, showed promising results in human MHC II transgenic mice.
- Created new clones of a single-chain T-cell receptor protein for use in a cell-free bioassay and expressed large quantities of T-cell receptor protein is support of the SEB therapeutics research effort.
- Developed a novel cell-based, high-throughput assay to evaluate therapeutics against SEA and SEB toxins.
- Obtained several diversity sets from the National Cancer Institute's Natural Products Repository and tested 2,238 of them for activity on SEB binding to MHC Class II molecules.
- Found several compounds from NCI diversity sets that inhibited SEB interaction with the receptors.
- Found that aerosolized SEB was lethal to all HLA transgenic mice, showing the potential utility of this "human-like" animal model.
- Determined that aerosolized SEB could induce high levels of inflammatory cytokines in the lungs and spleens of HLA transgenic mice.
- Found that aerosolized SEB could induce lung lesions in the HLA transgenic mice, similar to SEB lesions induced in non-human primates.
- Found that humanized transgenic mice succumbed to lethal shock induced by injection of superantigens without potentiation.
- Further characterized lethal shock induced by SEB or SEA in piglets, observing histological lesions, loss of regulation of vascular tone (doppler/laser blood pressure device) and pulmonary distress (blood gases). Also identified regulators of vascular tone that were disrupted upon challenge of piglets with SEB or SEA. Reversal of SEB-induced blood pressure plummeting was accomplished by intervening with the identified regulators of vascular tone.

- Characterized in a piglet model, SEA or SEB-induced incapacitation (vomiting, diarrhea, prostration) that can lead to dehydration and the requirement for intensive medical intervention.
- Identified a family of drugs that rescued SEA or SEB-induced incapacitation even after onset of initial symptoms. Diarrhea and vomiting stopped immediately upon drug administration; untreated SEB-challenged animals remained prostrate for ~5h while drug-treated SEB-challenged animals showed immediate recovery.
- Established cDNA array technology to analyze differential gene profiles following aerosol exposure to ricin for the identification of secondary therapeutic targets
- Established a novel fluorescent detection assay for ricin in cell-free media and used it to test candidate inhibitor compounds.

Viral Agents

The countermeasures, technical barriers, and accomplishments in the biological threat category of viral agents are outlined below.

Countermeasures:

- Vaccines for immunity against viral threat agents.
- Antibodies and antiviral drugs for treatment of viral disease.

Technical Barriers:

- Logistical difficulties from the necessity to work with live agents in high-containment (BL3 and BL4) laboratories.
- Difficulty in optimizing and comparing different expression vectors for recombinant products (vaccines and antibodies).
- Need for rapid virus identification technology.
- Insufficient or incompletely understood animal model systems for investigation of viral threats and countermeasures.
- Necessity to develop and fully characterize animal models for eventual FDA licensure of vaccines for which efficacy data from human clinical trials is impossible to obtain.
- Need for multivalent vaccines and compatible vaccine platforms to protect against an array of unrelated viral agents.
- Difficulty in defining surrogate markers of protection.
- Necessity to enhance the otherwise limited data on which to base rational drug and antibody therapies for viral agents of interest.
- Necessity to establish and maintain capabilities to assess threats and provide countermeasures for new, emerging, and genetically engineered hazardous viruses.

Vaccine Accomplishments:

- For the Venezuelan equine encephalitis (VEE) IE cleavage site deletion mutant vaccine construct (IE1150), a vaccine dose-escalation study was completed in mice, an onset/duration of immunity study was initiated, and safety and efficacy studies were begun in non-human primates.
- Demonstrated that IE1150 replicated inefficiently in mosquitoes and did not revert to virulence after passage through mosquitoes.

- Assessed the duration of immunity elicited by candidate VEE subtype IE vaccine (IE1150) for nine months. Protection determined to be sufficient for greater than 90% protection for the nine month test period. Additional testing to extend the time frame will continue.
- Demonstrated that the western equine encephalitis (WEE) cleavage site deletion mutants, W2102 and W2130, replicated inefficiently in mosquitoes and did not revert to virulence after mosquito passage.
- Demonstrated that WEE mutants W2102 and W2103 failed to provide 80% protection in mice.
- Initiated a vaccine dose-escalation study in mice using WEE candidate W2130.
- Constructed cleavage site deletion mutants of the VEE IIIA virus for evaluation as potential vaccine candidates for IIIA strains of the virus. Two vaccine candidates have been identified and attenuation has been demonstrated by challenge in mice.
- Determined by the aerosol route in two strains of mice, the lethal dose of wild-type eastern equine encephalitis (EEE) virus strain FLA and VEE virus IIIA strain Mucambo.
- Evaluated four monoclonal antibodies specific for WEE virus were evaluated for protective efficacy. Two failed to exhibit protective ability against a subcutaneous lethal challenge and two protected 70-100% of the challenged mice.
- Determined the nucleotide sequences of the complete genomes of a guinea pig-lethal Marburg virus (MBGV) Musoke, guinea pig attenuated MBGV Musoke, and MBGV Ci67.
- In a study in which macaques were vaccinated with DNA encoding MBGV glycoprotein (GP), baculovirus-derived MBGV GP, or a combination of the two, it was demonstrated that DNA alone offered protective immunity and that baculovirus-derived GP was not protective when administered with RIBI adjuvant or when used as a boost to DNA priming vaccination.
- Demonstrated that DNA-based vaccine for Marburg virus showed promising protection in the majority of non-human primates tested, raising the possibility of further improvement to match efficacy seen against this agent with replicon-based vaccines.
- Completed a guinea pig vaccination study with chimeric GPs (constructed by swapping GP1 and GP2 subunits between MBGV and Ebola viruses/EBOV). Results indicated that the smallest subunit, GP2, was sufficient for protecting the animals from challenge with the homologous virus.
- Demonstrated that immunization of guinea pigs with EBOV GP DNA was not enhanced with boosts of baculovirus-derived EBOV GP (with or without a transmembrane anchor).
- Demonstrated that adding subcellular targeting signals to EBOV GP or NP DNA constructs did not increase the protective efficacy afforded by the DNA/gene gun approach.
- Created a replicon construct to express EBOV secretory GP.
- Completed analysis of the vaccination results of guinea pigs inoculated with the bivalent VEE replicon expressing Lassa virus GP and EBOV GP genes. Results revealed the animals were protected against both Lassa and EBOV challenge.

- Concluded that VEE 26S DNA vaccine elicits strong antibody responses and confers protection in guinea pigs in the absence of neutralizing antibodies.
- Evaluated multiple-agent DNA vaccines (EBOV, MBGV, VEE, and anthrax) in guinea pigs and concluded there were no measurable differences between immunogenicity and protective efficacy of single agent and multiagent vaccines.
- Cloned and sequenced the hemagglutinin gene (A56R) from the DoD smallpox vaccine candidate TSI/Connaught as a precedent to mapping monoclonal antibodies reactive with that protein.
- Completed the evaluation of immunogenicity and protective efficacy of vaccinia LIR, A33R, B5R, and A27L genes in mice using DNA vaccine technology.
- Performed passive transfer experiments and demonstrated that LIR-specific monoclonal antibodies protects adult mice from a lethal vaccinia challenge.
- Demonstrated that DNA vaccination of rhesus monkeys elicited antibody responses against A27L, B5R, and A33R gene products.
- Cloned and sequenced six additional vaccinia virus genes.
- Evaluated human antibody response to vaccination with the current smallpox vaccine using naked DNA reagents expressing individual poxvirus genes.
- Compared the nucleotide sequence of vaccinia virus genes with those of variola and monkeypox homologues.

Therapeutics Accomplishments:

- Completed the large-scale production and purification of three EBOV GP-specific monoclonal antibodies for testing in the form of a cocktail as a possible prophylactic for Ebola virus.
- Purified and initiated characterization of additional monoclonal antibodies to the GP of EBOV to identify additional protective epitopes.
- Sequenced the genome of the mouse-adapted virus to identify mutations from the Mayinga strain of Ebola Zaire.
- Defined the role of EBOV VP40 in virus egress and it's role in causing cytopathic effects at the cellular level.
- Expressed and purified EBOV NP and established that it has preferential affinity for sequences at the 5'-end of the virus genome.
- Expressed EBOV NP, VP30, VP35 in E. coli and determined conditions for purification
- Completed evaluation of the pathology of EBOV infection in mice
- Showed that resistance to filovirus infection in mice is controlled by the type I interferon response.
- Discovered that an S-adenosylhomocysteine hydrolase inhibitor protects EBOV-infected mice by inducing massive α-interferon production.
- Determined that the antiviral compound cyanovirin has anti-EBOV activity.
- Comparatively sequenced selected fragments of variola and other orthopox viruses in collaboration with the Centers for Disease Control and Prevention (CDC).
- Collaborated with the CDC to complete the sequence of the variola viral DNA polymerase E9L from 31 variola strains.

- Tested 124 possible therapeutic compounds against five viruses (two variola, one monkeypox, one cowpox, and one vaccinia strain) in two cell lines. Determined that cowpox is the best choice for a surrogate virus for initial testing of therapeutic compounds.
- Identified the drug cidofovir (HPMPC, Vistide™; a viral DNA polymerase inhibitor) as an effective inhibitor of variola, monkeypox, cowpox and vaccinia.
- Using the cowpox mouse model, established that cidofovir treatment during vaccinia vaccination did not interfere with vaccine protection.
- Determined that cidofovir treatment initiated on the day of infection completely protected all three non-human primates infected with a small-particle aerosol of monkeypox.
- Characterized the inhibition of 32 variola strains in two cell lines by cidofovir. Results were sufficient to support the preclinical section of an IND for intravenous cidofovir for treating smallpox.
- Found that variola strain India 7124 was inhibited at the same concentrations of cidofovir as were the other strains.
- Determined that aerosol delivery of cidofovir was effective at a much lower concentration than intraperitoneal-delivered drug.
- Evaluated an approach to orally available therapy *in vitro* against a series of analogs based on cidofovir prodrugs and found that these prodrugs can inhibit poxvirus at 1,000-fold lower concentrations than the parent drug.
- Determined that intravenous administration of variola virus to cynomolgous monkeys resulted in development of smallpox-like lesions and lethal disease.

Diagnostic Assays for Biological Warfare Threat Agents

Countermeasures:

- Portable common diagnostic systems for a broad range of biological threats.
- Field laboratory capability to identify biological threat agents.
- Reference laboratory for confirmatory identification of biological threat agents.

Technical Barriers:

- Development of identification technologies and reagents of sufficient sensitivity and specificity to support early disease diagnosis.
- Development of rapid processing methods that can be used with a broad array of possible clinical specimens, including whole blood, sputum, swabs, feces, and tissues.
- Reduction of laboratory methods to portable devices.
- Lack of available data on genetic variability pertaining to markers used for diagnostic development.
- Inability to type organisms specifically and determine geographic origin.

Accomplishments:

- Completed design and sub-system prototype construction of a four-cartridge system with integrated specimen processing and gene amplification.

- Selected and optimized reagent sets to be incorporated into disposable cartridges for the rapid identification of *B. anthracis, Y. pestis, Francisella tularensis, and Clostridium botulinum* neurotoxin genes.
- Completed the production of purified nucleic acids under strict quality control for 77 bacterial agents for use as reference evaluation standards of emerging diagnostic technologies.
- Established an RNA virus reference panel of over 30 viral strains (including prototype alphaviruses and related viruses), completed purification of 25 strains, and prepared RNA master stocks of seven preparations.
- Demonstrated that two proposed rapid nucleic acid analysis systems had identical sensitivity and specificity and comparable limits of identification for identifying *B. anthracis*.
- Found that VEE could be detected by isolation and plaque assay of samples from pharyngeal swabs up to 6 days post-exposure in animal models.
- Demonstrated that VEE could be detected in buccal and nasal swabs 1 to 2 days post-exposure in high-dose animal models by standard culture methods and PCR.
- Developed an *in vitro* culture system of NHP alveolar macrophages to study host response and to identify potential diagnostic markers for EBOV.
- Characterized EBOV virus replication in alveolar macrophages by plaque assay, immunohistochemistry, and in situ hybridization.
- Designed fluorogenic 5'nuclease assays specific for non-human primate proinflammatory cytokines and chemokines and used them to evaluate mRNA transcription in macrophages infected with EBOV.
- Developed and evaluated one-tube reverse transcription PCR assays to detect Ebola-Zaire, Ebola Sudan and Marburg viruses by the ABI PRISM™ 7700 Sequence Detection System.
- Determined that the a newly designed primer/probe set (MBGGP3) was equivalent to or tenfold more sensitive for the identification of MBGV than previously designed primer sets.
- Found that the Marburg GP3 assay was able to detect specifically all MGBV strains, but was negative for other hemorrhagic fever and related viruses.
- Developed a real-time assay for rapid and specific identification of variola virus based on Taqman® chemistry with the orthopoxvirus hemagglutinin gene used as the target sequence.
- Evaluated the assay in a blind study at CDC using 164 samples, including genomic DNA from 40 different isolates of variola and 8 different isolates from camelpox, cowpox, monkeypox and vaccinia viruses. The assay was shown to be 100% specific for variola virus.
- Using genomic DNA purified from variola Bangladesh 1975, determined that the detection limit of the Taqman® assay was approximately 483 copies.
- Optimized and established the specificity of rapid gene amplification assays for nine bacterial agents against a panel of 65 related organisms and human DNA.
- Synthesized and optimized gene amplification primers for the rapid identificaiton of EEE virus.

- Demonstrated a host RNA transcription pattern of approximately 250 genes that were never expressed above baseline under normal conditions, yet showed some increased expression upon exposure to one or more of the nine different BW or infectious agents.
- Demonstrated the kinetics of host gene expression after exposing peripheral blood monocytes to botulinum neurotoxin A by using a custom microarray and a 3,900 gene microarray.
- Evaluated the single-site Autolyzer® (Model 303) spun fleece columns for their ability to bind, elute and purify biological agent nucleic acids from the binding matrix.
- Demonstrated the sensitivity (10 to 100 colony forming units per sample) of the Igene® Cartridge system for extracting DNA from *B. anthracis* spores and vegetative cells.
- Determined that the quartz fleece disks and suspended silica slurry were equivalent for rapid purification of biological agent nucleic acids, while spun fleece was less efficient.
- Demonstrated the Cepheid Microsonicator module enhanced rapid sample preparation by 10 to 1000 fold.
- Designed and tested two Taqman® assays for detecting *Brucella melitensis, B suis,* and *B. abortus*. The assay was successful for all samples tested.
- Found that the Taqman® Omp25 assay is capable of detecting *B, melitensis, B. suis,* and *B. abortus* genes.
- Tested and optimized Taqman® primers and probe for *Francisella tularensis* Tul4gene and FopA genes. The Tul4 gene assay was able to detect all seven *F. tularensis* isolates in the reference library.
- Designed and tested one set of fluorescence resonance transfer probes for *Brucella* Omp2b amplicons that will improve identification methods
- Determined the limit of detection (10 femtograms) of orthopoxvirus primers in the LightCycler® and the R.A.P.I.D.® gene amplification systems.
- Developed a Taqman® assay capable of distinguishing the SaspB gene of *B. anthracis* from the SaspB gene of other species of *Bacillus*.
- Developed rapid gene amplification assays for tetracycline resistance classes A, B, and C in *Y.pestis*.
- Identified an improved system for stabilization of enzyme linked immunosorbent assay reagents for biological threat agents.
- Optimized nine pre-coated and fieldable enzyme-linked immunosorbent assays for the identification of biological threat agents.
- Vaccinated mice with *B. anthracis* spore and capsule preparations, *Y. pestis*, botulinum pentavalent toxoid, ricin, and VEE virus to obtain recombinant antibodies using proprietary technology (Omniclones™) in collaboration with the Illinois Institute of Technology Research Institute and Omnisite, Inc.
- Cloned Ebola genes NP, GP, and sGP into a commercial vector (pUniV 5his TOPO) to obtain expression in the ECHO expression system to improve the production of critical diagnostic reagents.
- Cloned the heavy and light chain genes of a botulinum A/B reactive antibody into mammalian heavy and light chain expression vectors to improve production of critical reagents.

- Demonstrated the superiority of electrochemiluminescence assays as compared to time resolved fluorescence and Luminex technologies with multiple detection assays.
- Developed improved probe hydrolysis assays for *B. anthracis, Y. pestis, F. tularensis Brucellae sp, Burkholderia sp, C. burnetii* and Orthopoxviruses.
- Demonstrated the limits of sensitivity and specificity of existing hand-held assays specific for the detection of *B. anthracis* in oral and nasal swabs.
- Evaluated samples from a population of animals from two naturally occurring outbreaks of anthrax in wildlife in Etosha National Park, Namibia, by using hand-held specific assays. Results indicated the assay was 100% accurate in determining which animals had died of anthrax and was able to detect protective antigen up to 24 hr after death.
- Developed eight enzyme-linked immunosorbent assays for detecting biological warfare agents using time-resolved fluorescence technology.
- Demonstrated the use of HPLC and DNA sequencing to identify a single point mutation difference between *B. mallei* and *B. pseudomallei*.
- Optimized fluorogenic 5'nuclease assays for *B. anthracis* protective antigen (pX01), capsule B (pX02), 23sRNA gene targets on the SmartCycler® and R.A.P.I.D.® nucleic acid analysis systems.
- Determined the DNA sequences of five of seven *F. tularensis* isolates and demonstrated single nucleotide polymorphisms that are type-specific.
- Developed and optimized a real-time PCR assay that specifically and consistently detected *Rickettsia prowazekii*.
- Demonstrated the successful performance of candidate rapid nucleic acid analysis systems in extreme conditions, including a temperature of 115°F and humidity of 100%.
- Demonstrated sensitive detection of *B. anthracis* in post-mortem biomedical specimens and selected environmental samples at remote field sites by using rapid nucleic acid analysis systems.
- Demonstrated the rapid and sensitive detection of *Y. pestis* in fleas but not soils by using rapid nucleic acid analysis systems at a remote field site.
- Established that specimen processing methods compatible with field laboratories were required to sensitively identify biological agents in mock clinical specimens and environmental samples. Selected processing methods improved the sensitivity of gene detection by any platform by 10- to 1,000-fold, depending on the specimen matrix.
- Demonstrated the user friendliness and compatibility with the unit CONOPS for portable rapid nucleic acid analysis systems. R.A.P.I.D.® systems had better soldier interface that similar SmartCycler® XC systems.
- Evaluated assay result acceptance criteria for the SmartCycler® XC.
- Demonstrated that rapid nucleic acid analysis devices were 300% faster than standard PCR.
- Developed laboratory training packages to enhance transition of agent identification technologies to the Theater Army Medical Laboratory.
- Established patterns of gene expression responses in peripheral blood mononuclear cells (PBMC) upon exposure to *B. anthracis, Y. pestis, B. melitensis*, SEB toxin, VEE virus, cholera toxin, and other agents. Characterizing gene expression responses for PMBC may provide an opportunity for early and rapid diagnosis of exposure to biological

agents. Naturally or deliberately mutated pathogens unidentifiable by structural-based probes could be categorized as to type of illness based on gene patterns.

Unconventional Pathogen Countermeasures Program

The focus of this thrust is the development of revolutionary, broad-spectrum medical countermeasures against pathogenic microorganisms and/or their pathogenic products. By identifying those features of biological threat agents that are essential for their ability to cause disease and then undermining these disease-causing mechanisms, the medical countermeasures under development will be versatile enough to eliminate biological threats, whether from natural sources or modified through bioengineering or other manipulation. They will also have the potential to provide protection both within the body and at the most common portals of entry (*e.g.*, inhalation, ingestion, and transcutaneous). Strategies include:

- Defeat of a pathogen's ability to enter the body, traverse the bloodstream or lymphatics, and enter target tissues;
- Identification of novel pathogen vulnerabilities based on fundamental, critical molecular mechanisms of survival or pathogenesis (*e.g.*, Type III secretion, cellular energetics, virulence modulation);
- Construction of unique, robust vehicles for the delivery of countermeasures into or within the body;
- Development of effective treatments for late stage injections; and
- Modulation of the advantageous and/or deleterious aspects of the immune response to significantly neutralize pathogenic microorganisms and/or their pathogenic products in the body.

The work is divided into three main thrust areas: antiviral/immunizations, anti-bacterials/anti-toxins and multipurpose agents. Specific approaches currently under development include the identification of critical cellular pathways necessary for the proliferation of pathogens in the host, development of broad-spectrum vaccination schemes, development of broad-spectrum antibiotics with reduced chance of resistance development, enhancement of innate immunity, plant-based vaccine production and other protein production, and development of novel decontamination approaches for bio-threat agents.

E.2.3 Advanced Development Accomplishments

The Joint Program Office for Biological Defense (JPO-BD) is a DoD agency chartered to provide intensive centralized management of medical and non-medical programs to expedite materiel solutions for validated biological defense deficiencies. Vaccine products will be further developed by the Joint Vaccine Acquisition Program (JVAP), an ACAT II program under JPO-BD. Vaccines directed against high threat agents will be produced and stockpiled to fulfill a 1.2 million Troop Equivalent Doses (TEDs) requirement (Note: TED = total amount of vaccine required to immunize a service member to protect against a biological warfare agent.) Vaccines against low threat agents will be produced to fulfill a 300,000 TEDs requirement.

E.2.3.1 Botulism Immune Globulin (Human), Pentavalent (IND #1332)

- The IND remains open to accommodate emergency treatment requirements for exposure or possible exposure to botulinum toxin types A, B, C, D, or E.

E.2.3.2 Botulinum Type F Toxoid Vaccine (IND #5077)

- Completed the Phase 2 Safety and Immunogenicity clinical study of Botulinum Type F Toxoid Vaccine. The purpose of this study was to identify a vaccination schedule and route of vaccination that is safe and maximally immunogenic.
- A final report for the Phase 2 safety and immunogenicity clinical study was completed.
- Work has been stopped on the development of this product because it did not meet user requirements.

E.2.3.3 Anthrax Vaccine Adsorbed (AVA) (Human)

- BioPort, the sole manufacturer of AVA, obtained FDA approval for their renovated facility on December 27, 2001. There have been a series of issues that have delayed efforts to resume full production. Regulatory reform initiatives implemented in the mid-1990s led to changes in FDA regulation of biologics. More stringent Good Manufacturing Practices to validate production have extended this process at BioPort. However, since March 2001, BioPort has submitted 18 regulatory submissions to the FDA including its final supplement for its renovated facility and the supplement for their contract filler. On January 31, 2002, the FDA announced that it approved license supplements for anthrax vaccine, allowing lots from the renovated facility to be released and distributed.

E.2.3.4 Botulinum (Pentavalent) Toxoid Adsorbed (ABCDE) Vaccine (IND#3723)

- Clinical trial data showed that the vaccination schedule does not stimulate sufficient protective immunity against all serotypes (A, B, C, D, and E) to meet pre-set battlefield protection level requirements. However, preliminary data show that an additional booster vaccination may stimulate the desired level of immunity.
- Based upon the marginal performance of the vaccine, difficulties in producing new batches of vaccine, and progress being made in a new recombinant product, the JVAP PMO is reassessing efforts to license this product.

E.2.3.5 Botulism Immune Globulin $F(ab')_2$, Heptavalent, Equine, Types A, B, C, D, E, F, & G IND (#7451)

- This product does not meet the Combat Developer's requirements as an effective battlefield countermeasure. Further efforts to develop and license this product have been stopped.

E.2.4 Joint Vaccine Acquisition Program (JVAP) Accomplishments

E.2.4.1 Prime Systems Contract

- DynPort Vaccine Company continued to expand their operations, finding a variety of commercial subcontractors to engage in the advanced development of BD vaccines (Smallpox vaccine, Tularemia vaccine, Botulinum vaccines, Next Generation Anthrax Vaccine, and a recombinant plague, Venezuelan equine encephalitis vaccine) and Vaccinia Immune Globulin.

E.2.4.2 Contingency Stockpile of Biological Defense (BD) Vaccines

- Southern Research Institute (SRI), Frederick, Maryland, a subcontractor to DynPort Vaccine Company, continues the stability testing on all IND lots of Tularemia, VEE, EEE, and WEE vaccines.
- An assessment has been completed that determined the FDA requirements for additional testing would make this inventory ready for immediate use under a presidential executive order. The results of this assessment will be coordinated with the FDA prior to implementation.

E.2.4.3 Advanced Development of the Tularemia Vaccine

- Under the JVAP Prime Systems Contract, BioScience of Baltimore, Maryland was selected as the subcontractor for manufacture and stockpiling of Tularemia vaccine.
- Defined optimum culture and harvesting criteria needed for manufacturing process for the proposed vaccine.
- Work continued on animal models for safety and lot consistency evaluations at Defense Science Technology Laboratory (UK).

E.2.4.4 Advanced Development of the Smallpox Vaccine

- Under the JVAP Prime Systems Contract, BioReliance Corporation of Rockville, Maryland was selected as the manufacturer of the new Smallpox vaccine. BioReliance continued manufacturing efforts by completing process definition studies, manufacturing a GMP pilot lot suitable for a phase 1 clinical trial, and validating a plaque reduction assay to demonstrate product potency. The plaque reduction assay is antibody levels, and the FDA, for product licensure, requires a validated assay.
- The final report from a clinical trial to evaluate the candidate vaccine administered by scarification, indicates that the candidate is safe and immunogenic similar to the old licensed product, Dryvax. A phase 1 trial for the newly manufactured product is planned for execution in February 2002.
- Filed an annual report with the FDA under IND #8429 to insure continued availability of previously manufactured Vaccine Immune Globulin (VIG), which allows clinical trial to proceed.
- DynPort Vaccine Company filed the first annual report for IND (#9141) for a new VIG product for intravenous administration. Three lots have been manufactured by Massachusetts Biologics Laboratory, Boston, Massachusetts. A clinical trial using this material is currently in data analysis, and two more lots are being manufactured.
- A plaque neutralization assay necessary for lot release testing of the VIG product and to evaluate clinical specimens from both VIG and smallpox vaccine trials has been developed and is being validated by BioReliance Corporation, Rockville, Maryland. Clinical

specimens from the aforementioned VIG trial will be assayed once this method is validated.

E.2.4.5 Venezuelan Equine Encephalitis Vaccine

- Pilot lot in production with delivery of bulk product anticipated in 2QFY02.

E.2.4.6 Recombinant Botulinum Toxin Vaccine

- Selected Covance, Cary, North Carolina, as the subcontractor for manufacture of a multivalent (serotypes A and B) recombinant botulinum toxin vaccine.
- Began manufacturing process development for production of a multivalent recombinant botulinum vaccine.

E.2.4.7 International Cooperative Research and Development

- The new Chemical Biological and Radiological Memorandum of Understanding (CBR MOU) between the U.S., the UK, and Canada (CANUKUS) was signed and implemented on 1 June 2000. The new CANUKUS CBR MOU permits full cooperative research and development of vaccines. Negotiations are underway to develop a Project Arrangement for cooperative research and development of a smallpox vaccine.
- In addition to the Vaccinia Virus Vaccine Project Arrangement development, the JVAP is exploring opportunities for CANUKUS development of new vaccines against anthrax, plague, and brucellosis.

E.2.4.8 Joint Biological Agent Identification and Diagnostic System (JBAIDS)

The JBAIDS program is designed to fill a medical mission critical need to rapidly confirm and identify Biological Warfare (BW) and Infectious Disease (ID) agents in both environmental and clinical specimens. JBAIDS will provide medical personnel with the capability to identify the biological agents within one hour of specimen analysis. This system will provide this capability at a lower system cost, reduced logistical burden and with greater reliability than currently available commercial laboratory methods.

JBAIDS will be comprised of commercial and developmental identification technologies, components and military hardware integrated into a single platform. The design will stress modularity and capability for future technology insertion.

The Joint Program Manager for Biological Defense has structured the JBAIDS program in a block development format in order to expedite procurement and fielding while reducing technical risk. Block I is focused on quickly transitioning mature technology from the Common Diagnostics Systems Defense Technology Objective (DTO) or the commercial sector to a fielded system; and beginning the Food and Drug Administration (FDA) approval process for JBAIDS. Block II will focus on meeting the Joint Operational Requirements Document (JORD) objectives of integrating a biological toxin identification capability. Block III will fully integrate sample preparation, bacterial, viral and toxin identification capability into a single, small, lightweight, completely automated unit.

E.2.4.9 Integrated Digital Environment (IDE)

In order to meet the Under Secretary of Defense for Acquisition, Technology & Logistics mandate to transition acquisition activities to an IDE by 2002, and to achieve the streamlining and savings associated with the mandate the JVAP PMO continued efforts to establish a BD vaccine enterprise-wide IDE in collaboration with DynPort. An automated program assessment tool tailored to vaccine development has been developed and implemented at the PMO. DynPort, LLC has established a web-based, shared data base system. A detailed IDE system requirements analysis was completed in early 2000 and included implementation of an IDE test bed. In 2001, an IPT of government and contractor personnel completed an analysis of Electronic Data Management Systems and recommended Livelink for the JVAP IDE. Livelink licenses have been purchased and full-scale implementation was initiated late CY 2001. Implementation of Livelink has also expanded to include the Biological Defense Research Laboratory - United States Army Medical Institute of Infectious Diseases (USAMRIID). Implementation of common IDEs in both Tech Base and Advanced Development activities will provide significant streamlining opportunities.

E.3 MEDICAL RADIOLOGICAL DEFENSE RESEARCH PROGRAM

E.3.1 Fielded Products

Appropriately applied, advances in medical science and biotechnology can significantly effect the warfighting mission by sustaining unit effectiveness and conserving the fighting strength of our service members. The individual service member whose performance is decremented by injury or illness is significantly more likely to become a traumatic casualty. In this era of small, but highly lethal forces, loss of only a few team members can dramatically diminish a unit's capability. Medical R&D products (materiel and non-materiel solutions) provide the foundation that ensures fielding of a flexible, sustainable, modernized force across the spectrum of conflict and in the full breadth and depth of the battlefield. Overcoming medical threats and extending human performance have provided significant improvements in military effectiveness in the past and new developments promise even greater improvements in the future. Some of the materiel and non-materiel solutions developed for medical radiological defense are:

- Cytokine-based therapeutic applications to prevent two major fatal syndromes—sepsis and uncontrolled bleeding—of acute radiation injury.
- Cytogenetic biodosimetry analytical systems that accurately measure radiation exposure levels from blood samples.
- NATO Handbook on the Medical Aspects of NBC Defensive Operations, Volume 1-Nuclear (AMedP-6).
- Medical Effects of Ionizing Radiation (MEIR) Course—Training for approximately 350 Medical Department personnel in FY00.
- Videotapes and CD-ROM of MEIR course lectures produced for distribution to military medical units.

E.3.2 Nuclear Defense Research and Development Accomplishments

Technical barriers and accomplishments within the Medical Radiological Defense Research Program are grouped in the following threat categories:

- Prompt high-dose radiation.
- Protracted low-dose radiation.
- Combined radiation and chemical or biological agents.

"*Prompt high-dose radiation*" refers to the deposition of high levels of ionizing radiation energy in biological tissues in very short periods of time. Sources of high-energy radiation include emissions within the first 60 seconds of a nuclear weapon detonation and "criticality events" that occur when a nuclear reactor achieves peak energy output either accidentally or through an intentional act. The high linear-energy-transfer radiation imparted by the neutrons from these sources causes significant tissue injury within seconds of exposure, resulting in both short- and long-term health consequences.

"*Protracted low-dose radiation*" refers to the deposition of low-energy radiation energy in biological tissues over extended periods of time. Sources of low-energy radiation include fallout from nuclear weapon detonations, radiological dissemination devices, and any other

source of environmental radiation contamination. Health consequences are generally intermediate to long-term and result from cumulative tissue injury accruing over time due to chronic exposure. Health consequences can be exacerbated further when radionuclides are deposited internally by ingestion, inhalation or through open wounds in the external integument.

"*Combined ionizing radiation and either chemical or biological agents*" refers to the amplified health consequences when chemical or biological insults occur in conjunction with radiological injury. Exposures to ionizing radiation compromise host defenses against a variety of stressors, including infectious agents and chemical toxicants. Doses of radiation and infectious or chemical agents that are by themselves sub-lethal can produce mortality rates of nearly 100% when combined.

The Medical Radiological Defense Research Program focuses on developing medical countermeasures against the health consequences of both prompt high-dose and protracted low-dose exposures to ionizing radiation. The program also develops experimental data that quantifies lethality from combined exposure to NBC agents and is used in computer modeling for casualty prediction and operational planning. Specific research on medical countermeasures includes work on prophylactic and therapeutic drugs, drug delivery devices to enhance efficacy and simplify administration under field conditions, and combined prophylactic/therapeutic protocols to further enhance efficacy. Work also focuses on developing novel biological dosimetry techniques to measure individual absorbed doses. Knowledge of absorbed radiation dose helps guide medical treatment decisions and saves lives. It also provides field commanders with an assessment of the radiological health of deployed forces and leads to better-informed operational decision-making.

Threat Category: Prompt High-Dose Radiation

The countermeasures, technical barriers, and accomplishments in the threat area of prompt high-dose radiation are outlined below.

Countermeasures:

- Advanced medical treatment strategies for radiation injuries.
- Drugs designed to increase resistance of soldiers to radiation and protect the Service member against radiation injury without compromising performance.
- Drugs designed to prevent the onset of radiation-induced performance decrements such as fatigue, nausea and vomiting.
- Biological dosimetry techniques for rapid injury assessment needed to guide medical treatment decisions and assess radiological health of combat units.

Technical Barriers:

- Minimizing the performance-degrading effects of prophylactic drugs that otherwise have good efficacy for the prevention of radiological injury.
- Advancing knowledge of cellular, sub-cellular, and molecular mechanisms of radiological injury to improve rational development of prophylactic and therapeutic drugs.
- Increasing prophylactic drug stability in order to improve bioavailability and enhance drug efficacy.
- Increasing prophylactic drug stability for use in slow-release delivery devices that extend bioavailability and enhanced efficacy.

- Difficulty in identifying and calibrating biological markers that can both indicate the amount of absorbed radiation dose and differentiate between whole-body from partial-body exposures.
- Difficulty in automating sample preparation and reducing sample preparation times for cytogenetic-based biodosimetry tests.

Accomplishments:

- Demonstrated efficacy of orally administered 5-androstenediol (5-AED), a non-androgenic steroid with newly identified broad-spectrum radioprotective attributes (*i.e.*, protection against simple acute radiation injury, acute radiation injury complicated by infectious challenge, and chronic, late-arising radiation injury).
- Determined blood pharmacologic profile of injectable 5-AED in a large animal model. Verified non-androgenicity of 5-AED by demonstrating absence of testosterone-elevating effect following treatment.
- Continued assessment and optimization of a therapeutic regimen combining cytokine and clinical support modalities for enhancing survival following acute, lethal irradiation.
- Demonstrated in a pre-clinical model that 5-AED pretreatment enhances therapeutic efficacy of combined cytokine therapy (IL-11 and G-CSF) for acute, potentially lethal radiation injury.
- Verified initial experimental evidence of therapeutic efficacy of an epithelial tissue repair cytokine, keratinocyte growth factor, used to manage acute radiation-induced gastrointestinal injury and associated septicemia resulting from translocation of intestinal microflora.
- Continued exploring potential new prophylactic strategies for reducing acute radiation injury through (a) systematic screening of nutritional supplements and promising new pharmaceutical agents, (b) pharmacologic quenching of the toxic side effects of existing efficacious drugs, and (c) testing of new drug delivery systems.

Threat Category: Protracted Low-Dose Radiation

The countermeasures, technical barriers, and accomplishments in the threat area of protracted low-dose radiation from nuclear fallout, radiological explosive devices, *etc.* are outlined below.

Countermeasures:

- Advanced medical treatment strategies to mitigate injuries induced by protracted exposure to radiation from both external and internal sources.
- Drugs that protect against early and late effects of ionizing radiation and do not compromise performance.
- Improved techniques to detect and remove internally deposited sources of radioactivity.
- Improved drug delivery systems that provide non-encumbering protection during the entire period of radiation exposure.
- Persistent biological markers of radiation exposure that can be easily measured in deployed field laboratories and that give useful diagnostic information for triage and medical treatment decisions.

Technical Barriers:

- Difficulty in manipulating cellular repair mechanisms.

- Toxicity of chelating agents used to remove internally deposited radioisotopes.
- Short-lived activity of conventional radioprotective drugs.
- Toxicity of radioprotective drugs used over protracted periods of time.
- Limited knowledge of DNA damage surveillance and repair mechanisms under protracted exposure conditions hinders development of pharmacologic agents to prevent late-arising cancers.
- Microbial resistance to antibiotics.
- Difficulty in identifying a persistent biological marker to accurately measure low-dose radiation exposures.

Accomplishments:

- Determined that the radioprotectant 5-androstenediol inhibits low-level radiation-induced growth and development of cancer cells *in vitro*.
- Demonstrated therapeutic advantage of combined cytokine treatment (IL-11 plus G-CSF) in managing protracted radiation injury of the blood-forming and gastrointestinal tissues.
- Established ultra-sensitive and reliable assay to monitor blood and tissue levels of aminothiol-type radioprotectants following various dosing regimens and routes of administration.
- Demonstrated therapeutic efficacy of keratinocyte growth factor in managing protracted radiation injury of gastrointestinal tissues.
- Demonstrated dose-dependent increases in expression levels of specific oncogene m-RNA and protein species in an *in vivo* irradiated mouse model system that may provide the basis for important new biological markers of radiation exposure.
- Completed initial-phase optimization of PCR-based assays that quantify gene expression levels of single-target molecular biomarkers and that can be incorporated into existing field-deployable analytical platform.

Threat Category: Combined Ionizing Radiation and Either Chemical or Biological Agents

The countermeasures, technical barriers, and accomplishments in the threat area of combined effects of ionizing radiation and trauma, burns, infection, or chemical toxicants are outlined below.

Countermeasures:

- Therapeutic agents designed to decrease morbidity and mortality from multi-organ system failure due to the combined effects of radiation and trauma, burns, infections or chemical toxicants.
- Radioprotective drugs designed to harden the Service members against the effects of radiation in combination with trauma, burns, infection, or chemical toxicants.
- Combined preventive and therapeutic regimens that reduce morbidity and mortality from combined exposures.
- Computer models for predicting casualties from combined exposure to low levels of ionizing radiation and biological warfare/chemical warfare agent aerosols.

Technical Barriers:

- Limited surrogate models to improve extrapolation of data to human responses.
- Non-availability of radiation sources and biological containment capabilities within the

same research facility that would allow full range of experiments on combined effects of radiation and BW agents.
- Growing number of microbial organisms resistant to antibiotics.
- Variability in biological responses to different radiation qualities (*e.g.*, neutron *vs.* gamma radiation).
- Identifying the best surrogate model system for studying the combined effects of radiation and other toxicants; *e.g.*, the best radiation model may not be well suited for a particular infectious agent.

Accomplishments:
- Demonstrated in an irradiated animal model that standard antimicrobial therapy for anthrax, penicillin G, increases survival by only 5% upon challenge with *Bacillus anthracis* (Sterne) spores and that therapy needs to be initiated within 24 hours of challenge to have any effect.
- Discovered disseminated mixed bacterial infections from translocation of normal intestinal microflora in 40% of sub-lethally irradiated animals upon challenge with *B. anthracis* Sterne spores, implying the need for alternative antimicrobial therapy in cases of combined exposure.
- Determined in animal model that *B. anthracis* Sterne spore challenge followed by sub-lethal irradiation results in 50% mortality.
- Demonstrated a maximum 80% efficacy for the human anthrax-vaccine-absorbed (AVA) vaccine in sub-lethally gamma-irradiated animals challenged with *B. anthracis* Sterne spores, whereas non-irradiated animals are 100% protected.
- Continued incorporation of data from combined NBC effects animal studies into the Consequence Assessment Tool Set (CATS) and other casualty prediction model programs under development by the Defense Threat Reduction Agency.

E.3.3 Predevelopment Products

Technical developments in predevelopment products for medical radiological defense include the following:

- Androstene steroids as broad spectrum, nontoxic radioprotectants.
- “Slow release” radioprotectant for extended periods of protection.
- Cytokine therapeutic for the effective treatment of acute radiation injury of the gastrointestinal system.
- Therapeutic regimen for bacterial infections following sub-lethal irradiations and BW agent challenge.
- CATS model enhancements to incorporate radiation/BW interactions.
- Product improvement of the cytogenetic biodosimetry system by automation of satellite scoring subsystem to increase sample throughput.
- Rapid and sensitive method to measure urinary uranium concentration.

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Annex F

NBC Defense Logistics Readiness Data

F.1 BREAKOUT OF SERVICE WAR REQUIREMENTS, STOCKS ON-HAND, AND PLANNED ACQUISITIONS

The following tables (Tables F-1 through F-5) display NBC defense equipment total Service requirements, their wartime requirements, FY01 stocks on-hand quantities (as of 30 September 2001), and FY02–03 planned procurements for each of the four Services and Defense Logistics Agency. As described in Chapter 3, the two MTW requirements for consumables are based on the sum of the initial issue and the average consumption developed under the JCHEMRATES IV study, updated as of March 1999.

It should be emphasized that the JCHEMRATES IV study's two MTW requirement is not and should not be considered the total procurement target. This study did not fully consider air transport into theaters of conflict or Navy fleet requirements for ships at sea. While the Services agree with the methodology and intent of the study in general, it may require further refinement prior to becoming a fully accepted planning tool. The MTW requirement does not consider peacetime training requirements, sizing requirements, or full procurement for the entire active and Reserve forces and critical operational personnel. The MTW requirement does denote a minimum planning number, which if the total DoD inventory drops below, may represent a critical shortfall for that particular item, which should be immediately addressed to avoid diminishing the force's NBC defense capability.

The JCHEMRATES IV study also did not consider the requirements of units specifically identified to provide domestic CBRNE consequence management support. Units such as the Army CB-RRT, SMART and WMD CSTs, the Navy NMRC, the Marines Corps CBIRF, and the Air Force Medical NBC Teams will require individual and collective protection, detection, and decontamination equipment. Since domestic CBRNE consequence management response is not regarded as a mission of the two MTW scenario, these requirements are not included in the following tables.

Because of the limitations in the study, the Services have identified their total Service requirements as their procurement targets, while acknowledging JCHEMRATES as a necessary step in joint service management of the NBC defense program. The Services continually update these data call sheets on a frequent basis and consider these working papers rather than a static set of figures. The Services and DLA are working through the FY02 Joint Service NBC Defense Logistics Support Plan to update all figures and to provide 100% of the information required for logistics readiness and sustainment assessments.

The items listed under "NOMENCLATURE" in Tables F-1 through F-5 are 129 NBC defense items that are currently fielded in the Services. "TOTAL SERVICE REQUIREMENTS" include the quantity required for the entire Service (to include active and reserve forces), and includes peacetime replacements (wear and tear) and training requirements. Previously, the two MTW requirement quantities were based on the larger of (1) the initial issue for two MTW, or (2) the

two MTW consumption, as computed by the JCHEMRATES IV study (March 1999 data). Those quantities represented the minimum requirements for full sustainment through two conflicts. Recognizing that potentially U.S. forces would be left depleted of resources after the conflicts, the Logistics Support Plan Integrated Product Team (IPT) added initial issue quantities to consumption in calculating the two MTW requirement for consumable items. The consumption that is used to compute the two MTW requirement provided in Tables F-1 through F-5 is based on the final JCHEMRATES IV calculations dated March 1999. The Services and the JNBCDB have the option of providing different requirements if they determine the JCHEMRATES calculations to be inaccurate or outdated.

Note that materiel requirements for training, sizing variations and peacetime replacements are *not* included in the wartime requirements calculated by JCHEMRATES. This number represents an average expenditure calculated among four scenarios: chemical defense equipment expenditures under low chemical weapons use during favorable and marginal weather conditions; and of chemical defense equipment expenditures against high chemical weapons use during favorable and marginal weather conditions. All sets of conditions were run for the North-East Asia and South-West Asia scenarios.

The "**STOCKS ON-HAND**" represents the total of all serviceable NBC defense materiel available in each of the Services (stocks positioned with troops, stocks in the supply system and stocks stored in depots/facilities, both peacetime stores and war reserve). This number represents only those items physically "on-hand". Quantities for which a Service or agency has submitted a funded requisition or purchase order in FY01, but has not received the requisitioned items are included in FY02. Finally, the quantities depicted as "**PROJECTED DUE-IN**" are quantities the Services plan to buy to replace peacetime consumption of NBC defense assets (to include training use and shelf-life expiration), and to buy wartime sustainment stocks. It must be emphasized that these numbers are based on major command estimates of requirements. Actual procurements are contained within the On-Hand Column.

Table F-1a. Army Logistics Readiness Data - Non-Consumables

NOMENCLATURE	NSN	TOTAL SERVICE RQMTS	NO. REQUIRED FOR 2 MTW	FY01 STOCKS ON HAND (as of 30 Sept 01)	PROJECTED DUE IN FY02	FY03	FY04	FY05	FY06	FY07
INDIVIDUAL PROTECTION COMMODITY AREA										
CB MASK										
MASK, CB, M17A2	4240-01-143-2017-20	0	0	78,034	1	0	0	0	0	0
MASK, CB, M40/M40A1	4240-01-258-0061-63	957,624	610,506	800,518	2,660	0	0	0	0	0
MASK, M24, AVIATOR	4240-00-776-4384	0	0	5,413	5	0	0	0	0	0
MASK, M25A1, TANK	4240-00-994-8750-52	0	0	5,093	30	0	0	0	0	0
MASK, M42, TANK	4240-01-258-0064-66	84,742	69,015	100,690	441	0	0	0	0	0
MASK, M43, APACHE	4240-01-208-6966-69	0	0	3,158	38	0	0	0	0	0
MASK, M45, AVIATOR	4240-01-414-4034-35/-4051-52	20,156	18,909	15,562	107	0	0	0	0	0
MASK, M48, APACHE	4240-01-386-0198/-4686/-0201/-0207	1,825	1,609	2,055	0	0	0	0	0	0
MISC PROTECTION										
PATS, M41	4240-01-365-8241	3,763	3,763	6,125	33	0	0	0	0	0
CONTAMINATION AVOIDANCE COMMODITY AREA										
NUCLEAR DETECTION EQUIPMENT										
AN/PDR-75	6665-01-211-4217	5,445	5,445	4,841	132	0	0	0	0	0
AN/PDR-77	6665-01-347-6100	532	532	1,299	67	0	0	0	0	0
AN/UDR-13	6665-01-407-1237	51,918	26,901	16,790	4,574	0	0	0	0	0
AN/VDR-2	6665-01-222-1425	35,950	33,405	38,341	250	0	0	0	0	0
BIOLOGICAL DETECTION EQUIPMENT										
BIDS, M31	6665-01-392-6191	76	76	74	0	42	0	0	0	0
CHEMICAL DETECTION EQUIPMENT										
ACADA, M22	6665-01-438-6963	31,830	31,830	6,194	448	0	0	0	0	0
ALARM, CAA, M8A1	6665-01-105-5623	28,000	28,000	23,236	31	0	0	0	0	0
CAM/ICAM	6665-01-357-8502	19,595	19,595	11,559	371	0	0	0	0	0
M21 RSCAAL	6665-01-324-6637	191	191	378	1	0	0	0	0	0
NBC RECON SYS, M93A1	6665-01-372-1303	110	110	101	3	0	0	0	0	0
DECONTAMINATION COMMODITY AREA										
DECON APPAR, M11	4230-00-720-1618	40,998	40,221	31,483	2,090	0	0	0	0	0
DECON APPAR, M13	4230-01-133-4124	112,900	112,001	144,269	3,070	0	0	0	0	0
DECON APPAR, PDDA, M12A1	4230-00-926-9488	129	129	660	57	0	0	0	0	0
L/WT DEC SYS, M17A1	4230-01-303-5225	2,516	2,516	2,027	65	0	0	0	0	0
COLLECTIVE PROTECTION COMMODITY AREA										
CP DEPMEDS (HUB, CP, M28)	4240-01-395-5179	23	23							
SHELTER, CB PROTECT	5410-01-441-8054	779	779							
SHELTER, CP, M20/M20A1	4240-01-166-2254	1,747	1,747							
SHELTER, M51	4240-00-854-4144	0	0							
MEDICAL COMMODITY AREA										
LITTER, DECONTAMINABLE	6530-01-380-7309	7,320	5,148	2,127	0	0	0	0	0	0

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Table F-1b. Army Logistics Readiness Data – Consumables

NOMENCLATURE	NSN	TOTAL SERVICE RQMTS	NO. REQUIRED FOR 2 MTW	FY01 STOCKS ON HAND (as of 30 Sept 01)	PROJECTED DUE IN FY02	PROJECTED DUE IN FY03
INDIVIDUAL PROTECTION COMMODITY AREA						
OVERGARMENTS						
CHEM PROT UNDERGARMENT TOP	8415-01-363-8692-00		0	3,502	626	0
CPU DRAWERS	8415-01-363-8683-91	431,564	431,564	2,630	626	0
JSLIST (ABDO) 45 DAYS	SEE NSNs IN TABLE E-5	3,300,000	2,900,000	211,322	6,338	0
SCALP (TAN AND GREEN)	8415-01-333-0987-89		0	988	0	0
	8415-01-364-3320-22	151,490	151,385	457		0
SUIT, CP CAMO (BDOs)	8415-01-137-1700-07	0	0	2,655,752	41,504	0
OVERBOOTS/GLOVES						
JSLIST MULO	8430-01-464-9453-84					
BLK/GRN VINYL O/BOOTS	8430-01-317-3374-85		0	2,056,296	6,531	0
	8430-01-049-0878-87	2,899,864	2,899,864	120,157	384	0
CPO FOOT COVERS	8430-01-021-5978	71	0	76,701		0
CP GLOVES 7 MIL	8415-01-138-2501-04	154,612	154,612	95,141	937	0
CP GLOVES 14 MIL	8415-01-138-2497-00	618,448	618,448	200,374	1,209	0
CP GLOVES 25 MIL	8415-01-033-3517-20	3,861,320	3,861,320	3,693,769	30,277	0
MISC PROTECTION						
2D SKIN, M40 SERIES	4240-01-413-1540-43	691,040	691,040	303,184	8,149	0
BATTERY, BA-5800 (PRO MASK)	6665-99-760-9742	61,052	61,052	53,831	592	0
CP HELMET COVER	8415-01-111-9028	1,605,279	1,605,279	3,243,441	16,164	0
FILTER CAN, C2A1	4240-01-361-1319	1,367,626	1,367,626	1,306,357	11,256	0
FILTER CAN, M10A1	4240-00-127-7186	0	0	75,066	0	0
FILTER ELEMENT, M13A2	4240-00-165-5026	0	0	377,162	468	0
HOOD, M40	4240-01-376-3152	1,703,570	1,703,570	1,580,654	21,255	0
HOOD, M5 (FOR M25A1)	4240-00-860-8987	0	0	92,811	10	0
HOOD, M6A2 (FOR M17)	4240-00-999-0420	0	0	269,884	4	0
HOOD, M7 (FOR M24)	4240-00-021-8695	0	0	29,320	0	0
CONTAMINATION AVOIDANCE COMMODITY AREA						
CHEMICAL DETECTION EQUIPMENT						
BATTERY, ACADA BA-5590	6135-01-036-3495	110,000	110,000	25,347	1,137	0
BATTERY, BA-3517	6135-00-450-3528	52,645	52,645	18,572	660	0
BATTERY, ICAM BA-5800	6665-99-760-9742	52,645	52,645			0
BATTERY, M42 BA3030	6135-00-930-0030	220,000	440,000			
DET KIT, M256A1	6665-01-133-4964	48,027	48,027	93,516	1,255	0
DET PAPER, M8	6665-00-050-8529	2,169,231	2,169,231	1,530,986	10,890	0
DET PAPER, M9	6665-01-226-5589	2,023,873	2,023,873	1,297,303	2,880	0
MAINT KITS, M293/M273	5180-01-379-6409		0	42,491	561	0
	5180-01-108-1729	41,106	41,106	6,277	416	0
NBC MARK SET, M274	9905-12-124-5955	9,906	9,906	31,020	377	0
WATER TEST KIT, M272A1	6665-01-134-0885	9,580	9,580	10,138	123	0
DECONTAMINATION COMMODITY AREA						
DECON KIT, M291 (Box of 20)	6850-01-276-1905	183,382	183,382	395,023	5,718	0
DECON KIT, M295 (Box of 20)	6850-01-357-8456	166,892	166,892	219,902	10,866	0
DS2, 1 1/3 QT	6850-00-753-4827	192,388	192,338	252,161	830	0
DS2, 5 GAL	6850-00-753-4870	226,163	226,163	250,576	328	0

Table F-1b. Army Logistics Readiness Data - Consumables

NOMENCLATURE	NSN	TOTAL SERVICE RQMTS	NO. REQUIRED FOR 2 MTW	FY01 STOCKS ON HAND (as of 30 Sept 01)	PROJECTED DUE IN FY02	PROJECTED DUE IN FY03
DS2, M13 CAN	6850-01-136-8888	369,535	369,535	98,627	1,954	0
NITROGEN CYLINDERS	4230-00-775-7541	1,319,022	1,319,022	12,476		0
STB, 50 LB	6850-00-297-6653	10,628	10,628	49,580	140	0
COLLECTIVE PROTECTION COMMODITY AREA						
FILTER, CP, M12A2 (M14 GPFU)	4240-01-365-0981	12,816	12,816	4,433		0
FILTER, CP, M13 SERIES (M14 GPFU)	4240-00-368-6291	12,816	12,816	4,399		0
FILTER, CP, M18A1	4240-01-365-0982	60,580	60,580	19,417	1	0
FILTER, CP, M19	4240-00-866-1825	44,971	44,971	11,391	1	0
FILTER, GP, M48A1	4240-01-363-1311	15,930	15,930	12,696	1	0
FILTER SET FOR (M59, M56, SHIPBOARD)	4240-01-369-6533	1,167	1,167	3,706	7	0
MEDICAL COMMODITY AREA						
2-PAM CHLORIDE AUTOINJ	6505-01-125-3248	1,349,637	1,349,637	873,314		
ATROPINE AUTOINJ	6505-00-926-9083	1,874,828	1,874,828	142,173		
CANA AUTOINJ	6505-01-274-0951	1,554,920	1,554,920	471,548	92,579	92,579
NAAK, MKI	6705-01-174-9919	2,281,312	2,281,312	459,439		
PYRIDOSTIGIMINE TAB	6505-01-178-7903	1,317,309	1,317,309	88,749	14,813	14,813
PATIENT WRAPS	6530-01-383-6260	18,900	18,900	0	1,329	1,329
MED AEROS NERVE AG ANT (MANAA)	6505-01-332-1281	2,238		3,885		
OTHER TREATMENTS						
CIPROFLOXACIN (500 mg 50s)	6505-01-272-2385		0	13,786	24,688	24,688
(500 mg 100s)	6505-01-273-8650		0	45,703		
(500 mg 100s)	6505-01-333-4154	1,881,870	1,881,870	59		
DOXYCYCLINE CAPS	6505-01-153-4335		0	37,036	18,518	18,518
ANTIDOTE TREATMENT KIT, CYANIDE	6505-01-143-4641	67,140	67,140	616		
	6505-01-457-8901	22,380	22,380	0		

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Table F-2a. Air Force Readiness Data – Non-Consumables

NOMENCLATURE	NSN	TOTAL SERVICE RQMTS	NO. REQUIRED FOR 2 MTW	FY01 STOCKS ON HAND (as of 30 Sept 01)	PROJECTED DUE IN					
					FY02	FY03	FY04	FY05	FY06	FY07
INDIVIDUAL PROTECTION COMMODITY AREA										
CB MASK										
MASK, A/P22P2	NOT ASSIGNED		14,810	10	0	0	0	0	0	0
MASK, AERP	8475-01-339-9782(S)	32,864	29,879	26,449	0	0	0	0	0	0
MASK, CB, M17A2	4240-01-143-2017-20	5,132	5,132	5,129	0	0	0	0	0	0
MASK, MCU-2/P,	4240-01-415-4239-41	574,372		225,298	0	0	0	0	0	0
MASK, MCU-2A/P	4240-01-284-3615-17	0	345,856	65,588	0	0	0	0	0	0
MASK, MCU-2A/P (WR) USAF	4240-01-327-3299-01	39,978		20,083	0	0	0	0	0	0
MISC PROTECTION										
PATS, M41	4240-01-365-8241	1,500	1,208	281	0	0	0	0	0	0
CONTAMINATION AVOIDANCE COMMODITY AREA										
NUCLEAR DETECTION EQUIPMENT										
ADM 300 - A KIT	6665-01-363-6213NW	300		163	0	0	0	0	0	0
- B KIT	6665-01-342-7747NW	800	1,800	685	0	0	0	0	0	0
- C KIT	6665-01-320-4712NW	750		740	0	0	0	0	0	0
- E KIT	6665-01-426-5071NW	250		189	0	0	0	0	0	0
CHEMICAL DETECTION EQUIPMENT										
ACADA, M22	6665-01-438-6963	3,521	3,521	235	0	0	0	0	0	0
ALARM, CAA, M8A1	6665-01-105-5623	423	331	225	0	0	0	0	0	0
CAM/ICAM	6665-01-357-8502	0	0	662	0	0	0	0	0	0
	6665-01-199-4153	1,960	1,960	259	0	0	0	0	0	0
M90 CHEM WARFARE ALARM	6665-01-408-5108	65	58	140	0	0	0	0	0	0
DECONTAMINATION COMMODITY AREA										
A/E32U-8 DECON SYS	4230-01-153-8660	175	0		0	0	0	0	0	0
L/WT DEC SYS, M17	4230-01-251-8702	299	0		0	0	0	0	0	0
L/WT DEC SYS, M17A1	4230-01-303-5225	50	0		0	0	0	0	0	0
L/WT DEC SYS, M17A2	4230-01-349-1778	324	324		0	0	0	0	0	0
COLLECTIVE PROTECTION COMMODITY AREA										
CHATH (HUB, CPE, M28)	NOT ASSIGNED	* 21	20		0	0	0	0	0	0
MEDICAL COMMODITY AREA										
LITTER, DECONTAMINABLE	6530-01-380-7309	26,770	26,770		0	0	0	0	0	0

* CHATH fielding currently being reevaluated by Air Force Medical Service

Table F-2b. Air Force Logistics Readiness Data - Consumables

NOMENCLATURE	NSN	TOTAL SERVICE RQMTS	NO. REQUIRED FOR 2 MTW	FY01 STOCKS ON HAND (as of 30 Sept 01)	PROJECTED DUE IN FY02	PROJECTED DUE IN FY03
INDIVIDUAL PROTECTION COMMODITY AREA						
OVERGARMENTS						
AIRCREWMAN CAPE	8415-01-040-9018	290,014	283,502	257,319	0	0
CLOTHING TEST KIT	6630-00-783-8192	200	167	0	0	0
CP UNDERCOVERALL	8415-01-040-3136-44	75,000	67,376	12,484	0	0
EOD HGU-65P HOOD	4240-01-338-1646	225	192	1,293	0	0
EOD M-3 TAP	8415-00-099-6962/68/70	312	176	9	0	0
	8415-01-105-2535		0	9	0	0
EOD TAP BOOTCOVER	8430-00-820-6295-6306	275	199	1,168	0	0
EOD TAP GLOVES	8415-00-753-6550-54	500	375	1,442	0	0
IMPREG UNDERGARMENT	8415-00-782-3242-5	5,000	5,000	2,028	0	0
JSLIST (ABDO) 45 DAYS	SEE NSNs IN TABLE F-5	1,914,572	1,224,369	109,358	63,000	63,000
M-2 APRON	8415-00-281-7813-16	225	198	50	0	0
M3 COOLING HOOD	8415-00-261-6443	350	308	9	0	0
M3 COOLING SUIT	8415-00-264-2929	200	170	9	0	0
SUIT, AIRCREW, CWU-66/77P	8475-01-328-3434-57	150,000	126,000	73,948	0	0
SUIT, CP CAMO (BDO)	8415-01-137-1700-07	0	0	429,244	0	0
SUIT, CP CAMO-DESERT 3 clr	8415-00-327-5347-53	0	0	39,236	0	0
SUIT, CP CAMO-DESERT 6 clr	8415-01-324-3084-91	0	0	2,810	0	0
OVERBOOTS/GLOVES						
JLIST MULO	8430-01-464-9453-84	1,914,572		141,824		
BLK/GRN VINYL O/BOOTS BVO	8430-01-317-3374-85		0	308,066	0	0
GVO	8430-01-049-0878-87	1,175,090	528,880	218,892	0	0
CP FOOTWEAR COVERS	8430-01-118-8172		0	12,583	0	0
	8430-01-021-5978	154,802	0	69,162	0	0
CP GLOVES 7 MIL	8415-01-138-2501-04	2,350,181	1,057,760	397,338	0	0
CP GLOVES 14 MIL	8415-01-138-2497-00		1,257,871	834,485	0	0
CP GLOVES 25 MIL	8415-01-033-3517-20		23,051	16,005	0	0
CP SOCKS	8415-01-040-3169	200,056	170,768	150,358	0	0
DISP FOOTWEAR COVER	8430-00-580-1205-06	201,980	185,771	351,059	0	0
GLOVE INSERTS	8415-00-782-2809 (S)	2,350,181	1,057,760	1,008,160	0	0
MISC PROTECTION				0	0	0
FILTER CAN, C2/C2A1	4240-01-119-2315	2,350,181	1,057,760	1,281,412	0	0
FILTER, GP	4240-01-161-3110	2,090	1,750	33,075	0	0
FILTER ELEMENT, M13A2	4240-00-165-5026	12,596	12,596	64,112	0	0
HOOD, M6A2 (FOR M17)	4240-00-999-0420	95,093	76,707	324,566	0	0
HOOD, MCU-2/P	4240-01-189-9423	2,350,181	1,057,760	1,017,069	0	0
CONTAMINATION AVOIDANCE COMMODITY AREA						
CHEMICAL DETECTION EQUIPMENT						
BATTERY, ACADA BA-5590	6135-01-036-3495	46,331	46,331	506	0	0
BATTERY, BA-3517	6135-00-450-3528	880	0	727	0	0
BATTERY, ICAM BA-5800	6665-99-760-9742	67,295	67,295	1,178	0	0
DET KIT, M18A2	6665-00-903-4767	100	0	21,031	0	0

Table F-2b. Air Force Logistics Readiness Data – Consumables

NOMENCLATURE	NSN	TOTAL SERVICE RQMTS	NO. REQUIRED FOR 2 MTW	FY01 STOCKS ON HAND (as of 30 Sept 01)	PROJECTED DUE IN FY02	PROJECTED DUE IN FY03
DET KIT, M256A1	6665-01-133-4964	50,123	1,292	150,019	0	0
DET PAPER, M8	6665-00-050-8529	293,773	132,220	623,087	0	0
DET PAPER, M9	6665-01-049-8982		0	87,487	0	0
	6665-01-226-5589	293,773	132,220	227,337	0	0
MAINTENANCE KIT, M293	5180-01-379-6409	90	0	7,172	0	0
NBC MARK SET, M274	9905-12-124-5955	725	517	8,635	0	0
WATER TEST KIT, M272A1	6665-01-134-0885	764	764	45	0	0
DECONTAMINATION COMMODITY AREA						
CALCIUM HYPOCHLORITE (6 oz)	6810-00-255-0471	625	625	421	0	0
CALCIUM HYPOCHLORITE (100 lb)	6810-12-132-2439			57,190		
DECON KIT, M291	6850-01-276-1905	58,755	26,444	26,292	0	0
DECON KIT, M295	6850-01-357-8456	29,378	13,222	14,262	0	0
DRY SORBENT POWDER	6850-01-262-0484	1,150	100	26,234	0	0
SODIUM HYPOCHLORITE	6810-00-598-7316	100	0	29,238	0	0
STB, 50 LB	6850-00-297-6653	517	517	2,411	0	0
COLLECTIVE PROTECTION COMMODTY AREA						
FILTER, CP M13 SERIES (M14 GPFU)	4240-00-368-6291	0	0	450	0	0
FILTER, GP M48A1	4240-01-363-1311	8	8	0	0	0
FILTER SET FOR (M59, M56, SHIPBOARD)	4240-01-369-6533	0	0	252	0	0
MEDICAL COMMODITY AREA						
2-PAM CHLORIDE AUTOINJ	6505-01-125-3248	354,796	354,796	804,703		
	6505-01-080-1986		0	89,256		
ATROPINE AUTOINJ	6505-00-926-9083	354,796	354,796	754,285		
	6505-00-299-9673		0	23,635		
CANA AUTOINJ	6505-01-274-0951	113,323	113,323	291,324		
NAAK, MKI	6705-01-174-9919	2,947	0	1,913	0	0
PYRIDOSTIGIMINE TAB	6505-01-178-7903	26,731	23,460	151,437	0	0
TETRACYCLINE	6505-00-655-8355	0	0	14,752	0	0
PATIENT WRAPS	6530-01-383-6260	0	0	0	0	0
OTHER TREATMENTS						
DOXYCYCLINE CAPS, 100s	6505-00-009-5060		0	1,789	0	0
500s	6505-00-009-5063		0	209	0	0
CIPROFLOXACIN	6505-01-273-8650		0	70,175	0	0
	6505-01-333-4154	33,515	33,515	15,278	0	0

Table F-3a. Navy Logistics Readiness Data - Non-Consumables

NOMENCLATURE	NSN	TOTAL SERVICE RQMTS	NO. REQUIRED FOR 2 MTW	FY01 STOCKS ON HAND (as of 30 Sept 01)	PROJECTED DUE IN					
					FY02	FY03	FY04	FY05	FY06	FY07
INDIVIDUAL PROTECTION COMMODITY AREA										
CB MASK										
MASK, A/P 22P-14(V)2	NOT ASSIGNED	11,067	11,067	4,884	400	300				
MASK, A/P 22P-14(V)2	NOT ASSIGNED	(22&23)	(22&23)	2,900						
MASK, CB, M40/M40A1	4240-01-258-0061-63	26,400	26,400	4,246						
MASK, M45, AVIATOR	4240-01-414-4034-35/-4051-52		2,000	2,002						
MASK, MCU-2/P	4240-01-173-3443	50,000	50,000	74,288	0	0	0	0	0	0
MASK, MCU-2A/P	4240-01-284-3615/17	475,000	373,000	49,695	0	0	0	0	0	0
MASK, MCU-2A/P (WR) USN	4240-00-327-4148-50			159,213	21,063	16,263	0	0	0	0
CONTAMINATION AVOIDANCE COMMODITY AREA										
NUCLEAR DETECTION EQUIPMENT										
AN/PDR-27	6665-00-543-1435	3,824	3,824	1,252	0	0	0	0	0	0
AN/PDR-43	6665-00-580-9646	2,544	2,544	1,081	0	0	0	0	0	0
AN/PDR-56	6665-00-086-8060	1,280	1,280	47	0	0	0	0	0	0
AN/PDR-65	6665-01-279-7516	382	382	234	0	0	0	0	0	0
CP-95	6665-00-526-8645	1,216	1,216	450	0	0	0	0	0	0
PP-4276	6665-00-489-3106	2,912	2,912	599	0	0	0	0	0	0
IM-143	6665-00-764-6395	10,800	10,800	5,937	0	0	0	0	0	0
DT-60	6665-00-978-9637	145,300	145,300	121,922	0	0	0	0	0	0
BIOLOGICAL DETECTION EQUIPMENT										
IBAD	NOT ASSIGNED	25	20	20	0	0	0	0	0	0
CHEMICAL DETECTION EQUIPMENT										
ACADA, M22	6665-01-438-6963	444	444	378	0	0	0	0	0	0
ALARM, CAA, M8A1	6665-01-105-5623	98	98	50	0	0	0	0	0	0
CAPDS	6665-01-294-2556	145	145	79	0	0	0	0	0	0
CHEM AGENT MONITOR/ICAM	6665-01-199-4153	1,008	1,008	606	0	0	0	0	0	0
CWDD, AN/KAS-1	5855-01-147-4362	401	401	630	0	0	0	0	0	0
IMP POINT DETECTION SYSTEM	6665-LL-HAL-5532	254	254	108	72	72	0	0	0	0
M21 RSCAAL	6665-01-382-1968	0	0		0	0	0	0	0	0
DECONTAMINATION COMMODITY AREA										
DECON APPAR, M11	4230-00-720-1618	144	144	183	0	0	0	0	0	0
L/WT DEC SYS M17A3 DIESEL	4230-01-346-3122	412	412	6	0	0	0	0	0	0
COLLECTIVE PROTECTION COMMODITY AREA										
SHELTER, CP, M20/M20A1	4240-01-166-2254	7,311	7,311	516	0	0	0	0	0	0
MEDICAL COMMODITY AREA										
LITTER, DECONTAMINABLE	6530-01-380-7309	1,200	1,200	90						

Table F-3b. Navy Logistics Readiness Data – Consumables

NOMENCLATURE	NSN	TOTAL SERVICE RQMTS	NO. REQUIRED FOR 2 MTW	FY01 STOCKS ON HAND (as of 30 Sept 01)	PROJECTED DUE IN FY02	PROJECTED DUE IN FY03
INDIVIDUAL PROTECTION COMMODITY AREA						
OVERGARMENTS						
APRON,TAP	8415-00-281-7813-16	72	72	164	0	0
IMPREG UNDERGARMENT	8415-00-782-3242-5	240	240		0	0
JSLIST (ABDO) 45 DAYS	SEE NSNs IN TABLE E-5	1,755,600	1,236,000	140,742		
SUIT, CP CAMO (BDO)	8415-01-137-1700-07	0	0		0	0
SUIT, TAP 3	8415-00-099-6962/68/70	471	471	1,336	0	0
	8415-01-105-2535		0			
SUIT, CP, OG MK3 *	8415-01-214-8289-92	0	0	46,904	0	0
SUIT, CP, SARATOGA	8415-01-333-7573-76			44,122		
SUIT, CP SARATOGA-DESERT	8415-01-333-7577-80			40		
OVERBOOTS/GLOVES						
JLIST MULO	8430-01-464-9453-84					
BLK/GRN VINYL O/BOOTS BVO	8430-01-317-3374-85	97,094	97,094	76,549		
GVO	8430-01-049-0878-87		0		0	0
CP FOOTWEAR COVERS	8430-01-118-8172		0		0	0
	8430-01-021-5978	1,500,000	1,236,000	160,429	0	0
CP GLOVES 14 MIL	8415-01-138-2497-00	58,160	58,160	57,190	0	0
CP GLOVES 25 MIL	8415-01-033-3517-20	1,755,460	1,236,000	197,167	0	0
CP SOCKS	8415-01-040-3169	204,824	204,824		0	0
DISP FOOTWEAR COVER	8430-00-580-1205-06	204,824	204,824		0	0
GLOVE INSERTS	8415-00-782-2809	1,755,600	1,236,000	132,209	0	0
MISC PROTECTION						
CP HELMET COVER	8415-01-111-9028	450	450	200	0	0
FILTER CAN, C2/C2A1	4240-01-119-2315	1,500,000	1,236,000	369,071	0	0
HOOD, MCU-2/P	4240-01-189-9423	2,517	2,517	372	0	0
CONTAMINATION AVOIDANCE COMMODITY AREA						
CHEMICAL DETECTION EQUIPMENT						
DET KIT, M256A1	6665-01-133-4964	11,400	11,400	5,471	0	0
DET PAPER, M8	6665-00-050-8529	111,707	111,707	37,921	0	0
DET PAPER, M9	6665-01-226-5589	50,803	50,803	20,131	0	0
NBC MARK SET, M274	9905-12-124-5955	1,859	1,859	198	0	0
TUBE PHOSGENE	6665-01-010-7965	1,280	1,280	574	0	0
WATER TEST KIT, M272A1	6665-01-134-0885	142	142	243	0	0
DECONTAMINATION COMMODITY AREA						
CALCIUM HYPOCHLORITE (6 oz)	6810-00-255-0471	10,626	10,626	12,637	0	0
CALCIUM HYPOCHLORITE (100 lb)	6810-12-132-2439			0		
DECON KIT, M291	6850-01-276-1905	34,500	30,000	20,770	0	0
DECON KIT, M295	6850-01-357-8456	9,049	9,049	4,322	0	0
DS2, 5 GAL	6850-00-753-4870	42	42	62	0	0
SODIUM HYPOCHLORITE	6810-00-598-7316	12	12	380	0	0
STB, 50 LB	6850-00-297-6653	1,718	1,718	21	0	0

Table F-3b. Navy Logistics Readiness Data - Consumables

NOMENCLATURE	NSN	TOTAL SERVICE RQMTS	NO. REQUIRED FOR 2 MTW	FY01 STOCKS ON HAND (as of 30 Sept 01)	PROJECTED DUE IN FY02	PROJECTED DUE IN FY03
COLLECTIVE PROTECTION COMMODITY AREA						
FILTER, GP, M48A1	4240-01-363-1311	450	450		0	0
FILTER SET FOR (M59, M56, SHIPBOARD)	4240-01-369-6533	6,800	6,800	114	0	0
PRE-FILTER, SHIPBOARD CPE	4240-01-348-8785	7,481	7,481	462	0	0
MEDICAL COMMODITY AREA						
2-PAM CHLORIDE AUTOINJ	6505-01-125-3248	1,500,000	1,236,000	221,365		
ATROPINE AUTOINJ	6505-00-926-9083	1,500,000	1,236,000	200,402		
CANA AUTOINJ	6505-01-274-0951	500,000	436,000	7,515		
NAAK, MKI	6705-01-174-9919	113,051	113,051			
PYRIDOSTIGIMINE TAB	6505-01-178-7903	500,000	436,000	79,672		
TETRACYCLINE	6505-00-655-8355	1,212,205	1,212,205			
PATIENT WRAPS	6530-01-383-6260	0	0			
OTHER TREATMENTS						
CIPROFLOXACIN	6505-01-273-8650		0			
	6505-01-333-4154	100,472	100,472			
DOXYCYCLINE CAPS, 100s	6505-00-009-5060		0			
500s	6505-00-009-5063		0			

* Allowance is included in JSLIST total, which is the allowance for all protective suits

Table F-4a. Marine Corps Logistics Readiness Data – Non-Consumables

NOMENCLATURE	NSN	TOTAL SERVICE RQMTS	NO. REQUIRED FOR 2 MTW	FY01 STOCKS ON HAND (as of 30 Sept 01)	PROJECTED DUE IN					
					FY02	FY03	FY04	FY05	FY06	FY07
INDIVIDUAL PROTECTION COMMODITY AREA										
CB MASK										
MASK, A/P22P2	NOT ASSIGNED			0	0	0	0	0	0	0
MASK, CB, M40/M40A1	4240-01-258-0061-63	227,069	150,000	208,346	6,184	9,222	4,611	0	0	0
MASK, CB, M17A2	4240-01-143-2017-20	0	0	2,522	0	0	0	0	0	0
MASK, M24, AVIATOR	4240-00-776-4384	0	0	123	0	0	0	0	0	0
MASK, M25A1, TANK	4240-00-994-8750-52	0	0	0	0	0	0	0	0	0
MASK, M42, TANK	4240-01-258-0064-66	0	0	3,142	0	0	0	0	0	0
MASK, MCU-2/P, -2A/P	4240-01-284-3615-17	0	0	302	0	0	0	0	0	0
MISC PROTECTION										
MASK COMM ADAPTOR	5996-01-381-9012	50,000	50,000	16,517	0	0	0	0	0	0
PATS, M41	4240-01-365-8241	469	469	430	0	0	0	0	0	0
CONTAMINATION AVOIDANCE COMMODITY AREA										
NUCLEAR DETECTION EQUIPMENT										
AN/PDR-75	6665-01-211-4217	1,203	1,203	1,156		0	0	0	0	0
AN/VDR-2	6665-01-222-1425	1,182	1,182	2,275	67	0	0	0	0	0
CHEMICAL DETECTION EQUIPMENT										
ACADA, M22	6665-01-438-6963	762	762	728	0	0	0	0	0	0
ALARM, CAA, M8A1	6665-01-105-5623	28	28	22	0	0	0	0	0	0
CAM 1.5	6665-01-359-9006	1,854	1,565	278	0	0	0	0	0	0
CAM 2.0	6665-99-725-9996	1,528	875	2,469	0	0	0	0	0	0
M21 RSCAAL	6665-01-382-1968	151	151	131	0	0	0	0	0	0
NBC RECON SYS, M93	6665-01-372-1303	10	10	10	0	0	0	0	0	0
DECONTAMINATION COMMODITY AREA										
DECON APPAR, M11	4230-00-720-1618	21,050	7,235	46,728	0	0	0	0	0	0
DECON APPAR, M13	4230-01-133-4124	16,913	16,913	7,506	0	0	0	0	0	0
DECON APPAR, PDDA, M12A1	4230-00-926-9488	0	0	0	0	0	0	0	0	0
L/WT DEC SYS, M17A1	4230-01-303-5225	344	0	366	0	0	0	0	0	0
HEAVY FUEL DECON	4230-01-470-5288			17						
L/WT DEC SYS, M17A3	4230-01-346-3122	1,570	1,570	660	0	0	0	0	0	0
COLLECTIVE PROTECTION COMMODITY AREA										
** SHELTER, CP, PORTABLE	4240-01-346-2564			16	0	0	0	0	0	0
MEDICAL COMMODITY AREA										
LITTER, DECONTAMINABLE	6530-01-380-7309	0	0	0	0	0	0	0	0	0

* 40% of CAMs remain unserviceable, but refurbishment action should be completed during FY02

** - Note: The Marine Corps is using the Portable Collective Protection System for training purposes.

Table F-4b. Marine Corps Logistics Readiness Data - Consumables

NOMENCLATURE	NSN	TOTAL SERVICE RQMTS	NO. REQUIRED FOR 2 MTW	FY01 STOCKS ON HAND (as of 30 Sept 01)	PROJECTED DUE IN FY02	PROJECTED DUE IN FY03
INDIVIDUAL PROTECTION COMMODITY AREA						
OVERGARMENTS						
JSLIST (ABDO) 45 DAYS	SEE NSNs IN TABLE E-5	853,176	687,606	28,754	35,136	35,145
SUIT, CP CAMO (BDO)	8415-01-137-1700-07	0	0	1,405	0	0
SUIT, CP, SARATOGA	8415-01-333-7573-76	596,131	596,131	519,111	0	0
SUIT, CP SARATOGA-DESERT	8415-01-333-7577-80	50,000	50,000	16,164	0	0
OVERBOOTS/GLOVES						
JLIST MULO	8430-01-464-9453-84					
BLK/GRN VINYL O/BOOTS BVO	8430-01-317-3374-85		0	224,297		
GVO	8430-01-049-0878-87	654,000	651,146	24,144	0	0
CP FOOT COVERS	8430-01-021-5978		0	175,971	0	0
CP GLOVES 25 MIL	8415-01-033-3517-20	792,154	792,154	430,136	0	0
MISC PROTECTION						
2D SKIN, M40 SERIES	4240-01-413-1540-43	277,069	183,684	257,055	0	0
CP HELMET COVER	8415-01-111-9028	0	0	0	0	0
FILTER CAN, C2/C2A1	4240-01-119-2315		0	271,134		
	4240-01-361-1319	554,246	359,930	38,256	0	0
FITLER CAN, M10A1	4240-00-127-7186	2,468	0	26	0	0
FILTER ELEMENT, M13A2	4240-00-165-5026	27,766	0	40,557	0	0
HOOD, M40	4240-01-376-3152	343,869	343,869	2,799	0	0
HOOD, M5 FOR M25A1	4240-00-860-8987	867	0	0	0	0
HOOD, M6A2 FOR M17	4240-00-999-0420	25,973	0	2,348	0	0
HOOD, M7 (FOR M24)	4240-01-021-8695	323	0	0	0	0
HOOD, MCU-2/P	4240-01-189-9423		0	0	0	0
CONTAMINATION AVOIDANCE COMMODITY AREA						
CHEMICAL DETECTION EQUIPMENT						
BATTERY, BA-3517	6135-00-450-3528		0	0	0	0
BATTERY, ICAM BA-5800	6665-99-760-9742	27,136	27,136	35	0	0
BATTERY, ACADA BA-5590	6135-01-036-3495	20,706	20,706	855	0	0
DET KIT, M256A1	6665-01-133-4964	30,547	30,547	4,996	0	0
DET PAPER, M8	6665-00-050-8529	272,770	272,770	36,398	0	0
DET PAPER, M9	6665-01-049-8982		0	6,629		
	6665-01-226-5589	380,949	380,949	56,079	0	0
MAINT KITS, M273/M293	5180-01-379-6409		0	0	0	0
NBC MARK SET, M274	9905-12-346-4716	2,286	2,262	28	0	0
WATER TEST KIT, M272A1	6665-01-134-0885	3,159	1,115	375	0	0
DECONTAMINATION COMMODITY AREA						
DECON KIT, M291	6850-01-276-1905	408,220	33,067	116,655	0	0
DECON KIT, M295	6850-01-357-8456	29,244	29,244	0	0	0
DS2, 1 1/3 QT	6850-00-753-4827	1,006,813	1,006,813	9,503	0	0
DS2, 5 GAL	6850-00-753-4870	253,837	2,919	7,376	0	0
DS2, M13 CAN	6850-01-136-8888	32,451	0	0	0	0
NITROGEN CYLINDERS	4230-00-775-7541	27,993	27,993	12,296	0	0
STB, 50 LB	6850-00-297-6653	7,410	1,264	4,397	0	0

Table F-4b. Marine Corps Logistics Readiness Data – Consumables

NOMENCLATURE	NSN	TOTAL SERVICE RQMTS	NO. REQUIRED FOR 2 MTW	FY01 STOCKS ON HAND (as of 30 Sept 01)	PROJECTED DUE IN FY02	PROJECTED DUE IN FY03
COLLECTIVE PROTECTION COMMODITY AREA						
FILTER, CP, M12A2 (M14 GPFU)	4240-01-365-0981	1,108	1,108	0	0	0
FILTER, CP, M13 SERIES (M14 GPFU)	4240-00-368-6291	1,122	1,122	166	0	0
FILTER, CP, M18A1	4240-01-365-0982	3,236	3,236	2	0	0
FILTER, CP, M19	4240-00-866-1825	1,674	1,674	233	0	0
FILTER, GP, M48A1	4240-01-363-1311	644	644	50	0	0
FILTER SET FOR (M59, M56, SHIPBOARD)	4240-01-369-6533		0	0	0	0
MEDICAL COMMODITY AREA						
2-PAM CHLORIDE AUTOINJ	6505-01-125-3248	500,505	500,505	104,605		
ATROPINE AUTOINJ	6505-00-926-9083	500,505	500,505	29,440		
	6505-00-299-9673			493		
CANA AUTOINJ	6505-01-274-0951	142,481	142,481	0		
NAAK, MKI	6705-01-174-9919	405,446	405,446	0		
PYRIDOSTIGIMINE TAB	6505-01-178-7903	289,075	289,075	1,308,767		
OTHER TREATMENTS						
DOXYCYCLINE CAPS, 500s	6505-00-009-5063			14		

Table F-5. Defense Logistics Agency Logistics Readiness Data - Consumables

NOMENCLATURE	NSN	FY01 STOCKS ON HAND (as of 30 Sept 01)	PROJECTED DUE IN FY02	PROJECTED DUE IN FY03
INDIVIDUAL PROTECTION COMMODITY AREA				
OVERGARMENTS				
CAPE, AIRCREWMAN	8415-01-040-9018	0	60,000	44,000
CP UNDERCOVERALL	8415-01-040-3141	0	54,000	20,000
CHEM PROT UNDERGARMENT TOP	8415-01-363-8692-00	0		
CPU DRAWERS	8415-01-363-8683-91	5,645	24,000	8,000
EOD M-3 TAP	8415-00-099-6962/68/70			
	8415-01-105-2535	317	634	311
EOD TAP BOOTCOVER	8430-00-820-6295- 6306	312	634	311
EOD TAP GLOVES	8415-00-753-6550-54	101	634	311
IMPREG UNDERGARMENT	8415-00-782-3243	93	634	311
JSLIST SUITS *				
Wood - Coat	8415-01-444-1163/-1169/-1200/38/49/65/70	22,598	519,082	233,250
Wood Trousers	8415-01-444-1435/39/-1613-/2308/10/25/38	19,220	519,082	233,250
Desert Coat	8415-01-444-5902/05/13/26/-6116/31/38	377	202,110	77,500
Desert Trousers	8415-01-444-5417/5504/06/-5892/93/98/-5900	384	202,110	77,500
SCALP (TAN AND GREEN)	8415-01-333-0987	0	0	0
	8415-01-364-3320	0	0	0
SUIT, AIRCREW, CWU-66/77P	8475-01-328-3454(S)	22,600	15,000	15,000
SUIT, CP CAMO (BDO)	8415-01-137-1700-07	0	0	0
SUIT, CP CAMO-DESERT - 3 color	8415-00-327-5347-53	0	0	0
SUIT, CP CAMO-DESERT - 6 color	8415-01-324-3084-91	0	0	0
SUIT, CP, OG MK3	8415-00-214-8289-92	0	0	0
SUIT, CP, SARATOGA	8415-01-333-7573-76	0	0	0
OVERBOOTS/GLOVES				
JLIST MULO	8430-01-464-9453-84	0	0	0
BLK/GRN VINYL O/BOOTS	8430-01-317-3374-85	0	0	0
CPO FOOT COVERS	8430-01-021-5978	0	0	0
CP GLOVES 7 MIL	8415-01-138-2501-04	53,634	95,000	90,000
CP GLOVES 14 MIL	8415-01-138-2497-00	220,397	635,000	571,000
CP GLOVES 25 MIL	8415-01-033-3517-20	101,466	1,237,000	1,235,500
CP SOCKS	8415-01-040-3169	0	0	0
DISP FOOTWEAR COVER	8430-00-580-1205-06	0	0	0
MISC PROTECTION				
HOOD, MCU-2A/P	4240-01-189-9423	0	0	0
CP HELMET COVER	8415-01-111-9028	238	396,000	365,750
CONTAMINATION AVOIDANCE COMMODITY AREA				
CHEMICAL DETECTION EQUIPMENT				
BATTERY, BA3517	6135-00-450-3528	3,769	144	
MAINT KITS, M273/M293	5180-01-108-1729			
	5180-01-379-6409			
TUBE, DET, PHOSGENE GAS	6665-01-010-7965	9	64	

Table F-5. Defense Logistics Agency Logistics Readiness Data - Consumables

NOMENCLATURE	NSN	FY01 STOCKS ON HAND (as of 30 Sept 01)	PROJECTED DUE IN FY02	PROJECTED DUE IN FY03
DECONTAMINATION COMMODITY AREA				
CALCIUM HYPOCHLORITE (6 oz)	6810-00-255-0471	33,679	30,374	
CALCIUM HYPOCHLORITE (100 lb)	6810-12-132-2439			
DRY SORBENT POWDER	6850-01-262-0484	30	0	
STB, 50 LB	6850-00-297-6653	0	1,200	
COLLECTIVE PROTECTION COMMODITY AREA				
PRE-FILTER, SHIPBOARD CPE	4240-01-348-8785	0	0	0
MEDICAL COMMODITY AREA				
2-PAM CHLORIDE, AUTOINJ	6505-01-125-3248	88,298	0	0
ATROPINE AUTOINJ	6505-00-926-9083	3,220,000	0	0
CANA AUTOINJ	6505-01-274-0951	2,107,000	60,000	0
NAAK, MKI	6705-01-174-9919	2,914,000	0	0
PYRIDOSTIGIMINE TABLETS	6505-01-178-7903	113,806	0	0
LITTER, DECONTAMINABLE	6530-01-380-7309	8,868	0	0
ATROPINE SULFATE AEROSOL	6545-01-332-1281	0	0	0
OTHER TREATMENTS				
CIPROFLOXACIN, 500 MG	6505-01-272-2385	0	0	0
	6505-01-274-0951	0	0	0
	6505-01-333-4154	23,000	0	0
DOXYCYCLINE CAPS	6505-01-153-4335	0	0	0
100's	6505-00-009-5060	12	0	0
500's	6505-00-009-5063	0	300	0
ANTIDOTE TREAT KIT, CYANIDE	6505-01-143-4641	0	0	0
	6505-01-457-8901	0	0	0

* DLA purchases JSLIST suits for the Services. These suits are allocated to the Services in the following manner: 50% to the Army, 20% each to the Air Force and Navy, and 10% to the Marine Corps.

F.2 FIELDED NBC DEFENSE ITEMS - ISSUES AND CONCERNS

NBC defense items are generally used in combination to form a system or subsystem for a particular function. Therefore, this report will address items used as a system. These systems are categorized into five functional areas: (1) Contamination Avoidance, (2) Individual Protection, (3) Collective Protection, (4) Decontamination, and (5) Medical.

F.2.1 CONTAMINATION AVOIDANCE

Contamination avoidance programs generally include equipment that is used to conduct NBC agent reconnaissance, detection, and identification. This area represents approximately half of the annual DoD NBC defense RDT&E budget. Due to recent type-classification of several programs that are intended to modernize contamination avoidance programs, this area has an unusually high number of developmental programs, as compared to other commodity areas. Many programs will complete their fielding beyond FY05. Thus several systems appear in the moderate and high risk categories, but their risk will improve with continued procurement in coming years.

Current numbers of biological detection devices, to include the Biological Integrated Detection System (BIDS), Interim Biological Agent Detector (IBAD), and Joint Portal Shield are insufficient as measured against the MTW requirements. Automatic biological agent point detectors and stand-off detectors are currently in development, and will not be deployed in significant numbers prior to FY02. The USAF is fielding an off-the-shelf capability called the Ruggedized Advanced Pathogen Identification Device (RAPID). RAPID is a medical tool used for clinical identification of pathogenic agents within 25 minutes. It is capable of processing up to 32 samples simultaneously. Also, the USAF has limited quantities of the Joint Portal Shield biological networked Sensor Systems. Until fielding of the Joint Biological Point Detection System, Marine Corps will not have that capability either.

The combined total of chemical agent detection systems remains at moderate risk, but will improve slowly as the M22 Automatic Chemical Agent/Detector (ACADA) supplements the M8A1 Automatic Chemical Agent Alarm. An Army initiative to inspect and repair M8A1 alarms at Anniston Army Depot has resulted in the quick assessment and return of 1,600 units to the field. Another 1,500 alarms were coded as requiring depot maintenance and are undergoing repairs. As a result of this program, the Army has no shortage of alarms for training purposes and there is no longer an acquisition gap between the combined acquisition of M8A1 and M22 alarms.

Although the combined number of CAM/ICAMs reported by the Services places them in the high risk category, the actual number available for use by the Marine Corps is currently much lower but will improve in the near term. Collectively, 60% of the Marine Corps inventory of CAM 1.5 and CAM 2.0 have been refurbished and are currently being shipped to Marine Corps users. Funding for the remaining CAMs has been received and refurbishment action should be completed during FY02.

The M21 Remote Sensing Chemical Agent Alarm (RSCAAL) is at low risk with present quantities exceeding the two MTW requirement. The M93A1 NBCRS is currently fielded at less than half of its projected requirements. This system adds improved mass spectrometer sampling system along with stand-off chemical vapor detection. Several units continue to

use trained reconnaissance personnel in HMMWVs and APCs, thus moderating this risk as continued fielding and developmental systems enter the inventory. Also, the M93 NBC Recon System completes the fill in the interim when added to the on-hand quantity of M93A1 systems.

Traditional consumables in this commodity area (M8 and M9 detection paper, M256A1 kits and M272A1 water test kits) are available in sufficient quantities to meet wartime requirements. Some shortages exist in individual Services, but overall there is little risk. Shelf life concerns may change this projection; this area remains under review.

The Army and Air Force radiac programs are expected to just meet the two MTW scenario average requirements. The Army National Guard still has a large number of obsolete radiacs. These will be replaced in the near future by the AN/VDR-2 which is available in sufficient quantities through the depot system. The Navy has small quantities of older radiacs still in the inventory, which will be replaced through a modernization program currently underway. The Marine Corps has most of the required AN/VDR-2s and about three-quarters of its AN/PDR-75s as compared to the MTW requirements, putting it in a moderate risk category. While Army stores or industry could compensate for this shortfall, it represents a potential risk, especially at the onset of any contingency.

F.2.2 INDIVIDUAL PROTECTION

Currently fielded protective suits and masks are designed to protect against all known CB threat agents. Past Service-unique requirements led to Service-specific procurements and some duplication in capability resulting in the procurement of six different chemical protective suits and six different masks. This has caused difficulties in meeting current needs and exacerbated logistics planning. Fielding of the M40/42 protective masks, JSLIST protective suits and the MULO boot has begun to resolve many of these former challenges.

F.2.2.1 Protective Ensembles

The Services are continuing acquisition of the Joint Services Lightweight Integrated Suit Technology (JSLIST) suits as a replacement for the BDO and other chemical protective suits. As such, the protective suits should be viewed as a system with the older suits providing readiness stocks until the end of their service life. The initial JSLIST contracts did not include surge option clauses. Defense Supply Center Philadelphia (DSCP), whose solicitations include the surge option as a requirement, took management of JSLIST in FY98. By examining the year-by-year status of protective suits, a number of older suits still within service life were added to the number of JSLIST suits purchased by that year and matched the total against the requirements. In FY01, the total Services' inventory of protective suits are at high risk of not meeting projected average two MTW requirements. Additionally, available inventory will continue to drop as the service life of older protective suits, such as BDOs, expires in large quantities. Near term buys will moderate that risk, however. Also, DLA is taking steps to identify alternative sources for JSLIST suits which will add to the overall production capacity.

The Battle Dress Overgarment (BDO) is reaching its maximum extended shelf life limit (14 years), and the Services have no plans for new production. There are no companies currently manufacturing the BDO. The Army and Air Force have sufficient suits on hand in war reserves to sustain its requirements for the near term. The Saratoga suit, purchased by DSCP for the

Marine Corps, is also out of production, but current stocks will sustain the Marine Corps until the JSLIST is available in adequate numbers. The Navy is relying on existing stocks of their Mark III chemical protective suit (also out of production) as stocks of JSLIST are being procured.

Armor crews and aircrews require special protective ensembles to integrate with their weapon systems. Services have sufficient numbers of aircrew suits to meet requirements, given the smaller total requirements for aircrews (relative to ground troops). An exception is the Chemical Protective Undercoverall, which is now obsolete. It is replaced by the CWU-66/77 which remains low in inventory resulting in a moderate risk rating. To protect armor crewmen when they exit their vehicles, the Services have developed the Suit Contamination Avoidance Liquid Protection (SCALP), which is available in sufficient quantities to meet MTW requirements.

The Services have adequate stocks of 7 and 25-mil chemical protective gloves on-hand for contingency use. Currently, DLA and the Marine Corps do not have adequate stocks of 14 mil chemical protective gloves on-hand for contingency use. DLA currently has an emergency buy for 14 mil gloves with a February 2002 estimated delivery date. An additional buy will be made shortly thereafter and at that time DLA will have adequate stock on hand. Recent DoD surveillance tests have validated the protective qualities of the existing butyl rubber glove stocks. The status of the Services on-hand inventories has allowed DLA to pursue an Industrial Base Maintenance Contract (IBMC) with both current manufacturers (Siebe North, Inc., Charleston, SC, and Guardian Corp., Willard, Ohio) to sustain the industrial base with "War Stopper" funding. The IBMC is to maintain the equipment only.

Chemical Protective Footwear Covers, also known as the "fishtail" boot, have been out of production for several years. Their shortages are supplemented by the Black/Green Vinyl Overboot (BVO/GVO), which is the interim chemical protective footwear until the JSLIST MULO boots have been fielded. Because the GVO's primary purpose is not chemical protection, current contracts do not include surge option clauses. Again, one should view protective footwear as a system with older GVOs providing readiness stocks until the MULO is fielded in sufficient quantities. Currently, the total DoD inventory shows adequate quantities of protective footwear, resulting in low risk assessment. The USMC is the only service reporting a shortage of footwear, but DLA can fill their shortfall.

F.2.2.2 Eye/Respiratory Protection

The Services continue modernizing their chemical protective mask inventories. Different versions of the protective mask were developed to meet the requirements of different military occupational specialties (*e.g.*, air crew, tank crew, *etc.*). For the Army and Marine Corps, the M40 (for generic use) and M42 (for armor crew members) series masks are replacing the M17 and M25-series masks, respectively. Some Army aviation units are still equipped with the old M24 mask, which will be replaced by the M45 mask. The M43-series mask, designed to be used by Apache equipped units, was in fact issued to all types of aviation units. It is being replaced by the M48 (Apache) series mask. The M45 will replace the M49 as the general aviation mask. This modernization effort is still ongoing; not all units have replaced their M43-series masks. All of these masks are at low risk, as the combined numbers of all aviator masks on hand exceeds the requirement. These newer masks provide increased protection, improved fit and comfort, and compatibility with most Services' weapons systems' optics and sights.

The Marine corps is performing a product improvement program (PIP) to modify the existing M40/M42 series mask. The PIP will be completed in Fiscal Year 2004. PIP actions include installation of a new nose cup, polycarbonate eye lenses, drink tube coupling, and drink tube quick disconnect: banding of the outlet valve housing: and laser etching serial numbers on the mask. The new components and banding procedure will improve the mask's durability and protective capability requirements established by the Marine Corps and eliminate inadvertent damage to the mask by the unit (*i.e.*, painting a number on the head harness, engraving in the eyelens-retaining ring). The cost to perform the PIP is estimated at $12M with the Marine Corps saving approximately $10M by performing the rebuild vice buying new modified masks.

The MCU-2A/P mask is designed to meet the needs of the Air Force ground crews, Navy shipboard and shore-based support missions, and Marine Corps rotary wing forces. The number of these masks on hand generally exceeds the requirement. The USAF has some shortages in masks and does not have second skins to provide complete personal protection. It will continue to be the mainstay of these units until the Joint Service General Purpose Mask is fielded, which will also replace the M40/42 masks. The Aircrew Eye/Respiratory Protection (AERP) mask is specially designed to enable pilots of high performance aircraft to conduct missions in a contaminated environment. Quantities of this mask are currently below the MTW requirement, making this a moderate risk.

In order to provide complete protection to our forces on the contaminated battlefield, particularly from liquid chemical agents, protective hoods and helmet covers are required as part of the individual protective ensemble. The protective hood for the M40 is rated as low risk. It is being replaced by the second skin for the M40 series mask, which is a high risk program with only 65 percent of requirements on hand in FY02. The MCU-2P hood is at low risk with an abundant inventory. Protective hoods for the M17-series, M24, and M25A1 masks are also in good supply, and thus are not a readiness issue. These masks are leaving the inventory, however. The Chemical Protective Helmet Cover is also available in sufficient quantities.

Filters and canisters provide the active ingredients that absorb the chemical and biological agents and provide the essential protection required. The C2/C2A1 canister is used with the M40, M42, M43, M45, M48, and MCU-2/P masks. The number on hand falls short of the MTW requirements as a moderate risk. The M13A2 filter element exceeds requirements, but will be leaving the inventory with the retirement of the M17-series mask. The M10A1 filter canister used on the M24/25 is short of the requirement, but these masks will also leave the inventory and will not be a readiness problem.

F.2.3 COLLECTIVE PROTECTION

There are two general categories of collective protection: stand-alone shelters and integrated systems. Integrated collective protection equipment is component equipment designed to provide protection against CB agents through the use of filtered air under positive pressure to a variety of facilities, vans, vehicles, aircraft and ships. Filters for these integrated collective protection systems (CPS) are in short supply due to low peacetime demand and low production quantities. The increased emphasis on procuring individual protection and contamination avoidance equipment has resulted in a corresponding decrease in procurements of shelters and large collective protection filters.

The Air Force has expressed interest in a greater collective protective shelter capability. The Air Force fielded through FY 00 the Pacific Air Force Interim Transportable Collective Protection System (PITCOPS). PITCOPS is an above ground NBC shelter that provides NBC filtration integrated with an environmental control unit and auxiliary power unit. Beginning in FY 05 the Air Force plans to field the Joint Transportable Collective Protection System (JTCOPS). Combined with the Navy's increasing shipboard collective protection filter requirements and the Army and Marine Corps traditional integrated vehicular systems and tactical shelter requirements, the near-term MTW requirements for large carbon-based filters have outpaced current inventories even aided by industrial surge capability. As a result, much of this sector is assessed as high risk, though the risk is primarily due to the level of funding rather than technical shortfalls. Most of the filter manufacturers retain the industrial capability to produce them.

In the near term, the M51 shelter is replaced by the new Chemical and Biological Protective Shelter (CBPS). All Army M51 shelters have been coded as unserviceable. The CBPS is presently in limited production with only limited fielding during 3QFY02. Both Army and Air Force field hospitals are being integrated with environmentally controlled collective protection. The Army's Chemically Protected Deployable Medical Systems (CP DEPMEDS) and the Air Force's Chemically Hardened Air Transportable Hospital (CHATH) achieve collective protection through the integration of the M28 Simplified CPE, chemically protected air conditioner, heaters, water distribution and latrine and alarm systems. The M28 Simplified CPE is in production and chemically protected heaters and air conditioners initiated production in FY99. Procurement and production of CP DEPMEDS components has initiated. All components will be assembled into CP DEPMEDS sets at depot. The FY02-07 POM fully supports the production of 14 of the required 17 CP DEPMEDS. In FY00, production initiated for remaining M28 CPE, CB protected water distribution and latrine systems, CB ISO Shelter Seals and Low Pressure Alarms.

The M20-series Simplified CPEs are used to provide a contamination-free, environmentally controlled work space for Echelon I and II forward area medical treatment facilities. Current funding levels, however, only will meet Force Package I requirements. There are some Force Package II units designated for deployments into high threat regions that will not be equipped with M20 shelters. This leads to an assessment as high risk. Current policy is that the M20/M20A1 Simplified CPE is a free issue item with no requirement to stock other than spares replenishment. The Marine Corps has Portable Collective Protection Shelters (PCPS) but does not plan to field them. The Marine Corps is instead using them for training purposes. The M20A1 SCPE is by default the only modern collective protection stand-alone shelter outside of the medical community in the inventory.

The Services have continued to improve integrated collective protection systems in armored vehicles and vans. All modern armored vehicles and armored vehicles in development have either filtered air systems, hybrid collective protection or full collective protection systems designed into their chaises. Notable progress has been made in providing shipboard collective protection. By the year 2000, most Naval ships that have close-in support roles (including amphibious ships, gunfire support combatants, and new logistics support ships) will contain significant CPS capabilities.

Collective protection filters for integrated systems (such as armored vehicles, ships and planes) continue to suffer from low stocks. While the Services have been proactive in selecting more capable industrial sources, actual procurement and storage of these filters to MTW

requirements has not been initiated for all filters. As a result, stocks of some filters remain at a low level. However, the filters associated with the 200 CFM Particulate Filter Set for Shipboard Collective Protection Systems are being procured in sufficient quantities. Continued difficulties in obtaining a strong industrial base in this field compounds the issue of fielding and sustaining these items.

F.2.4 DECONTAMINATION

Current decontaminants are highly effective against all CB agents, but most present environmental hazards and are manpower intensive. The services are attempting to find environmentally safe decontaminants that are less labor intensive.

Basic soldier skills for decontamination of vehicle and crew-served weapons rely on the M11 Decontamination Apparatus, Portable (DAP) and M13 DAP. While the M11 is assessed as posing low risk, there are insufficient quantities of the M13 DAP as measured against the MTW requirements. The 1-1/3 quart M11 can be used in place of the 14-liter M13 DAP, but they do not fulfill the same exact capability (in part due to the volume of DS-2).

The M17-series Lightweight Decontamination System (LDS) is used to provide operational equipment decontamination in many battalion-level units and dual-purpose (smoke/decontamination) chemical companies. The Air Force employs the M17 at the squadron level for operational equipment decontamination. The M17 is assessed as a moderate risk, due in part to a delay in rebuilding several hundred systems caused by a lack of funding since 1990. There is still a large mix of different models in the inventory, forcing the Services to retain a large number of differing spare parts to maintain the different models. Based on projected inventory, should spare parts become difficult to obtain for the different models, the risk may become high. Overall, this risk should drop as more systems are produced and the older models are upgraded or replaced. The Marine Corps is upgrading all of their LDS to the diesel engine. The Air Force is deleting stocks of A/E32-U systems by attrition, modifying existing M17s to M17A2s, and procuring additional M17A3s to satisfy shortages.

In the Army, the M12A1 Power-Driven Decontamination Apparatus (PDDA) and the M17A3 LDS are the primary pieces of equipment used to decontaminate vehicles, crew-served equipment and large areas of terrain. The M12A1 is assessed as high risk. The maintenance requirements due to the age of this item limit its full utilization and increases its risk. The M21/M22 Modular Decontamination System will displace 200 M12A1 PDDAs over the POM period, resulting in a high-low mix of technology. By FY02, the on-hand quantities of the M21/M22 MDS alone should satisfy the two MTW requirement. Additionally, the Marine Corps is replacing their M12A1 PDDAs with the M17-series LDS.

The Army and Marine Corps plans for stocking containers of DS-2 (5-GAL and M13 Can) are below the MTW requirements expected for decontamination operations. The situation is compounded by a decreasing availability of DS-2. Bulk DS-2 stored at Seneca Army Depot underwent lot testing to ascertain how much has deteriorated and is unusable. As a result, stocks of DS-2 are being released for contingency use only. While less hazardous replacement decontaminants, such as sorbent decon are being developed, the quantities and packaging of current decontaminants present potential risk. The projected stockage of STB meets average MTW requirements, but has been considered a high-risk category in the past. Slight shortages in calcium hypochlorite and sodium hypochlorite can be made up by the industrial base, using

commercially available alternatives. These increased requirements come as a result of increased attention to the need for decontamination capabilities in the 2 MTW scenario, and will be further refined. Continued monitoring is recommended.

The shelf life of the M258A1 Skin Decontamination Kit expired on 30 July 1999. Its replacement, the M291 Skin Decontaminating Kit, became the primary item used in personnel decontamination. Although M258A1 stocks are no longer available to supplement inventory of the M291, the risk assessment is low. Projected buys are expected to meet the 2 MTW requirements, but may need to be augmented to meet the total service requirements. Rohm & Haas, Co., the sole supplier of the resin, sold the mixing and packaging equipment they used to manufacture the M291 Decontaminating Kit. Pine Bluff Arsenal, Arkansas, set up a production line and began to manufacture the M291 Decontaminating Kit in October 1996. Rohm & Haas continues to provide some of the XE-555 resin components. Quantities of the proprietary resin component are being purchased by the item manager and provided to Pine Bluff for production of additional M291 Kits. Alternatives to producing a kit that does not use the XE-555 resin are being studied, including novel sorbent decontaminants.

The projected stockage of the M295 Individual Equipment Decontamination Kit puts it in a low risk category when compared with 2 MTW requirements. The M295 Decontamination Kit uses the same resin mix as the M291 Decontaminating Kit, and began delivery in December 1997. True Tech Inc. has been producing this item. Increased funding for its procurement would maintain the low risk.

F.2.5 MEDICAL

Medical NBC defense items are used to counteract the effects of exposure to chemical, biological, or nuclear agents through pre-treatment, vaccines, or post-treatment. Current projections for medical chemical defense material indicates that sufficient quantities should be on hand through the POM years and present overall low risk. Quantities of Nerve Agent Antidote Kits (NAAK), and Atropine and 2-PAM Chloride Autoinjectors now support two MTW requirements. Convulsant Antidote Nerve Agent (CANA), and Nerve Agent Pyridostigmine Pretreatment (NAPP) Tablets (also known as PB Tablets) are now at low risk because of continued purchases. This report includes medical treatments for biological warfare agents and cyanide exposure along with the addition of new chemical treatments.

NAPP is still an Investigational New Drug (IND) for the use as a nerve agent pre-treatment. The U.S. Army Medical Materiel Development Activity (USAMMDA) has continued to work with the FDA for approval. Defense Supply Center – Philadelphia (DSCP) is working with ICN Pharmaceuticals to establish a requirements contract for the manufacture of NAPP.

The sole supplier to DoD for NAAK, atropine autoinjectors, pralidoxime autoinjectors and CANA is Meridian Medical Technologies, St Louis, Missouri. The medical chemical defense production line is being maintained with an IBMC. Meridian is an U.S. company but it obtains its atropine for the autoinjectors from a German supplier. Currently there is no domestic source for this drug. Pralidoxime and diazepam (CANA) for the autoinjectors is available from U.S. sources. The replacement for NAAK is the Antidote Treatment, Nerve Agent, Autoinjector (ATNAA), which is a multi-chambered injector that will begin procurement in FY01.

Patient Chemical Wraps have not been procured since 1991 and are made of the BDO materiel. USAMMA and the AMEDDC&S are currently assessing several versions of the

patient wrap before initiating new procurement of this item. All services are procuring the new decontaminable litter, but in limited quantities, for first line units. There is a very large stockpile of canvas litters that can be used once in an NBC environment and then destroyed. As the canvas litters are depleted, they will be replaced with the new nylon decontaminable litter.

The Office of the Surgeon General has centrally programmed and funded the Army's Medical Chemical Defense Materiel since 1994. USAMMA has procured, stored and maintained this materiel for the Army in strategic locations for early deployers and forward deployed forces as Division Ready Brigades (DRB) sets, which support 5,000 personnel each. The Marine Corps has consolidated its medical defense materiel into five centralized locations. The materiel is issued from one of the centralized locations whenever a Marine Corps element deploys, and is returned to the centralized program upon redeployment. The Air Force and Navy maintain their medical CB materiel in decentralized unit locations. Visibility of on-hand assets has been improved with the release of the Joint Medical Asset Repository, which is the Class VIII (medical) portion of JTAV.

Currently, the U.S. total force (active and reserve forces) is being vaccinated against anthrax, which is considered the primary high-threat BW agent. The anthrax vaccination program is a three-phase program, starting with the troops serving in—or identified to deploy to—the two high-threat areas where hostile anthrax-use poses the greatest potential danger. That status and schedule of the anthrax vaccination program is provided in Table 2-10 in Chapter 2 of this report.

JPO-BD continues to support the sole domestic supplier of anthrax vaccine to achieve FDA approval of their contract filler. In the area of medical therapeutics, the Department is maintaining a stockpile of antibiotics (*e.g.*, ciprofloxacin, doxycycline) sufficient to address the treatment needs of potential BW exposures, where such treatment is medically indicated.

The DoD/FDA Shelf Life Program was developed by OSD Health Affairs and the Military Medical Departments in response to Congressional concern over the conservation of military medical resources. The program's focus is to save replacement cost of date sensitive medical materiel especially medical materiel in War Reserve Stocks, Medical Biological Defense Materiel Programs and Medical Chemical Defense Materiel Programs. The Joint Readiness Clinical Advisory Board (JRCAB) manages the shelf-life extension program for the Services and interfaces with the FDA. The FDA requests samples from the JRCAB and the Services. The samples have an initial potency test performed, followed by a 90-day stress test, and then a final potency test. The potency results are compared against a degradation curve, and a new potency period is assigned. The FDA sends the information to the JRCAB and Services who disseminate instructions to extend and re-mark or destroy the materiel to activities and units worldwide. The same lots are subjected to yearly retest and subsequent extensions until the materiel fails or is removed for lack of sufficient on-hand quantities required for testing. The Army maintains its extended materiel at Meridian Medical Technologies for use by Force Package 3 and 4 units. The Air Force maintains its materiel at its local medical logistics activities that re-mark the materiel and maintains it for the deploying units. The Navy remarks the materiel and maintains it with the unit. The Marines remark the materiel at its centralized storage locations. It is currently looking at other alternatives, similar to the Army's, the replace pen and ink changes. The DoD/FDA Shelf Life Program has saved an average of $118.50 of medical chemical defense materiel from having to be destroyed and repurchased for every $1.00 it has cost the Services to get materiel tested and extended by the FDA.

Annex G

DoD Joint Service Chemical and Biological Defense Program Funding Summary

In accordance with 50 USC 1522, *Department of Defense Chemical and Biological Defense Program*, research, development, test and evaluation (RDT&E) and procurement for all DoD chemical and biological (CB) defense programs (with the exception of those biological warfare defense RDT&E programs conducted by the Defense Advanced Research Projects Agency, DARPA) are consolidated into defense-wide program element (PE) funding lines. The detailed funding information in this annex is provided annually to Congress in the DoD Joint Service Chemical and Biological Defense Program, President's Budget Submission, Research, RDT&E, Defense-Wide and Procurement, Defense-Wide budget exhibits, and in the Department of Defense Extract found in the Budget of the United States. These budget submissions provide a detailed account of prior year accomplishments and planned activities for the budget request period. Table G-1 (and Figure G-1) provides a summary of appropriated and requested funding from FY 1996 – FY 2007. Detailed funding request for FY 2003-2007 are provided separately in the President's FY2003 Budget Submission. Fiscal year 1996 was the first year in which all Service and Defense Agency CB defense programs were consolidated into defense-wide funding lines. Prior to FY 1996, funding was included in several separate Service and Defense Agency funding lines. Also, during FY 1996 approximately $30 million was transferred to the CB Defense Program procurement line from the Army's operations and maintenance (O&M) accounts for bio-defense vaccine acquisition. Much of the growth in program funding between FY 1996 and FY 1997 resulted from the transfer of funds between existing accounts rather than real growth in the overall DoD CB Defense Program.

Table G-2 (and Figure G-2) provides a summary of expenditures by the DoD Chemical and Biological Defense Program. Expenditures represent the amount of checks issued or other payments made (including advances to others), net of refunds and reimbursements. The term is frequently used interchangeably with the term "outlays," which are the measure of government spending (*i.e.*, payments to liquidate obligations (other than the repayment of debt), net of refunds and offsetting collections.) It is important to note that funds appropriated for a given year may be expended incrementally over a period of years. Thus, expenditures shown in Table G-2 will be updated in following years to show total expenditures of appropriated funds.

Table G-1. Chemical and Biological Defense Program Appropriations Summary

Program Element PE ($ in millions)	FY96‡	FY97‡	FY98‡	FY99‡	FY00‡	FY01‡	FY02*	FY03**	FY04**	FY05**	FY06**	FY07**
0601384BP – Basic Research	26.492	28.372	25.263	28.505	42.737	38.369	45.791	64.119	36.434	37.540	38.958	42.192
0602384BP – Applied Research	68.571	70.823	69.632	62.301	90.360	93.172	146.431	262.177	95.242	94.494	92.528	91.171
0603384BP – Advanced Tech. Dev.	33.727	41.693	43.517	59.186	44.548	58.241	75.266	249.842	106.003	100.922	87.288	92.228
Science & Technology Base Subtotal	**128.790**	**140.888**	**138.412**	**149.992**	**177.645**	**189.782**	**267.488**	**576.138**	**237.679**	**232.956**	**218.774**	**225.591**
0603884BP – Demonstration/Validation	29.184	44.747	49.465	61.409	67.317	82.315	89.756	144.790	102.500	69.659	47.994	43.976
0604384BP – EMD	87.229	97.468	123.045	103.159	112.619	98.836	161.383	169.018	126.678	108.418	117.042	98.465
0605384BP – Management Support	6.954	17.936	21.137	25.099	25.806	27.236	31.052	42.959	36.530	34.495	39.520	40.086
0605502BP- Small Business Innovative Research (SBIR)	0.000	0.000	5.612	5.638	5.938	6.630	0.000	0.000	0.000	0.000	0.000	0.000
RDT&E Subtotal	**252.157**	**301.039**	**337.671**	**345.297**	**389.325**	**404.799**	**549.679**	**932.905**	**503.387**	**445.528**	**423.330**	**408.118**
0208384BP – Procurement Subtotal	**135.647**	**232.952**	**233.943**	**295.189**	**373.152**	**469.753**	**354.229**	**435.731**	**397.026**	**479.532**	**550.219**	**539.031**
CB Defense Program Total	**387.804**	**533.991**	**571.614**	**640.486**	**762.477**	**874.552**	**903.908**	**1368.636**	**900.413**	**925.060**	**973.549**	**947.149**

‡ Total Obligation Authority (TOA)
* FY02 President's Budget Request
** Estimated [from FY03 President's Budget]

Table G-2. Chemical and Biological Defense Program Expenditures Summary

Program Element (PE) ($ millions)	FY96†	FY97†	FY98†	FY99†	FY00†	FY01†
RDT&E, Defense-Wide	248.697	286.753	329.828	323.823	323.255	208.878
Procurement, Defense-Wide	131.830	227.691	224.800	281.201	281.289	193.525
CB Defense Program Total	**380.527**	**514.444**	**554.628**	**605.024**	**604.544**	**402.403**

† Expenditures as of September 30, 2001.

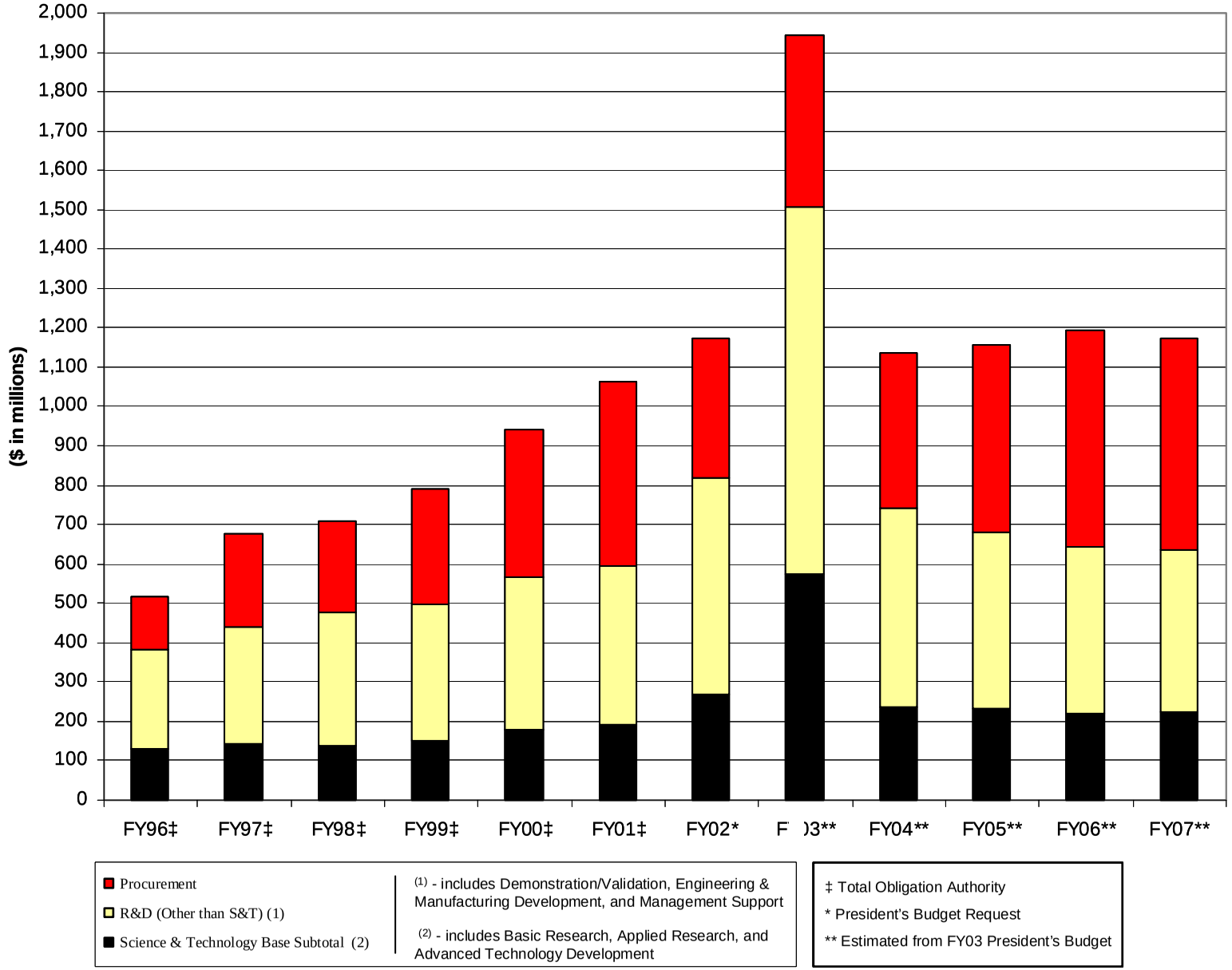
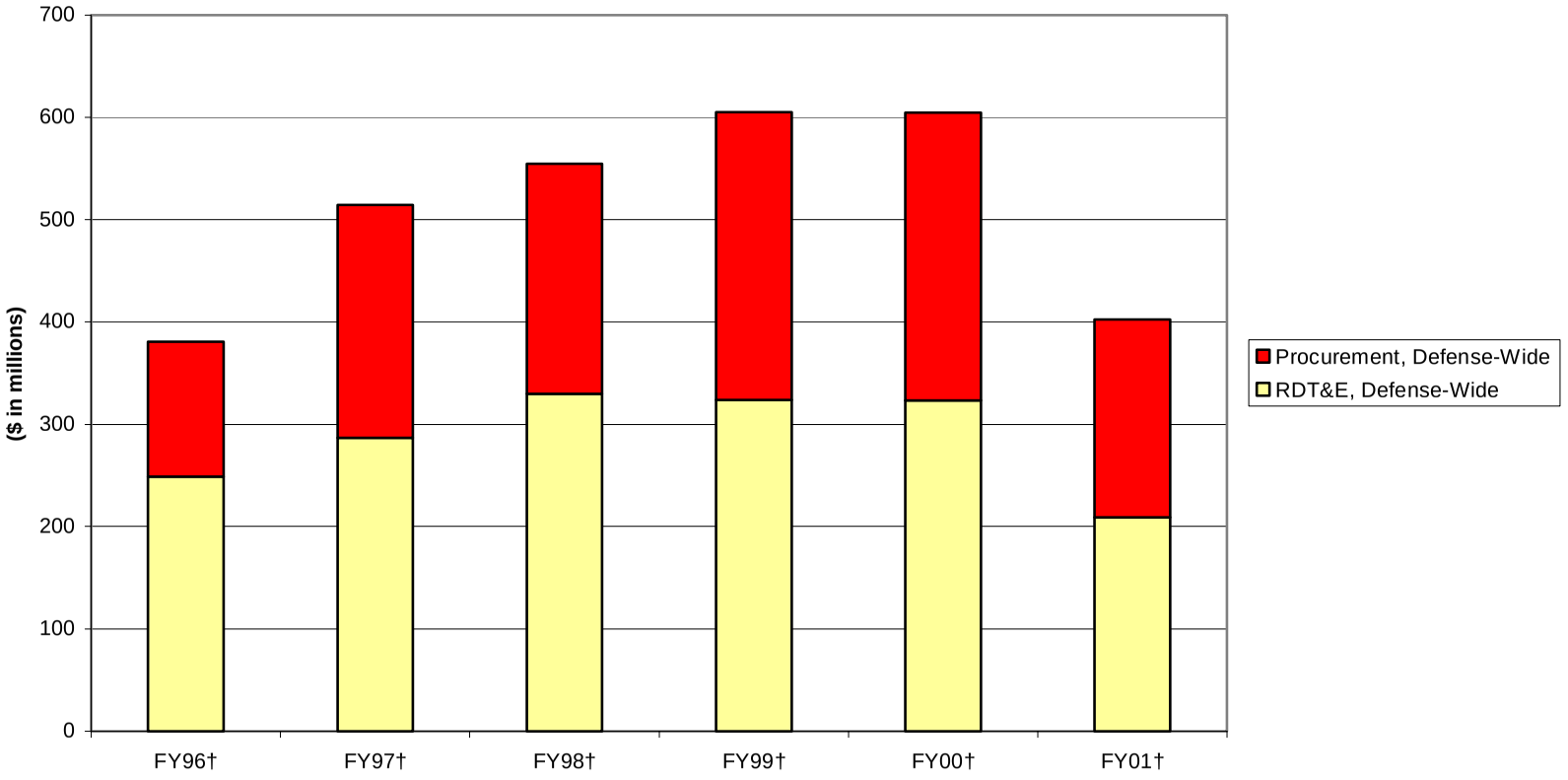


Figure G-1. Chemical and Biological Defense Program Appropriations Summary



†as of September 30, 2001

Figure G-2. Chemical and Biological Defense Program Expenditures Summary

Annex H

Statement Regarding Chemical and Biological Defense Programs Involving Human Subjects

The reporting requirement (50 USC 1523) for the annual report to Congress on the DoD Chemical and Biological Defense Program was modified by Section 1086 of the FY98 National Defense Authorization Act. The amendment requires the following information:

> A description of any program involving the testing of biological or chemical agents on human subjects that was carried out by the Department of Defense during the period covered by the report, together with a detailed justification for the testing, a detailed explanation of the purposes of the testing, the chemical or biological agents tested, and the Secretary's certification that informed consent to the testing was obtained from each human subject in advance of the testing on that subject.

Table H-1 provides a summary of prior and planned tests conducted by the Department of Defense, both directly or under contract, which involve the use of human subjects for the testing of chemical or biological agents. In summary, there has been no such testing since 1969 with biological agents, since 1975 for chemical agents, and no testing is planned.

Table H-1. Summary of Experiments and Studies with Human Subjects Involving the Use of Chemical or Biological Agents

November 25, 1969	–	Human biological agent testing ended
July 28, 1975	–	Human chemical agent testing ended
Since 1969/1975	–	No activities with human subjects involving exposure to biological agents nor chemical agents have occurred since testing ended

The Department is in full compliance with the requirements of all laws regarding the use of human subjects involving chemical or biological agents. DoD is involved in no experimentation or any other efforts which involve the exposure of human subjects to chemical or biological agents.

As part of the DoD Chemical and Biological Defense Program, DoD requires the use of small quantities of chemical and biological agents in the research, development, test and evaluation of detection, protection, and decontamination equipment and systems. Chemical and biological agents are also used in small quantities in training U.S. forces to operate in protective equipment and to operate detection and decontamination systems in a chemical or biological

environment. However, no research, development, test or evaluation involves the exposure of human subjects to chemical or biological agents.

Medical chemical and biological defense programs involve the use of human subjects in controlled clinical trials to test and evaluate the safety, immunogenicity, and other effects of medical products (drugs, vaccines, therapies, *etc.*) to protect against chemical and biological agents. The use of human subjects in these trials involves volunteers who have provided informed consent. All use of human subjects in these trials is in full compliance with the "Common Rule," Federal Policy for the Protection of Human Subjects, Food and Drug Administration (FDA) regulations, Federal Acquisition Regulations (FAR), DoD Directives and Instructions, and *all* other applicable laws, regulations, issuances, and requirements. The FDA has a proposed rule "New Drug and Biological Drug Products; Evidence needed to Demonstrate Efficacy of New Drugs for Use Against Lethal or Permanently Disabling Toxic Substances When Efficacy Studies in Human Ethically Cannot be Conducted" October 5, 1999. No medical chemical or biological defense programs involving human subjects involves the exposure of these subjects to chemical or biological agents.

While DoD conducted tests involving the exposure of human subjects to chemical and biological agents in the past, all such tests and programs have been halted and disbanded. The United States formally renounced the "use of lethal biological agents and weapons, and all other methods of biological warfare" in National Security Decision 35, November 25, 1969. Human testing with lethal biological warfare agents was never done and testing with incapacitating biological warfare agents was ceased in 1969. The last human testing of chemical warfare agents occurred on July 25, 1975. Acting Secretary of Army Norman Augustine suspended testing of chemical compounds on human volunteers on July 28, 1975.

Tests involving the exposure of human subjects to chemical agents began in the 1940s and continued following World War II through the Cold War until the early 1970s. Such testing has been documented and reported to Congress. See for example, Department of Army, Inspector General Report, DAIG-IN 21-75, *Use of Volunteers in Chemical Agent Research*, March 1976. In addition, there was extensive congressional testimony on this subject during 1975 and 1976. DoD has not conducted any experimentation since that time involving the exposure of human subjects to chemical warfare agents.

Annex I

Congressional Reporting Requirement: 50 USC 1523

Text of Public Law Mandating Report on
The Department of Defense Chemical and Biological Defense Program

Title 50 of the U.S. Code, Sec. 1523. Annual report on chemical and biological warfare defense
Implemented by Public Law 103-160, The FY94 National Defense Authorization Act

(a) Report required

The Secretary of Defense shall include in the annual report of the Secretary under section 113(c) of title 10, a report on chemical and biological warfare defense. The report shall assess--

(1) the overall readiness of the Armed Forces to fight in a chemical-biological warfare environment and shall describe steps taken and planned to be taken to improve such readiness; and

(2) requirements for the chemical and biological warfare defense program, including requirements for training, detection, and protective equipment, for medical prophylaxis, and for treatment of casualties resulting from use of chemical or biological weapons.

(b) Matters to be included

The report shall include information on the following:

(1) The quantities, characteristics, and capabilities of fielded chemical and biological defense equipment to meet wartime and peacetime requirements for support of the Armed Forces, including individual protective items.

(2) The status of research and development programs, and acquisition programs, for required improvements in chemical and biological defense equipment and medical treatment, including an assessment of the ability of the Department of Defense and the industrial base to meet those requirements.

(3) Measures taken to ensure the integration of requirements for chemical and biological defense equipment and material among the Armed Forces.

(4) The status of nuclear, biological, and chemical (NBC) warfare defense training and readiness among the Armed Forces and measures being taken to include realistic nuclear, biological, and chemical warfare simulations in war games, battle simulations, and training exercises.

(5) Measures taken to improve overall management and coordination of the chemical and biological defense program.

(6) Problems encountered in the chemical and biological warfare defense program during the past year and recommended solutions to those problems for which additional resources or actions by the Congress are required.

(7) A description of the chemical warfare defense preparations that have been and are being undertaken by the Department of Defense to address needs which may arise under article X of the Chemical Weapons Convention.

(8) A summary of other preparations undertaken by the Department of Defense and the On-Site Inspection Agency to prepare for and to assist in the implementation of the convention, including activities such as training for inspectors, preparation of defense installations for inspections under the convention using the Defense Treaty Inspection

Readiness Program, provision of chemical weapons detection equipment, and assistance in the safe transportation, storage, and destruction of chemical weapons in other signatory nations to the convention.

(9) A description of any program involving the testing of biological or chemical agents on human subjects that was carried out by the Department of Defense during the period covered by the report, together with a detailed justification for the testing, a detailed explanation of the purposes of the testing, the chemical or biological agents tested, and the Secretary's certification that informed consent to the testing was obtained from each human subject in advance of the testing on that subject.

Annex J

Acronyms and Abbreviations

Note: The acronyms and abbreviations in this annex reflect an extensive, though not exhaustive, list of terms related to the various and diverse CB defense activities. The acronyms may have different meanings in other contexts.

–A–

AAAV – Advanced Amphibious Assault Vehicle
AAR – after action report
AARS – Advanced Airborne Radiac System
AB – Air Base
ABDU – Aviation Battle Dress Utilities
ABO – Agent of Biological Origin
AC – Active Component
ACAA – Automatic Chemical Agent Alarm
ACADA – Automatic Chemical Agent Detector
ACAT – Acquisition Category
ACC – Air Combat Command
ACES – Air Force Command Exercise System
Ach – acetylcholine
ACOM – Atlantic Command
ACPLA – agent containing particle per liter of air
ACPM – Aircrew Protective Mask
ACTD – Advanced Concept Technology Demonstration
ADS – Area Detection System
AERP – Aircrew Eye/Respiratory Protection
AFB – Air Force Base
AFI – Air Force Instruction
AFIP – Armed Forces Institute of Pathology
AFMAN – Air Force Manual
AFMS – Air Force Medical Service
AFRRI – Armed Forces Radiobiology Research Institute
AG – Australia Group
AICPS – Advanced Integrated Collective Protective System
AIDET – Aircraft Interior Detector
AIT – Aeromedical Isolation Team
ALAD – Automatic Liquid Agent Detector
ALSA – Air Land Sea Application
AMAD – Automatic Mustard Agent Detector
AMC – U.S. Army Materiel Command
AMEDDC&S – Army Medical Department Center and School
ANCOC – Advanced NCO Course
ANG – Air National Guard
AN/VDR-2 – Portable dose-rate gamma/beta radiation meter
AN/VDR-13 – Compact, digital whole body radiation meter
APC – Armored Personnel Carrier
APODS – Aerial Port of Debarkation
ARNG – Army National Guard
ARTEP – Army Training and Exercise Plan
ASA(ALT) – Assistant Secretary of the Army for Acquisition, Logistics & Technology
ASBREM – Armed Services Biomedical Research Evaluation and Management
ASCC – Air Standardization Coordinating Committee
ASD(HA) – Assistant Secretary of Defense for Health Affairs
ASD(S&TR) – Assistant Secretary of Defense for Strategy and Threat Reduction
ASD(SO/LIC) – Assistant Secretary of Defense for Special Operations and Low-Intensity Conflict
ATD – Advanced Technology Demonstration
AT/FP – Antiterrorism Force Protection
ATG – Afloat Training Group
ATH – Air Transportable Hospital
ATNA – Antidote Treatment Nerve Agent Autoinjector
ATP – Adenosine Triphosphate or Allied Tactical Publication
ATS – Automatic Transfer Switch
ATSD(NCB) – Assistant to the Secretary of Defense for Nuclear and Chemical and Biological Defense Programs
ATSO – Ability to Survive and Operate
aTSP – active Topical Skin Protectant
AVA – Anthrax Vaccine Adsorbed
AVIB – Aircrew Uniform Integrated Battlefield
AVIP – Anthrax Vaccine Immunization Program

–B–

B. anthracis – *Bacillus anthracis* (anthrax)
B. mallei– *Burkholderia mallei* (glanders)
BBS – Brigade Battle Simulation
BCTP – Battle Command Training Center
BD – biological detector (also, biological defense)
BDO – Battledress Overgarment
BDU – Battledress Uniform

BES – Budget Estimate Submission
BG – *Bacillus Globigii*
BIDS – Biological Integrated Detection System
BIODET – biological detection
BL – Biosafety Level
BLA – Biologics Licensing Application
BNCOC – Basic Non-Commissioned Officer Course
BOG – Board of Governors
BoNT – Botulinum Neurotoxin
BoNT/A – Botulinum Neurotoxin A
BoNT/B – Botulinum Neurotoxin B
BRP – Basic Research Plan
BSPS – Biological Sample Preparation System
BTN – below the neck
BTRC – Biological Threat Response Cell
BuChE – butyrylcholinesterase
BVO/GVO – black vinyl overboot/green vinyl overboot
BW – biological warfare
BWC – Biological Weapons Convention
BWD – Biological Warfare Defense

–C–

C4I – command, control, communication, computer, and intelligence
C4ISR – command, control, communication, computer, intelligence, surveillance, and reconnaissance
C. burnetii – *Coxiella burnetii* (Q fever)
CA – Commodity Area
CAA – Center for Army Analysis
CA/D – Chemical Activity/Depot
CaE – carboxylesterase
CAM – Chemical Agent Monitor (also, Commodity Area Manager)
CAMEX – Computer Assisted Map Exercise
CANA – Convulsant Antidote, Nerve Agent autoinjector
CANE – Combined Arms in a Nuclear/Chemical Environment
CAPDS – Chemical Agent Point Detection System
CARDS – Chemical Agent Remote Detection System
CASTFOREM – Combined Arms and Support Task Force Evaluation Model
CatOx – catalytic oxidation
CATS – Consequence Assessment Tool Set
CAWM – Chemical Agent Water Monitor
CAX – Combined Arms Exercise
CB – chemical and biological (also C/B)
CBAAG – Chemical and Biological Agent Advisory Group
CBAT – Chemical Biological Augmentation Team
CBAWM – Chemical Biological Agent Water Monitor
CBD – chemical and biological defense
CBDP – Chemical/Biological Defense Program
CBIAC – Chemical and Biological Information Analysis Center
CBIRF – Chemical Biological Incident Response Force
CBIS – CB Individual Sampler
CBM&S – Chemical/Biological Modeling & Simulation
CBMS – chemical biological mass spectrometer
CBNP – Chemical Biological Nonproliferation Program
CBPS – Chemical Biological Protective Shelter
CBR – Chemical, Biological, and Radiological
CBR-D – Chemical, Biological, Radiological Defense
CBRNE – Chemical , Biological, Radiological, Nuclear, and High-Yield Explosives
CBRNC – Chemical, Biological, Radiological & Nuclear Countermeasures
C/B-RRT – Chemical Biological Rapid Response Team
CBS – Corps Battle Simulation
CBSD – Chemical Biological Stand-off Detector
CBTAP – Chemical and Biological Threat Agent Program
CBW – chemical and biological warfare
CCD – Camouflage, Concealment, and Deception
CCTI – Chairman's Commended Training Issues
CDC – Centers for Disease Control and Prevention
CD-ROM – Compact Disk - Read Only Memory
CDTF – Chemical Defense Training Facility (at the U.S. Army Chemical School)
CE – Civil Engineering
CEES – half mustard (2-chloroethyl ethylsulfide)
CEM – Concept Evaluation Model
CENTCOM – Central Command
CESM – Chemical Environment Survivability Mask
CESS – Chemical Environment Survivability Suit
CFD – Computational Fluid Dynamics
CFM – cubic feet per minute
CFR – Code of Federal Regulations
CFX – computational fluid effects
cGMP – current Good Manufacturing Practices
CHAMP – Chemically/biologically Hardened Air Management Plant
CHATH – Chemically/Biologically Hardened Air Transportable Hospital
ChE – Cholinesterase
CIA – Central Intelligence Agency
CINC – Commander-in-Chief

CINCCENT – Commander-in-Chief Central Command
CINCPAC – Commander-in-Chief Pacific Command
CJCS – Chairman of the Joint Chief of Staff
CM – Chloroform-Methanol
(also, consequence management, crisis management, or countermeasures)
CMO – Central MASINT Office
CMR – Chloroform-Methanol Residue
CMTC – Combat Maneuver Training Center
CMX – Crisis Management Exercise
CNS – Central Nervous System
COBC – Chemical Officer Basic Course
CoM – Consequence Management
COMMZ – Communications Zone
COMPTUEX – Composite Training Unit Exercise
CONOPS – Concept of Operations
CONUS – continental Untied States
COTS – Commercial Off-the-Shelf
CP – chemical protective (also, collective protection, command post, or counterproliferation)
CP/CBD – Counterproliferation/Chemical and Biological Defense
CPE – Collective Protection Equipment
CPO – Chemical Protective Overgarment
CPRC – Counterproliferation Review Council
CPS – Collective Protection System
CPU – Chemical Protective Undergarment
CRDA – Cooperative Research & Development Agreement
CRG – Compliance Review Group
CRP – Critical Reagents Program
CS – tear gas
CSAT – Command and Staff Awareness Training
CSST – Chemical Casualty Site Team
CT – Concentration over time
CTC – Combat Training Center
CTR – Cooperative Threat Reduction
CTS – Casualty Training System
CVC – Combat Vehicle Crewmen
CVIP – Chemical Vision Implementation Plan
CW – Chemical Warfare
CWA – Chemical Warfare Agent
CWC – Chemical Weapons Convention
CWCIWG – Chemical Weapons Convention Implementation Working Group
CWDD – Chemical Warfare Directional Detector (AN/KAS-1A)
CWICS – Chemical Weapons Interior Compartment System
CWNAVSIM – Chemical Warfare Naval Simulation

–D–

DAB – Defense Acquisition Board
DAIG – Department of the Army Inspector General
DAP – Decontaminating Apparatus Portable
DARPA – Defense Advanced Research Projects Agency
DASG-HCO – Department of the Army Surgeon General-Health Care Office
DATSD (CBD) – Deputy Assistant to the Secretary of Defense for Chemical/Biological Defense
DCSOPS – U.S. Army Deputy Chief of Staff for Operations
DDR&E – Director, Defense Research and Engineering
DEA – Data Exchange Agreement
DEPMEDS – Deployable Medical Systems
DEST – Domestic Emergency Response Team
DHHS – Department of Health and Human Services
DLA – Defense Logistics Agency
DMMP – Dimethyl Methyl Phosphonate
DNA – Deoxyribonucleic Acid
DNBI – Disease and Non-Battle Injury
DNWS – Defense Nuclear Weapons School
DoD – Department of Defense
DoE – Department of Energy
DPE – Demilitarization Protective Ensemble
DPG – Defense Planning Guidance; Also Dugway Proving Grounds
DRB – Defense Review Board (also, Defense Resources Board, or Division Ready Brigade)
DRI – Defense Reform Initiative
DS2 – Decontamination Solution 2
DSCP – Defense Supply Center Philadelphia
DSO – Defense Sciences Office
DSTAG – Defense Science and Technology Advisory Group
DTO – Defense Technology Objective
DTAP – Defense Technology Area Plan
DTIRP – Defense Technical Inspection Readiness Program
DTLOMS – Doctrine, Training, Leader Development, Organization, Material, and Soldier/Personnel
DTN – Decision Tree Network
DTO – Defense Technology Objective
DT/OT – developmental/operational testing
DTRA – Defense Threat Reduction Agency
DTRA(CB) – Defense Threat Reduction Agency's Chemical and Biological Defense Directorate

–E–

E. coli – *Escherichia coli*
EBO – ebola virus

ECBC – Edgewood Chemical & Biological Center
ECU – Environmental Control Unit
ECV – Expanded Capacity Vehicle
ED – ethyl dichlorarsine
EEE – Eastern Equine Encephalomyelitis
EEG – electroencephalographic
ELISA – Enzyme-Linked Immunosorbent Assay
EMD – Engineering and Manufacturing Development
ENCOMPASS – Enhanced Consequence Management Planning and Support System
EOD – Explosive Ordnance Disposal
ESS – Environmental Support System
EUCOM – European Command

–F–

F1 – Fraction 1
F1-V – Fraction 1 - "V" Antigen
Fab – Fragment Antigen Binding
FABS – Force Amplified Biosensor
FAR – Federal Acquisition Regulations
FBI – Federal Bureau of Investigations
Fc – Fragment Crystallizable
FCBC – Field Management of Chemical and Biological Casualties Course
FDA – Food and Drug Administration
FDTE – Force Development Testing and Experimentation
FEST – Foreign Emergency Response Team
FGA – Fourth Generation Agents
FLEETEX – Fleet Exercise
FM – Field Manual
FORCEM – Force Evaluation Model
FORSCOM – Forces Command
FR – flame resistance
FUE – First Unit Equipped
FY – fiscal year
FY99 – Fiscal Year 1999
FYDP – Future Years Defense Plan

–G–

G-CSF – Gramucolyte Colony Stimulating Factor
GA – tabun, a nerve agent
GAO – General Accounting Office
GAS – Group A *Streptococcus*
GB – sarin , a nerve agent
GC – gas chromatography
GD – soman, a nerve agent
GEMS – Global Expeditionary Medical System
GF – a nerve agent
GMP – Good Manufacturing Practice
GOCO – Government-Owned/Contractor-Operated
GP – glycoprotein
GPFU – Gas Particulate Filter Unit
GPRA – Government Performance and Results Act

–H–

HAZWARN – NBC Hazardous Warning System
HAZWOPER – Hazardous Waste Operations and Emergency Response
hBuChE – Human Butrylcholinesterase
hCaE – Human Carboxylesterase
HD – sulfur mustard, a blister agent
HEPA – high efficiency particulate
HHA – Hand Held Immunochromatographic Assay
HLA – high level architecture
HMMWV – High Mobility Multipurpose Wheeled Vehicle
HN – Host Nation
HPAC – Hazard Prediction Assessment Capability
HQ – headquarters
HSC/YA – Human Systems Program Office
HTA – high threat area
HTH – High Test Hypochlorite
HVAC – heating, ventilation, and air conditioning

–I–

IBAD – Interim Biological Agent Detector
IBMC – Industrial Base Maintenance Contract
ICAD – Individual Chemical Agent Detector
ICAM – Improved Chemical Agent Monitor
ICDS – Improved Chemical Detection System
ID – infantry division
IDE – integrated digital environment
IDLH – Immediate Danger to Life and Health
IEG – Information Exchange Group
IET – Initial Entry Training
IL – Interleukin
IL CBDWS – In-Line Chemical Biological Defense Water System
IM – intramuscular
IMS – Ion Mobility Spectroscopy
IND – Investigational New Drug
IOT&E – Initial Operational Testing & Evaluation
IP – intraperitoneal
IPDS – Improved (chemical) Point Detection System
IPE – Individual Protective Equipment
IPR – In-Process Review
IPT – Integrated Product Team
IR&D – Independent Research & Development
IR-LIDAR – Infrared Light Detection and Ranging
IS – Instrumentation System
ISD – Individual Soldier Detector
ISO – International Standards Organization
ITAP – Improved Toxicological Agent Protective Ensemble
ITS – Individual Training Standard

IVD – Individual Vapor Detector

–J–

JAGG – Joint Air and Ground Glove
JAWG – Joint Assessment Working Group
JB1GU – JSLIST Block 1 Glove Upgrade
JB2GU – JSLIST Block 2 Glove Uprgrade
JBAIDS – Joint Biological Agent Identification and Diagnostic System
JBPDS – Joint Biological Point Detection System
JBREWS – Joint Biological Remote Early Warning System
JBSDS – Joint Biological Standoff Detection System
JBUD – Joint Biological Universal Detector
JCAD – Joint Chemical Agent Detector
JCATS – Joint Conflict and Tactical Simulation
JCBAWM – Joint Chemical Biological Agent Water Monitor
JCBUD – Joint Chemical and Biological Universal Detector
JCHEMRATES – Joint Chemical Defense Equipment Consumption Rates
JCPE – Joint Collective Protection Equipment
JCRS – Joint Canteen Refill System
JCS – Joint Chiefs of Staff
JFCOM – Joint Forces Command
JFIRE – Joint CB Protective Firefighter Suit
JFOC – Joint Future Operational Capabilities
JFT – Joint Field Trail
JGEM – Joint Ground Effects Model
JLAS – Joint Land, Aerospace, and Sea Simulation
JMANS – Joint Multimission Advanced NBC System
JMAR – Joint Medical Asset Repository
JMCBDRP – Joint Medical Chemical and Biological Defense Research Program
JMCBRDRP – Joint Medical Chemical, Biological, and Radiological Defense Research Program
JMCBDS – Joint Modular Chemical and Biological Detection System
JMCDRP – Joint Medical Chemical Defense Research Program
JMNS – Joint Mission Need Statement
JMRR – Joint Monthly Readiness Review
JNBCDB – Joint NBC Defense Board
JOA – Joint Operations Area
JORD – Joint Operational Requirements Document
JPACE – Joint Protective Aircrew Ensemble
JPO-BD – Joint Program Office for Biological Defense
JRCAB – Joint Readiness Clinical Advisory Board
JRTC – Joint Readiness Training Center
JSA – Joint Service Agreement
JSAF – Joint Simulated Automated Force
JSAM – Joint Service Aircrew Mask
JSCBIS – Joint Service Chemical Biological Information System
JSFXD – Joint Service Fixed Site Decon
JSGPM – Joint Service General Purpose Mask
JSIG – Joint Service Integration Group
JSIMS – Joint Simulation System
JSLIST – Joint Service Lightweight Integrated Technology (individual protection)
JSLNBCRS – Joint Service Light NBC Reconnaissance System
JSLSCAD – Joint Service Lightweight Stand-off Chemical Agent Detector
JSMG – Joint Service Materiel Group
JSMLT – Joint Service Mask Leakage Tester
JSNBCRS – Joint Service NBC Reconnaissance System
JSTPCBD – Joint Science and Technology Panel for Chemical/Biological Defense
JSWILD – Joint Service Warning and Identification LIDAR Detector
JTASC – Joint Training and Analysis Center
JTAV – Joint Total Asset Visibility
JTWAG – Joint Training Assessment Working Group
JTC – Joint Training Council
JTCG – Joint Technology Coordinating Group
JTCOPS – Joint Transportable Collective Protection System
JTF – Joint Task Force
JVAP – Joint Vaccine Acquisition Program
JWARN – Joint Warning and Reporting Network
JWARS – Joint Warfighting Simulator
JWFC – Joint Warfighting Center
JWSTP – Joint Warfighting S & T Plan

–L–

L – lewisite, a vesicant agent
LAM – Louisiana Maneuvers
LAV – Light Armored Vehicle
LCBPG – Lightweight CB Protective Garment
LD_{50} – Median Lethal Dose
LDS – Lightweight Decontamination System
LG7 – Land Group 7
LHA – general purpose amphibious assault ship
LHD – general purpose amphibious assault ship (with internal dock)
LIDAR – LIght Detection And Ranging
LLC – limited liability corporation
LLR – Low Level Radiological
LMS – Lightweight Multipurpose Shelter
LMSR – Large, Medium-speed Roll-on, Roll-off Ship

LNBCRS – Light NBC Reconnaissance System
LRBSDS – Long-Range Biological Stand-off Detection System
LSCAD – Lightweight Stand-off Chemical Agent Detector
LSCD – Laser Stand-off Chemical Detector
LSD – landing ship, dock
LSP – Logistics Support Plan
LWRS – Lightweight Reconnaissance System

–M–

M&S – Modeling and Simulation
M&S CA – Modeling and Simulation commodity Area
M&S R&D – Modeling and Simulation Research and Development
MAGTF – Marine Air Ground Task Force
MAJCOM – Major Command
MALDI – Matrix-Assisted Laser Desorption Ionization
MANAA – Medical Aerosolized Nerve Agent Antidote
MANSCEN – Maneuver Support Center
MANTECH – Manufacturing Technology
MASINT – Measures & Signatures Intelligence
MBDRP – Medical Biological Defense Research Program
MBGV – *marburg* virus
MCBAT – Medical Chem-Bio Advisory Team
MCBC – Management of Chemical and Biological Casualties Course
MCO – Marine Corps Order
MCPE – Modular Collective Protection System
MCU-2A/P – a chemical protective mask
MCWP – Marine Corps Warfighting Publication
MD – methyl dichlorarsine
MDS – Modular Decontamination System
MED – Medical
MEIR – Medical Effects of Ionizing Radiation
MEPS – Multiplex Electronic/Photonic Sensor
METL – Mission Essential Task List
metL, thrA – methionine biosynthesis
MEU – Marine Expeditionary Unit
MFR – Multi-Function Radiac Set
MHC – Major Histocompatibility Complex
MICAD – Multipurpose Integrated Chemical Agent Detector
MIL STD – Military Standard
MIPR – Military Interdepartmental Purchase Request
MLRS – Multiple Launch Rocket System
MNDRP – Medical Nuclear Defense Research Program
MNS – Mission Needs Statement
MOE– Measure of Effectiveness
MOP – Memorandum of Policy
MOPP – Mission Oriented Protective Posture
MOS – Military Occupational Specialist
MOU – Memorandum of Understanding
MPH – miles per hour
MPS – Mission Performance Standard (also, Multipurpose Protective Sock)
MPSP – Medical Program Sub-Panel
MRMC – Medical Research and Materiel Command
MS – Mass Spectrometry or Milestone
MSC – Military Sealift Command or Mesenchymal Stem Cells
MTF – Medical Treatment Facility
MTTP – Multiservice Tactics, Techniques, and Procedures
MTW – Major Theater War
MULO – Multi-purpose Overboot
murE – murein biosynthesis

–N–

NAADS – Nerve Agent Antidote Delivery System
NAAG – NATO Army Armaments Group
NAAK – Nerve Agent Antidote Kit
NAAS – Nerve Agent Antidote System
NAPP – Nerve Agent Pyridostigmine Pretreatment
NATO – North Atlantic Treaty Organization
NAVMED – Naval Medical
NBC – Nuclear, Biological, and Chemical
NBCD – NBC Defense
NBCDT – NBC Defense Training
NBC-E – nuclear, biological, and chemical-environment
NBC-R – nuclear, biological, chemical, and radiological
NBCRS – NBC Reconnaissance System (Fox Vehicle)
NBCWP – NBC Defense Interservice Working Party
NCO – Non-Commissioned Officer
NDA – New Drug Application
NDI – Non-Developmental Item
NEHC – Naval Environmental Health Center
NEPMU – Navy Environmental and Preventative Medicine Unit
NFPA – National Fire Protection Agency
NGIC – National Ground Intelligence Center
NICP – National Inventory Control Points
NIEX – No-Notice Interoperability Exercise
NIH – National Institute of Health
NIOSH – National Institute for Occupational Safety and Health
NIRF – Nuclear Incident Response Force

NMSO – Nuclear Medical Science Officer
NO – nitric oxide
NSC – National Security Council
NSN – National Stock Number
NSTC – National Science and Technology Council
NTA – Novel Threat Agent
NTC – National Training Center
NTTP – Naval Tactics, Techniques, and Procedures
NWDC – Naval Warfare Development Command
NWP – Naval Warfare Publication

–O–

O49 – Joint Contact Point and Test Project
OAC – Officer Advance Course
OBC – Officer Basic Course
OCONUS – Outside the continental United States
OG – Overgarment
O&M – Operations & Maintenance
OPCW – Organization for the Prohibition of Chemical Weapons (in The Hague)
OPLAN – Operational Plan
OPR – Office of Primary Responsibility
ORD – Operational Requirements Document
ORF – Open Reading Frames
OSD – Office of the Secretary of Defense
OSHA – Occupational Safety and Health Administration
OSM3 – oximeter instrument
OT – Operational Testing
OTSG – Office of the Surgeon General

–P–

P3I – Pre-Planned Program Improvement
PA – protective antigen
PACAF – Pacific Command
PACOM – Pacific Command
PAM – Preventative and Aerospace Medicine
PATS – Protective Assessment Test System
PB – President's Budget
PBAS – Program Budget Accounting System
PCPS – Portable Collective Protection System
PCR – polymerase chain reaction
PCS – Permanent Change of Station
PD – phenyl dichlorarsine
PDDA – Power Driven Decontamination Apparatus
PDM – Program Decision Memorandum
PDRR – Program Definition and Risk Reduction
PE – Program Element
PF – Positive Force Exercise
PICS – Personal Ice Cooling System
PIP – Product Improvement Program
PL 103-160 – Public Law 103-160, The National Defense Authorization Act of FY94
PMCD – Program Manager for Chemical Demilitarization
PMCS – Preventative Maintenance Checks and Services
PMO – Product Management Office
POL – petroleum, oil, and lubricant
POM – Program Objectives Memorandum
PPBS – Program Planning and Budgeting System
PQS – Personnel Qualification
PR – Positive Response Exercise
PRD – Presidential Review Directive
PRG – Program Review Group
PROFIS – Medical NBC Professional Filler Course
PSA – Pressure Swing Adsorption

–Q–

QDR – Quadrennial Review
QNFT – Quantitative fit testing
QRR – Qualitative Research Requirements
QSTAG – Quadripartite Standardization Agreement
QWG – Quadripartite Working Group

–R–

R&D – Research and Development
RADIAC – Radiation
RAPID – Ruggedized Advanced Pathogen Identification Device
RBC-AchE – red blood cell acetylcholinesterase
RC – Reserve Component
RDA – Research, Development, and Acquisition
RDD – Radiological Dispersal Device
RDTE (Also, RDT&E) – Research, Development, Test and Evaluation
RestOps – Restoration of Operations
RFP – Request for Proposal
RMC – Regional Medical Commands
rPA – recombinant protective antigen
RSCAAL – Remote Sensing Chemical Agent Alarm
RSTA – Reconnaissance, Surveillance, and Target Acquisition
RTP – Readiness Training Plan
rTSP – Reactive Topical Skin Protectant
RW – radiological/nuclear warfare

–S–

S&T – Science & Technology Base
SACPS – Selected Area Collective Protection System
SAF – Semi-Automated Forces

SAFEGUARD – Scanning Airborne Fourier Emission for Gaseous Ultraspectral Analysis and Radiometric Detection
SAG – Study Advisory Group
SALAD – Shipboard Automatic Liquid Agent Detector
Saratoga – a CB protective overgarment
SASO – Stability and Support Operations
SAT – Systems Approach to Training
SAW – Surface Acoustic Wave
SBA – Simulation Based Acquisition
SBCCOM – Solider, Biological and Chemical Command (U.S. Army)
SCALP – Suit Contamination Avoidance Liquid Protection
SCAMP – Shipboard Chemical Agent Monitor Portable
SCPE – Simplified Collective Protective Equipment
SCUD – surface-to-surface missile system
SD – Stand-off Detector
SD/ASM – Stand-off Detector for Armor System Modernization
SDK – Skin Decontamination Kit
SDS – Sorbent Decon System
SE – staphylococcal enterotoxins or status ellepticus
SEA – Staphylococcal Enterotoxin A
SEB – Staphylococcal Enterotoxin B
SECDEF – Secretary of Defense
SERPACWA – skin exposure reduction paste against chemical warfare agents
SFR – System Function Requirement
SGXA – Air Force Surgeon General
SIMBAD – Sensor Integrated Modeling for Biological Agent Detection
SMART-CB – Special Medical Augmentation Response Team-Chemical./Biological
SMART-PM – Special Medical Augmentation Response Team-Preventative Medicine
SNCO – Staff-Noncommissioned Officer
SOF – Special Operations Forces
SOFCAS – Special Operation Forces Chemical Agent Detector
SOI – School of Infantry
SO/LIC – Special Operations and Low Intensity Conflict
SOMCBD – Special Operations Modular CB Detector
SORTS – Status of Resources and Training System
SOW – Statement of Work
SPA – surface protein antigen
SPOD – Seaport of Debarkation
SRT – Specialty Response Team
STAFFS – Simulation Training and Analysis for Fixed Sites
STANAG – standard agreement
STB – Super Tropical Bleach
STEPO – Self-Contained Toxic Environment Protective Outfit
STEPO-I – Interim Self-Contained Toxic Environment Protective Outfit
STO – Science and Technology Objective
STRAC – Standards in Training Commission
STS – Specialty Training Standard
SUBD – Small Unit Biological Detector
SWA – Southwest Asia

–T–

T&D – Transport and Diffusion
TAA – Total Army Analysis
TACWAR – Tactical Warfare
TAP – Toxicological Agent Protective boots and gloves
TARA – Technology Area Review and Assessment
TAV – Total Asset Visibility
TB – Technical Bulletin
TBM – Transportation of Biomedical Materials or Tactical Ballistic Missiles
TDA – table of distribution and allowances
TED – Troop Equivalent Dose
TEI – Technical Equipment Inspection
TEMPER – Tent Extendable Modular Personnel
TEU – Technical Escort Unit
TIC – Toxic Industrial Chemical
TIM – toxic industrial material
TM – Transport Molecules
TOF – Time of Flight
TSA – Transition State Analogue
TSG – The Surgeon General
TSP – Topical Skin Protectant
TSWG – Technical Support Working Group
TTP – Tactics, Techniques, and Procedures

–U–

UAV – Unmanned Aerial Vehicle
UCP – Upconverting Phosphors or Unified Command Plan
UDP – Unit Deployment Program
UN – United Nations
UNSCOM – United Nations Special Commission
USA – United States Army
USACHPPM – United States Army Center for Health Promotion and Preventive Medicine
USACMLS – US Army Chemical School
USAF – United States Air Force
USAF(SGXR) – USAF Surgeon General

USAMEDDC&S – U.S. Army Medical Department Center and School
USAMMA – U.S. Army Medical Materiel Agency
USAMMDA – U.S. Army Medical Materiel Development Activity
USAMRICD – U.S. Army Medical Research Institute of Chemical Defense
USAMRIID – U.S. Army Medical Research Institute of Infectious Diseases
USAMRMC – U.S. Army Medical Research and Materiel Command
USANCA – United States Army Nuclear and Chemical Agency
USAR – US Army Reserve
USARAK – US Army Alaska
USARJ – US Army Japan
USC – United States Code
USCENTCOM – US Central Command
USCINCEUR – US Command in Chief, Europe
USCINCPAC – US Commander in Chief, Pacific
USD(AT&L) – Undersecretary of Defense (Acquisition Technology and Logistics)
USEUCOM – US European Command
USFK – U. S. Forces, Korea
USG – United States Government
USJFCOM – US Joint Forces Command
USMC – United States Marines Corps
USN – United States Navy
USPACOM – US Pacific Command
USSTRATCOM – US Strategic Command
USTC – US Transportation Command
USUHS – Uniformed Services University of the Health Sciences
UTC – Unit Type Code
UV – ultra-violet

–V–

VCA – Voice Communication Adapter
VCSA – Vice Chief-of-Staff of the Army
VEE – Venezuelan equine encephalomyelitis
VIC – Vector-In-Command
VIG – Vaccinia Immune Globulin
VLP – virus-like particles
VLSTRACK – Vapor, Liquid, and Solid Tracking Model
VNTR – Variable Number Tandem Repeat
VPU – Vapor Protective Undergarment
VTC – Video Teleconference
VVA – verification, validation, and accredidation
VVS – Vehicles, Vans and Shelters
VX – a nerve agent

–W–

WCF – Working Capital Fund
WDTC – West Desert Test Center
WDTIC – West Desert Technical Information Center
WEE – Western Equine Encephalomyelitis
WG – Working Group
WMD – weapons of mass destruction
WMD-CST – Weapons of Mass Destruction Civil Support Teams
WRAIR – Walter Reed Army Institute of Research
WRM – war reserve materiel
WRSI – War Reserves Secondary Items

–Y–

Y. pestis – *Yersinia Pestis* (Plague)

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