



# DEPARTMENT OF DEFENSE CHEMICAL AND BIOLOGICAL DEFENSE PROGRAM

## ANNUAL REPORT TO CONGRESS AND PERFORMANCE PLAN

**JULY 2001**



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# *Executive Summary*

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In accordance with 50 USC 1523 (Section 1703, Public Law No. 103-160) the Secretary of Defense is required to submit an annual report to Congress on chemical and biological (CB) defense. This report is intended to 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 and biological weapons.

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 established a mission 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—from peacetime contingency missions through two nearly simultaneous major theater wars across the entire spectrum of conflict—in battlespace environments contaminated with chemical or biological warfare agents. The probability of U.S. forces encountering CB agents during worldwide conflicts remains high. An effective defense reduces the probability of a CB attack, and if an attack occurs, it enables U.S. forces to survive, continue operations, and win. The unique physical, toxicological, destructive, and other properties of each threat requires that operational and technological responses be tailored to the threat. Scientific, technological, and resource limitations remain in preventing U.S. forces from having complete full dimensional protection or in meeting all requirements for two nearly simultaneous Major Theater Wars. Nevertheless, significant progress has been made in overcoming many of these limitations since the establishment of the DoD CBDP. *U.S. forces remain the best protected forces in the world for surviving and conducting operations in chemically or biologically contaminated environments.*

During the past year, DoD took several steps to ensure the protection of U.S. forces against both immediate and future chemical and biological threats. This report details DoD's current and planned capabilities. For the first time, this report provides a performance plan (Annex G) for the DoD CBDP to align the program more closely with the tenets of the Government Performance and Results Act (GPRA). The performance plan demonstrates full compliance with the GPRA, which requires agencies to submit an annual performance plan to Congress. This plan serves as a reference tool for the effective oversight and management of the CBDP. The Office of the Secretary of Defense CB Defense Steering Committee prepared this performance plan with targets—both planned and actual—for the current assessed year (FY2000) and the next two planning years (FY 2001 and FY2002).

Numerous rapidly changing factors continually influence the program and its management. These factors include limited DoD resources, planning for warfighting support to

numerous regional threat contingencies, the evolving geopolitical environment resulting from the breakup of the Soviet Union, the entry into force of the Chemical Weapons Convention, and continuing proliferation of chemical and biological weapons.

Chemical and biological defense programs are 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.

The DoD CBDP invests in technologies to provide improved capabilities that have minimal adverse impact on warfighting potential. Chemical and biological defenses are conducted within the framework of four operational concepts: contamination avoidance, CB battle management, protection, and decontamination. Contamination avoidance consists of capabilities and procedures to detect, identify, and conduct reconnaissance of the battlespace for CB warfare threats. The information from contamination avoidance systems provide input to CB battle management systems to provide commanders with a view of the battlespace to enable them to determine the appropriate protective posture and plan operational responses. When contamination cannot be avoided, protection provides capabilities to survive, fight, and win in a CB contaminated environment. Protection consists of individual protection, collective protection, and medical systems. Finally, decontamination provides critical capabilities to allow the sustainment of operations in a contaminated environment.

Several capabilities have been fielded that address shortcomings in CB defense capabilities that were identified to have existed during the Persian Gulf War (Operation Desert Storm.) These systems are in addition to the continued sustainment of legacy systems and the development of new capabilities within the research and science and technology base programs. Selected examples of capabilities fielded since the establishment of the DoD CBDP include:

- Automatic Chemical Agent Detector Alarm (M22 ACADA),
- Biological Integrated Detection System (M31 BIDS),
- Biological Warfare Sampling Kit,
- Chemically and Biologically Protected Shelter (CBPS),
- Improved (Chemical Agent) Point Detection System,
- M291 Personal Decontamination Kit,
- M295 Equipment Decontamination Kit,
- M41 Protective Assessment Test System,
- M99 Portal Shield Network Sensor System,
- M93A1 NBC Reconnaissance System (NBCRS), and
- Modular Decontamination System.

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 counter-proliferation 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 that operational and technological responses be tailored to the threat. 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. Since the program's inception, DoD has made significant progress in improving the overall joint management and coordination of the NBC defense program, including integration of medical and non-medical chemical and biological defense programs. *50 USC 1522 has been a critical tool for ensuring the elimination of redundant programs, focusing funds on program priorities, and enhancing readiness.* This chapter outlines the changes within the oversight and management structure that have occurred as a result of the Defense Reform Initiative and the establishment of the Defense Threat Reduction Agency.

*CHAPTER 2* provides information on medical and non-medical NBC defense requirements and research, development, and acquisition programs. Requirements and the status of research and development assessments are described within the framework of the functional areas of NBC defense. 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).

*CHAPTER 3* provides an analysis of NBC defense logistics posture. 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.

**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. This chapter also provides information on the move of the Chemical School from Fort McClellan, Alabama to Fort Leonard Wood, Missouri.

**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 D** provide detailed information on Joint and Service-unique NBC defense equipment, including contamination avoidance, protection, decontamination, and medical programs. Detailed descriptions are provided for systems and equipment that have been fielded, are in production, or under development. **Annex E** 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 F** provides a summary of funds appropriated, budgeted, and expended by the DoD CDBP. 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 the DOD CB Defense Program Performance Plan. **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*

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## **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 eighth 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 in Annex G 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 (FY2000) and the next two planning years (FY2001 & 2002). Specifically, the plan:

- Establishes explicit and outcome-oriented goals linked to warfighters' ability to survive, fight, and win in a CB environment,
- Identifies quantitative and/or qualitative performance measures that can be used to assess progress towards goal achievement,
- Describes how performance data is validated,
- Describes how RDT&E activities of participating DoD and non-DoD organizations are coordinated to achieve program goals, and
- Identifies human capital, financial, and resource challenges or external factors that limit the ability of the program to achieve its goals.

The performance plan draws on information and consolidates data from reports and plans already being prepared within the CBDP, including (1) the Modernization Plan, (2) the Research, Development, and Acquisition (RDA) Plan, (3) the Logistics Support Plan, (4) the Joint Warfighting Science and Technology Plan, (5) the Defense Technology Area Plan, (6) Joint Service Chemical/Biological Information System (JSCBIS) materiel fact sheets, and (7) the Annual Report to Congress. In addition, the performance plan draws on current data contained in documents prepared in support of the Planning, Programming, and Budgeting System (PPBS), including Defense Planning Guidance, the CBDP Program Strategy Guidance,

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\* 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.

the Program Objectives Memorandum, the President’s Budget and supporting detailed information in the RDT&E and Procurement Congressional Exhibits Forms.

**CBDP Vision, Mission, and Goals**

DoD has developed a vision statement, mission statement, and corporate-level goals that reflect critical steps in the execution of the National Security Strategy. To support and relate to the DoD plan, the CBDP has developed supporting mission, vision and corporate goals.

**DoD Vision:**

- Fields the best trained, best equipped, best-prepared fighting force in the world.
- Supports alliances and security relationships that protect and advance U.S. security interests.
- Advances national interests by working effectively with other federal agencies, congress, and the private sector.
- Serves as a model of effective, efficient, innovative management and leadership.

**Chemical and Biological Defense Program Vision**

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.

**DoD Mission:**

Support and defend the Constitution of the United States; to provide for the common defense of the United States, its citizens, and its allies; and to protect and advance U.S. interests around the world.

**Chemical and Biological Defense Program Mission**

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—from peacetime contingency missions through two nearly simultaneous major theater wars across the entire spectrum of conflict—in battlespace environments contaminated with chemical or biological warfare agents.

**DoD Corporate-Level Goals:**

- Shape the international environment and respond to the full spectrum of crises by providing appropriately sized positioned and mobile forces.
- Prepare now for an uncertain future by pursuing a focused modernization effort that maintains U.S. qualitative superiority in key warfighting capabilities. Transform the force by exploiting the Revolution in Military Affairs, and reengineer the Department to achieve a 21<sup>st</sup> century infrastructure.

### **Chemical and Biological Defense Program Corporate-Level Goals**

Develop, acquire and field NBC defense equipment that meets warfighter requirements while reducing acquisition costs and time of development. Equipment will be developed that permits the warfighters to:

- *View NBC Warfare Agents within the Theater Area of Operations.*
- *Dominate the Battlespace through Reconnaissance, Surveillance, and Target Acquisition.*
- *Enhance the Situational Awareness of Unit Battlespace.*
- *Provide Real-Time Hazard Information to Influence Current Operations.*
- *Enhance Personnel and Equipment Survivability.*
- *Maintain Ground, Air and Maritime Operational Tempo.*
- *Sustain Operations, Recovery and Reconstitution Efforts.*

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.

On February 13, 2001, at Norfolk Naval Air Station, President Bush stated, “we must prepare our nations against the dangers of a new era. The grave threat from nuclear, biological and chemical weapons has not gone away with the Cold War. It has evolved into many separate threats, some of them harder to see and harder to answer. And the adversaries seeking these tools of terror are less predictable, more diverse.” 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 I-1. Capabilities that are supported by the CB defense program are highlighted in **bold**. As currently identified, CB defense capabilities are listed in four of the top ten CINC priorities. *Individual protection* includes physical protection devices, medical countermeasures (vaccines, prophylaxes, pre-treatments, antibiotics, antidotes, and post-exposure treatments), and CB mass casualty medical treatment. *Detect and Monitor Use of WMD* includes establishing and maintaining the necessary capabilities to detect CB use, including medical diagnostics. *Communicate the Ability and Will to Employ Defensive Capabilities* includes demonstrating the capacity to employ defensive capabilities to reduce an enemy’s perceived utility in developing, producing, and threatening to use or actually using CB weapons. *Collective protection* provides relief from sustained operations in full individual CB protective equipment, shelters for sensitive equipment not easily decontaminated, and clean environments for operations that cannot be performed under CB contaminated conditions. *Establish/Maintain Ability to Restore from WMD* use includes establishing and maintaining the necessary capabilities to restore operations after the employment of CB contamination. Restoration activities may include decontamination operations.

**Table I-1. Finalized Geographic CINC Prioritized Counterproliferation Requirements**

<b>Rank</b>	<b>CP Requirement</b>
<b>1</b>	<b>Provide individual protection to forces and assist allies/coalition partners with relief from the effects of NBC</b>
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
<b>5</b>	<b>Detect and Monitor Use of WMD</b>
6	Conduct Off-Site Attack to Destroy, Disable, and Deny WMD Targets
<b>7</b>	<b>Communicate the Ability and Will to Employ Defensive Capabilities</b>
8	Establish and Maintain Relations with Allies, and Potential Adversaries to Discourage Development, Production, and Use of WMD
<b>9</b>	<b>Provide Collective Protection to Forces and Assist Allies / Coalition with Relief from the Effects of NBC</b>
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
<b>17</b>	<b>Establish / Maintain Ability to Restore from WMD use</b>
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 which 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**

#### ***Northeast Asia***

*North Korea* has been pursuing research and development related to biological warfare 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. In the early 1990s, an open press release by a foreign government referred to applied military biotechnology work at numerous North Korean medical institutes and universities dealing with the anthrax, cholera, plague and smallpox pathogens. North Korea possesses a sufficient munitions-production infrastructure to accomplish weaponization of BW agents. North Korea does possess a sufficient munitions production infrastructure to accomplish weaponization of BW agents.

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 as well as a variety of filled munitions systems. North Korea is believed to possess a sizable stockpile of chemical weapons, which could be employed 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) and 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 civilian 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 requisite 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 cannon artillery, multiple rocket launchers, mortars, land mines, aerial bombs, SRBMs, and MRBMs. Chinese military forces most likely have a good understanding of chemical warfare doctrine, and its forces 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 many 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 dedicated chemical warfare production program. This was the first time India had publicly 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 and actively participates in compliance protocol negotiations for the treaty.

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 aerial bombs.

### ***The Middle East and North Africa***

*Iran* has a growing biotechnology industry, significant pharmaceutical experience and the overall infrastructure to support 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. 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. Iran has ratified the BWC.

Iran ratified the chemical Weapons Convention (CWC), and in a May 1998 session of the CWC Conference of the States Parties, Tehran, for the first time, 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.

Nevertheless, Iran has continued 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. In the past, Tehran has manufactured and stockpiled blister, blood and choking chemical agents, and weaponized some of these into artillery shells, mortars, rockets, and aerial bombs. It also is believed to be conducting research on nerve agents. 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, and in the absence of UNSCOM or other international inspections and monitoring during 1999 and 2000, DoD is concerned that Baghdad again may have produced some biological warfare agents.

Since the Gulf War, Baghdad has rebuilt key portions of its industrial and 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 1999, Iraq may have begun installing or repairing dual-use equipment at these or other 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 related to its chemical program. UNSCOM inspectors, which indicated that Iraq had not consumed as many chemical munitions during the Iran-Iraq War as had been declared previously by Baghdad. This document 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 chemical warfare program for many years, although it has never used chemical agents in a conflict. Damascus already has a stock-

pile 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 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.

Following the suspension of UN sanctions in April 1999, *Libya* wasted no time in reestablishing contacts with foreign sources of expertise, parts and precursor chemicals for its program. Clearly, Tripoli has not given up its goal of reestablishing its offensive chemical warfare ability and continues to pursue an indigenous chemical warfare production capability.

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 FSU 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 BIOPRPARAT, the principal Soviet 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.

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* offensive biological warfare capabilities and the status of some elements of the offensive biological warfare capability inherited from 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 former Soviet program may remain largely intact and may support a possible future mobilization capability for the production of biological agents and delivery systems. Despite Russian ratification of the BWC, work outside the scope of legitimate biological defense may be occurring now that selected facilities within *Russia*, and the United States continues to receive unconfirmed reports of some ongoing offensive biological warfare activities.

*Moscow* has acknowledged the world's largest stockpile of chemical agents of 40,000 metric tons of agent. The Russian chemical warfare 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. In addition, since 1992, Russian scientists familiar with Moscow'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, DoD believes that the Russians probably have not divulged the full extent of their chemical agent and weapon inventory.

## **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*. In the Middle East, Iran continues with a concerted effort to acquire an independent production capability for all aspects of its chemical weapons program and has reduced dependency on foreign assistance. Nevertheless, Iran has continued 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 is also 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. Russian entities have been key sources of biotechnology and chemicals for Iran. Russia's world-leading expertise in biological and chemical weapons makes it an attractive source for Iranians seeking technical information and training on biological and chemical warfare agent production processes.

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

### ***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.

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 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 wasted no time in reestablishing contacts with foreign sources of expertise, parts, and precursor chemicals for its program. Clearly, Tripoli has not given up its goal of reestablishing its offensive chemical warfare ability and continues to pursue 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 and from the adoption of more capable delivery systems.\* 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 as well as to the apparent growing interest in CBW on the part of sub-national groups such as terrorist organizations. Any nation with the political will and a minimal industrial base could produce CBW agents suitable for use in warfare. 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.

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\* 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.

# *Chapter 1*

## *DoD Chemical and Biological Defense Program Management and Oversight*

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### **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 viable structure that ensures 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 proved to be 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.

### **1.3 ORGANIZATIONAL RELATIONSHIPS**

The CB Defense Program management structure, portrayed in Figure 1-1, represents current organizational relationships. 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.

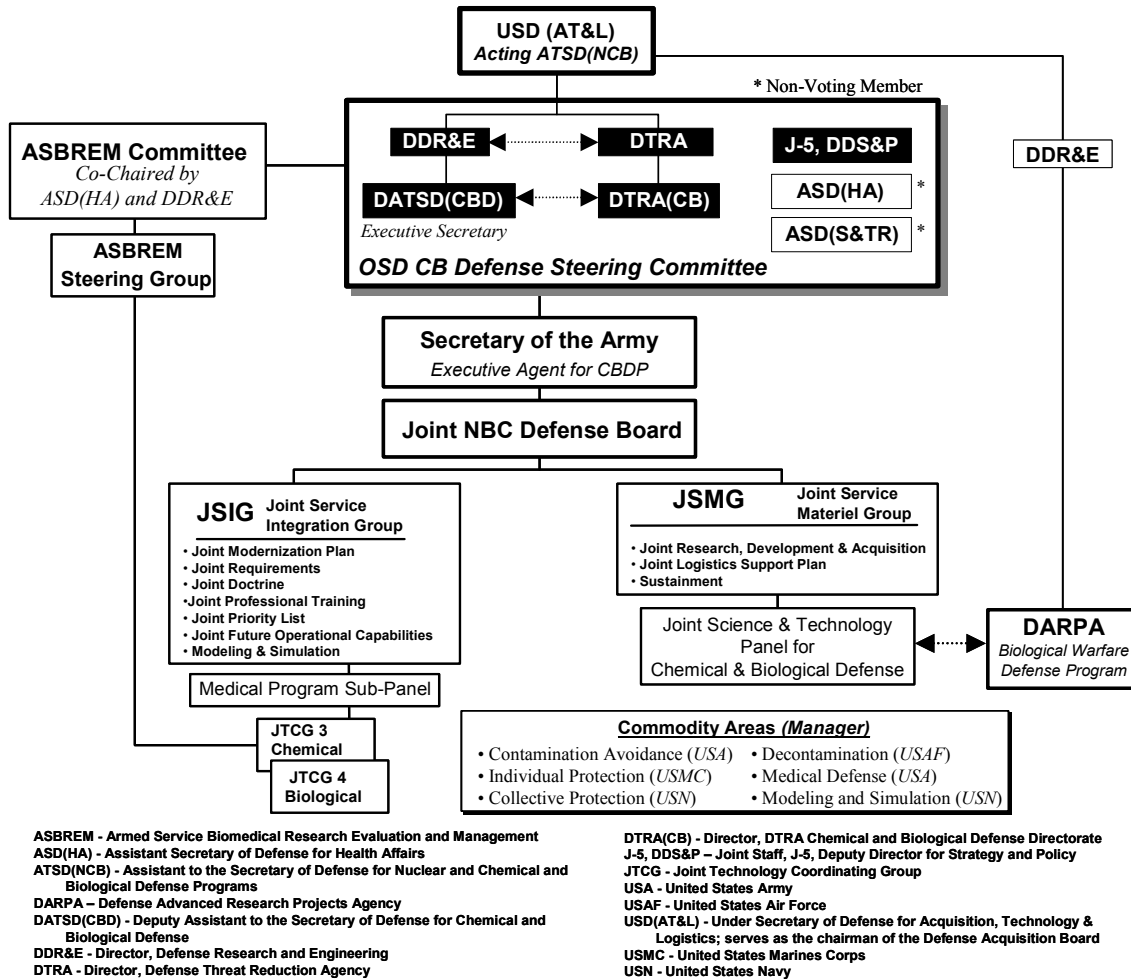


Figure 1-1 CBDP Management & Oversight

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:

- Director, Defense Research and Engineering (DDR&E),
- 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 Strategy and Threat Reduction, ASD(S&TR), 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:

<b><u>Commodity Area</u></b>	<b><u>Commodity Area Manager</u></b>
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 and the OSD CB Defense Steering Committee 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 (JMCBRP) as prescribed in DoD Directive 5160.5 and, as such, is the lead requirements coordinator. The JMCBRP 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 *CB Defense Technology Area Plan* and *The Joint Nuclear Biological Chemical Defense Research, Development, and Acquisition Plan* are the primary program drivers for joint CB research programs. The science and technology base is managed through the development and execution of Defense Technology Objectives (DTOs). The predevelopment program (basic research, exploratory development, and concept exploration and definition) is executed by the U.S. Army Medical Research and Materiel Command (USAMRMC) through its 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 for Infectious Diseases (USAMRIID)] with input from the Navy and the Air Force. The advanced development program (Program Definition and Risk Reduction [PDRR]) and Engineering and Manufacturing Development (EMD) for medical *chemical* defense products is executed by the U.S. Army Medical Materiel Development Activity (a USAMRMC asset). The advanced development program (PDRR and EMD) 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 (ACAT) II program under JPO-BD to transition candidate biological defense vaccines from research laboratories to the Prime Systems Contractor for the development, testing, licensure, production, and storage of vaccine stockpiles.

## 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 U.S. Department of Agriculture, the Center for Disease Control and Prevention, 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, with rapidly decreasing involvement in the succeeding stages that lead to system development and deployment.

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 eight subgroups. One of the subgroups is the Chemical, Biological, Radiological, and Nuclear Countermeasures (CBRNC) subgroup, which is co-chaired by the Federal Bureau of Investigation (FBI) and the Central Intelligence Agency (CIA). 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, the scope and mission of the combating terrorism community often requires different technologies to satisfy user requirements.

**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 Assistant to the Secretary of Defense for Civil Support.** In the event of an incident on American soil resulting in the release of chemical, biological, radiological or nuclear agents, or high-yield explosives (CBRNE), state and local government may request assistance from the federal government through the lead federal agency, as designated in The Federal Response Plan. By Presidential direction, DoD and other federal agencies are planning and coordinating a federal response to a domestic CBRNE incident. In order to provide timely and effective support to the lead federal agency charged with CBRNE consequence management (that is, the Federal Emergency Management Agency), the Secretary of Defense appointed an Assistant to the Secretary of Defense for Civil Support, ATSD(CS), to serve as the principal staff assistant and civilian advisor to the Secretary and Deputy Secretary of Defense for oversight of policy, requirements, priorities, resources, and programs related to the DoD role in management the consequences of a domestic incident involving the naturally occurring, accidental, or deliberate release of CBRNE.

**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 Counterproliferation 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. Membership in the Focus Group is currently limited to the representatives from the CBDP, DARPA, and the DOE Chemical and Biological Nonproliferation Program (CBNP). The Focus Group submitted its first report to Congress in April 2000. This report provided an overview of the roles and responsibilities of DoD and DOE and discussed interagency coordination.

In an effort to supplement the original report and formally integrate programs, the Focus Group is currently developing a detailed, integrated plan including an interagency roadmap for the Biological Point Detection focus area. This integrated plan will discuss the process for developing and annually reviewing DOD and DOE interagency R&D roadmaps, CB technologies related to biological point detection, and findings resulting from an analysis conducted among technology approaches within the biological point detection thrust area. The plan will also contain an integrated roadmap that will illustrate how biological point detection technologies will feed into testing activities or transition into ACTDs, DoD acquisition programs and/or DOE demonstrations. The integration process and roadmap developed during this effort will be used as a template for developing detailed integration plans for other technology areas such as chemical point detection, wide area detection, decontamination, and modeling and simulation.

The integration plan development effort will facilitate interagency awareness, coordination and cooperation between DoD and DOE at all levels. The biological point detection integrated plan will be submitted to Congress as a part of the 2001 CPRC Annual Report to Congress. A goal of the group is broaden its representation to include other DOD and DOE programs and users.

**1.4.3 International Cooperation.**

The CDBP 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) long-term Memoranda of Understanding (MOU). Table 1-1 list examples of international cooperative efforts.

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

<ul style="list-style-type: none"> <li>• Ability to Detect and Identify Bacterial Spores.</li> <li>• Enhancement of Downwind Hazard Model.</li> <li>• First Generation Urban Dispersion Model.</li> <li>• Laser Standoff Chemical Detection Technology.</li> <li>• Next Generation Medical Countermeasures.</li> <li>• Encapsulated Antibiotics.</li> <li>• Multivalent Botulinum Toxin Vaccine candidate.</li> <li>• Improved Plague Vaccine candidate.</li> <li>• Report on Coalition CB Detection Capability to CENTCOM.</li> <li>• Current Detector/Monitor Technology.</li> <li>• CS Riot Control Capability on Light Vehicles.</li> </ul>	<ul style="list-style-type: none"> <li>• Urban Field Trial.</li> <li>• Test and Procurement of Child/Infant CB System (USFK).</li> <li>• Generic Individual Protection in Hot/Dry Environments.</li> <li>• Standardized Test for Individual Protection.</li> <li>• Standards for Measuring Biological Backgrounds.</li> <li>• Joint Medical Procedures in a BW Contaminated Environment.</li> <li>• Chemical Protective Clothing.</li> <li>• Next Generation Passive Standoff Technology.</li> <li>• Water Monitoring.</li> <li>• New Technologies for Biological Detection.</li> </ul>
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During FY99, the United States participated in numerous international cooperative research and development efforts. Highlights of these efforts include (1) 50 DEAs with 15 countries, (2) two Technology Development Project Agreements, (3) one MOU, and (4) over 100 scientists and engineers participating in exchange programs. In addition to these efforts, in FY00, there are (1) two new DEAs in development in biological defense, (2) three Technology Development Project Agreements in development addressing chemical detection, protection, and fundamental toxicology, and (3) two Engineer and Scientist Exchange Programs.

All cooperative agreements yield benefits to all participants in the agreement. Some key systems within the CDBP were procured through Foreign Military Sales, including the Improved Chemical Agent Monitor (ICAM), the NBC Reconnaissance System (Fox Vehicle), components of the Biological Integrated Detection Systems, and the Automatic Chemical Agent Detector and Alarm (ACADA). In addition, there have been numerous CB defense capability gains from FY98 and through FY00 as a result of international cooperation.

## **1.5 TECHNOLOGY BASE REVIEW AND ASSESSMENT**

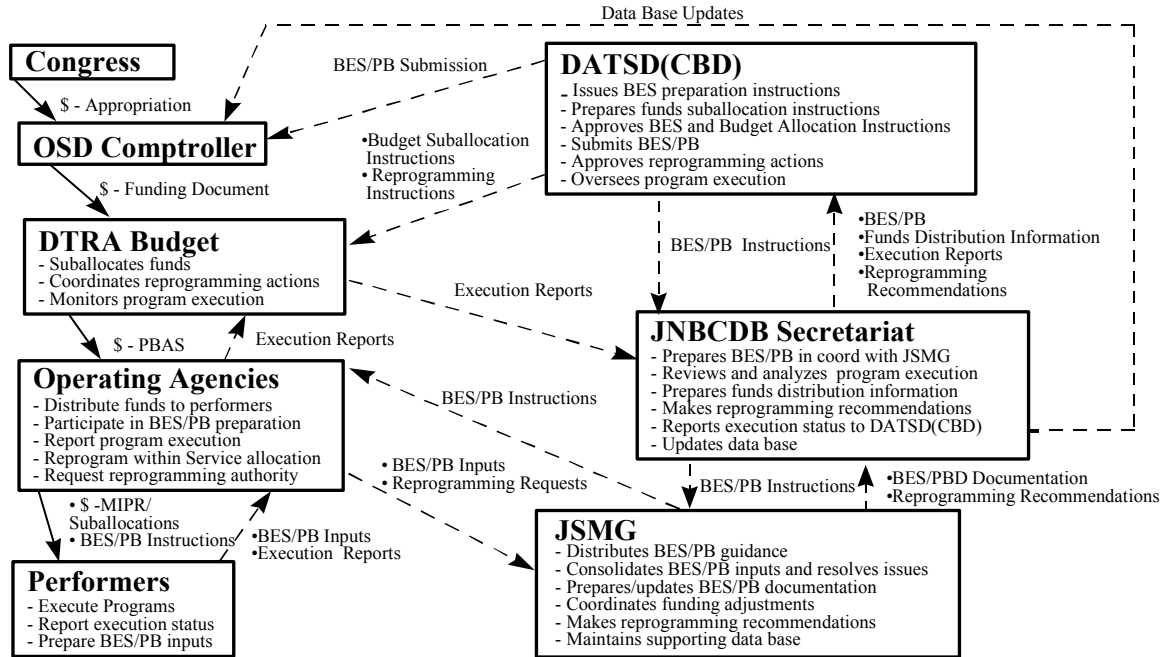
The DATSD(CBD) is the DDR&E office responsible for chemical and biological defense programs science and technology base programs. DATSD(CBD) provides technical oversight of all Service and Defense Agency chemical and biological defense science and technology base (S&T) programs and reviews these programs. 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 FY2000 TARA results is provided in Section 3 of the CBDP Performance Plan included at Annex G 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 forwards 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:** Oversight and management of the DoD CB Defense Program continues to mature. It is imperative that the management system produces joint CB defense requirements and NBC defense equipment that can be used by all forces. Public Law 103-160 (50 USC 1522) has provided a key tool for ensuring a jointly focused CB Defense Program. The continued support of Congress and implementation of current plans will continue to improve jointness and readiness.

**SOLUTION:** DoD has completed implementation of 50 USC 1522:

- DoD has developed an organizational structure ensuring close and continuous coordination of CB warfare defense and CB medical defense programs.
- The DoD CB Defense Program is fully integrated and coordinated and is based on validated Service requirements generated in response to defined threats. In addition, the Services now jointly prepare (1) Modernization Plans, (2) Research, Development and Acquisition (RDA) Plans, and (3) Joint Logistics Support Plans for NBC defense programs.
- Responsibility for the CB Defense Program is vested in a single office in OSD, DATSD(CBD), which provides the overall guidance for planning, programming, budgeting, and executing the CB Defense Program.
- The overall integrity of the CB Defense Program's organizational structure has been maintained throughout implementation of the Defense Reform Initiative (DRI) and establishment of the Defense Threat Reduction Agency through establishment of the OSD CB Defense Steering Committee.

**ISSUE:** In its August 1999 report (NSIAD 99-159, 16 Aug 99), the General Accounting Office (GAO) recommended that a performance plan for the CB Defense Program should be developed and based on the outcome-oriented management principles embodied in the Government Performance and Results Act (GPRA).

**SOLUTION:** A performance plan for the DoD Chemical and Biological Defense Program is included as Annex G to this report.

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# Chapter 2

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

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### 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. 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).

In coordination with the Commanders-in-Chief (CINCs), 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 cycle. If a valid need exists, then the research and development modernization process will identify technological approaches which 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. 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 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).

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

- |  |
|--|
| <p><b>1: NBC Battle Management</b>—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.</p> <p><b>2: Contamination Avoidance</b>—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.</p> <p><b>3: Individual Protection</b>—To protect the joint force by allowing it to operate safely, at near-normal levels of effectiveness, while under NBC threat, or in NBC, TIM or other environmental hazards area.</p> <p><b>4: Restoration Capability</b>—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.</p> <p><b>5: Collective Protection</b>—To protect the joint force by 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.</p> |
|--|

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.

## 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 working closely together to increase jointness in ongoing programs for each of these areas. This report highlights improvements during FY00 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 developmental and fielded equipment can be found in Annexes A–C and medical accomplishments are listed in Annex D of this report.

To identify, prioritize, and integrate the Services' medical NBC defense needs and requirements, the Medical Program Sub-Panel (MPSP) of the JSIG was formed in 1998. The Principals and Action Officers of the MPSP bring significant medical expertise to the panel and have access to the considerable medical expertise across their individual Service.

The MPSP improved the Joint Requirements Determination Process alongside the JSIG. Each Service has different methods to determine its unique needs and develop its requirements. The Joint process continues to improve as the MPSP promulgates Joint Operational Requirements Documents (JORDs) for the Joint Biological Agent Identification and Diagnosis System, Vaccines against Biological Threat Agents, and Chemical Warfare Agent Medical Countermeasures and Devices. Services continue to introduce requirements to the Joint arena for possible adoption and prioritization. The overall Medical NBC Defense Materiel Development Program is discussed below.

The following sections (2.3 through 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, "Chemical and Biological Defense and Protection and Counter 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 devel-

oped 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 drive the overall CB defense program. Toxicological 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, or 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. The issues of prevention, diagnosis, and treatment of 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 the 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 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 CB 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 CB 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<sup>4</sup>I) networks.

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

#### Ongoing DTOs:

- Laser Standoff Chemical Detection Technology
- Chemical Imaging Sensor
- Biological Sample Preparation System for Biological Identification
- Joint Biological Remote Early Warning System ACTD
- Force Medical Protection/Dosimeter ACTD
- Terrorist Chemical/Biological Countermeasures

#### Completed DTOs (in ACTD Sustainment Phase):

- Airbase/Port Biological Detection ACTD
- 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 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 2001	By 2006	By 2011
<ul style="list-style-type: none"> <li>• Complete installation of the Joint Portal Shield biological and chemical detection network sensor systems at CINC air bases and ports and transition to full production status</li> <li>• Complete demonstration of integrated point biodetection capability (Advanced Technology Demonstration)</li> <li>• Joint Biological Remote Early Warning System (JBREWS) ACTD</li> <li>• 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.</li> </ul>	<ul style="list-style-type: none"> <li>• Demonstrate Chemical Imaging Sensor for wide area detection</li> <li>• Complete development of Joint Service Lightweight Standoff Chemical Agent Detector (JSLSCAD)</li> <li>• Complete development of Joint Service Warning and Identification LIDAR Detection (JSWILD/Artemis)</li> <li>• Complete development of Joint Chemical Agent Detector (JCAD)</li> <li>• Complete development of Block II Joint Biological Point Detection System (JBPDS)</li> <li>• Initiate development of the Joint Biological Standoff Detection System Program</li> <li>• Complete fielding of Portal Shield production to 23 critical sites</li> </ul>	<ul style="list-style-type: none"> <li>• Demonstrate integration of chemical and biological agent detection modules into a single sensor suite</li> <li>• Complete development of CB water monitor</li> <li>• Initiate development of the Joint Modular Chem/Bio Detection System (JMCBDS)</li> </ul>

**2.3.1.3 Major Technical Challenges.** 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 the future battlefield demand responsive NBC detection and warning capabilities in order to reduce force degradation caused by contamination. These capabilities—which also 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 distant future. Table 2-3 shows the roadmap of DoD requirements for contamination avoidance. While requirements identified in the near-term 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.

**Table 2-3. Contamination Avoidance Modernization Strategy**

	NEAR (FY01-02)	MID (FY03-07)	FAR (FY08-17)
Chemical Point Detection	<ul style="list-style-type: none"> <li>• Surface off-gas sampling capability (ICAM)</li> <li>• Automatic point detection of nerve and blister agents (ACADA)</li> <li>• <i>Navy-Ship based improved automatic point detection of nerve/blister (IPDS)</i></li> </ul>	<ul style="list-style-type: none"> <li>• 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)</li> </ul>	<ul style="list-style-type: none"> <li>• Improved surface contamination monitor</li> <li>• Detection of CB contamination in water (Joint Chemical Biological Agent Water Monitor, JCBAWM)</li> </ul>
Biological Point Detection	<ul style="list-style-type: none"> <li>• Fixed site defense biological detection Portal Shield network sensor system</li> <li>• <i>Navy-Ship based Interim Biological Agent Detector (IBAD)</i></li> <li>• <i>Army-Biological Integrated Detection System (BIDS)</i></li> <li>• Portal Shield network sensor system to protect high value fixed sites against BW attacks</li> </ul>	<ul style="list-style-type: none"> <li>• Automatic long line source and point/mobile biodetection to detect and identify bio-agents; programmable (JBPDS Block I)</li> <li>• 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.</li> </ul>	<ul style="list-style-type: none"> <li>• Automatic point biodetection, to detect and identify; programmable (JBPDS Block II)</li> <li>• Automated, integrated detection of both biological and chemical agents in a single sensor package (Joint Modular Chemical/Biological Detector System, JMCBDS)</li> <li>• JCBAWM (See above)</li> </ul>
NBC Recon-Naissance and CB Remote and Stand-off Detection	<ul style="list-style-type: none"> <li>• Improved NBC Reconnaissance Vehicle with remote/early warning and data fusion capabilities (JSNBCRS)</li> </ul>	<ul style="list-style-type: none"> <li>• Lightweight passive stand-off detection for chemical agent vapors (JLSCAD)</li> <li>• Add biological detection and identification capabilities (JSNBCRS P3I)</li> <li>• Light reconnaissance vehicle (JSLNBCRS)</li> </ul>	<ul style="list-style-type: none"> <li>• Automated biological remote detection and early warning capabilities (JBSDS)</li> <li>• Stand-off detection, ranging, and mapping of chemical vapors and aerosols (JSWILD)</li> <li>• Wide area detection</li> </ul>
Battle Management Systems	<ul style="list-style-type: none"> <li>• Automated warning and reporting (JWARN Phase I)</li> </ul>	<ul style="list-style-type: none"> <li>• Automatic NBC warning and reporting interoperable with all Services (JWARN Phase II)</li> </ul>	<ul style="list-style-type: none"> <li>• Integrated and automatic warning and reporting (JWARN Phase III)</li> </ul>
Radiation Detection	<ul style="list-style-type: none"> <li>• <i>Army-Compact, digital whole body radiation measurement (AN/UDR-13)</i></li> </ul>		<ul style="list-style-type: none"> <li>• Stand-off radiation detection and measurement</li> <li>• Portable radiation meter</li> </ul>

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.

Early detection and warning is the key 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 Remote Early Warning System (JBREWS) ACTD.
- Joint Service Light NBC Reconnaissance System (JSLNBCRS).
- Joint Warning and Reporting Network (JWARN).
- Joint Chemical Biological Agent Water Monitor (JCBAWM).
- Joint Portal Shield network sensor system.
- Critical Reagents Program.

### **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 interferences, 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 FOX NBCRS fulfills heavy requirements. The FOX 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 a 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.

***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 (JSBDS).
- (3) Air Base/Port Biological Detection (Portal Shield) ACTD.
- (4) Joint Portal Shield Network Sensor System Production.

- (5) Joint Biological Remote Early Warning System (JBREWS) ACTD.
- (6) Critical Reagents Program.
- (7) Technology Transfer Program.
- (8) Biological Integrated Detection Systems (BIDS NDI and P3I).
- (9) Interim Biological Agent Detector (IBAD).

Currently fielded systems include the Navy's shipboard detection system (IBAD) rapid prototype, Joint Portal Shield network sensor systems, 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.

In the near-term, the Air Base/Port Biological Detection (Portal Shield) ACTD has developed and demonstrated the capability of networked sensors to protect high value fixed sites against BW attacks. Portal Shield (PS) has been deployed to a total of nine sites in Southwest Asia (SWA) and Northeast Asia (NEA). Fourteen additional sites will be fielded with PS production systems by the end of 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 Block I JPBDS is scheduled for 3QFY03. 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.

Also JPO-BD conducted the Joint Biological Remote Early Warning ACTD during FY00. The JBREWS ACTD is 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 ACTD Military Utility Assessment of the JBREWS components will be provided in FY01.

In the mid-term the JPO-BD will develop of the JBPDS BLK 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 standoff detection program. The system will be capable of being mounted on a variety of military platforms and provide discrimination and early warning of a biological attack.

In the far-term, JPO-BD will pursue the integration of chemical and biological detection 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 the JCAD and miniaturized biological point detection capabilities into a single system. It will automatically warn troops and provide fused sensor data to JWARN.

#### **2.3.4 CB 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 CB defense assets throughout the battlespace and integrate that with other relevant battlespace information and C<sup>4</sup>I systems. It will integrate threat information, CB sensor and reconnaissance data, protective posture, environmental conditions, and other data pertaining to the CB 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 CB detection and CB 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<sup>4</sup>I 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 will commence 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**

Various detection and warning requirements have unique 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 a 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 is conducting a Force Medical Protection/Dosimeter ACTD, the goal of which is to develop an individually worn sampler that can measure and archive exposure levels of chemical and biological agents. The objectives of the system are 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. Enhanced multiplexing is being developed to reveal BW agent family, genus, and species on a single chip. A mass spectrometer is being miniaturized for potential use in identifying BW agents and contaminants without the use of liquids. 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 modeling and simulation is intended to provide the warfighter a capability to train in a realistic manner when the use of live chemical or biological agents is not available due to legal, ethical, financial, or other constraints. Modeling and simulation is used as a tool to track and maintain battlespace situational awareness, to provide hazard warning and prediction, and for planning or modification of operations. In addition, it aids in the assessment of Joint Service doctrine, training, materiel development, and equipment design (*i.e.*, Simulation Based Acquisition). It is also used in conflict simulations to support both training of battle staffs and analysis of CB defense operations within the context of larger military operations. Models are also critical components of sensors that function by taking the input signals and processing them into meaningful output information. Thus, models and simulations can be either stand-alone systems or imbedded within other pieces of hardware.

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**

Modeling and simulation technology base efforts focus on capabilities to provide improved transport and diffusion (T&D) methodologies, address specific environmental flow regime issues (such as high altitude and urban T&D methodologies), fixed site simulations, and support first principles physics, chemistry, and meteorology efforts. In addition, advances in conflict simulation methodologies and distributed information systems efforts are being pursued. The technology base efforts also collaborate with both the weapons effects and medical communities to address source term and toxicology issues.

**2.4.1.1 Goals and Timeframes.** The goals of CB defense M&S are as follows:

- support the warfighter directly through existing C<sup>4</sup>I 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.

Current modeling capabilities support warfighter efforts to conduct scenario simulations prior to engagements and to train in a realistic manner. Recent advances allow CB defense planning to be folded into larger conflict simulation and consequence management tools. SBA tools will be used for detectors in conjunction with other CB defense environment models to assess acquisition strategies for several Service 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 in 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.

**2.4.1.2 Potential Payoffs and Transition Opportunities.** 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 analytic and real time CBD environment M&S tools, (3) CB defense 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 CB warfare 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 CB defense equipment that can participate in distributed simulations to support SBA from inception to system retirement.



### **2.4.2 Modeling and Simulation Modernization Strategy**

During FY2000, the Joint Service Integration Group will prepare a *Modeling and Simulation Master Plan* that will detail the modernization strategy and research, development, and acquisition (RDA) efforts for M&S within the CBDP. The Master Plan will also highlight coordination efforts with other organizations throughout the Department.

One of the key initiatives for coordination of modeling and simulation throughout DoD came as a result of a memorandum signed by the Deputy Secretary of Defense on 1 November 2000, which charged the Under Secretary of Defense for Acquisition, Technology, and Logistics, USD(AT&L), with responsibility and authority for approval of common use CB models, simulations, and associated data. The USD(AT&L) delegated this responsibility to DATSD(CBD). DATSD(CBD) was given the following responsibilities:

- Collect, coordinate, integrate, and approve requirements for common use CB models.
- Review & approve rigorous & independent verification & validation standards and development & implementation plans.
- Direct the development, maintenance & certification of data for CB program needs.
- Accredite common use CB models & simulations.
- Class accreditation for common use models.
- User's must still accredit for specific applications.

These responsibilities extend beyond the scope of the Chemical and Biological Defense Program and include responsibility for coordinating CB modeling and simulation efforts throughout the Department. On 25 Jan 2001, the DATSD(CBD) announced formation of Modeling and Simulation Oversight Group (MSOG), which held its first meeting in February 2001 to develop a charter and identify issues.

### **2.4.3 Defense Advanced Research Projects Agency (DARPA) Programs**

**DARPA Sensor Integration and Modeling for Biological Agent Detection (SIMBAD).** This is a combined program of hardware and software. DARPA is investigating various biodetection technologies and is developing the simulation tools to be able to evaluate conceptual systems against postulated reasonable attacks. The goal of the program is to develop well characterized, optimized, fully integrated BW and CW sensor systems by maturing current and emerging sensor technologies, and developing new technologies as required. BW agent sensor systems are the primary goal, with CW agent sensor systems a secondary goal. The ultimate product of SIMBAD is one or more fully integrated and well-characterized sensor systems capable of responding to the threats defined during the duration of the SIMBAD program.

As part of achieving this goal, several other supporting goals must be achieved. These are (1) to develop engineering models for the widest possible array of current and emerging CW and BW sensor systems at a level of detail that permits both component-level and system-level optimization and performance prediction, and (2) to develop protocols for validation of both the component-level and system-level sensors and sensor models. This validation must include models, experimental model validation and direct experimental validation of sensor perform-

ance. Innovative methodologies for characterizing sensor performance against live agents and real clutter, interference and backgrounds are an important element of the SIMBAD program.

Finally, sensors can only be developed, optimized and evaluated in the context of specific threats to which they are designed to respond. Therefore, several other supporting goals of the program are (3) to develop a sufficiently detailed engineering description of the threat—corresponding to several realistic scenarios—to support both measurements and prediction of sensor component and sensor system response to this threat, and (4) to evaluate (using measurements and predictions) both sensor component and sensor system response to the threat under conditions corresponding to several realistic scenarios.

## **2.5 DECONTAMINATION**

When contamination cannot be avoided, personnel and equipment must 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 without performance degradation to the contaminated object, are non-corrosive, environmentally safe, and lightweight (see Table 2-4). 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 and solvent wash technologies are among the candidates being evaluated as a decontaminant for interior spaces of vehicles such as aircraft. 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. Enzyme-based decontaminants that are nontoxic, noncorrosive, and environmentally safe are being pursued through DTO CB.09, Enzymatic Decontamination.

**Table 2-4. Decontamination Science and Technology Strategy**

By 2001	By 2006	By 2011
<ul style="list-style-type: none"> <li>• Demo improved sorbent delivery systems</li> <li>• Aircraft Interior Decon procedures (non-system, Project O49)</li> <li>• Demonstrate Fixed Site decontaminants</li> </ul>	<ul style="list-style-type: none"> <li>• Sensitive Equipment Decon Systems</li> <li>• Demonstrate enzymatic decon</li> <li>• Fixed Site applicators</li> </ul>	<ul style="list-style-type: none"> <li>• Demonstrate environmentally safe, sensitive equipment decon materials</li> <li>• New self-decontaminating materials</li> <li>• Improved decon material to replace DS2</li> <li>• Aircraft and other vehicle interior decontamination</li> </ul>

**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 units that become contaminated. 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 2-5 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. Other efforts include 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 four Services. Table C-1 in Annex C provides an overview of Joint Service RDA efforts and Service involvement.

**Table 2-5. Decontamination Modernization Strategy**

	NEAR (FY01-02)	MID (FY03-07)	FAR (FY08-17)
Personal Equipment Decontaminants	<ul style="list-style-type: none"> <li>• More reactive, high capacity adsorbent (M291/M295)</li> <li>• Army-<i>Higher efficiency decon methods (Sorbent Decon)</i></li> </ul>	<ul style="list-style-type: none"> <li>• Non-caustic, non-corrosive decontaminant for personnel and equipment</li> </ul>	
Bulk Decontaminants	<ul style="list-style-type: none"> <li>• Non-caustic, non-corrosive, easy to store and manufacture multipurpose decontaminants</li> </ul>	<ul style="list-style-type: none"> <li>• Decontaminants for fixed sites</li> <li>• Navy -<i>Less caustic capability</i></li> </ul>	<ul style="list-style-type: none"> <li>• Mission tailored decontaminants</li> <li>• Navy -<i>Contamination resistant shipboard materials</i></li> <li>• Army -<i>Environmentally acceptable replacement for DS2</i></li> <li>• Army -<i>Enzymes for chemical agent decontamination</i></li> </ul>
Expedient Delivery Systems		<ul style="list-style-type: none"> <li>• Auto-releasing coatings; reduces skin contact hazard &amp; labor requirements</li> </ul>	<ul style="list-style-type: none"> <li>• Self-decontaminating, auto-releasing coatings; reduces man-power and logistic requirements eliminates skin contact hazard</li> </ul>
Deliberate Delivery Systems	<ul style="list-style-type: none"> <li>• High pressure water wash; mechanical scrubber; improved decontaminant dispenser (increased vehicle throughput)</li> <li>• Army -<i>High pressure hot water washing and decontaminate scrubber capability; reduced water, labor, and logistic burden (M21/M22 Modular Decon System)</i></li> </ul>	<ul style="list-style-type: none"> <li>• Rapid large scale decon capability for fixed sites; reduced manpower and logistic burden</li> <li>• Non-aqueous capability for electronics, avionics and other sensitive equipment</li> </ul>	<ul style="list-style-type: none"> <li>• Vehicle interior decon capability</li> <li>• Supercritical fluid decontamination apparatus</li> <li>• Army -<i>Waterless decon capability for electronics and avionics</i></li> <li>• Air Force - <i>Sensitive equipment decontamination system for aircraft interiors</i></li> </ul>

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, peroxy-carboxylic 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. Additionally, there is interest and 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 C.

#### **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 explored an alternative man-portable decontamination system and is in the process of procuring an M17 Lightweight Decontamination System (LDS) with a diesel engine. The Air Force is upgrading existing M17 LDS to M17A2 versions and expanding sorbent kit inventories to improve operational and personnel decontamination programs.

## **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 generic NBC protective filters 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 2-6). 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. During FY00, a new generation of lightweight CB protective clothing based on selectively permeable membrane technology was developed and demonstrated, thus fulfilling many of the technology goals.

**Table 2-6. Protection Science and Technology Strategy**

By 2001	By 2006	By 2011
<ul style="list-style-type: none"> <li>Demonstrate semi-permeable membranes as a viable alternative to adsorbent lined permeable materials for clothing</li> <li>Demonstrate improved filtration media and advanced filter bed configurations for c applications</li> <li>Demonstrate lightweight, low cost materials and advanced closures for shelters</li> </ul>	<ul style="list-style-type: none"> <li>Investigate reactive materials as a means of self-detoxifying clothing and shelters</li> <li>Investigate residual life indicators for mask filters, collective protection filters, and clothing</li> <li>Investigate advanced adsorbents and filter bed configurations to provide protection against a wider spectrum of threats (NBC &amp; TIM)</li> </ul>	<ul style="list-style-type: none"> <li>Investigate membrane/ adsorbent composites for clothing</li> <li>Investigate nontraditional filtration (non-adsorbent based and/or non-single pass) for collective protection applications</li> <li>Investigate protective shelter materials to replace general purpose (non-protective) shelter materials</li> </ul>

**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 2-6). 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.

## **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 2-7.

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, tactical systems, and fixed and rotary wing aircraft. 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, and improved models and test technologies for protection assessment.

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 first truly joint program for the next generation chemical garments—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 V-22 Osprey, and other advanced weapons platforms.

### **2.6.3 Joint Service Protection Programs**

Joint programs are shown in Table 2-7; Service-unique programs are italicized. A detailed description of Joint IPE and CPE programs is provided in Annex B.



**Table 2-7. Protection Modernization Strategy**

	<b>NEAR (FY01-02)</b>	<b>MID (FY03-07)</b>	<b>FAR (FY08-17)</b>
Individual Eye/ Respiratory	<ul style="list-style-type: none"> <li>• Voice amplification; laser/ballistic eye protection; improved decontaminability, better comfort (M40A1/M42A2)</li> <li>• Army - <i>Aircrew mask compatible with Apache helicopter systems with a significantly lighter motor/blower unit (M48)</i></li> <li>• Army - <i>Improved compatibility with aviation sighting/night vision systems; reduced logistics burden using non-blower systems, selected for Land Warrior (M45)</i></li> </ul>	<ul style="list-style-type: none"> <li>• Reduced physiological and psychological burden, improved comfort, enhanced optical and communications, improved compatibility</li> <li>• New mask systems for general purpose and aviation masks (JSGPM, JSAM)</li> <li>• Navy - <i>Improved complete protection for all aircrews (CB Respiratory System)</i></li> </ul>	<ul style="list-style-type: none"> <li>• Advanced Integrated Individual Soldier Protection system (Future Soldier System)</li> <li>• Improved multiple agent protection</li> </ul>
Individual Clothing	<ul style="list-style-type: none"> <li>• Advanced protective suit technology; lighter, improved agent protection; reduced heat stress integrated with all respiratory systems.                             <ul style="list-style-type: none"> <li>- Improved foot protection (MULO)</li> </ul> </li> <li>• Army - <i>Improved protection for short term use for special purposes (ITAP)</i></li> <li>• Army - <i>Improved protection with self contained breathing capability for special purposes (STEPO)</i></li> </ul>	<ul style="list-style-type: none"> <li>• Improved cutaneous protection</li> <li>• Improved protection for aviators (JPACE)</li> <li>• Service Life Indicator</li> <li>• Improved hand protection</li> </ul>	<ul style="list-style-type: none"> <li>• Integrated multiple threat modular protection (chemical, biological, environmental, and flame)</li> <li>• Self-detoxifying clothing</li> </ul>
Collective Protection	<ul style="list-style-type: none"> <li>• Chemically Protected Deployable Medical Systems (CP DEPMEDS)</li> <li>• Chemically Hardened Air Transportable Hospital (CHATH)</li> <li>• Lighter, more mobile, easier setup, more affordable shelters (JTCOPS)</li> <li>• Marine Corps - <i>Protection for all combat vehicles and unit shelters</i></li> <li>• Army - <i>NBC protection for tactical Medical units (CB Protective Shelter, CBPS).</i> <ul style="list-style-type: none"> <li>- <i>Apply regenerable vapor filter to Comanche,</i></li> <li>- <i>Apply collective protection to advanced vehicle concepts.</i></li> <li>- <i>Modular, reduced size, weight and power for vehicle/ shelter collective protection - Advanced Integrated Collective Protection Shelter (AICPS)</i></li> </ul> </li> <li>• Air Force - <i>Upgrade/install collective protection into existing rest/relief shelters.</i></li> </ul>	<ul style="list-style-type: none"> <li>• Improved filters to extend filter life, reduce maintenance and reduce logistical burden</li> <li>• Reduced logistics burden, improved protection against current and future threats</li> <li>• Improved current collective protection filters and equipment (JCPE)</li> <li>• Support medical treatment in a CB environment for Airborne, Air Assault, and Heavy Divisions (CBPS)</li> <li>• Navy - <i>Backfit ships with contamination free protected zones - (Selected Area Collective Protection System, SACPS), Integrate collective protection system into V-22</i></li> </ul>	<ul style="list-style-type: none"> <li>• Family of advanced protective filtration systems for vehicles, shelters, ships, and light forces</li> <li>• Regenerable/advanced protective filtration for vehicles/vans/shelters</li> </ul>

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.

## **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.

Mid- and far-term research is focused on improved vapor and particulate filtration technology, as well as 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. Protective mask efforts will focus on 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, and better chemical protection than the BVO/GVO.

The JSLIST Pre-Planned Product Improvement (P3I) addressed requirements not met through the baseline JSLIST program. This program sought new material technologies for overgarments and duty uniforms using the existing JSLIST design. Fabric technologies for a chemical protective undergarment and materials and designs for chemical protective socks were also addressed. No candidate materials were found to meet the requirements under this program. In

addition, the Air Force is leveraging 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 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. CP DEPMEDS successfully completed an Operational Test in 4QFY97, with type classification scheduled for 2QFY01 and fielding in 4QFY01. Training sets will be issued to Regional Training Sites—Medical beginning in 4QFY01.

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 with initial fielding scheduled for 4QFY01 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 will be 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 Advanced Integrated Collective Protection System (AICPS) will provide a compact, integrated package for power, filtration, and environmental control (heating/cooling). AICPS will provide transportability and maintainability enhancements and decrease system set-up times. 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. JCPE and JTCOPS initiated engineering development in FY00. 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 AAV, 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**

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-throughput technologies for water purification and desalinization, and to explore pioneering air filtration schemes of high utility to enable 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 and brackish water and NBC 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 is being conducted to develop simple air filtration/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 individual (and can be scaled up for collective) protection that will require much less maintenance and greater personal safety than current carbon-based recirculating filters

#### **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 B.

##### ***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 be lighter and offer enhanced protection and compatibility with night vision and aircrew systems.

In the near-term, the Army will replace the M43 mask for the general aviator 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 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 will backfit selected spaces critical to amphibious ships with CPS starting in FY00. These spaces include hospital areas, command and control areas, and rest and relief areas. In the mid-term, the Navy is designing the V-22 Osprey to be the first Naval aircraft to incorporate CBR protection for both aircrew and passengers. The ability to provide a pressurized, contamination free environment is a design requirement. 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.

## **2.7 MEDICAL SYSTEMS**

### **2.7.1 Introduction**

Many countries and terrorist groups have acquired the means to produce chemical, biological, and radiological weapons and the means to deliver them. 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 that can be produced by any group with 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, Hiroshima-type nuclear weapons. Exposure to multiple threats may result in synergistic effects.

In response, the U.S. joint medical chemical, biological, and radiological defense research programs' (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 CW threats, BW threats, and threats associated with RW devices.

The third commodity area associated with the principle of Protection is Medical Systems. *Medical Systems* include all pharmaceuticals, biologics, and devices that preserve combat effectiveness by timely 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. Rapid portable diagnostics enabling quick medical response for exposed warfighters are being pursued.

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.

The DoD medical NBC defense research and development program has provided numerous products to protect and treat service members. Assessment methodologies enable threat evaluation and injury prediction. Medical prophylaxis and treatment strategies reduce the performance decrement, injury, and death of military personnel in the field, thereby enabling them to accomplish their missions, reducing the need for medical resources, and decreasing the probability of long-term health effects. The DoD program to stockpile biological defense products has been smaller than the chemical defense effort, but has received greater emphasis in recent years.

Specific initiatives programmed to improve NBC defense medical readiness include:

- Continued emphasis on NBC medical countermeasures research.
- 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 initiated 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 chronic 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.

### **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 diagnoses.

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.

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. 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 Code of Federal Regulations (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 drafted a proposed 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)].

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.

Medical NBC defense research programs discussed in this section are divided into chemical, biological, and nuclear areas of research. Table 2-8 provides a summary of the programs and the planned modernization strategy over the next sixteen years.

### **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. The JMCBRDRP employs 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 when possible. All research proposals that use animals are evaluated by a statistician 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, all procedures that might cause pain or distress in laboratory animals are reviewed by a veterinarian with expertise in laboratory animal medicine to determine the procedural modifications, analgesics and/or anesthetic regimens to 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 primates undergoes further scrutiny at 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 states that animal use will 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.



**Table 2-8. Medical NBC Defense Programs and Modernization Strategy**

	<b>NEAR (FY01-02)</b>	<b>MID (FY03-07)</b>	<b>FAR (FY08-17)</b>
<b>Medical Chemical Defense</b>	Licensed topical skin protectant	Licensed multichambered autoinjector Licensed pyridostigmine Bromide	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 ophthalmic ointment for vesicant injury Licensed therapeutic lotion for burns caused by vesicant agents Licensed vesicant agent prophylaxis Licensed advanced anticonvulsant
<b>Medical Biological Defense</b>	Anthrax vaccine amendment for new dosing schedule	Licensed smallpox (vaccinia virus, cell culture-derived) vaccine JBAID - Joint Biological Agent Identification and Diagnosis System	Licensed Next Generation Anthrax vaccine Licensed new Plague vaccine Licensed new Venezuelan Equine Encephalitis (VEE) vaccine Licensed multivalent equine encephalitis (VEE/WEE/EEE) vaccine Multiagent vaccine delivery system Portable Common Diagnostic System Licensed Recombinant Multivalent (A,B,C,E, and F) Botulinum vaccine Licensed Ricin vaccine Licensed Tularemia vaccine
<b>Medical Nuclear Defense</b>	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 <i>B. anthracis</i> spores and ionizing radiation	Sustained, slow-release radioprotective drug delivery for extended-exposure protection New-generation neutraceutical and recombinant 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 <i>B. anthracis</i> and radiation exposure Evaluation of therapeutic approach (genistein and <i>Lactobacillus reuteri</i> ) 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/ <i>B. anthracis</i> 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.

#### **2.7.4 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.
  - Provide education on medical management of chemical casualties.

##### **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) can be developed that will improve protection by enhancing barrier properties and will detoxify any agent that penetrates the protective barrier.

- For nerve agents, one objective is the fielding of a safe and effective improved anti-convulsant. 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 compounds safe and effective for use as a cyanide pretreatment.
- 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 D (Section D.1). Countermeasures and diagnostic techniques for chemical weapons are shown in Table 2-9. Critical issues of 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 2-9. Medical Chemical Defense Countermeasures and Diagnostic Techniques**

- **Chemical Warfare Agent (CWA) Scavengers** – Human enzymes that have been genetically 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 control of nerve agent-induced seizure activity.
- **Active Topical Skin Protectant** – Development of topical creams that act as barriers to skin contact with CWA. The creams are being developed to actively destroy CWAs as well.
- **Antivesicants** – Countermeasures that provide reduction in mustard-induced blister formation, corneal opacity, and dermal histopathology are being evaluated.
- **Effects of exposure to non-lethal levels of CWA** – The probability and severity of chronic 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 a countermeasure for Fourth Generation Agents.
- **Cyanide Countermeasures** – Methemoglobin formers and sulfide donors are being evaluated for safety and efficacy as pretreatments for cyanide intoxication. A non-invasive methemoglobin/cyanide monitor is ready for transitioning development.
- **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, drug therapies, 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 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.
  - Provide education on medical management of biological warfare casualties.

One of the key efforts to achieve the goals and objectives of the medical biological defense program has been the protection of U.S. forces against anthrax — a deadly biological warfare agent. This is being accomplished through total force vaccination against anthrax, as described in Table 2-10.

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 our troops 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 presence 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.

**Table 2-10. Anthrax Vaccine Immunization Program (AVIP)**

Detailed information on the AVIP may be found on the internet at <http://www.anthrax.osd.mil/>

This web site provides detailed account on the nature of threat from anthrax (*Bacillus anthracis*), description of the vaccine, explanation of U.S. policies regarding biological defense vaccines, U.S. policies regarding the anthrax vaccine, immunization schedule, information on adverse event reporting, and other information related to the AVIP.

As of May 29, 2001, 2,052,928 doses of the vaccine have been administered to 511,052 persons. Also as of this date, 71,844 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. The Secretary of Defense announced the Total Force Anthrax Vaccine Immunization Program in May 1998 and vaccinations 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 vaccination of the Total Force (active and reserve components) and critical DoD civilians and contractors to be executed in three phases. The AVIP will be implemented in three phases over a seven- to eight-year period. Forces at highest risk will be immunized first. Due to an unanticipated delay in release of FDA approved vaccine, DoD slowed its implementation of the AVIP on 17 Jul 00 and again on 27 Nov 00. DoD is currently executing a modified Phase I, which vaccinates Service Members (Active and Reserve Components) and Emergency Essential DoD civilians and contractors assigned or deployed to the high-threat area (HTA) of Southwest Asia for 30 days or more. Phase I began in Mar 98, due to increasing tensions in the region. Phase II vaccinates the early deploying forces projected to deploy in support of contingency plans into the HTA; DoD will begin Phase II only after FDA approval of BioPort's newly renovated anthrax vaccine production facility. Phase III vaccinates the remainder of the Total Force, begins vaccinations to accessions, and sustains the Program.

The DARPA BW defense program includes collaborating with USAMRMC on new platforms to enhance delivery and effectiveness of multi-agent vaccines (for example, stem cells genetically programmed to express antigens sequentially in order to provide automatic boosters in the body). Multi-agent vaccines are similar to the measles-mumps-rubella vaccine administered to children except that 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. Research within USAMRMC in both the naked DNA and replicon approaches is advancing rapidly with demonstration 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 to be licensed over the next ten years.

Development of a common diagnostic system is proceeding with the adoption of rapid nucleic acid analysis methods. Three configurations of portable instruments using common polymerase chain reaction (PCR) chemistries were demonstrated for the identification of biological warfare agents and naturally occurring infectious diseases. 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 to intervene in the pathogenic effects of threat agents.

Post-exposure Countermeasures: Research efforts in this area are focused on developing safe, effective 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 assay of bacteria, viruses, toxins, metabolites, and analogs in clinical specimens are major goals of this program area.

**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 weapons are shown in Table 2-11. 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. The 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.

**Table 2-11. Medical Biological Defense Countermeasures and Diagnostic Techniques**

<p style="text-align: center;"><b>VACCINES</b></p> <ul style="list-style-type: none"><li>• <i>Killed</i> – killed or inactivated microorganism that is incapable of replicating but stimulates immunity.</li><li>• <i>Live, attenuated</i> – live organism, selected not to cause disease but able to stimulate immunity.</li><li>• <i>Toxoid</i> – toxin protein treated to inactivate its toxicity but retains its ability to stimulate immunity.</li><li>• <i>Recombinant</i> – 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.</li><li>• <i>Deoxyribonucleic Acid (DNA)</i> – 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.</li><li>• <i>Polyvalent/Multivalent/Multiagent</i> – mixture of antigens or vaccine constructs that protect against a number of different BW agents.</li><li>• <i>Vectored</i> – carrier organism bioengineered to confer immunity against an unrelated BW agent or multiple agents.</li></ul> <p style="text-align: center;"><b>ANTIBODY (ANTISERUM, ANTITOXIN)</b></p> <ul style="list-style-type: none"><li>• <i>Heterologous</i> – antibodies collected from animals (<i>i.e.</i>, 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).</li><li>• <i>Homologous</i> – antibodies of human origin (<i>i.e.</i>, same species as the recipient) that provide protective immunity against the BW threat. These antibodies are not prone to stimulating serum sickness.</li><li>• <i>Monoclonal</i> – a cell culture technique for producing highly specific antibodies against a disease agent.</li><li>• <i>Bioengineered</i> – 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.</li></ul> <p style="text-align: center;"><b>DRUGS</b></p> <ul style="list-style-type: none"><li>• <i>Antibiotics</i> – very effective against bacteria, but are ineffective against viruses and toxins.</li><li>• <i>Antiviral compounds</i> – promising drugs in development by the pharmaceutical industry are being evaluated against biological threat viruses</li><li>• <i>Others</i> – 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.)</li></ul> <p style="text-align: center;"><b>DIAGNOSTIC TECHNOLOGIES</b></p> <ul style="list-style-type: none"><li>• <i>Immunological technologies</i> – 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.</li><li>• <i>Nucleic acid technologies</i> – 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.</li></ul>
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Technical shortcoming 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, and (2) lack of widespread scientific expertise in biological defense. 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 maintain scientific and technological expertise.

Details of the biological warfare threats and countermeasures, as well as biological defense research and development technical barriers and accomplishments, are presented in Annex D (Section D.2).

**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); Advanced Medical Diagnostics for the most virulent pathogens and their molecular mechanisms; and Consequence Management Tools.

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 D.

Mission effectiveness requires rapid, correct medical responses to biological threats. The objective of the Consequence Management thrust is to provide comprehensive protocols to protect or treat combatants by using current and emerging biological countermeasures. It will provide accelerated situational awareness for biological agents events by detecting exposure to agents through an analysis of casualty electronic theater medical records, and will locate and determine the most effective logistical support for providing appropriate treatment and pathogen-specific resources required to mitigate effects of the attack.

#### **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 counterproliferation 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.

The nuclear weapons inventory of current adversaries is thought to be small, but if a weapon is used for military advantage, 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 radionuclides. Prompt effects of moderate- to high-dose radiation injury diminish the soldier's ability to fight and survive. Effective radiation countermeasures must protect the soldier 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 2-12 presents an overview of countermeasures to radiological exposure and research accomplishments during FY00.

**Table 2-12. Medical Nuclear Defense Countermeasures**

<p><b>PRETREATMENTS</b></p> <p><i>Single agents:</i> Injections and/or oral administration of androstene steroid, vitamin E, genistein and/or amifostine (Ethyol®) enhance survival of acutely irradiated laboratory animals.</p> <p><i>Multidrug combinations:</i> 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.</p> <p style="text-align: center;"><b>MEDICAL THERAPIES</b></p> <p><i>Blood Forming Cell Stimulants:</i> 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.</p> <p><i>Broad Range Cellular Recovery Stimulants:</i> Research continues into biologically stable compounds that stimulate recovery of multiple hematopoietic cell lineages.</p> <p><i>Susceptibility to Infectious Agents and Efficacious Therapy:</i> 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.</p> <p style="text-align: center;"><b>DIAGNOSTIC TECHNIQUES</b></p> <p><i>Biodosimetry and Dose Assessment:</i> 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.</p> <p style="text-align: center;"><b>CHEMICAL AND BIOLOGICAL WARFARE CONSEQUENCES WITH RADIATION</b></p> <p><i>Increased lethality of biological weapons after low level irradiation:</i> 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.</p>
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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 casu-

ality 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 D (Section D.3).

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

### **2.8.1 Introduction**

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 this year and for the next three years. (Related activities of the overall Joint Medical Biological Defense Research Program are described in Section 2.7.5 of this chapter and Annex D 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. Additionally, Congress directed that in the report to be submitted in calendar year 2001, the following information should be included:

- (1) an estimate and update of the life cycle costs of the anthrax vaccination program;
- (2) a description of the anthrax vaccine acquisition strategy;
- (3) an assessment of government requirements (defense and non-defense) for the anthrax vaccine;
- (4) an assessment of the financial and manufacturing ability of the manufacturer of the anthrax vaccine to meet government requirements; and
- (5) a description of any activity related to any anthrax vaccine license with significant implications for the Department of Defense.

### **2.8.2 Costs Incurred by, and Payments Made to, Each Contractor or Other Entity Engaged in the Production, Storage, Distribution, or Marketing of the Anthrax Vaccine.**

Table 2-13 provides a list of all obligations associated with the manufacture of the Anthrax Vaccine Adsorbed (AVA) as of March 22, 2001. Storage costs outside of BioPort, distribution, and marketing are funded by the Anthrax Vaccine Immunization Program (AVIP) agency as shown in Table 2-14.

**Table 2-13. Obligation of Funds for Anthrax Vaccine Adsorbed (\$000)**

<b>System Cost Element</b>	<b>FY 00 &amp; Prior</b>	<b>FY 01</b>
<b>Vaccine Program</b>		
BioPort K DAMD17-98-C-8052	<b>54,881</b>	<b>0</b>
<b>Redundancy</b>		
BioPort K DAMD17-98-C-8052	<b>4,361</b>	<b>0</b>
<b>Process Validation/BLA Supplement Approval</b>		
BioPort K DAMD17-91-C-1139	<b>26,836</b>	<b>14,100</b>
<b>Testing, Labeling, Shipping, &amp; Security</b>		
BioPort K DAMD17-97-D-0003	<b>3,232</b>	<b>378</b>
<b>Facility Renovation</b>		
BioPort K DAMD17-91-C-1139	390	
BioPort K DAMD17-98-C-8052	303	
Washington Group International	65	
<b>Facility Renovation Subtotal</b>	<b>758</b>	<b>0</b>
<b>Oversight</b>		
Camber	833	2,393
Quantic	1,886	
Don Hill Associates	142	
Quintiles	2	
<b>Oversight Subtotal</b>	<b>2,863</b>	<b>2,393</b>
<b>Second Source</b>		
Battelle	50	
DynPort	50	
Antex	50	
Center for Applied Microbiology & Research	50	
CanGene	50	
<b>Second Source Subtotal</b>	<b>250</b>	<b>0</b>
<b>Total</b>	<b>93,181</b>	<b>16,871</b>

**Table 2-14. Storage and Marketing Costs for Anthrax Vaccine Adsorbed (\$000)**

<b>AVIP costs</b>	<b>FY99</b>	<b>FY00</b>
Contract Personnel/ Support	3,509	3,214
Vaccine Distribution	327	348
Education	946	1,724
Program Research and Evaluation	--	2,602
VA-DoD Force Health Protection Initiative	628	517
<b>Total</b>	<b>5,410</b>	<b>8,405</b>

**2.8.3 An Estimate and Update of the Life Cycle Costs of the Anthrax Vaccination Program.**

Table 2-15 provides an estimate of the procurement program costs for the anthrax vaccination program. Table 2-16 provides life cycle costs for the Anthrax Vaccine Immunization Program (AVIP). Future costs beyond FY2002 to complete the program are to be determined.

**Table 2-15. Estimated Anthrax Vaccine Adsorbed Procurement Program Costs (\$000)**

FY 00 & Prior	FY 01	FY 02
93,181	52,876	56,074

**Table 2-16. Estimated Anthrax Vaccine Immunization Program (AVIP) Costs (\$000)**

AVIP costs	FY 00	FY01	FY02
Contract Personnel/ Support	3,214	3,264	3,259
Vaccine Distribution	348	360	373
Education	1,724	1,149	1,244
Program Research and Evaluation	2,602	2,618	2,733
VA-DoD Force Health Protection Initiative	517	521	3,758
<b>Total</b>	<b>8,405</b>	<b>7,912</b>	<b>11,367</b>

**2.8.4 Anthrax Vaccine Acquisition Strategy.**

BioPort Corporation is the only Food and Drug Administration (FDA)-licensed manufacturer of the AVA. DoD personnel are working with BioPort in Lansing, Michigan, to complete the essential tasks for achieving FDA approval of the renovated facility, restoration of assured vaccine production, and to enable resumption of the immunization program mandated by the Secretary of Defense.

DoD conducted an evaluation of the advantages and disadvantages of converting the BioPort facility to a Government-Owned, Contractor-Operated (GOCO) facility. The evaluation concluded that converting BioPort to a GOCO facility would not result in vaccine being delivered any faster than under the current strategy.

Risk mitigation measures are also being pursued for a second source, and, in the long term, for a GOCO Vaccine Production Facility. A GOCO Vaccine Production Facility is being evaluated as a long-term strategy for Biological Defense (BD) vaccine production. This facility would provide the capability to manufacture AVA along with smallpox, botulinum toxins, tularemia, plague, and other required BD vaccines.

**2.8.5 An assessment of government requirements (defense and non-defense) for the anthrax vaccine.**

**Defense**

In December 1997, the Secretary of Defense (SECDEF) ordered the immunization of all U.S. forces by 2005. This requires over 14 million doses of AVA (2.6 million doses annually based on AVIP estimates). Phase I vaccination of forces assigned or rotating to the highest threat areas was started in FY98. Phase II vaccination will begin after the FDA approves BioPort’s renovated production facility and BioPort can supply AVA on a scheduled basis. Phase III involves vaccination of the remaining forces and sustainment vaccination.

## **Non-Defense**

Identification of domestic requirements will be met through efforts of a BioDefense Vaccine Production Facility Advisory Group. Members of this group represent various agencies such as the Centers for Disease Control and Prevention, FDA, National Security Council (NSC), and the Department of Health and Human Services (DHHS).

### **2.8.6 An Assessment of the Financial and Manufacturing Ability of the Manufacturer of the Anthrax Vaccine to Meet Government Requirements.**

BioPort is, at present, not generating revenue, because dose release cannot resume until the renovated facility is approved by the FDA. Therefore, DoD is funding all activities related to obtaining FDA approval for AVA. DoD is providing extensive assistance and oversight, including pharmaceutical and regulatory experts, to ensure that the supplier is capable of manufacturing vaccine in accordance with all Federal regulations. Progress is being made toward achieving FDA approval to produce vaccine. The two key elements to successful Biologics License Application (BLA) supplement approval are 1) process validation and submission of the documentation 2) approval of the potency test supplement. When FDA approval is received, BioPort will have the capacity to manufacture enough vaccine to resume the SECDEF-mandated immunization program.

### **2.8.7 A Description of Any Activity Related to Any Anthrax Vaccine License with Significant Implications for the Department of Defense.**

There is only one FDA license for the manufacture of anthrax vaccine. It is held by BioPort, the manufacturer of AVA. There are several activities that are relevant to the anthrax vaccine license. These activities are:

- Submission of the BLA supplement.
- Submission of the potency supplement.
- Recent FDA inspection of BioPort.
- Awarding subcontract for the filling & packaging operation.
- Potential Second Source award.

BioPort's BLA supplement is expected to be submitted to the FDA in 2001 for approval of their renovated production facility. The FDA review and inspection process will take several months. BLA supplement approval is not expected until 2002.

Complications with the potency test caused delay in the release of stockpiled lots. A DoD/BioPort team was established to resolve technical issues associated with BioPort's vaccine potency test. A new potency supplement addressing resolution of these issues was submitted to the FDA. Approval of this supplement is integral to BLA supplement approval.

The FDA Regulatory Compliance Division completed a biennial review at BioPort in October 2000. On 6 December 2000, BioPort submitted a corrective plan to address deficiencies noted by the FDA.

BioPort awarded a contract to Hollister-Steir for filling and packaging of the vaccine. Filling and packaging was outsourced because BioPort's filling and packaging suite does not meet current Good Manufacturing standards.

In order to reduce the risk associated with a sole source for the anthrax vaccine, DoD sought industry interest in developing a second source for anthrax vaccine. Five companies responded and submitted program plans. If DoD awards a contract for a second source, BioPort may share the existing license with the selected company, or the selected company may request a new license from the FDA.

## **2.9 OPERATIONAL TESTING - PROJECT O49**

Increased awareness of the chemical and biological (CB) defense 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. In FY00, the WDTIC fielded more than 3,000 requests for CB defense information, including Freedom of Information Act requests and Congressional inquiries.

Following are summaries of recent, significant Project O49 operational tests:

- *Cargo Aircraft Contamination Control Field Test*, conducted 15–19 Sep 1998 at the WDTC at DPG for the U.S. Transportation Command (USTC), in conjunction with Air Mobility Command and the 305 Air Mobility Wing. This test evaluated the effectiveness of contamination control procedures for operating in a CB environment. The results of this test may affect the way cargo is handled in a chemical-contaminated environment throughout the DoD. It also demonstrated that auxiliary ventilation procedures should not be used and aircrew must remain in protective posture if the aircraft is hit with heavy liquid contamination.
- *Air-Platform Interface Field Test*, conducted 16–26 Mar 1999 at U.S. Army Yuma Proving Ground, Arizona for the Naval Air Warfare Center, Aircraft Division, in conjunction with Marine Heavy Helicopter Squadron 466. This test sought to validate current ingress and egress procedures, and this test answered crucial questions concerning aircrew personal protection, cross contamination and aircraft decontamination.



Lessons learned were applied to standard operating procedures for Marine aviation units deploying to Bosnia.

- *Operation Southern Breeze Field Test*, scheduled for April/May 2001 at Charleston Naval Weapons Station, South Carolina for the USTC, in conjunction with Military Sealift Command and Military Traffic Management Command. Test objectives are to: (1) Evaluate the extent of internal contamination allowed by the ventilation system of a Large Medium Speed Roll On, Roll Off Ship (LMSR) 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.

## 2.10 CB DEFENSE RDA PROGRAMS REQUIREMENTS ASSESSMENT

**ISSUE:** Advanced technologies and new methods are currently being examined for fixed site decontamination. Follow-up investigations are planned to determine the requirements necessary to perform decontamination of large areas, including cleaning areas to sustain cargo handling operations. Over the past year, the Services have worked together to improve the Joint orientation of NBC defense requirements. The work being accomplished will improve the equipment fielded in the near future. More emphasis needs to be placed on the Warfighting CINCs' requirements as input for equipment research and development. This is necessary to ensure that future equipment meets the needs of the Joint battlespace environment.

**SOLUTION:** Areas of concern which are addressed under the management improvement initiatives include the following:

- Identifying baseline capabilities as a measure for determining what tactics, techniques, and procedures may be required.
- Focusing and prioritizing chemical and biological detector programs to ensure that resources are leveraging the most promising technologies and are not diluted by excessive Service unique requirements.
- Developing advanced individual protection ensembles that minimally degrade an individual's performance for all tasks performed in contaminated environments.
- Identifying requirements for collective protection programs to ensure that enough assets are available to complete missions in a CB contaminated environment.
- Developing advanced detection capabilities for the purpose of directing decontamination efforts and monitoring the effectiveness of those efforts.
- Identifying an environmentally safe decontaminant and development of a capability to accomplish fixed site and sensitive equipment decontamination.

In FY99 a Science and Technology Decontamination Master Plan was developed that linked technologies with decontamination needs and programs, resulting in a ten year roadmap that

illustrated how the science and technology base should transition to engineering development to meet those needs. The Master Plan was an outgrowth of a front end analysis that provided a systematic evaluation of technologies and their applicability to CB decontamination in the areas outlined above.

**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. 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. DoD is currently updating the license for production of this vaccine due to facility renovations. For other biological defense vaccines, DoD awarded a prime systems contract to DynPort LLC, now called Dynport Vaccine Corporation. This contract establishes a single integrator to develop, license, produce, and maintain a stockpile of BD vaccines for protection against BW agents. DynPort LLC 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.

**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:** On 18 May 1998, DoD decided to systematically vaccinate all U.S. military personnel against anthrax. Current plans call for personnel serving in high threat regions to receive vaccinations, which began in summer 1998. As of January 2001, about 2,000,000 doses of the vaccine have been administered to approximately 500,000 persons. Also as of

this date, 70,249 service members have completed the 6-shot series. This decision is crucial for developing a strategy to maintain the industrial base capability for vaccine production. See Table 2-13 in this chapter for further details on the implementation schedule.

DoD continues to work with BioPort to meet the more stringent requirements the FDA has imposed on all vaccine manufacturers. DoD has provided technical guidance on testing and evaluation and the auditing of quality systems. DoD conducted preliminary testing of a reduction of the dosage regime for Anthrax Vaccine Adsorbed from six vaccinations to five over an 18 month period. The results of this study were presented to the FDA in FY99. Subsequently Congress awarded \$20M to the Department of Health and Human Services for expanded, pivotal studies. For more information on the DoD anthrax vaccine program, visit "Concerning the Anthrax Threat" on the Internet at <http://www.anthrax.osd.mil/>.

**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, and the vaccine is being further developed for FDA licensure. The manufacturing process is being refined to produce a flexible, scalable, state-of-the-art method. FDA licensure is expected in 2005. An immune globulin product is also being developed to treat some adverse reactions to vaccination with the smallpox vaccine. This product is in clinical testing, with licensure expected in 2003.

**ISSUE: The effects on humans resulting from the exposure to low doses of chemical agents, particularly organophosphate (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.

**ISSUE: Radiation exposures below a level that cause acute effects predispose military personnel to injury from other battlefield agents. The magnitude of this interaction has not been fully evaluated.**

**SOLUTION:** Experiments were carried out to assess the protective efficacy of anthrax vaccine in sub-lethally irradiated animals challenged with *Bacillus anthracis* Sterne spores. Antibody titers to *B. anthracis* protective antigen in the plasma of irradiated and infected animals were determined. Increased susceptibility to infection was quantified when sub-lethal doses of radiation were administered either before or after challenge with *B. anthracis* Sterne spores. Researchers discovered that combined exposure to sub-lethal doses of radiation and *B. anthracis* Sterne spores leads to translocation and systemic infection of intestinal microflora that would be refractory to conventional antimicrobial therapy. Preliminary experiments have identified a potential alternative antimicrobial regimen for cases of combined exposure to radiation and *B. anthracis*. In continuing collaborative studies, AFRRI-generated experimental data for combined radiation/BW agent injury was incorporated into algorithmic model systems for casualty prediction.

**ISSUE: The toxic characteristics of the Fourth Generation Agents (FGAs) may be similar to the conventional nerve agents. Therefore, FGAs are recognized as a potential threat to the safety of our warfighters. Current medical countermeasures may not provide the same level of protection against the FGAs as they do against the conventional nerve agents.**

**SOLUTION:** Develop prophylactics, pretreatment, or therapeutics for the FGAs to reduce the likelihood that our adversaries will employ these agents. Basic pharmacokinetic characteristics such as absorption, distribution, metabolism, and excretion of these agents are necessary to determine the differences in the mechanism of action of the novel agents and the conventional nerve agents in order to develop effective countermeasures.

The Chemical and Biological Agents Action Group (CBAAG) was established to address the FGA threat. This group—composed of senior representatives from the intelligence, requirements, materiel development, and medical research and development communities—has reviewed applicable intelligence sources, requirements documents, and materiel development programs to assess the impact of the FGA threat to defense requirements and defensive systems development. Joint Service Integration Group and Joint Service Materiel Group representatives are working with representatives of the intelligence community to assess the FGA threat effect on current, developmental, and future defense systems. The CBAAG findings and recommendations will be published in an initial report and action plan in 2001.

As part of the effort develop a more responsive process to coordinate and integrate activities among the intelligence, requirements, and R&D communities to react to emerging threats for the CB Defense Program, the Chemical and Biological Threat Agent Program (CBTAP) has been established. The objectives of the CBTAP are to promote continuing communication among these communities, to facilitate technical documentation, and to provide an information reach-back capability.

**ISSUE:** Victims of a nerve agent attack may suffer silent seizures, *i.e.*, without behavioral manifestations. In a battlefield scenario a medic may not know whether an unconscious victim should be given an anticonvulsant. Left untreated, prolonged seizure activity can produce irreversible neuronal damage and death.

**SOLUTION:** Develop a miniaturized hand held EEG system for use on the battlefield to detect seizure activity in unconscious victims.

**ISSUE:** Nerve agents are a significant battlefield threat to the warfighter. Presently fielded antidotes are efficacious if administered promptly. However, some exposure victims may go into prolonged status epilepticus (SE) before being discovered and treated with antidotes. Prolonged untreated SE will lead to development of irreversible neuronal damage, severe incapacitation, and death.

**SOLUTION:** The benzodiazepine, midazolam, was transitioned to Advanced Development (MS I, Phase 1) in FY00. This compound has been shown in animals to be absorbed more efficiently than diazepam (the current fielded anticonvulsant), to prevent brain pathology that results from nerve agent-induced seizures, and to reduce the likelihood of seizure recurrence. During Phase I development the FDA will determine whether the surrogate marker, status epilepticus, is adequate proof of efficacy to allow the use of midazolam by military medical personnel.

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# Chapter 3

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

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### 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 and their desires 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) funding accounts has ensured the joint integration of NBC defense programs. However, no defense-wide (that is, joint) funding mechanism exists for the NBC defense logistics area. 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.

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 not fully assured, due to current and potential critical shortfalls of specific program areas. Contingent upon completion of the Secretary of Defense's Strategic 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 Analysis. The goal of the JCHEMRATES study is to define the 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. These 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. Thus, while the Services agree with the methodology and intent of the study, the Navy and Air Force disagree with some of the findings. The study may require further refinement prior to becoming a fully accepted planning tool. The 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 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.

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 is addressing secondary item procurement policies independently. However, there continue to be shortfalls of specific NBC defense items when measured against DoD requirements of a two MTW scenario.

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



JCHEMRATES V study is being discussed 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 fifth Joint Service NBC Defense Logistics Support Plan (LSP) in August 2000. 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 FY01 LSP was used to develop the findings in this chapter.

### **3.2 NBC DEFENSE LOGISTICS MANAGEMENT**

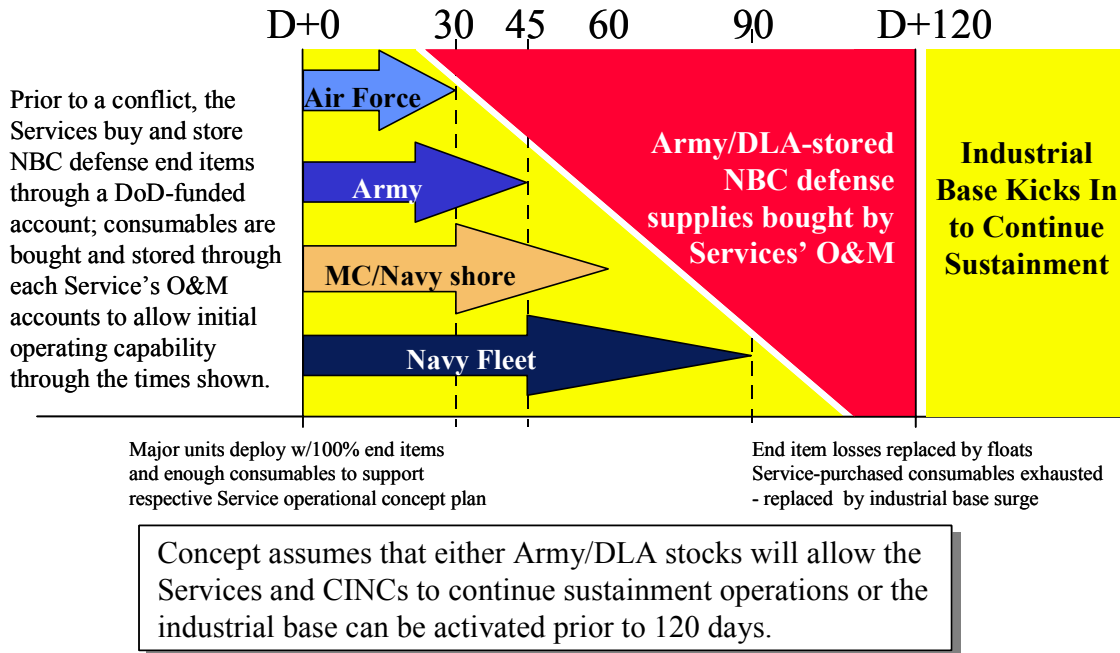
NBC defense logistics management remains in transition. The Joint NBC Defense Board has begun to exercise full authority in this area, and the JSMG, which reports to the Joint NBC Defense Board, has been charged with coordinating and integrating logistics readiness. The Joint NBC Defense Board has undertaken consolidation of two MTW DoD NBC equipment requirements among the Services 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, these 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.

Currently, only Army owned sustainment stocks are stored in DLA and AMC depots, providing limited back-up for deployed forces during a contingency. 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 E.



**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 E-1 through E-5 in Annex E, NBC Defense Logistics Readiness Data. A table is included for each of the four Services and DLA.

The items listed under “Nomenclature” in Tables E-1 through E-5 of Annex E 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. Last year, 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 our forces would be left depleted of resources after the conflicts, the LSP Integrated Product Team (IPT) voted to add 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 E-1 through E-5 is based on the final JCHEMRATES IV calculations, dated March 1999.

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 of 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 includes quantities for which a Service or agency has submitted a funded requisition or purchase order in FY00, but has not received the requisitioned items. Finally, the quantities depicted as “Projected Due-Ins” 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 will be based on available funding.

### 3.4 LOGISTICS STATUS

During collection of FY00 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 sometimes 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-D 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 last year's 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

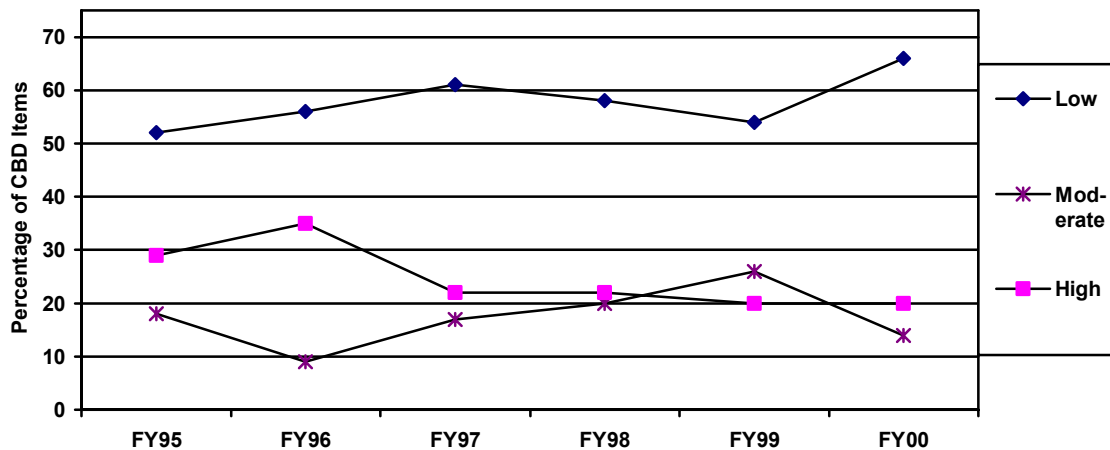
**Readiness for the next conflict is enhanced**

Of the 129 items extensively reviewed, DoD developed risk assessments for 50 items based on data gathered as of 30 September 2000 (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 FY00 were calculated by comparing the two MTW requirements, as defined for this year, to on-hand quantities, as shown in Annex E, Tables E-1 through E-5.

**RISK ASSESSMENT**

<b>Low</b> –	Services have at least 85 percent of wartime requirement on-hand to support two nearly simultaneous major theater wars
<b>Moderate</b> –	Services have between 70 to 84 percent of wartime requirement on-hand to support two nearly simultaneous major theater wars
<b>High</b> –	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 E. A six-year comparison of data assessments is shown in Figure 3-2. In comparison to FY99 report data, the percentage of the FY00 report's items in the low risk category rose from 54 percent to 66 percent. The percentage of items in moderate dropped from 26 percent to 14 percent, while the percentage of items in the high risk category remained at 20 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, 61% of the Marine Corps inventory of CAM/ICAM 1.5 and CAM/ICAM 2.0 are at the Marine Corps Logistics Base needing repair. No funds are yet available for repair, thereby raising their risk.
- Limited quantities of M93A1 NBC Recon Systems continue to constrain early warning chemical reconnaissance and detection capabilities. Continued purchases through FY05 and acquisition of the Joint Service Lightweight NBC Reconnaissance System (JSLNBCRS) will reduce this risk. Meanwhile, the collective stocks of M93 NBC

Recon Systems and M93A1 NBC Recon Systems provide complete fill against the two MTW requirement, also mitigating the risk.

- 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 (WRM) 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 Nerve Agent Antidote Kits (NAAK) can be supplemented with existing supplies of atropine and 2-PAM autoinjectors, reducing its risk from moderate to low. These items will gradually be replaced by the Nerve Agent Antidote Treatment Kit beginning about FY04.
- To meet JVAP requirements, the prime systems contractor (DynPort Vaccine Production 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. A thorough and ongoing review of this information in the light of current FDA requirements for product licensure has uncovered previously unknown risks. These risks are affecting program cost and schedule. Identifying and understanding these risks has enabled the development and implementation of a comprehensive risk management and mitigation program between the project management office and the prime contractor. There is less than 70 percent of wartime requirements on hand, thus a risk assessment of “high” is defined.

**Table 3-1. Logistic Risk Assessments: 50 NBC Defense Items**

Items	Risk Assessment	Remarks
<b>CONTAMINATION AVOIDANCE/DETECTION EQUIPMENT</b>		
<i>Radiological</i>		
AN/VDR-2 Radiac Set	Low	USMC at moderate risk (USA quantities offset risk) Low inventory, still fielding
AN/PDR-75 Radiac Set	Low	
AN/UDR-13 Pocket Radiac	High	
<i>Biological</i>		
Biological Integrated Detection System (BIDS)	Low	
<i>Chemical</i>		
M256A1 Chemical Agent Detector Kit	Low	Shelf life expiration may reduce stocks in future, but has been extended from five to six years  Being replaced by M22 ACADA Low inventory; 59% of USMC stock needs repair  Low inventory; still fielding Low inventory; still fielding; M93 available
M8 Detection Paper	Low	
M8A1 Automatic Chemical Agent Alarm	Low	
M1 Chemical Agent Monitor (CAM)/Improved CAM	High	
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	
M93A1 NBC Reconnaissance System "Fox"	Moderate	
M272A1 Water Testing Kit	Low	
M274 NBC Marking Set	Low	
<b>INDIVIDUAL PROTECTION</b>		
<i>Masks</i>		
MCU-2/P-series Mask	Low	USAF/USN mask
M40-series General Purpose Mask	Low	USA/USMC mask
M42-series Tank Mask	Low	
M48 Apache Mask	High	Replaces M43-series mask
MBU-19/9 Aircrew Eye/Resp. Protection (AERP)	Low	Replaces MBU-13/P; still fielding
<i>Suits</i>		
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 Underoverall	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	Moderate	Low inventory
<i>Gloves/Overboots</i>		
Chemical Protective Gloves (7/14/25-mil)	Low	Risk lowered due to chemical protective footwear cover stocks Replaced by GVO/BVO
Green/Black Vinyl Overshoes (GVO/BVO)	Low	
Chemical Protective Footwear Covers	Low	
Disposable Chemical Protective Footwear Covers	Low	

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

**Table 3-1. Logistic Risk Assessments: 50 NBC Defense Items (continued)**

Items	Risk Assessment	Remarks
<b>COLLECTIVE PROTECTION</b>		
Chemical and Biological Protective Shelter (CBPS)	High	Limited fielding in FY01
M20A1 Simplified Collective Protective Equipment (SCPE)	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)	Low	
<b>DECONTAMINATION EQUIPMENT</b>		
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)	Low	
M12A1 Power Driven Decontamination Apparatus (PDDA)	Low	
<b>MEDICAL DEFENSE</b>		
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	High	Due to new 2 MTW requirement
Convulsant Antidote Nerve Agent (CANAN) Autoinjector	Low	
Biological Defense Vaccines	High	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.

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.

### 3.5 PEACETIME REQUIREMENTS

In peacetime, quantities of NBC defense equipment are necessary to train personnel in NBC defense and to build confidence 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) end 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 Marine Corps, through its normal requirements generation and acquisition process, was able to obtain 100% war reserve of Saratogas for initial projected war reserves requirement (the Marine Corps no longer considers the BDO to be a viable asset). 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 is intended to provide more accurate requirements on which the Services can base their planning.

### 3.7 INDUSTRIAL BASE

With the end of the Cold War, a smaller DoD force, and subsequently reduced requirements for NBC defense items, lowered purchases of NBC defense consumables continue to threaten the industrial viability of this sector. While the sector is improving, vulnerabilities still exist. Collective protection systems (filters in particular) continue to be the most critical sub-sector 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.

These assessments indicate that the NBC defense industrial base sector is primarily supported by small to medium-sized highly specialized companies dedicated to producing military unique products with little or no commercial utility. These companies have become 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 41 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's NBC 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 were addressed in the POM (FY02-07). 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 JCHEMRATES V study is currently being planned 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 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.

**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 focus entirely 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.

**ISSUE: Equipment assets needing repair reduce inventory. Mechanisms to track maintenance requirements and initiate repairs are needed to reduce this risk. Emphasis on Preventive Maintenance Checks and Services also reduce this risk.**

**SOLUTION:** In 1984, with the assistance of the U. S. Army Defense Chemical Equipment (DCTE) Division, Pine Bluff Arsenal, the NBC Test and Evaluation Program was established to conduct surveillance testing and evaluation of all Individual Chemical Protective Equipment throughout the Marine Corps. The focus of the program was to ensure the combat readiness of NBC assets held at all levels of supply, from the depots to the using units, while maximizing the service life of assets. A surveillance unit was established at each of the Marine Corps Logistics Bases to perform both mobile and fixed site testing. Testing of overseas assets was accomplished utilizing a mail in program.

During Desert Shield, the two facilities conducted around the clock operations to ensure every Marine deploying to Southwest Asia had a serviceable Field Protective Mask and chemical ensemble. The two Test and Evaluation Units performed tests on over 94,000 masks from field units and warehouse stockpiles during this period.

The program was re-evaluated following Desert Shield/Desert Storm and reorganized to better support the Marine Forces. The Test and Evaluation Units were moved from the Logistics Bases to sites at Camp Lejeune, NC and Camp Pendleton, CA. A new test facility was stood up in Okinawa, Japan to support the high demand for overseas testing. Unmanned sites in Iwakuni, Japan (supported by the Okinawa unit) and Kaneohe Bay, Hawaii (supported by the Camp Pendleton unit) were also established.

In 1997, DoD encouraged the program to support NBC surveillance within all the branches of service. The program's name was changed to the Joint Service Equipment Surveillance Program and the Test and Evaluation Units were renamed as Equipment Surveillance Units.

The program provides surveillance, directed screening services, contracted toxic testing, repair, vacuum packaging, technical support, guidance and training to all services in support of NBC Individual Protective Equipment. Asset surveillance is utilized to detect degradation trends and promote unit readiness. Certified personnel and equipment are used to visually and mechanically test the assets.

The Equipment Surveillance Units perform intermediate level repairs of NBC assets, including M41 PATS and diagnostic checks on CAMs to correct defective assets. These repairs range from parts replacement, patching eye lens, crimping to packaging and repackaging. While on site, these teams provide training in the preventive maintenance and care of assets.

The DCTE Division at Pine Bluff Arsenal is the alternate source for NBC Individual Protective Equipment to support special surveillance efforts beyond the current program's capacity. Future plans are to expand the program to include Navy surveillance personnel support and providing surveillance services in support of general clothing and equipment. The program has a far-reaching impact upon NBC readiness throughout the services. It provides critical input into the research, development, testing and evaluation of new NBC equipment. The program is also a key player in the joint service's efforts to standardize NBC policy and procedures.

The USMC NBC Equipment Surveillance Unit (ESU) was also assigned to perform the surveillance for the Joint Service Materiel Group Joint Service Mask Technical Working Group (JSMTWG), to evaluate issues related to Preventive Maintenance Checks and Services (PMCS) on protective masks. The Joint Service Integration Group evaluated the results of the surveillance. Following is a summary of the *Joint Service Integration Group Mask Surveillance Process Action Team Final Report*.

**1. Background.** The Joint Services initiated a two-year pilot program starting in FY97 to assess the condition of fielded protective masks, and to determine the best approach for follow-on Joint Service retail mask surveillance. The two-year retail mask surveillance pilot program was completed and the results were provided in a final report in August 1999. In light of the data provided in this report, the JSIG PAT was tasked to provide a final review that addresses the current status of the problems and recommendations identified in its interim report. The PAT reconvened 13–14 October 1999. This report summarizes the findings of the PAT.

**2. Discussion.** Surveillance was conducted on 19,218 protective masks throughout DoD utilizing visual examinations followed by assessment on special test equipment. Defect severity was classified as minor, major, and critical. In general, most visual defects and many of the machine detected defects could have been recognized and fixed at the individual or unit level by following procedures outlined in the appropriate Technical Manuals/Technical Orders (TM/TO).

**3. Observations/Conclusions.** The PAT identified four broad areas of concern; TMs/TOs, training, leadership, and service unique problems. Generally, TMs/TOs are not being used effectively, training is not adequate, and leader emphasis on NBC defense is lacking. The PAT concluded that the problems and recommendations are for the most part service-specific and service representatives made recommendations accordingly that must be addressed.

#### **4. General Recommendations.**

A. That the Joint NBC Defense Board forward the Joint Service FY97 & FY98 Retail Mask Surveillance Final Report and this report to the Joint Staff. In order to increase awareness throughout the Services, these reports should also be disseminated to the lowest level within each service.

B. That the Joint Services continue mask surveillance to monitor fielded protective masks for degradation trends and potential maintenance improvements. It is also recommended that the Office of the Secretary of Defense establish a separate funding line for mask surveillance.

C. That future protective masks be developed that require lower maintenance and are more “user friendly”. Masks of the future should be designed with a reduction of sharp edges; *e.g.*, eyelens retaining rings and drink tube connecting blocks. Some operational concepts of a future mask could include a built-in leak detector and/or the color coding of the inside of the mask that depicts critical areas which need to be checked to determine operational efficiency.

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# Chapter 4

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

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### 4.1 INTRODUCTION

The Services' vision for Joint NBC Defense Management is: *America's Armed Forces trained and ready for the 21st Century, protecting our nation and its forces against toxic industrial hazards as well as nuclear, biological and chemical threats.* 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 Air Land Sea Application (ALSA) Center, U.S. Army Chemical School (USACMLS), and the Joint Warfighting Center to lead the effort in the development of multi-service NBC defense doctrine. The JSIG is sponsoring the revision 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. Using the ALSA process, and 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 Operations.
- NBC Decontamination (Restoration) MTTP.
- NBC Protection MTTP.
- Field Behavior of NBC Agents.

- Technical Aspects of NBC Agents.
- NBC Vulnerability Analysis.
- MTTP for NBC Reconnaissance and Surveillance.

The FY00 effort consisted of JSIG sponsored initiatives to continue the development of NBC multi-service Doctrine. The USACMLS in conjunction with all the Service doctrine centers worked three multi-service doctrinal products, *Multi-service Tactics, Techniques, and Procedures for NBC Aspects of Consequence Management, NBC Defense Operations, and Contamination Avoidance*. Additionally, ALSA has approval from all Services to print and release *Multi-Service Procedures for NBC Defense of Fixed Sites, Ports, and Airfields* to the Reimer Digital Library and Army Training Support Center (ATSC). The multi-service doctrine manuals planned for revision in FY01 are *NBC Protection* and *NBC Reconnaissance and Surveillance*.

*Multiservice Tactics, Techniques, and Procedures for NBC Aspects of Consequence Management* provides all forces guidance on being part of the DoD response to provide NBC support to the lead federal agency for consequence management. This support includes the civil support response to a WMD event occurring CONUS, or OCONUS.

*NBC Defense Operations* is a multiservice manual that provides the doctrine to support an integrated NBC defense across the spectrum of operations.

*Contamination Avoidance* is a multiservice manual that provides tactics, techniques, and procedures to support an integrated NBC warning and reporting system that provides situational awareness of NBC events that occur in an area of operation.

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 USACMLS was tasked by the Joint Staff to revise Joint Pub 3-11, *Joint Doctrine for Nuclear, Biological, and Chemical (NBC) Defense*. The title of the Joint Publication has been changed to *Operations in an NBC Environment*. This change reflects an increased emphasis on sustaining operations in a contaminated environment. Joint Pub 3-11 was updated and published in July 2000.

The USACMLS also provided exercise and training support to CINCs and various organizations throughout the year. Subject matter experts were provided to the Army War College for their "Strategic Crisis Exercise", Crisis Action Exercises, to the Joint Forces Command (JFCOM) for Joint Task Force (JTF) training, and to Exercise Silent Breeze II.

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 preliminary coordinating draft was completed, staffed, and the Medical Doctrine Working Party reviewed and incorporated critical and major comments. A final draft is being prepared. The final draft will be forwarded to the Joint Staff for worldwide staffing. The revision contains additional information on the medical aspects of NBC defense.

#### **4.2.3 Army Medical Doctrine Development Program**

Multi-Service Doctrine.\* The FY00 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. Field Manual (FM) 8-284/NAVMED P-5042/AFMAN (I) 44-156/MCRP 4-11.1C, *Treatment of Biological Warfare Agent Casualties* is complete. The FM was printed and distributed in July 2000. FM 8-283 *Treatment of Nuclear Warfare Casualties and Low-Level Radiation Exposure* is under development. This manual is being developed as a multi-service publication. The manual will be printed and distributed in FY01. 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 8-10-7.

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\* Note: Army non-medical doctrine is included in Multi-Service NBC Defense Doctrine in Section 4.2 above.

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 FY01.

#### **4.2.4 Air Force Doctrine Program**

HQ USAF/XONP and the Air Force Doctrine Center have filled a void in Air Force doctrine by developing an overarching Counter-NBC Operations Doctrine for the USAF. The new document brings the Air Force into compliance with DoD Directive 2060.2, which requires each Service to develop a counter-NBC doctrine, and outlines integration with Joint and Multi-Service doctrine. USAF guidance historically has focused piecemeal on updating USAF doctrine by incorporating counter-NBC concepts, whereas the new document integrates all the essential areas—proliferation prevention, counterforce, active defense, passive defense, counter NBC terrorism and command, control, communications and computers, intelligence, surveillance, and reconnaissance (C4ISR).

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*. AF Medical Service tactics, techniques and procedures (TTP) were completed and are in final coordination through the AFDC. During FY00 SGXR also participated in the review of numerous NATO Standardization Agreements that were updated during the year.

#### **4.2.5. Navy Doctrine**

The Navy actively participated in all phases of Joint, Multi-service and Service-unique Chemical Biological Defense Doctrine development. Navy revisions were incorporated into Joint Pub 3-11, *Joint Doctrine for Nuclear, Biological, and Chemical (NBC) Defense Operations*. *Multi-Service Procedures for NBC Defense of Fixed Sites, Ports, and Airfields* was revised in coordination with the other Services and received a Naval Tactics, Techniques and Procedures publication designation as NTTP 3-11.23. The Navy unique publication NWP 3-20.31 *Surface Ship Survivability* also was updated to reflect new shipboard chemical and biological defense actions and provide better coordination with existing multi-service publications.

The Naval 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* and NTTP 3-11.25 *NBC Contamination Avoidance*.

#### **4.2.6 Marine Corps Doctrine**

The Marine Corps is fully participating in all joint doctrine working groups to produce and update jointly funded 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. Recent Congressional interest has focused upon conduct of Preventive Maintenance Checks and Services on the M40-Series Protective Mask. One of the steps the Army has taken to address this is to make the task: “Maintain Your Assigned Protective Mask” an element of the Common Task Test for FY 01. Soldiers will practice this task until they can meet the test standards. Another step has been to prepare M40 Protective Mask Preventive Maintenance Checks and Services Assistance Cards. These cards will be issued in FY 01 to M40 Mask users to assist them when performing PMCS. It is required that the NBC protective mask be worn during weapons qualification training at least twice a year, depending on the unit category within the Standards in Training Commission (STRAC). Additionally, essential Army civilians are trained in NBC survival skills. Because of today’s battlefield complexities, the Army takes a systems approach to its training. NBC tasks for individuals are published in Soldiers’ Training Publications and trained in the Army School System. Sustainment training occurs in the unit. 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 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. 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 methods include presentations at training commands (In-House training), at the requesting unit's site (On-Site training), and 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 below. Over 22,500 Service Members, DoD and non-DoD civilians were trained.

**Table 4-1. Summary of Army Medical NBC Training (FY2000)**

Training Command	Type of Training	Training Method	Number of Students
AMEDDC&S	Leader Development	In House	2953
	Leader-Development	Distance Learning	460
	Force Health Protection	In House	71
USAMRICD	Patient Care	In House	420
	Patient Care	Distance Learning	5301
	Patient Care	On-Site	1104
	Leader-Development	On-Site	108
	Leader-Development	In House	323
USAMRIID	Patient Care	In House	420
	Patient Care	Distance Learning	9335
	Patient Care	On-Site	1104
	Leader-Development	In House	323
	Leader-Development	On-Site	108
	Leader-Development	Distance Learning	41
AFRRI	Patient Care	In House	62
	Patient Care	On-Site	577
	Patient Care	Distance Learning	70

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 leader development. During FY00, increasing attention has been paid to preparing leaders to meet the challenges of supporting 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 the fundamental knowledge and skills necessary to conduct medical operations in NBC environments, control NBC contamination in medical units, and understand the medical implication of NBC exposures, including battlefield Low-Level Radiological (LLR) hazards.

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.

Prior to promotion to the rank of Staff Sergeant, Army combat medics attend the AMEDDC&S Basic NCO Course (BNCOC). BNCOC includes 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.

The AMEDDC&S also sponsors annual Medical NBC Readiness workshops. Preventive medicine officers and personnel assigned to deployable units, or leaders directly responsible for NBC consequence management, attended the Medical NBC Readiness Workshops. Sponsored by the U.S. Army Office of the Surgeon General, these workshops provide instruction in the medical management of the full spectrum of possible NBC threats, from battlefield NBC scenarios to the conduct of peacetime operations in areas deliberately contaminated with radioactive materials or industrial chemicals. The AMEDDC&S presented a modified version of the two-week Medical NBC Readiness Workshop to the National Guard Weapons of Mass Destruction-Civil Support Teams (WMD-CST) at Fort Leonard Wood, Missouri. When certified, the WMD-CSTs will support domestic preparedness by maintaining a high state of readiness to respond to a suspected or actual WMD attack.

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 and exposure, principles of triage and decontamination of chemical and biological agent casualties. During FY00, USAMRICD presented the FCBC to 431 AMEDD Officers and NCOs using in-house, on-site training and distance learning (video tape) courses.

The AMEDDC&S is increasingly incorporating NBC Force Health Protection training into courses attended by Army preventive medicine personnel. The Principles of Preventive Medicine Course was revised during this fiscal year to prepare future preventive medicine officers to support force health protection programs in NBC environments. The Preventive Medicine Specialist Course was revised to incorporate 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 force health protection to deploy forces confronting Radiological Dispersal Devices (RDDs) 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 the 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 1,524 medical professionals with 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. The in-house MCBC course, which has doubled in size from 70 to 140 students per course, was offered four times this year.

AFRRI, a DoD agency, trained 709 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) with the assistance of the Director of Military Support, Consequence Management Program Management Integration Office (DOMS, CoM-PIO) 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, offer an alternative for those otherwise unable to attend training. The convenience of distance learning also enables large numbers of medical professionals to receive training. USAMRIID, in collaboration with the Food and Drug Administration (FDA), broadcast a live, interactive satellite distance learning course entitled “Biological Warfare and Terrorism: Medical Issues and Response” to 9,935 military and civilian health professionals and first responders at 500 sites across the United States. USAMRICD’s initial satellite broadcast entitled “The Medical Response to Chemical Warfare and Terrorism” also conducted in conjunction with the FDA reached 5,301 military and civilian health professionals and first responders. These satellite distance learning courses represent a new era in cooperation between civilian and government agencies to provide important information to all whom may confront threats from chemical and biological agents. 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 *Textbook of Military Medicine: Medical Aspects of Chemical and*

*Biological Warfare, 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 (FORSCOM) 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. USACHPPM completed the initial FORSCOM active component assistance visits in FY2000; reserve components will be completed in FY 2001-2002.

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.

#### **4.3.2 Air Force**

Air Force policy is to provide initial and annual refresher training to personnel in or deployable to 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 February 2001*. 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 the following NBC defense training courses: (Requirement changes per draft AFI 10-2501 are included in parenthesis)

AUDIENCE <sup>1,2</sup>	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:

CB Threat Area	Minimum Exercise Requirements
<p align="center"><b>Low</b></p>	<p><b>Annually</b></p> <ul style="list-style-type: none"> <li>- Conduct attack response exercise implementing the base OPlan 32-1 and other contingency plans (<i>i.e.</i>, NBC, terrorist, or conventional attack).</li> <li>- Conduct an attack response exercise for units' mobility commitments based upon the threat at deployment locations.</li> </ul>
<p align="center"><b>Medium</b></p>	<p><b>Semiannually</b></p> <ul style="list-style-type: none"> <li>- Conduct attack response exercise implementing the base OPlan 32-1, BSP, and other contingency plans (<i>i.e.</i>, NBC, terrorist, or conventional attack). One exercise may be satisfied by a tabletop exercise.</li> <li>- Conduct attack response exercise for unit mobility commitments based on the threat at deployment locations. One exercise can be satisfied by a tabletop exercise.</li> </ul>
<p align="center"><b>High</b></p>	<p><b>Semiannually</b></p> <ul style="list-style-type: none"> <li>- Conduct attack response exercises implementing the base OPlan 32-1, BSP, and other contingency plans.</li> </ul>

**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. After reporting to designated units, Navy personnel also are required to complete basic and advanced CBR-D PQS training.

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.

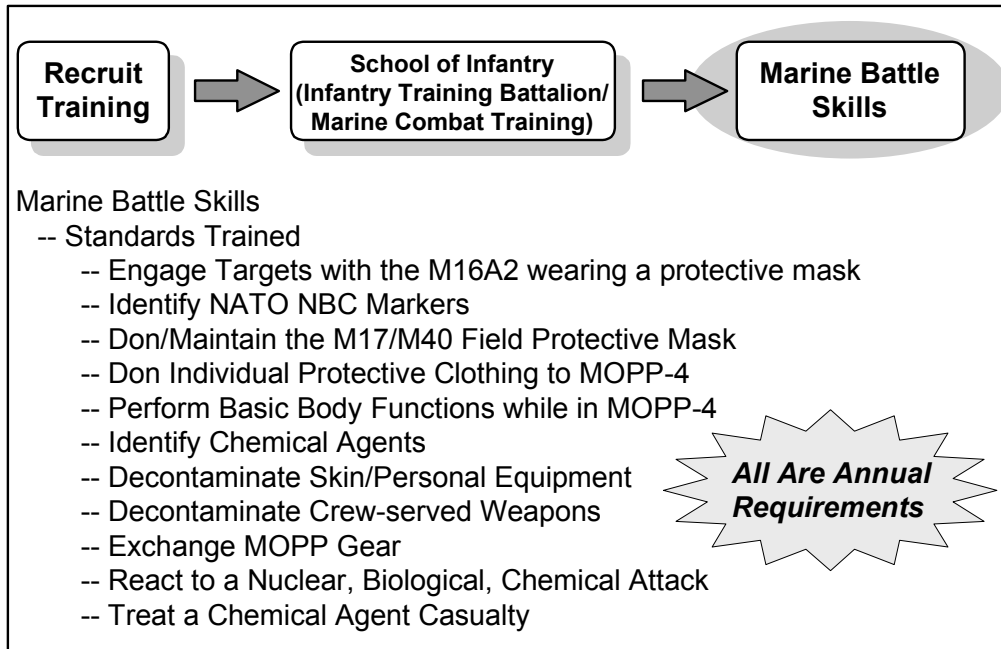
**Unit Training.** Proficiency training is conducted at the unit level by Navy instructors who are graduates of the CBR-D Operations and Training Specialist Course conducted at the U.S. Army Chemical School. Navy units conduct basic, intermediate, and advanced training exercises as part of the Training and Readiness Cycle prior to deployment. During the basic training phase, CBR-D training exercises may involve additional unit training by CBR-D specialists from an Afloat Training Group (ATG). During the intermediate and advanced phases of the training cycle, combat readiness is reinforced through Composite Training Unit Exercises and Fleet Exercises.

#### 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 Fleet Operational 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.

The Marine Corps conduct 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.

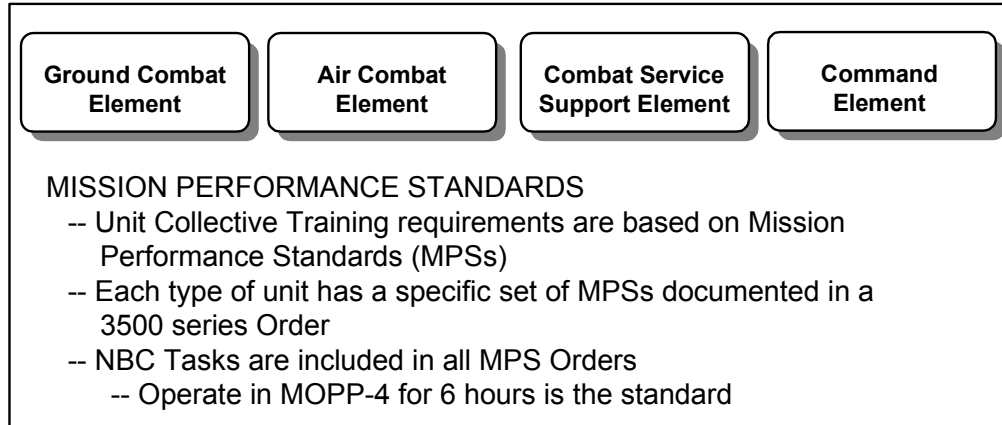


**Figure 4-1. USMC Individual NBC Training**

**Individual Training.** Enlisted Marine entry-level training begins at recruit training or “Boot Camp” where Marines are introduced to the field protective mask and the gas (CS) chamber. All enlisted Marines then proceed to the School of Infantry (SOI). The training focus is surviving and functioning in an NBC environment. Training transitions from a classroom/academic environment to practical application/field environment to provide students more hands-on experience.

Once Marines reach their units they begin the Marine Battle Skills Training program. Marine Battle Skills is a set of tasks, which all Marines are required to be proficient in and are evaluated annually. Marine Battle Skills NBC training focuses on providing Marines the capability to survive as well as function in an NBC environment.

**Unit Training.** Unit level (or collective) training includes classroom and field training and is included in unit training exercises and plans. (See figure 4-2.) Units are also required to meet very specific training standards. These requirements take the form of Mission Performance Standards (MPSs). Each type of unit in the Marine Corps has a set of MPSs assigned to it. These MPSs are published as 3500 Series 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 evaluations are conducted annually for all Marine Corps units. 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.

#### **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 Joint Training Assessment Working Group (JTAWG) 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.

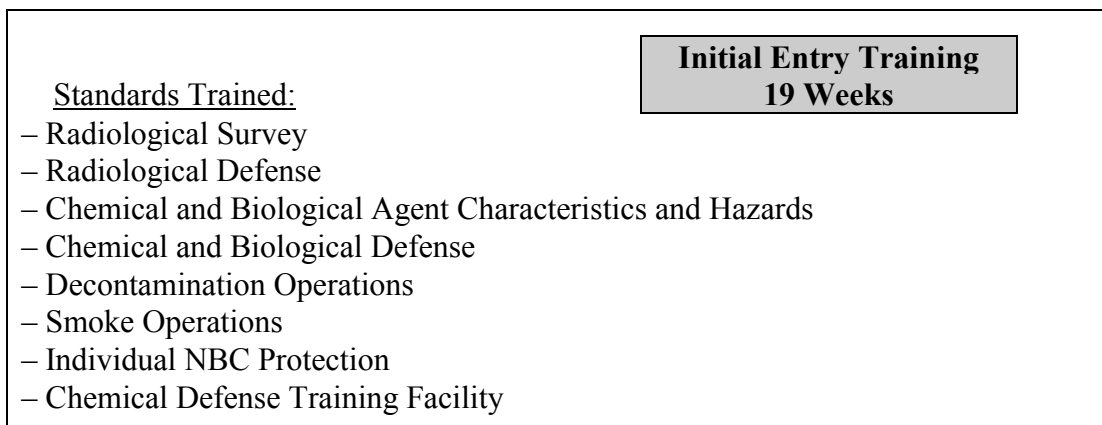
Joint Professional Military Education, Phases I and II, currently contains a limited degree of NBC defense considerations and requirements. It is essential that officers of all Services assigned to joint staffs understand the NBC threat, are familiar with U.S. capabilities to detect and mitigate the 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 short-falls. 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. Additional information on this course can be found in Section 4.3.1. Based on guidance contained in DoD Directive 6025.3, *Clinical Quality Management Program in the Military Health Services* (signed 20 July 1995), health care providers are directed to receive certification for assignments during military operations. This certification includes NBC defense training and provider courses where applicable. The medical commander will review certification annually. In addition, on 20 December 1995 the DoD completed DoD Instruction 1322.24, *Military Medical Readiness Skill Training*, which implements policy, assigns responsibility, and prescribes procedures for developing and sustaining comprehensive systems for providing, assessing, and monitoring military medical skills training essential for all military personnel, health care personnel, and medical units. NBC defense training, to include chemical and biological warfare defense measures and medical specialty training such as casualty management, are specifically articulated in the instruction.

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.



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

Chemical Corps sergeants attend the 15 week 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, and protective measures and to lead smoke/decontamination squads.

Chemical Corps staff sergeants and sergeants first class attend the 13 week 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. During training they receive advanced technical operations, hazard estimates, logistics and maintenance management, combined arms operations, smoke and flame support, and 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 and NBC defensive planning, individual and unit tactical operations, and biological detection operations. This course includes classroom instruction, hands-on equipment training, and field exercises. 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, in which they are trained to serve as the commander of a Chemical Company and 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 and NBC defensive planning to include: hazard prediction, NBC reconnaissance and decontamination operations. Additionally, officers receive training in nuclear, biological and chemical vulnerability analysis, operational radiological safety, and environmental management. 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).

<p><u>Standards Trained:</u></p> <ul style="list-style-type: none"> <li>– Leadership</li> <li>– Army Operations</li> <li>– Plan and Conduct NBC Reconnaissance</li> <li>– Decontamination Operations</li> <li>– Chemical and Biological Agent Detection Operations</li> <li>– Smoke and Flame Operations</li> <li>– Nuclear, Biological, and Chemical Vulnerability Analysis</li> <li>– Operational Radiation Safety</li> <li>– Environmental Management</li> <li>– Chemical Defense Training Facility</li> </ul>	<div style="border: 1px solid black; padding: 5px; background-color: #cccccc;"> <p><b>Chemical Captains Career Training 18 Weeks</b></p> </div>
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**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)

**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.

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/ lethal-



ity 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 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 capitalizes on the unique capabilities of the Army Chemical School. 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.

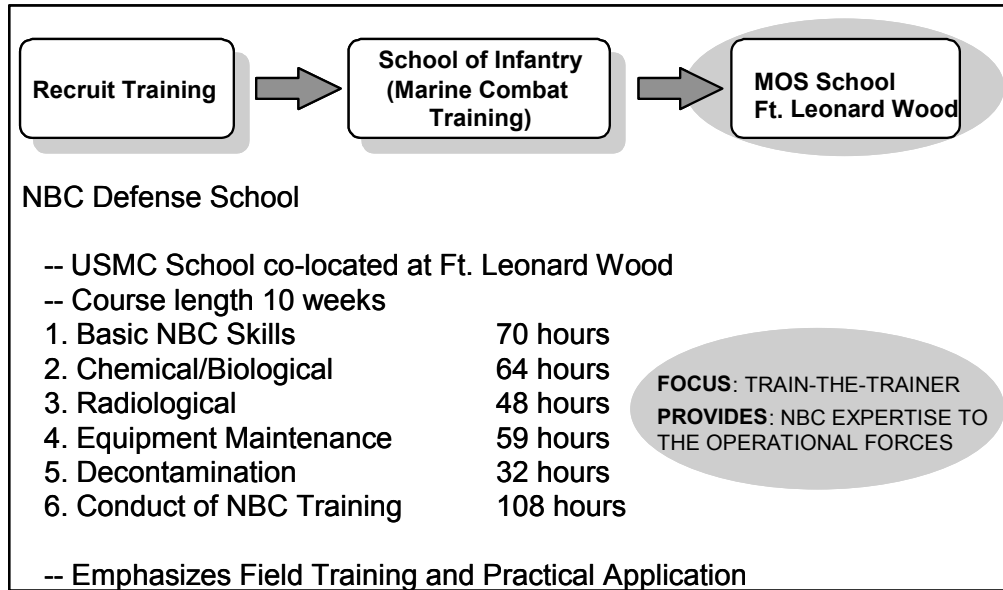
<b>Course Name</b>	<b>Course Location</b>
Recruit Training CBR-D	Naval Training Center Great Lakes, IL
Damage Control “A” School	
Senior Enlisted Damage Control	Fleet Training Center San Diego, CA
Hospital Corpsman “A” School	Naval Training Center Great Lakes, IL
Independent Duty Corpsman	Naval School 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 the courses conducted by the Marine Corps NBC Defense School, Marines attend three other

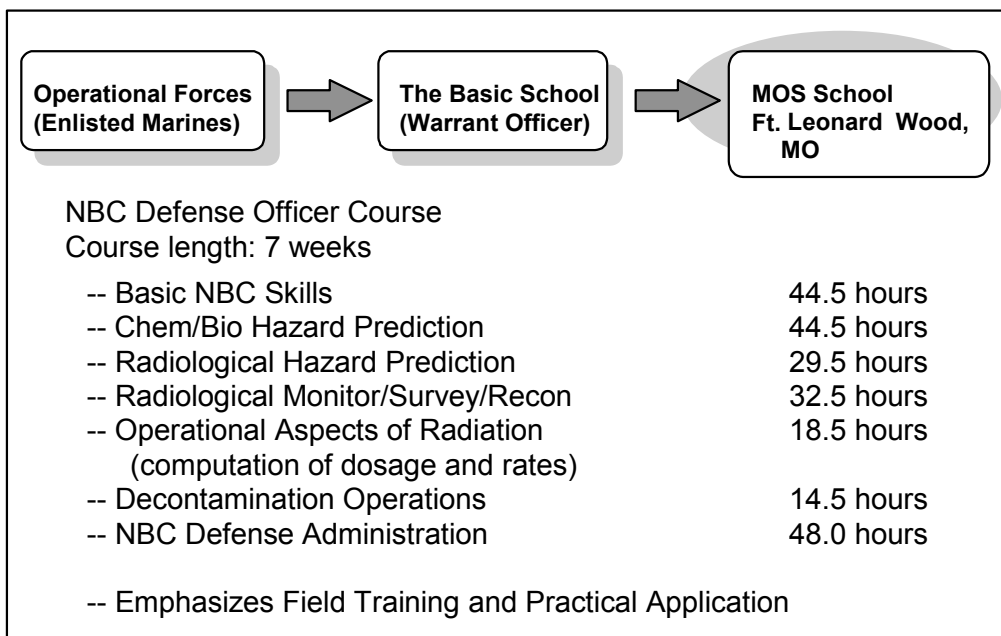
functional courses (Chemical Captain's Career Course, NBC Reconnaissance Course, and the Master FOX Scout) conducted by the Army Chemical School.

The USMC Enlisted Basic NBC Defense Course trains approximately 220 NBC 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 seven blocks of instruction as shown in Figure 4-5.



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

**Training For NBC Officers.** Establishment of a Marine Corps Basic NBC Officer Course is complete. This course, shown in Figure 4-6, provides the requisite NBC skills to newly selected Marine Corps NBC Defense Officers. The first course began in June 1997. All Marine NBC Officers are Warrant Officers, usually selected from NBC Defense specialist enlisted ranks. As Warrant Officers, they focus entirely on technical expertise, NBC defense training, and supervision of enlisted NBC defense specialists. The NBC Defense Officers Course focuses on Warrant Officers and builds on previous training received. NBC Officers also attend the Army's Chemical Captain's Career Course and Joint NBC courses as part of advanced Military Occupational Specialist (MOS) training.



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

#### 4.5 TRAINING IN A TOXIC CHEMICAL ENVIRONMENT

In 1987 the Army established the 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 55,000 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 now training 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 growing international interest in CDTF training participation. Germany celebrated its 10th year of CDTF training. The Netherlands has been taking advantage of this

training opportunity for about seven years. There is also interest from the Danish and British militaries to conduct this training.

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/WARFIGHTEREXERCISES**

### **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 images which replicate adjacent elements, the enemy, and the environments upon which the battle is waged.

There are over 750 virtual and constructive models and simulations in the Army community alone. Table 4-2 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.

Current training exercise warfighting simulations have not received sufficient priority and/or funding to adequately portray 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.

**Table 4-2. 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	

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 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 into 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. 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 and Fort Polk, Louisiana.

A virtual simulation for the P3I BIDS system has been installed at Fort Leonard Wood, Missouri and a portable unit is to be installed with the 7<sup>th</sup> Chemical Company, which is stationed at Fort Polk, Louisiana.

#### **4.6.2 Joint NBC Training/Joint and Combined Exercises**

***Chairman of the Joint Chiefs of Staff (CJCS) Exercise Program.*** Joint NBC defense training objectives must be incorporated into the CJCS Exercise Program. This program includes four

exercises sponsored by the Chairman and exercises sponsored by combatant commanders. The four CJCS-sponsored exercises are:

- (1) **Positive Force (PF)** exercises are large scale Command Post Exercises that normally consider national level issues such as mobilization and deployment. PF-99 was to have focused primarily on deployment. The exercise was canceled by the DEPSECDEF in order to provide resources required to mitigate the impact of Y2K anomalies. PF-01 will focus primarily on deployment. NBC events are scheduled as part of PF-01.
- (2) **Positive Response (PR)** exercises normally consider strategic level issues. In 1999, four PR exercises were devoted to dealing with Y2K issues. In FY01, PR exercises will focus on Foreign Humanitarian Assistance, Non-combatant evacuation, continuity of operations, and mobilization.
- (3) The **No-Notice Interoperability Exercise (NIEX)** program focuses on themes important to the Chairman. Past exercises have dealt with such issues as weapons of mass destruction and information operations. Future exercise dates, locations, and themes are classified.
- (4) The **NATO Crisis Management Exercises (CMX)** are conducted annually and are designed to practice and test procedures for NATO crisis management response with emphasis on response options, the NATO Precautionary System, and the generation of forces with associated rules of engagement. NBC play is not normally a major issue in NATO CMX exercises.
- (5) TOPOFF 2000 was a Congressionally mandated “no-notice” exercise conducted from 17 through 24 May 2000 involving multiple weapons of mass destruction (WMD) attacks in several geographically dispersed venues throughout the continental U.S. (CONUS). TOPOFF was co-sponsored by the Department of Justice (DoJ) and the Federal Emergency Management Agency (FEMA) in coordination with the National Security Council. The Assistant to the Secretary of Defense for Civil Support, ATSD(CS), was designated as the lead for the Department of Defense, in conjunction with the ASD (SO/LIC) for crisis response support. TOPOFF incorporated command post exercises (CPX), field training exercises (FTX), tactical exercises (TACEX) and several large-scale “subexercises”. It involved deployment of DoD components in both the counterterrorism (CT) and consequence management (CM) arenas.

The following CINC exercises conducted under the CJCS Exercise Program in FY 00 incorporated NBC situations:

- GLOBAL GUARDIAN (USSTRATCOM) – Strategic Readiness Training Exercise designed to test and validate Nuclear Command & Control and Execution Procedures.
- GLOBAL ARCHER (USSTRATCOM) – Exercised and evaluated the effectiveness of C4I equipment during a trans-/post-attack nuclear environment.
- ABLE ALLY (USCINCEUR) – Exercised Nuclear Procedural Command Post.
- ROVING SANDS (USJFCOM) – Joint Tactical Air Operations exercise that employed Army Air Defense Artillery (ADA) and USAF, USN, USMC and Allied air assets. Exercise included CJCS directed Theater Missile Defense initiative and Strategic

Forcible Entry Operations. Exercise included coordination for chemical/biological defense as an interoperability task.

- ULCHI FOCUS LENS (USCINCPAC) – Exercised the impact of chemical weapons on campaign strategy and maneuver.
- DINGO DAWN (DTRA) – Generated response planning in support of national policy and tested and validated national policies, procedures, planning, coordination, and execution in response to a nuclear weapon accident.
- DIMMING SUN (USCINCEUR) – Exercised US and UK response to a nuclear accident.
- KEEN EDGE 00 (PACOM) – US Army, Air Force, Navy, and Marine Corps. Exercised and evaluated NBC operations for forces operating in Japan and Korea. Highlights included planning for Large Frame Aircraft Decontamination, Non-Combatant Evacuation Operations in an NBC environment, establishing and NBC Warning and Reporting System with the Japanese Army and Air Force, and integration of US services in the theater.
- DETERMINED PROMISE (USJFCOM) – Exercised the deployment of JTF-CS in support of the Lead Federal Agency for Domestic CBRNE consequence management response.

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 will influence and guide development of CINC exercises and training, which will be conducted in Fiscal Year 2001.



**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.

The XVIII Airborne Corps' chemical units, both AC and RC, train throughout the year on unit collective tasks at the Combat Training Centers and during the RC's annual training periods. The XVIII Airborne Corps integrates Nuclear, Biological, and Chemical Defense units into all Combat Training Center (CTC) rotations. The various Corps units conducted four National Training Center rotations. Throughout every NTC rotation there were either divisional chemical elements and/or Corps units providing smoke, decon and NBC recon elements to the exercises. XVIII Airborne Corps units executed five Joint Readiness Training Center (JRTC) rotations, each had Chemical Corps units providing smoke, decon and NBC recon support. We are also examining the feasibility of integrating biological detection support in future JRTC rotations. The Corps' Wartraced 415<sup>th</sup> Chemical Brigade along with its aligned chemical units conducted the RIO LOBO exercise at Ft. Bragg during June 2000. The Chemical Brigade and subordinate Chemical Battalions conducted training on their collective tasks and exercised the assigned chemical companies in a demanding FTX scenario.

- ULCHI FOCUS LENS (UFL) incorporates CBW play. UFL focuses on training to execute USPACOM supporting plans.
- FOAL EAGLE (FTX) incorporates significant number CBW events, including Mass Casualties, Decontamination, and response to TBM launches/hits.
- TEMPO BRAVE (TB) is a computer-assisted, joint theater-level simulation-driven command post exercise, and the CINC's premier JTF crisis action planning event. Consequence Management (CM)/CBW play is integrated into the Master Scenario Events List when appropriate.
- CORAL BREEZE seminars involving USFK and scenarios involving CBW use.
- CM seminars and workshops including both domestic and foreign USPACOM support to FEMA/Department of State. This has included working level seminars with local first responders to tri-lateral minister / ambassador level involving Japan, Korea, and the United States. USCINCPAC has also actively supported the Department of State executive seminars to Japan, Malaysia, Thailand, and the Philippines to respond to CBW terrorist incidents and US-supported CM.

- SOCPAC participates in two exercises in USPACOM, which exercise CM/CBW scenarios.
- USARPAC participates in CBW CONOPS development through participation in JCS and USAPACOM sponsored seminars, exercises/ wargames (UFL, TEMPO BRAVE, and CORAL BREEZE.)

The following two paragraphs highlight examples of training by specific Army units. United States Army Hawaii, (25 ID) 3 BCT, has its full complement of required chemical personnel assigned at Bde HQs and two Infantry battalions. Also supporting for smoke and decon missions is one Chemical Platoon from the 71st Chem Company. United States Army Alaska, as reported by 172 SIB and USARAK, unit NBC teams are training on detection measures and decontamination. NBC is played as a condition in all company, battalion and Brigade Field Training Exercises.

United States Army Japan (USARJ) assesses the NBC defense training and readiness of US Army Japan and subordinate units to be Partially Trained (Minus) (P-) for Calendar Year 00. In response to the specific inquiries, currently USARJ has no subordinate elements that participated in BCTP or CTC training programs during the calendar year. As such there is no training and readiness associated with CTC and BCTP. Further, due to the unique relationship between Japan and the United States as defined in mutual defense treaty, U.S. Army Japan does not participate in any combined exercises. Exercises are bilateral in nature. USARJ, as a “player” unit, participated in one Joint-level exercise—Keen Edge. Though there were NBC events in this exercise, none of these lead to the direct involvement of USARJ. NBC training was limited to pre-exercise planning. USARJ did however co-sponsor with the Japanese a number of bilateral exercises for visiting units. These exercise included Yama Sakura (I Corps, 9th TSC - bilateral NBC training objective: Warning and Reporting), Keen Sword (1-27 Infantry, 25th Divisions - bilateral NBC training objective: Bilateral Decontamination Operations) Unilateral (US only) Joint exercises sponsored by USARJ included MEDEX 2000 (NBC training objective: Patient Decontamination). Generally small NBC events are built into the exercises sponsored by USARJ, but these events are designed to meet very specific training objectives, not integrating NBC as a major training event. Overall, training in US Army Japan and its subordinate elements is limited to Company-level and below collective training and individual/common task training. Collective training at higher level is limited by USARJ’s status as a TDA unit. NBC Training for the USARJ staff itself has been limited to individual level training.

**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.
- EFX – Air Combat Command sponsored expeditionary force projection exercise.
- The Global Expeditionary Medical System (GEMS), including patient encounter module and RAPID biological agent diagnosis, was successfully exercised at JEFX 3-16 Sep 00. Through near real time epidemiology, this system rapidly identifies possible epidemics, including first warning of covert CB attack, to enable and reduce commander decision time in saving lives. The RAPID pathogen diagnostic technologies proved invaluable in the real world infectious disease outbreaks in Southwest Asia.
- KEEN EDGE 00 (PACOM) – US Army, Air Force, Navy, and Marine Corps. Exercised and evaluated NBC operations for forces operating in Japan and Korea. Highlights included planning for Large Frame Aircraft Decontamination, Non-Combatant Evacuation Operations in an NBC environment, establishing and NBC Warning and Reporting System with the Japanese Army and Air Force, and integration of US services in the theater.

**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). During the intermediate and advanced phases of the training cycle, combat readiness is reinforced through Composite Training Unit Exercises and Fleet Exercises.

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 incorporates 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 FY99–00, 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
- Lucky Warrior

It should be noted that all Marine Corps units must also conduct quarterly NBC exercises to evaluate the readiness for combat. Evaluations include operational, administrative, and logistical functional areas. These exercises incorporate realistic NBC defense training into the exercise scenario to enhance the value of the exercise.

## 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 initiated 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 the JFCOM 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. Workshops will be organized to facilitate coordination of WMD/NBC Defense synergism across the Joint Professional Military Education (JPME) system. Action Reports and Lessons Learned of CINC exercises will be used WMD/NBC experts to assist exercise planners in incorporating WMD/NBC into CINC exercises.

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.** The JSIG established a Commodity Area (CA) for CB Modeling and Simulation (M&S) and appointed the Navy to be the lead service. Unlike other commodity areas, which manage advanced development programs, the M&S CA worked to develop joint requirements, identify funding requirements to improve training and doctrine development, and promote standardization. The mission of the M&S CA was shifted to the Joint Service Materiel Group in April 2000. The mission and scope for the M&S CA Manager is responsible for Joint Service coordination and integration of all M&S product development efforts, technology base through development, fielding, and logistics sustainment to meet Service CBD M&S requirements. M&S CA Manager works with the JSIG MSRP and M&S Integrator to establish and maintain an integrated, requirements-driven, M&S program. The CA Manager will provide recommendations for requirements integration and prioritization to the JSIG. The CA Manager will use requirements, and other appropriate metrics, in assessing both project health and establishing funding priorities.

To support the M&S CA Manager, the JSIG developed a CB M&S Master Plan, Joint Future Operational Capabilities (JFOC), Mission Needs Statements (MNS), and Operational Requirements Documents (ORD). The Master Plan has been drafted and provides the vision for future M&S development. The JFOCs were completed and form the basis for future M&S research and development conducted by the JSMG. The MNS and ORDs will be written in FY01 and define the future M&S systems required for training, analysis, and acquisition.

The DepSecDef signed a letter dated 1 Nov 00, which delegates 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**

In an effort to refine doctrine and training, the Army is quantifying the impact of NBC environments on combat operations. Two programs have been executed to achieve this goal: (1) Combined Arms in a Nuclear/Chemical Environment (CANE), and (2) Physiological and

Psychological Effects of the NBC Environment and Sustained Operations on Systems in Combat (P2NBC2). These Force Development Testing and Experimentation (FDTE) evaluations have improved our understanding of individual and unit operations and performance degradation while in MOPP. The CANE FDTE evaluations quantified field data that commanders can use for planning, training, and decision making to respond to the threat.

The Army, as proponent for CANE tests, has completed five field evaluations (mechanized infantry squad/platoon in 1983, tank company team in 1985, armor heavy battalion task force in 1988, light infantry forces in 1992, and air defense artillery in 1993). The Army has established the Chemical Vision Implementation Plan (CVIP) a systematic review process to ensure identified deficiencies are addressed and corrected. The Commandant of the Army's Chemical School reviews the CVIP annually. Army field manuals are then revised to address deficiencies identified in CANE tests.

Before CANE FDTEs were conducted, commanders' training in a simulated NBC environment had an indication of the degradation that MOPP places on their operations. They were aware that training could maximize proficiency, but they lacked the feedback to direct that training. Consequently, training was often sporadic and incomplete.

The Army is now implementing several training guidance improvements by:

- Providing heightened command emphasis to unit commanders on NBC threat with attention to Third World countries;
- Simulating NBC environments in training;
- Continuing emphasis and effort to integrate safe, realistic NBC defense in all types of training.

Over the past several years, the Army has also 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 will begin 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.
- Identify doctrinal voids for subsequent proposal, preparation and submission to April 01 Joint Doctrine Working Party.

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 both CB Defense Training and Doctrine across the fleet and also improving coordination of defense actions with the other services. To raise the level of CBR-D knowledge, CB Defense interactive CD-ROM trainers and videotapes were fielded to operational units.

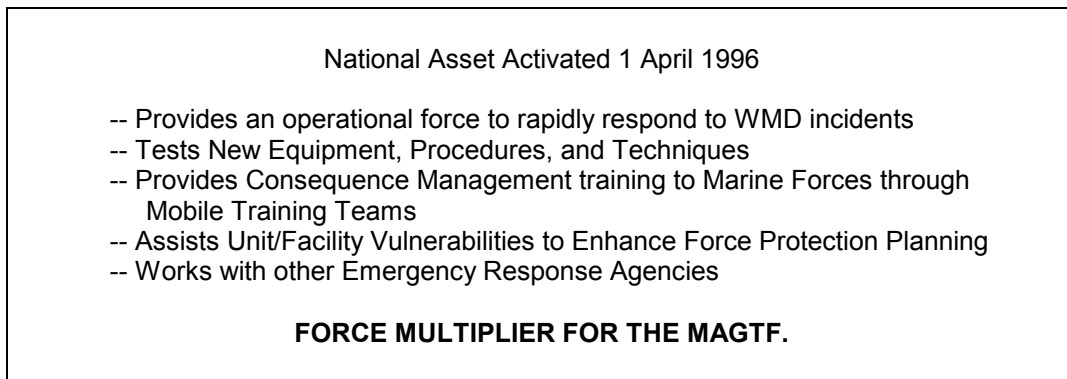
Under the direction of the Navy Environmental Health Center (NEHC), Navy Environmental Preventive Medicine Units (NEPMUs) in San Diego, CA, Norfolk, VA, Pearl Harbor, HI, and Sigonella, Italy have instituted a course of instruction for the training of medical personnel in the medical management of casualties caused by chemical, biological, radiological, and environmental (CBRE) exposures.

Personnel from the Navy Warfare Development Command, Surface Warfare Officer School Command, and the Naval Construction Training Center assisted in revisions to CB Defense Doctrine, including NWP 3-20.31 *Surface Ship Survivability* and NWP 3-11.23 *Joint Doctrine for Nuclear, Biological, and Chemical (NBC) Defense Operations*. These doctrine changes were developed and tested during Joint/Combined training exercises.

The Navy also maintains a response capability at the Naval Medical Research Center (NMRC). NMRC is primarily a research institute. However, NMRC's Biological Defense Research Directorate has developed a capability that consists of a transportable biological field laboratory, expressly for the identification of biological warfare agents.

#### 4.7.5 Marine Corps

During FY00 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.



**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 Marine Force Commanders 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



five elements: Headquarters (including a Reach-Back Advisory Group), Security, Search and Rescue, Service Support, Force Protection (Reconnaissance/Decontamination) and Medical. 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 serves as a training asset to the operational forces. The CBIRF will provide mobile training teams to various units to provide advanced consequence management. This will 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 FY00 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 Operations Southern Watch and Fleet Battle Experiment-Foxtrot.
- The Marine Corps NBC Defense School completed integration of Joint Warning and Reporting Network software into current programs of instruction.
- Developed the Equipment Requirements for the "Enhanced NBC" capability set for the Marine Expeditionary Units (MEUs) that are forward deployed with the Navy.
- Completed the analysis for an NBC SNCO Advanced Course in Fort Leonard Wood Missouri.
- Participated in Joint Marine Corps and Navy Shipboard decontamination exercises with the 7<sup>th</sup> Fleet.
- Revised Marine Corps Order on Nuclear, Biological and Chemical Defense Training MCO 3400. July 00.
- Conducted the Annual NBC Conference in Dumfries, Virginia on 18–22 September 2000.
- The Marine Corps' Chemical/Biological Incident Response Force (CBIRF) moved from Camp Lejeune, North Carolina to the Naval Surface Warfare Center (NSWC) Indian Head, Maryland during the summer of 2000.

**Marine Corps FY00 Initiatives:**

- Initiated development of a 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 Joint Training Assessment Working Group activities regarding assistance with identification of training requirements for all joint NBC defense equipment development programs.
- The Marine Corps is planning the Operational Testing (OT) for the Sorbent Decontamination System, which will help continue the process of replacing DS2 with a waterless decontaminant.

#### **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 assistance 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/deceased to assist in the identification of agent(s) used against U.S. personnel.
- Provide guidance on the vaccination and prophylaxis against biological warfare agents.

The Office of the Surgeon General is currently updating Army Regulation 40-13, *Nuclear/Chemical Accident Incident Response*, to include all medical teams which could potentially be available to support civil authorities in the event of a terrorist attack with WMD. The regulation will also include the Army policy for fixed facility medical treatment facilities in support of local domestic first responders. The Office of the Surgeon General published MEDCOM Regulation 525-4, *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 SMART's 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 SMART's 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 mission of the SMART-PM is to provide short duration Expert Preventive Medicine Augmentation to DoD, other Federal, State and Local Agencies during regional and domestic emergencies, civil-military cooperative actions, weapons of mass destruction, humanitarian and disaster relief operations. The SMART-PM can:

- Conduct public health assessment and community characterization to help identify the population at risk.
- Conduct environmental health consultation to help identify possible hazards and threats that may be a target or result of industrial terrorism.

- Conduct health risk assessment to help determine the possible effects of toxic industrial material exposures and assist in development of educated casualty estimates and controls.
- Conduct hazard countermeasures planning to help protect DoD response assets and assist with planning for safe consequence restoration and recovery.
- Serve as DoD Public Health and Environment Technical Liaisons to other DoD assets and Federal.
- Provided emergency support functions.

In general, SMART-PM can provide expert consultation for the re-entry and restoration portions of the consequence management phase of federal emergency response in the following areas:

- Health Physics (Nuclear/Radiological)
- Epidemiology & Disease Surveillance
- Medical Entomology
- Environmental Health Science
- Toxicology
- Industrial Hygiene
- Environmental Sampling and Analysis (Air, Water and Soil)
- Health Risk Assessment
- Sanitation and Hygiene
- Solid & Hazardous Waste Management
- Health Risk Communication

SMART-PM normally would work in support of SBCCOM's C/B-RRT during a WMD response mission.

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 casualties, 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**

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.

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. Historically, most veterans' health and benefit issues related to service in combat operations. Now, U.S. forces are more likely to deploy into non-combat environments such as peace-keeping, peacemaking, humanitarian assistance, or training. Pre-deployment medical screening of U.S. Forces prior to deployment is now a DoD requirement.

Joint Medical Surveillance within the Joint Operational Area should be initiated at the earliest opportunity to provide the Joint Force Commander with the information needed to position U.S. forces safely upon deployment. Medical surveillance information also is useful in identifying and applying pre-deployment medical countermeasures to protect the health of the force.

It is DoD policy that pre- and post-deployment health assessments, screenings, and briefings shall be required for all troop movements of active and reserve component personnel resulting from 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. All policy memorandums, instructions, and copies of blank DD forms can be found on the internet at <http://www.cba.ha.osd.mil> — select "Projects/Deployment Surveillance".

Recent deployments have confronted the JFC with toxic industrial chemicals, radiological hazards, and long term environmental contamination from industrial operations within the host nation. Standard U.S. occupational health and environmental standards are not effective for protecting the force during these deployments. 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. Prior identification of potentially hazardous industrial or medical sites and areas of known environmental contamination are essential to the risk management and risk communication process.

This type of information, if not provided by the host nation, is available from the Armed Forces Medical Intelligence Center and the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM). 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 USACHPPM Technical Guide 230A, "Short-Term Chemical Exposure Guidelines for Deployed Military Personnel". The "target population" consists of healthy 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.

Central to force protection is the integration into campaign and operational plans of force health protection measures such as risk management and risk communication. Medical counter-measures include pre- and post- deployment medical screening, immunizations, medical pre-treatments, NBC casualty treatments, and medical record keeping. Functions being considered in medical readiness planning are area medical support, hospitalization, evacuation, preventive medicine, and laboratory. Joint medical surveillance within the theater of operations can identify NBC related occupational, industrial, and environmental health hazards. Preventive medicine 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. Current military deployments are Stability and Support Operations (SASO), peacekeeping, or humanitarian in nature. Commanders are being confronted with industrial hazards and environmental contamination within the host country which place the health of the force at risk. 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.

#### 4.9 NBC DEFENSE TRAINING AND READINESS ASSESSMENT

**ISSUE:** There are limited chemical or biological features in wargaming and planning models.

**SOLUTION:** Funding to add chemical and biological warfare defense to joint simulations has been allocated by the JSIG M&S Commodity Area for FY99 and beyond. The program will focus on incorporating chemical effects into JCATS and JSIMS in FY99-00 and BW effects in FY00-01. To add CB defense capabilities to OneSAF, the possibility of incorporating the CB-ModSAF model developed by SBCCOM will be considered.

**ACTIONS DURING REPORTING PERIOD:** The Joint Service Materiel Group formed the Modeling and Simulation Commodity Area Manager (M&S CAM) in April 2000 to manage the CBD modeling and simulation development programs from tech base through fielding. A manager has been appointed. Funding for the program activities is pending the development of an investment strategy and plan. The report of the M&S CAM is located in Chapter 2. The JWARS simulation will have a chemical module in release 1.1. The CB defense capability has been identified in the OneSAF development. However, incorporation of the capability for this development cycle was not funded.

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# *Chapter 5*

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

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### **5.1 INTRODUCTION**

The Chemical Weapons Convention (CWC) was opened for signature on January 13, 1993. The Convention entered into force on April 29, 1997. As of November 28, 2000, 141 countries, including the United States, had signed and ratified the CWC. Another 33 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 300 visits and inspections at chemical weapons 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. OPCW inspectors conduct both continuous monitoring at DoD CW destruction facilities and systematic inspections at DoD CW storage and former production facilities. DTRA provides CWC Orientation Training to USG national escorts and to date, has provided training to 676 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 December 15, 2000, the OPCW had conducted 18 inspections.

The Department of Defense 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 meet, as needed, to address CWC compliance concerns, should they arise.

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 OPCW is charged with overseeing worldwide implementation of the CWC.

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), and destruction of other chemical warfare materiel and former CW production facilities. There is a separate non-PMCD program to demonstrate alternative technologies to destroy assembled CW munitions. DoD and the Army coordinate closely 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 presented by the Army that is broken down into two sections. One section is a 24-hour hazardous waste operations and emergency response (HAZWOPER) course which is a U.S. Government 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 Technical Secretariat, whose responsibilities would include the use of such protective equipment. Approximately 219 inspectors have attended HAZWOPER training; 88 of the 219 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. 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 compliance implementation 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 to further ensure DoD readiness for 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 is organizing both a tabletop and a mock challenge inspection exercise to be conducted in 2001 at a DoD facility and has invited the Technical Secretariat to participate by providing an inspection team. DoD's objective in including the Technical Secretariat is to better understand the challenges DoD will face in demonstrating compliance and protecting national security and gauge Technical Secretariat 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 (printed and video) 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 U.S. government personnel from the departments of Defense, Commerce, and Justice.

In August 1999, 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 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 OPCW. 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 U.S. Government 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 signatory nations. Such assistance, however, is being provided to Russia under DoD's Cooperative Threat Reduction (CTR) program.

## **5.8 ARMS CONTROL TECHNOLOGY**

DTRA conducts RDT&E to support U.S. roles in global chemical weapons (CW) arms control 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, and enhance the safety of inspections. Current emphasis is on technologies and procedures for on-site analysis under the CWC. Other key development areas include non-destructive evaluation and off-site monitoring. Verification technologies are not developed for OPCW inspectors, as the OPCW has not entered into a cost sharing agreement with the U.S. as required by the Senate conditions for ratification.

DTRA developments to date include analytical software for use in chemical analysis by gas chromatography/mass spectrometry. This software satisfied a critical requirement to prevent the release of potential sensitive or confidential business data to the international inspectorate during CWC inspections. Additionally DTRA has developed and fielded non-destructive analysis technologies that have been employed as confidence building measure and also demonstrated their multi-functional role in other arms control related efforts such as UNSCOM inspections in Iraq. DTRA, in cooperation with Finland, is also developing and validating procedures for analytical sample preparation in an effort to minimize intrusiveness and time delays that could lead to requests to remove samples from U.S. facilities.

The Arms Control Technology program also participates in the mock challenge exercise process by providing input on analytical equipment and procedures, to include the potential impact of their use at DoD facilities.

# 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			
	- Joint Portal Shield Network Sensor System	Production	Joint	Joint	Joint	Joint
- Joint Bio Point Detection System (JBPDS), Block I	RDTE	Joint	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)	RDTE	Interest	Interest		
	- Biological Stand-off					
	--Joint Remote Biological Early Warning System (JBREWS) ACTD	RDTE	Interest	Interest	Interest	Interest
--Long Range Bio Stand-off Detection System-NDI (LRBDS-NDI)	Fielded	Rqmt	Interest			
NBC Recon	- Joint Service NBC Reconnaissance System (JSNBCRS)	RDTE				
	--M93A1 NBCRS/CB Mass spectrometer (See BIDS)	*	Rqmt		Rqmt	
	--Joint Service Light NBCRS/Lightweight Recon System (JSLNBCRS)	*	Joint	Joint	Joint	Interest
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		

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

#### FIELDDED 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 surveil-

lance, 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



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



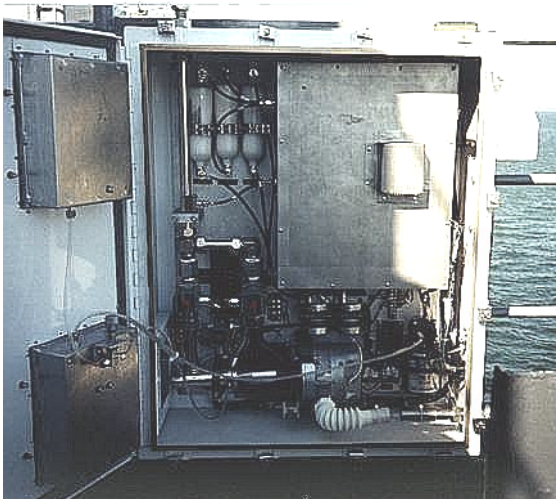
detecting and presumptively identifying 8 BW agents simultaneously in 30 minutes. The suite is semi-automated and contains next generation technologies such as the Ultraviolet Particle Sizer, Chemical Biological Mass Spectrometer, and the Biological Detector. Fielding of 38 systems to the 7<sup>th</sup> Chemical Company was completed in October 1999.

The Biological Detector is an antibody-based device capable of identifying specific biological agents. It consists of electronics processing equipment, fluid processing modules, reservoirs for antibody reagents, and a light addressable potentiometric sensor to provide biological agent identification. The total processing time, from insertion of sample to data readout, will be approximately 15 minutes at threshold concentrations. The biodetector includes an operator display which will provide identification and relative concentration of the biological agent detected. Built-in tests will also be provided to identify system malfunctions.

CBMS detects and characterizes chemical and biological threat agents. It continuously and automatically detects threat agents via a mass analyzer chassis, a biological aerosol sampling probe, a surface sampling probe and sample identification device. The mass analyzer chassis houses the mass analyzer, pumps, control electronics, and computers. With the aerosol probe attached, the CBMS detects biological agent aerosols and chemical agents as aerosols and/or vapors in the air. With the ground probe attached, the CBMS detects chemical agents whether they exist as airborne vapors or aerosols, or as liquid droplets on surfaces. The CBMS will replace the MM1 and be mounted within the NBC Recon System to search for areas of CB agent contamination.



### **Interim Biological Agent Detector (IBAD)**

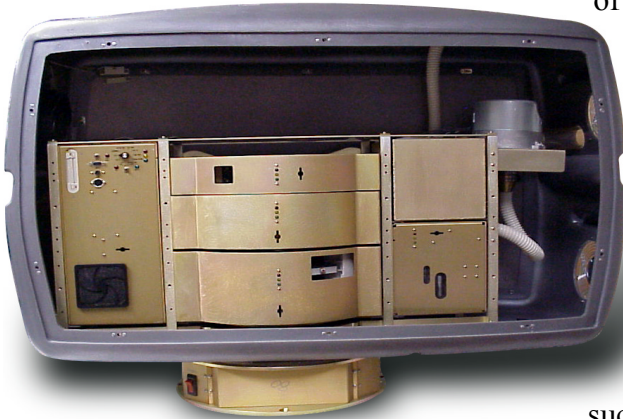


IBAD provides shipboard detection of biological warfare agents. IBAD consists of a particle sizer/counter, wet wall cyclone particle sampler, and hand held assays (HHAs) for the presumptive identification of suspect aerosol particles. IBAD is capable of detecting an increase in the particulate background, 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.

### Joint Portal Shield Network Sensor System

Portal Shield is an interim capability for biological detection at high value fixed overseas sites. Portal Shield has transitioned from an ACTD to a formal production program. The system uses an innovative network of sensors to increase probability of detecting a BW attack while decreasing false alarms and consumables. The Portal Shield system consists of a variable number

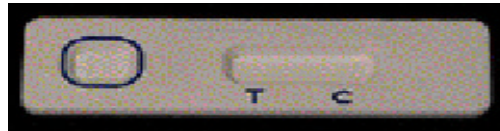


of biological sensors mounted around the perimeter of a fixed site forming a network under the command and control of a centralized command post (CP) computer. The CP communicates with and monitors the operation of each sensor. The sensor is modular in design and can detect and presumptively identify up to eight BW agents simultaneously in less than 25 minutes. The Portal Shield was successfully deployed overseas in support of Operation Desert Thunder, and was also successfully operated during the NATO 50<sup>th</sup> anniversary.

Eight overseas sites are currently fielded and outfitted with Portal Shield networks. An additional 19 sites are scheduled and funded for fielding in FY01-02. Portal Shield has chemical sensor interfaces (M22 ACADA, M21 RSCAAL, M90 AMAD) for an integrated chemical and biological sensor network capability.

### Hand Held immunochromatographic Assay (HHA)

The HHA is a simple, antibody-based assay test used to presumptively identify BW agents. HHAs are inexpensive, highly specific, sensitive and very reliable. HHAs are designed to identify one agent per assay and can currently identify 9 different BW threat and 4 simulant agents. The HHAs can either be read by eye or incorporated into automated detection device (*e.g.*, 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.

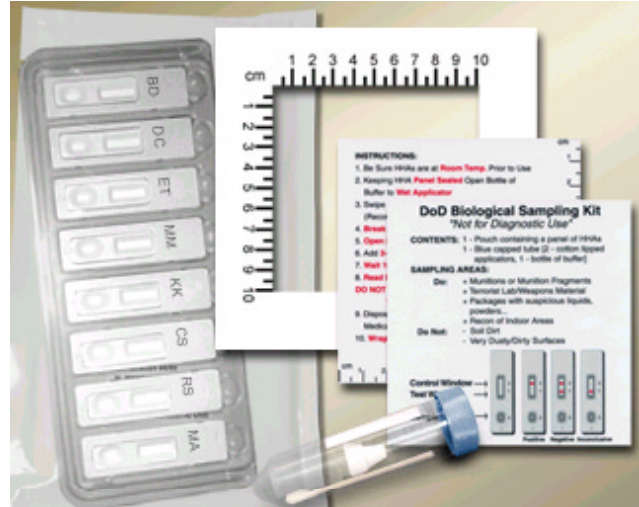


### DoD Biological Sampling Kit



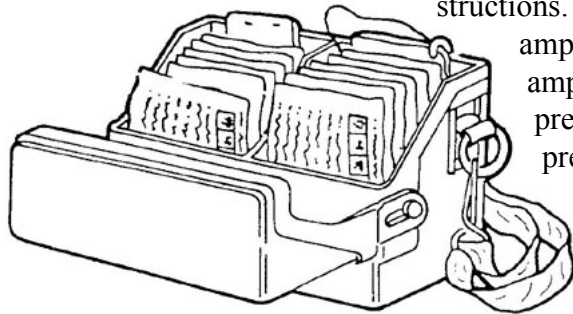
The DoD Biological Sampling Kit, with its associated HHAs, are employed for: field screening suspect munitions or munitions fragments for presence of biological warfare (BW) agents; screening packages that display suspicious liquids, powders or suspensions; screening suspect terrorist laboratory or weapons 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 can also be used as a back-up presumptive identification

capability for the Joint Biological Point Detection System (JBPDS), Biological Integrated Detection System (BIDS), Interim Biological Agent Detector (IBAD) and Portal Shield. 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. The DoD Biological Sampling Kit must be stored at 4° C, has a one-time use only capability, and cannot be reused. All components of the DoD Biological Sampling Kit must be disposed of as medical waste.



### 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 comes in 4" by 2 1/2" booklets. Each booklet contains 25 sheets of detector paper that are capable of detecting G series nerve



M9 Paper

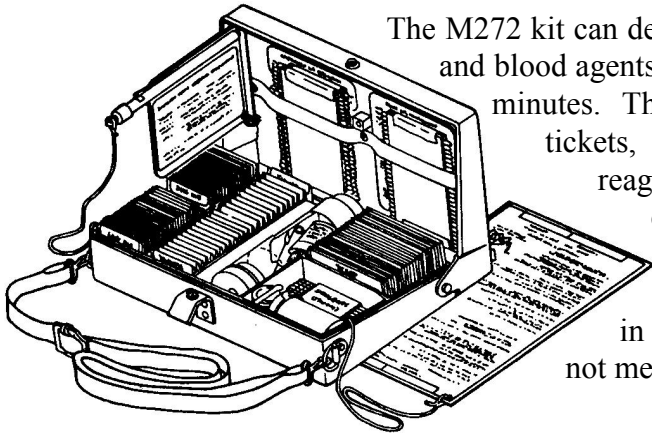
agents (sarin, tabun, soman, and GF), V type nerve agents, and H (mustard) type blister agents. M8 paper can identify agents through distinctive color changes from its original off-white: yellow-orange for G, blue-green for V, and red for H. M8 paper is typically used to identify unknown liquid droplets during chemical reconnaissance/surveillance missions. M9 (SR119) detector paper is rolled into 2-inch wide by 30-foot 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 will be fielded in October 2000 and only used by special teams such as surety teams or technical escort personnel.

### **M272 Water Test Kit**

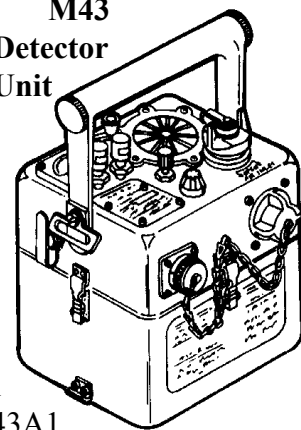


The M272 kit can detect and identify hazardous levels of nerve, blister, and blood agents in treated or untreated water resources in about 20 minutes. The kit contains enough detector tubes, detector tickets, a test bottle, and pre-packed, pre-measured test reagents to conduct 25 tests for each agent. 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.

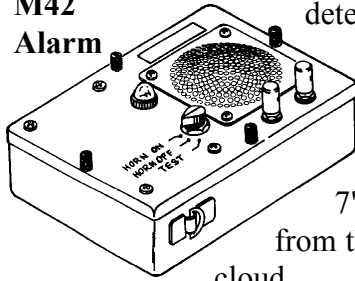
### **M8A1 Automatic Chemical Agent Alarm (ACAA)**

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 6 1/2" x 5 1/2" x 11" with the battery used in ground mounted operations adding another 7 3/4" in height. The M43A1

**M43  
Detector  
Unit**



**M42 Alarm**



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.



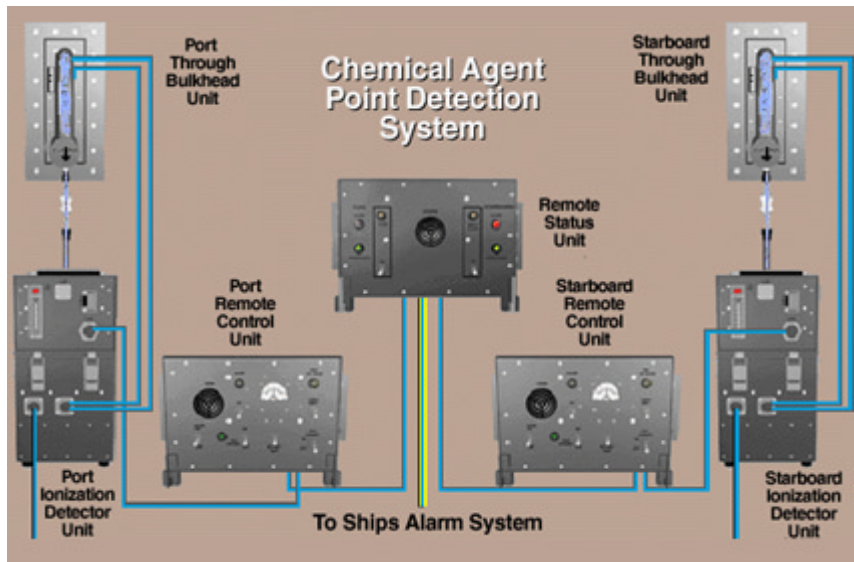
**Automatic Liquid Agent Detector (ALAD)**

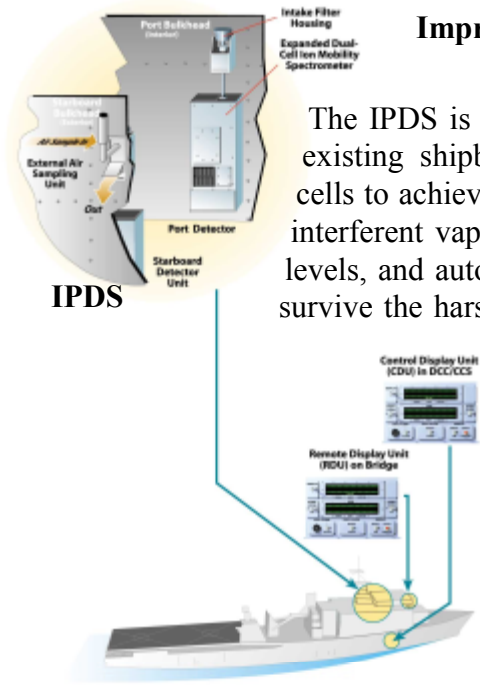


The ALAD is a liquid agent detector that can detect droplets of GD, VX, HD, and L as well as thickened agents. It transmits its alarm by field wire to a central alarm unit. Although the remote transmission is useful, the device only detects droplets of liquid agents. It must be used in conjunction with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



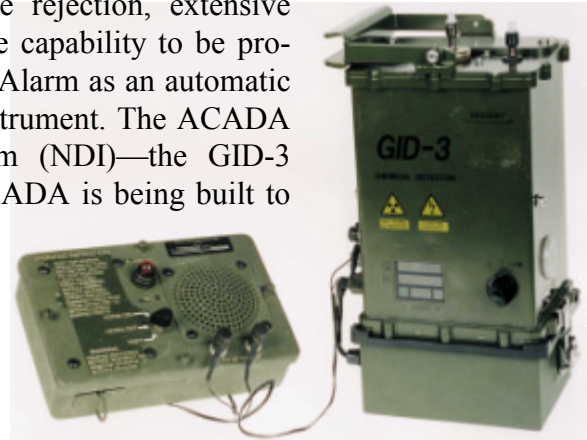


### Improved (Chemical Agent) Point Detection System (IPDS) - Production

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 interferences. 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.

### **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 will emphasize collection and archiving of exposure to chemical agents using passive sampling methodology. Phase II will include 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)

**Rationale:**

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

**Key Requirements:**

- Automatically detect, identify and warn of the presence of aerosolized biological warfare and produce a sample for transport to and further analysis by in-theater, CONUS or other designated laboratories agents at levels of sensitivity, speed and reliability equal to or better than currently fielded detection systems BW detection capability greater or equal to existing fielded interim systems
- Probability greater than or equal to 0.98 of identifying a biological agent, at sensitivity levels greater than currently fielded interim systems, in 15 minutes or less.
- False positive response for identification of less than or equal to two percent of analyses conducted
- Reliability of 0.92
- Availability of 0.90
- Mean Time Between Operational Mission Failure of 144 hours
- Mean Corrective Maintenance Time for Operational Mission Failure Repair of 5 hours
- Provide a common suite of biological detection equipment that can be applied to all four services' designated platforms
- Provide a man-portable version (Air Force and Marine Corps)

**Description:**

JBPDS is a joint biological point detection system. This developmental system will replace all existing biological detection systems (BIDS, IBAD and the Joint Portal Shield Network System), and provide biological detection capabilities throughout the services and throughout the battlespace. The common biological detection suite will consist of four functions: *trigger* (detects a significant change in the ambient aerosol in real time), *collection* (collects samples of the suspect aerosol for analysis by the JBPDS, and for confirmatory analysis by supporting laboratories in the Com-



munications Zone and CONUS), *detection* (able to broadly categorize the contents of the aerosol and lend confidence to the detection process; e.g., biological material in the aerosol or not, bacteriological, spore, protein, etc.), and *identification* (provides presumptive identification of the suspect BW agent and increases confidence in the detection process). These four functions will be integrated to allow fully automatic operation, and warning of a positive BW detection. The JBPDS program consists of two phases (Block I and Block II) to allow the fastest possible fielding of a joint biological detection system, while at the same time preparing to take advantage of the rapid advances taking place in the biological detection/identification, information processing and engineering sciences. JPO-BD awarded an Engineering and Manufacturing Development (EMD) contract in FY97 for the development of Block I JBPDS prototypes for all four services. Production is anticipated to start in 1QFY01, with first unit equipped in 3QFY03. This joint acquisition strategy will allow for significant economies throughout the RDA process by eliminating duplicative efforts among the services, and greater logistic supportability in joint operations as each service will be able to support the other services' JBPDSs.

### **Critical Reagents Program (CRP)**

#### Rationale:

- Supports all Services, DoD first responders, and NATO countries' biological detection programs

#### Key Requirements:

- Provide Total Life Cycle Management for the critical reagents (antibodies, and gene probes and primers) that are necessary to the operation of nearly all DoD biological detection systems.
- Ensure best quality reagents are available in time and in adequate quantities.
- Ensure adequate security and surge capability of critical reagents.
- Produce Hand Held Assays (HHAs) and DoD Biological Sampling Kits that are critical to several bio detection programs.

#### Description:

The Critical Reagents Program will ensure the quality and availability of reagents, Hand Held Assays (HHAs), and DoD Biological Sampling Kits that are critical to the successful development, test and operation of biological warfare detection systems and medical biological products managed by JPO-BD. The program will maintain an R&D effort to ensure the best possible reagents are available for use against both current and emerging threats. The program will institute a program wide quality assurance program and address relevant security issues. During the first four years of the program, the CRP will require the greatest level of effort and funding to ensure required reagents are available to support fielded systems (BIDS NDI, BIDS P3I, the Joint Portal Shield Network System, and IBAD), and developmental systems (JBPDS Block I and JBREWS ACTD), as well as DoD first responders and NATO countries. The next three years require the development of 12 additional reagents to support the development and fielding of the JBPDS Block II. Outlying years will focus on the development of reagents to

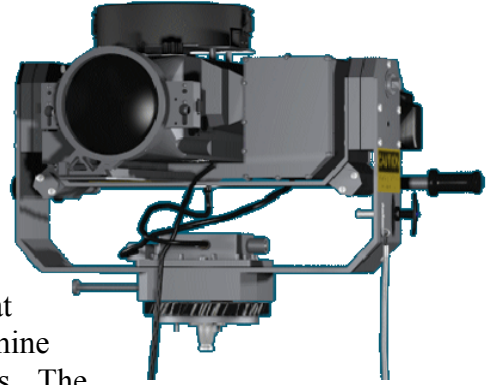
detect new and emerging threats, molecular and diagnostic reagents, and procurement of more effective reagents to replace older stocks.

## 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.

#### Long Range Biological Stand-off Detector System (LRBSDS) - NDI

LRBSDS utilizes elastic backscatter and infrared light detection and ranging (IR-LIDAR) technology to detect, range, and track particulate clouds that are indicative of a BW attack; the LR-BSDS cannot discriminate biological from non-biological clouds. The system, which is approximately 1,240 pounds and 2.3 cubic meters, has three major components: a pulsed laser transmitter operating at IR wavelengths; a receiver and telescope; and an information processor and display. The system is mounted on a UH 60 Blackhawk helicopter for operations. This program has been designed in two phases; an NDI phase designed to rapidly field an interim capability and a pre-



planned product improvement (P3I) phase. The three NDI LR-BSDSs have been fielded to the 310<sup>th</sup> Chemical Company (USAR). The NDI system is able to detect and track man-made aerosols out to 30 km, but is non-eyesafe out to about 2.5 km.

## STAND-OFF DETECTION AND REMOTE/EARLY WARNING

### RDTE ITEMS

#### Joint Service Lightweight Standoff Chemical Agent Detector (JSLSCAD)

*The JSLSCAD is a fully coordinated joint service RDTE program, chartered to develop a lightweight standoff chemical detector for the four services. The JSLSCAD will utilize a passive infrared sensor with 360° scanning to satisfy requirements for all four services.*

#### 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.

## Joint Service Warning and Identification LIDAR Detector (JSWILD/Artemis)

*JSWILD is a joint effort chartered to develop a chemical warning and identification system for the quad-services. JSWILD will utilize an active LIDAR sensor to perform rapid agent identification and ranging to satisfy requirement for all four services.*

### Rationale:

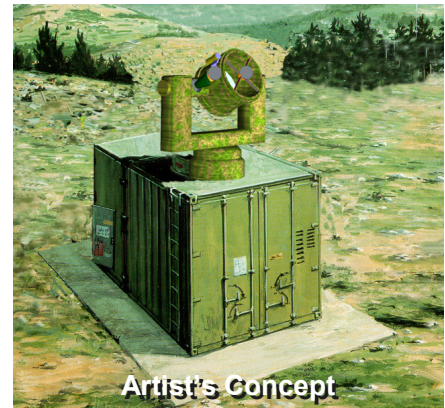
- Army and Air Force interest

### 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, 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 and ground vehicles. The system has distance-ranging and contamination-mapping capabilities and transmits this information to a battlefield information network.



## Biological Remote/Early Warning

*The Army's Biological Standoff Detection System (NDI BSDS) is a legacy system that is being incorporated into what is envisioned to be a family of early warning systems*

*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:**

- Standoff detection of aerosol clouds at ranges of up to 25 with an objective of 40 km
- Capable of providing automated biological discrimination
- Capable of operating from multiple platforms

### **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 System (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.

## **Joint Biological Remote Early Warning System (JBREWS) ACTD**

### **Rationale:**

- EUCOM requirement (ACTD)
- All services interest (ACTD)

### **Key Requirements:**

- The ACTD formally started in FY98, with fielding of ACTD systems to the EUCOM CINC sponsor around FY01

### **Description:**

JBREWS ACTD is a “system of systems.” That is, it may have standoff LIDAR systems, such as short range biological standoff detection systems (SR-BSDS) and dense arrays of small, rugged point detectors, integrated into a distributed network of sensors. The small sensors will possess only one or two of the functions that the much more robust JBPDS will have. The point detectors may be employed in a variety of ways: carried on vehicles,

or emplaced by hand around unit/site perimeters. The systems need to be networked to provide the greatest confidence of accurate detection and rapid warning. They will need to be deployed and distributed widely and in high numbers to ensure point releases are not missed.

## 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 to the M93A1 Fox NBCRS will incorporate enhanced chemical and biological detectors that will allow on-the-move standoff chemical agent vapor detection. Biological agent detection capability is added for the first time through the Chemical Biological Mass Spectrometer (CBMS). The CBMS (shown) 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.

#### Joint Service Light NBC Reconnaissance System (LNBCRS)

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 (*HMMWV variant shown*) 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) 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:

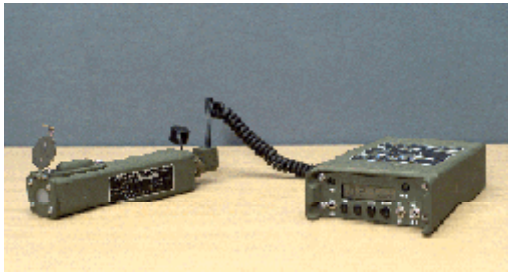
The Joint Warning and Reporting Network (JWARN) is an automated Nuclear, Biological, and Chemical (NBC) Information System. The JWARN will be essential for integrating the data from NBC detectors and sensors into the Joint Service Command, Control, Communication, Computers, Information and Intelligence (C<sup>4</sup>I<sup>2</sup>) 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

### FIELDDED AND PRODUCTION ITEMS

#### AN/VDR-2



The AN/VDR-2 measures gamma dose rates from 0.01  $\mu\text{Gy/hr}$  (micro-Grays per hour) to 100 Gy/hr and beta dose rates from 0.01  $\mu\text{Gy/hr}$  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 pre-sets 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 dielectrophoresis 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 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.

### **Pathogen Genome Sequencing Program**

Accomplishments:

- Initiated sequencing of the pathogenic bacteria *Brucella suis*, *Coxiella burnetti*, *Burkholderia mallei*, *Rickettsia typhi*, and several orthopoxvirus variants.
- Initiated sequencing of *Ochrobactrum anthrop*, a near neighbor of *Brucella suis*, and *Bacillus cereus*, a near neighbor of *Bacillus anthracis*.

Description:

DARPA is committed to sequencing the genomes of high threat biowarfare agents. This effort, undertaken with broad community interaction, will support 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. 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 electrochemical 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.

# Annex B

## Non-Medical Protection Programs

**Table B-1. Protection RDA Efforts**

Category	Nomenclature	Status	USA	USAF	USMC	USN
Eye/ Respiratory Protective Masks	<b>INDIVIDUAL PROTECTION:</b>					
	- MBU-19/P Aircrew Eye/Respiratory Protection (AERP)	Production	Interest	Fielded	Interest	
	- M48 Aircraft Mask	Production	Rqmt			Rqmt
	- CB Respiratory System (A/P22P-14(V))	Production			Rqmt	
	- M45 Aircrew Protective Mask (ACPM)	Production	Rqmt		Interest	
	- M40A1/M42A2	Fielded	Rqmt		Rqmt	Rqmt
	- MCU-2A/P	Production		Fielded		Rqmt
Ancillary Equipment	- Joint Service Aircrew Mask (JSAM)	RDTE	Rqmt	Rqmt	Rqmt	Rqmt
	- Joint Service General Purpose Mask (JSGPM)	RDTE	Rqmt	Rqmt	Rqmt	Rqmt
Battlefield Protective Suits	- Protection Assessment Test System (PATS)	Production	Rqmt	Fielding	Fielded	Interest
	- Voice Communication Adapter	Production	Rqmt	Rqmt	Fielded	Fielded
	- CB Protective Overgarment Saratoga	Fielded	Interest		Fielded	Interest
Integrated	- Chemical Protective Undergarment (CPU)	Fielded	Rqmt		Int-NIR	
	- Joint Service Lightweight Integrated Suit Technology (JSLIST/JSLIST P3I)					
	-- Overgarment	Prod.*	Rqmt	Rqmt	Rqmt	Rqmt
	-- Boots (MULO)	MS III*	Rqmt	Rqmt	Rqmt	
	- Battledress Overgarment (BDO)	Fielded				
Specialty Suits	- Force XXI Land Warrior	RDTE	Rqmt	Interest	Interest	Interest
Tentage and Shelter Systems	- STEPO	Fielding	Rqmt			
	- EOD Ensemble	Production	Rqmt			
	- Improved Toxicological Agent Protective (ITAP)	MS III	Rqmt		Interest	Interest
	- Joint Firefighter Integrated Response Ensemble (JFIRE)	Production	Rqmt	Rqmt		
Collective Protection (CP) Systems	<b>COLLECTIVE PROTECTION:</b>					
	- M20A1/M28 Simplified CP Equipment (CPE)	Fielded	Rqmt	Rqmt		Rqmt
	- CB Protective Shelter (CBPS) (Medical)	Production	Rqmt		Interest	Interest
	- Portable Collective Protection System (PCPS)	Fielded			Rqmt	
	- 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
Generic Filters	- Shipboard Collective Protection System (CPS)	Production	Interest	Interest		Rqmt
	- Shipboard CPE	RDTE	Interest	Interest		Rqmt
	- Modular Collective Protection System (MCPE)	Fielded	Rqmt	Interest		Interest
	- Advanced Integrated Collective Protection System (AICPS) for Vehicle, Vans, and Shelters	RDTE	Rqmt			
	- Selected Area Collective Protection System (SACPS)	Production			Interest	Rqmt
	- 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	
	- Fixed Installation Filters	Fielded	Rqmt	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

#### FIELDDED AND PRODUCTION ITEMS

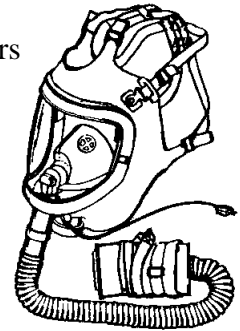
##### M17A2 Protective Mask



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 short is too large.

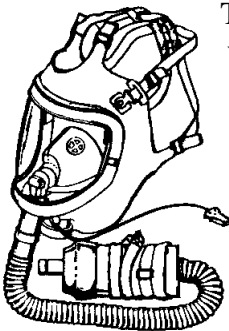
##### ABC-M24 Aircraft Protective Mask

This protective mask provides the wearer protection from NBC aerosols/vapors both in aircraft, and on the ground. The mask consists of: wide view, clear plastic lens embedded in a butyl rubber face blank; an integral microphone; eyelens outserts; carrying case; anti-fog kit; and a hose-mounted filter canister. The mask has a microphone connection to fit the aircraft communications systems. The M24 has an adapter that allows coupling to the aircraft's oxygen supply system. The M24 is being replaced by the M45 mask.



##### M25A1 Tank Protective Mask

This protective mask provides the wearer protection from NBC aerosols and vapors both in the vehicle/aircraft, and on the ground. The mask consists of: wide view, clear plastic lens embedded in a butyl rubber face blank; an integral microphone; eyelens outserts; carrying case; anti-fog kit; and a hose mounted filter canister. The mask has a microphone connection to fit the armored vehicle communications systems. The M25A1 has an adapter that allows it to be coupled to the tank's filtered and temperature controlled Gas Particulate Filtration Unit (GPFU). The M25A1 is being replaced by the M42/M42A1/M42A2 protective mask.





### 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



M42 Mask

accommodates NATO standard canisters, which can be worn on either cheek of the mask. The M40 series is designed for the individual dismounted ground warrior, while the M42 series 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 to be used in both the M40 and M42 configuration. This has resulted in significant operational and support cost savings.



M40 Mask

### 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.



### M45 Aircrew Protective Mask (ACPM) (FUE FY98)



The M45 Air Crew Protective Mask is specially designed to meet the requirements of helicopter and special crews. 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 M48 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.

### 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 the facepiece of the M43A1.



### 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 features
- Hypoxia protection up to 60,000 feet

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, reduce heat stress imposed by current CB protective masks, and the CB portion will be capable of being donned in flight. JSAM will also be compatible with existing aircrew life support equipment.

## ANCILLARY MASK EQUIPMENT

### FIELDDED 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.

## BATTLEFIELD PROTECTIVE SUITS

### FIELDDED 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 laundering. 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.

### **Chemical Protective Suit, OG MK-III (Navy Suit)**



The Chemical Protective Overgarment (CPO) protects the wearer against all known chemical and biological agents which present a percutaneous hazard. The suit consists of a smock and separate pair of trousers, and is sized to accommodate the 5 percentile female through the 95 percent male ratio. This garment will be replaced Navy-wide by a superior suit developed under the auspices of the JSLIST program. The Mark III suit protects against chemical agent vapors, aerosols, droplets of liquid, and biological agents.



### **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).*

#### **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 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.

**PROTECTIVE ACCESSORIES**

**FIELDED AND PRODUCTION ITEMS**

**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 12 hours and are durable for up to 14 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.

## SPECIALTY SUITS

### FIELDDED 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 (CW) 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<sup>2</sup> 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<sub>2</sub>, 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™ material.



### Self-Contained Toxic Environment Protective Outfit (STEPO)



**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 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), 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.



**PICS**

### 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<sup>2</sup> 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 overhead 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.

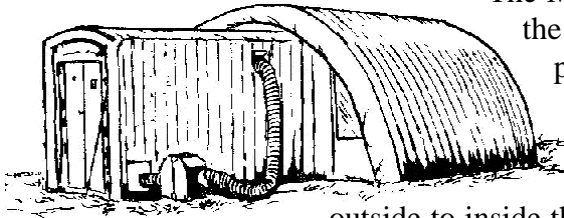
The ITAP fabric is self-extinguishing meeting NFPA 1991. The fabric is also static dissipative and does not hold a charge sufficient to set off munitions and explosives in accordance with current Explosive Safety Board requirements. The fabric is light in color to reduce operator solar heat load, and 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

#### FIELDDED AND PRODUCTION ITEMS

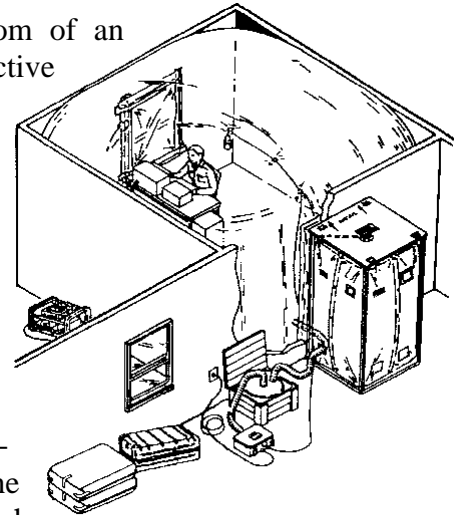
##### M51 Protective Shelter, CB



The M51 shelter is a trailer-mounted system consisting of the following major components: a 10-man shelter, a protective entrance, and a support system. The shelter and protective entrance support themselves through air filled ribs. The protective entrance minimizes carry-over of vapor contamination from outside to inside the shelter, and paces entries to the shelter to prevent loss of shelter over-pressure. The air handling system is permanently mounted in the trailer, and provides forced, filtered, and environmentally conditioned air to the shelter. This system can be erected and employed by 4–6 personnel in approximately one hour. This system provides heat stress relief from the effects of MOPP for 12–14 personnel. The M51 is mostly used by battalion aid stations and other medical units. It can also be used as a temporary rest and relief shelter. The M51 utilizes outdated technologies and is being replaced with CBPS. The M51s have been withdrawn from the field. They use a unique filter which is currently not in production.

##### 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 over-garment. 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<sup>3</sup>), 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<sup>3</sup>), 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<sup>3</sup>I) 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. Implementation of the Aerospace Expeditionary Force concept and resulting changes in Air Force Medical Service support concept of operations during FY99 has altered plans to field CHATH systems during FY99–FY00.

### 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 as a replacement for 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 conditioned by a hydraulically powered environmental support system, which provides filtered air, heating, air conditioning, and electrical power. The system is presently in limited production.

### Portable Collective Protection System

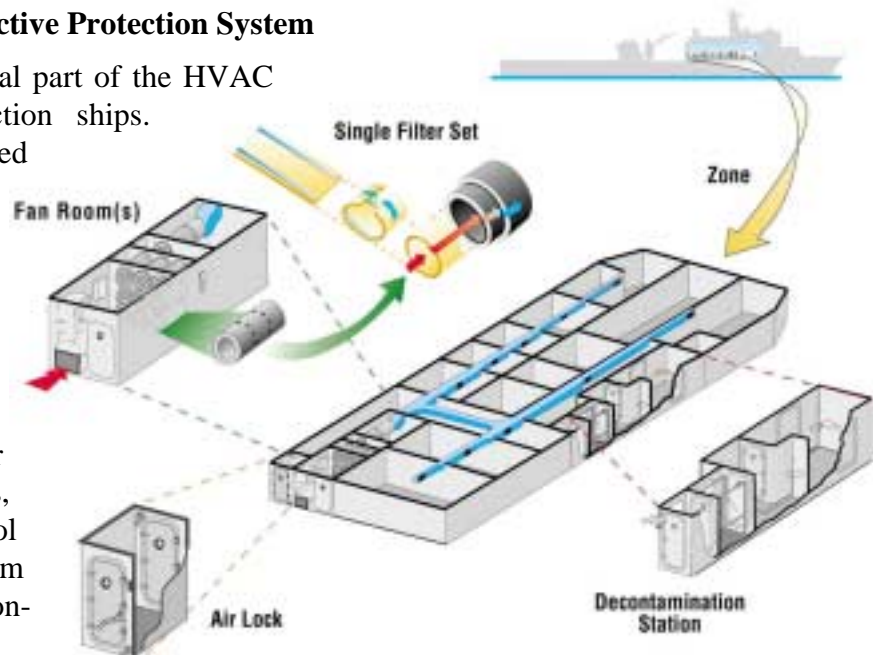
The transportability and ease of use of the Portable Collective Protection System (PCPS) permit mobility and flexibility in chemically or biologically contaminated areas. PCPS can be erected by four Marines within 30 minutes wearing MOPP 4 gear. The protective shelter is divided into a main area and two smaller compartments; the entry area, and the storage area. When overpressure is applied, the protective shelter provides protection from liquid and vapor chemical and biological agent. An airlock (protective entrance) allows purging of possible chemical agent vapors and additional decontamination of personnel entering the main area.

## COLLECTIVE PROTECTION SYSTEMS

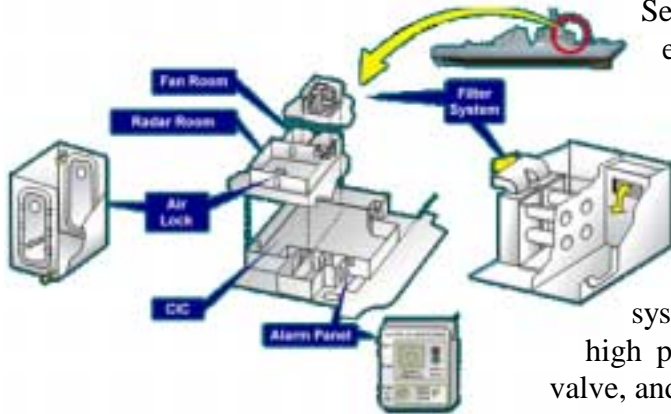
### FIELDED AND PRODUCTION ITEMS

#### 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 overpressure of 2.0 inches water gage. 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.



### Selected Area Collective Protection System



Selected Area CPS (SACPS) is designed to be easily adaptable to current ships to provide selected spaces (*i.e.*, command and control, berthing areas, *etc.*) with an affordable CPS system. SACPS is modular and is based on a Navy-improved version of the 200 cfm M56 filter. SACPS is easily integrated into the ship's existing HVAC system, and includes filters, filter housings, a high pressure fan, an airlock, a pressure control valve, and a low pressure alarm system.

## COLLECTIVE PROTECTION SYSTEMS

### RDTE ITEMS

#### Advanced Integrated Collective Protection System (AICPS) for Vehicles, Vans and Shelters (VVS)

Rationale:

- Army requirement
- Marine Corps interest

Key Requirements:

- Integral NBC filtration power and environmental control for vehicles, vans and shelters
- Minimize filter changes and overall system logistics burden
- Reduced size, weight and energy requirements

Description:

The AICPS (shown mounted to an S788 Shelter on an M1097 HMMWV) is an NBC filtration system integrated with an environmental control unit and auxiliary power unit for combat systems. It uses a deep-bed carbon vapor filter for extended gas filter life. The combined components provide overall size, weight and energy reduction, and eliminate the need for additional electrical power from the host system.



## **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.

## **Collective Protection System (CPS) Backfit**

### Rationale:

- Navy Service-Unique requirement

### Key Requirements:

- Provides protection to forces operating ships within a chemical/biological threat environment
- Provides plans for backfitting existing non-CPS ships

### Description:

Collective protection systems use filtered air to pressurize ship zones such that specified contamination-free spaces can remain functional for mission critical and sustaining operations within a chemical/biological threat or contaminated area. CPS backfit provides a means for retrofitting existing ships with required collective protection. Only ships with significant operational life beyond the FY05 through FY10 time frame will be considered for CPS Backfit.

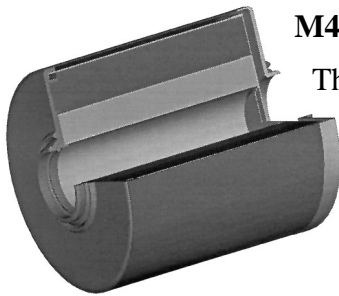
## GENERIC NBC FILTERS AND COLLECTIVE PROTECTION FILTRATION SYSTEMS

### FIELDDED 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.

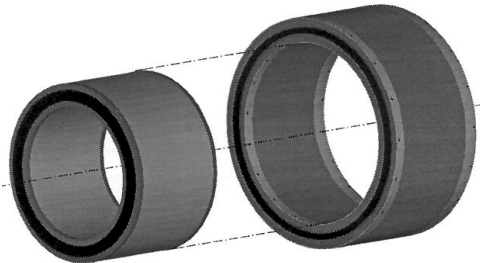


**M48/M48A1**

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**

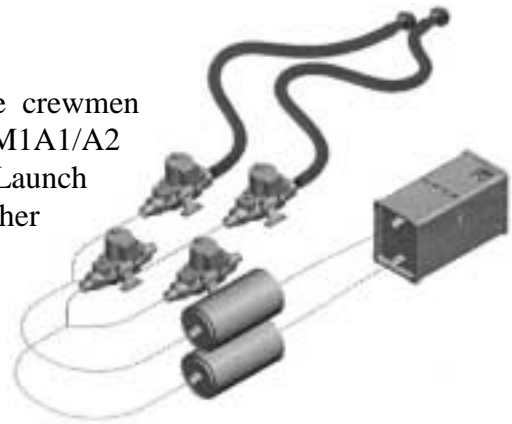
The following are modular NBC CP filtration systems which are applied to a wide variety of applications. They consist of an NBC filter, motor/blower unit, housings, and integration housings/ductwork. Some can be integrated into environmental control equipment.

### **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.

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# Annex C

## Decontamination Programs

**Table C-1. Decontamination RDA Efforts**

Category	Nomenclature	Status	USA	USAF	USMC	USN
Personnel	- M295 Individual Equipment Decontaminating Kit - M291 Skin Decontaminating Kit	Production Production	Fielded	Fielded Fielded	Interest Fielded	Fielded Fielded
Combat Equipment, Vehicles, and Aircraft	- M17A2/A3 Lightweight Decontamination System	Production	Fielded	Rqmt	Fielded	Rqmt
	- M21/M22 Modular Decontamination System (MDS)	Production	Rqmt	Int-NIR	Int-NIR	Int-NIR
	- M17 Diesel Lightweight Decontamination System	RDTE		Int-NIR	Rqmt	Rqmt
	- Joint Service Sensitive Equipment Decon	RDTE	Rqmt	Rqmt	Rqmt	Rqmt
	- Joint Service Fixed Site Decon	RDTE		Rqmt	Rqmt	Rqmt
Decontaminant Solutions and Coatings	- Sorbent Decontamination System and Solution Decontaminants	RDTE	Rqmt	Interest	Rqmt	Interest

Rqmt = Product Requirement  
Interest = Product Interest  
Int-NIR = Product Interest, No Imminent Requirement

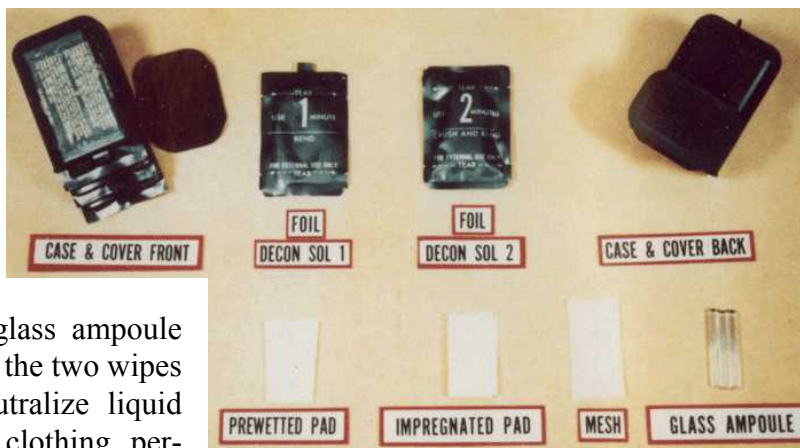
\* = sub-Product(s) of a Consolidated Joint Service Project  
Rqmt, Interest = Sub-Product Requirement or Interest

### PERSONNEL

#### FIELDED AND PRODUCTION ITEMS

##### M258A1 Skin Decontamination Kit (SDK)

The M258A1 consists of a pocket-sized plastic case containing three sets of foil-packaged decontaminating wipes. The decontaminating sets consist of PACKET 1 containing an aqueous decon solution soaked gauze pad, and PACKET 2 containing a decon solution filled glass ampoule within a gauze pad. Personnel use the two wipes successively to remove and neutralize liquid chemical agents from their skin, clothing, personal equipment and weapons. The shelf life of the M258A1 expired in July 1999 and is replaced by the M291 Skin Decontamination Kit.



### 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 a pouch containing four individual wipedown mitts, each enclosed in a soft, protective packet. The pouch 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

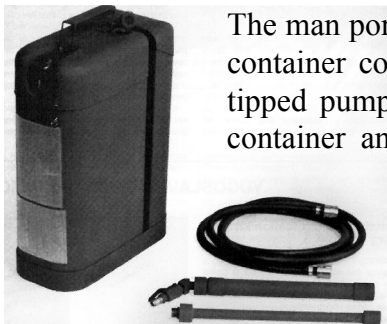
#### ABC-M11 Portable Decontaminating Apparatus



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 (DAP) 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 dismantled to facilitate air transport. The USMC has replaced the M12A1 PDDA with the M17 series Lightweight Decontamination Apparatus.



### **M17 Series Lightweight Decontamination System**



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.

### 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 Decon-

tamination 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.

### **M17 Diesel Lightweight Decontamination System (LDS)**

Rationale:

- Navy and Marine Corps requirement

Key Requirements:

- Be capable of operation using Military Standard fuels
- Have no component which cannot be moved by a four man crew
- Be capable of decontaminating both sides of a vehicle or aircraft simultaneously
- Generate no new manpower requirements
- Decontaminate personnel, equipment, and other material without an external power source and in coordination with a water tank or natural water resource.

Description:

The Diesel LDS is a portable, lightweight, compact, engine-driven pump and multifuel-fired water heating system. The system will be capable of performing the same hasty and deliberate decontamination procedures as required of the M17 series LDS.

### **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.

## DECONTAMINANT SOLUTIONS AND COATINGS

### RDTE ITEMS

#### Sorbent Decontamination System

Rationale:

- Army and Marine Corps requirement

Key Requirements:

- Effectively decontaminates all CB warfare agents from contaminated surfaces
- Easy-to use and possess no hazard to users
- Non-damaging and non-corrosive to military equipment
- Environmentally safe to store
- More compatible with MOPP and military equipment than the currently used DS2

Description:

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 system uses a catalytic component that reacts with the chemical agents being sorbed; this eliminates the potential hazard created by the off-gassing of agents from used sorbents.





# Annex D

## Joint Medical Chemical, Biological, and Nuclear Defense Research Programs

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The joint medical chemical, biological, and nuclear (radiological) defense research programs are each addressed in the next three sections.

### D.1 MEDICAL CHEMICAL DEFENSE RESEARCH PROGRAM

#### D.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.
- Handbook, "Medical Management of Chemical Casualties," 1995.
- Field Management Handbook, "Medical Management of Chemical Casualties," 1996
- 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, August 1999.

### **D.1.2 Medical Chemical Defense R&D Accomplishments**

The medical chemical defense R&D technical barriers and accomplishments during FY00 are grouped by medical chemical defense strategies, which include the following:

- *Pretreatment.*
- *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. 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).

### **Research Category: Pretreatments**

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.
- Pretreatment regimen that protects against rapid action and incapacitating effect of chemical threat category 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 Fourth Generation Agents to understand the mechanism of their unique chemical properties.
- Potential performance decrement with pretreatment is being investigated.

#### *Accomplishments:*

Accomplishments are shown for the basic research , applied research, and concept exploration related to the development of pretreatments.

- Demonstrated that the L286GH, L286HG, and L286GHG mutants of BuChE catalyze the hydrolysis of GB, GD, and echothiophate, and possibly VX .
- Showed that human paraoxonase (PON 1) at concentrations of PON normally found in human plasma catalyzed GB, GD and GF at a rate sufficient to reduce the concentration by 80% within 15 minutes.

- Found that PON (R form) does not contribute a significant protection against GD in mice.
- Performed a pH profile study of in vitro HI-6 reactivation of AChE inhibited with two novel agents that showed a small but reproducible burst of reactivation at  $\text{pH} > 7.4$  suggesting that oximes with lower  $\text{pK}_a$ 's and consequently more oximate ion at physiological pH (*i.e.*, 7.4) may be more effective than HI-6.
- Showed no correlation between in vivo protection against 2 novel agents with pyridostigmine and in vitro reactivation with 18 oximes (Reported in ITF-34 Final Report).
- Developed mathematical regression models for time of onset of signs after percutaneous exposure to one of eight nerve agents.
- Extended scope of pb/pk model for exposure to soman to include intramuscular by addition of muscle injection site compartment, reaction with muscle CaE, and first order absorption from muscle into blood.
- Demonstrated that OP-hydrolase can accelerate ACHE/oxime detoxification of nerve agents by catalyzing the breakdown of oxime-OP intermediate formed during oxime reactivation of OP-inhibited AChE.
- Initiated studies to investigate use of potent hepatotoxic cyclic heptapeptides (*i.e.*,  $\text{LD}_{50} < 100 \text{ ug/kg}$ ) as scaffolds for transport of secretory cyclopeptides into liver to determine whether human carboxylesterase levels in plasma could be elevated to a level that would afford protection against nerve agent exposure.
- Initiated efforts to generate serum carboxylesterase deficient mice by sequencing a cDNA copy of the Es-1 gene from 129 background mice. A partial genomic DNA sequence of the 129 background gene ( $\sim 7000$  basepairs) was carried out in preparation for assembling a "knockout" substrate.
- Developed a modified version of the Ellman assay to screen a panel of anti-GD monoclonal antibodies for catalytic anti-GD activity.
- Investigated ability of three anti-GD monoclonal antibodies to recognize GF and five novel nerve agents (E1, E2, E3, E4, and E5). Two of the antibodies recognized with high relative affinity several of the novel agents.
- Isolated the phosphoryl oximes formed by MEPQ, an organophosphate with toxogonin or  $\text{TMB}_4$  and demonstrated that their structures corresponded to monophosphorylated oximes.
- Synthesized and evaluated the stability and anti-cholinesterase properties of phosphonylated oximes containing the phosphorus moieties of G- and V-type nerve agents. Initiated a joint program by WRAIR, USAMRICD, American Red Cross, MedImmune Inc., and NIDA to prepare  $\sim 1000$  doses of human butyrylcholinesterase under GMP conditions.
- Assessed the immunogenicity and safety of injected homologous butyrylcholinesterase by injecting macaque butyrylcholinesterase into macaque monkeys twice (phase I SBIR awarded to Therimmune Research Corp., Gaithersburg, MD). The results indicated prolonged residence of homologous butyrylcholinesterase in plasma and an absence of side effects or induction of anti-butyrylcholinesterase antibodies.
- Determined the C-terminus sequence of the natural monomeric form of fetal bovine serum acetylcholinesterase and demonstrated that its inability to assemble into tetramers

is due to truncation at the C-terminus. Obtained a full-length cDNA clone for the mature tetrameric subunit of bovine brain acetylcholinesterase, which consists of 1760 base pairs and excludes only 91 base pairs of the signal peptide sequence that is also part of the full-length clone. Determined the primary structures of carbohydrate moieties of glyco-peptides derived from equine butyrylcholinesterase, an important step to elucidating the requirements for prolonged circulatory time of the enzyme.

- Improved sensitivity of non-human primate serial probe recognition task by adding a reaction time contingency. This task is used to determine whether pretreatment compounds adversely affect cognitive performance using a task that is equivalent in humans and non-human primates.
- Elucidated the amino acid residues that control the binding of anti-Alzheimer's drug, Aricept (E2020) to cholinesterases and demonstrated that E2020 interacts with the active-site and the peripheral anionic site in acetylcholinesterase, but in the case of butyrylcholinesterase, since the gorge is larger, E2020 cannot simultaneously interact at both sites.
- Synthesized and evaluated eleven analogs of tacrine (in collaboration with Sienna University, Italy) as candidate pretreatment drugs for protection against organophosphate toxicity.
- Synthesized and evaluated the anti-cholinesterase and neuroprotective properties of the enantiomers of dimethyl huperzine A (in collaboration with Georgetown University, Washington, D.C.).
- Performed pharmacokinetics on huperzine A and dimethylhuperzine A in animal models, showing differential accumulation in different tissues. Huperzine A and its analogs are potential pretreatment drugs for OP poisoning and also have neuroprotective properties.
- Huperzine A dose-dependently reduced soman-induced seizures and mortality in guinea pigs.
- Huperzine A pretreatment significantly reduced "popcorn convulsions" in a rat model at excitatory amino acid receptors (specifically an *N*-methyl-d-aspartate (NMDA)-induced convulsion).
- In rats, even near-lethal doses of the cholinesterase inhibitor, huperzine A were found to be without significant functional or pathological central nervous system intoxication, based on no EEG evidence.
- Light microscopic evaluation of brains and other major organs from animals euthanized 24 hours after huperzine A injection revealed no significant lesions.
- Evaluated huperzine A analogs for inhibition of radioligand binding specifically to NMDA and excitatory amino acid receptors.
- Demonstrated that huperzine A and dimethylhuperzine A were 10 to 100 fold more potent at blocking the ion channel of the receptor than other cholinesterase inhibitors such as tacrine, E2020, or physostigmine.
- Determined that huperzine A blocks the NMDA ion channel, but does not interfere with the GABA (gamma amino butyric acid) chloride ion channel site as defined by radioligand EBOB binding.
- Developed a research plan to identify reactive moieties, prepare candidate formulations, provide models for evaluation, and established a Decision Tree Network (DTN) for selecting the best candidates.

- Developed and validated six evaluation models needed in the aTSP DTN including the M8 paper test, penetration cell test, proof of decon test, weanling pig test, rabbit lesion area ratio test, and the rabbit acetyl cholinesterase inhibition test.
- Identified a novel compound that alters the structure of the stratum corneum to increase skin resistance to penetration by chemicals. This concept has the potential to be used in a multiple layer protection system.
- Identified 78 candidate reactive moieties for developing an active TSP of which 9 classes have been selected for further evaluation.
- Prepared over 200 candidate formulations for aTSP DTN evaluation.
- Bronchoalveolar lavage studies with 9 candidate HD therapeutic compounds given 30 minutes prior to mustard exposure produced positive glutathione and N-acetyl-cysteine levels.

**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.
- 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, 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:*

- Discovered that for sulfur mustard exposed eyes, early administration of steroid eye drops supplemented up to two hours later by triamcinolone/cefazolin administered as a depot injection provides considerable protection against HD-induced ocular damage.
- Discovered that a customized therapeutic mixture (Varma mixture) significantly attenuated sulfur mustard-induced ocular lesions in an in vivo rat eye model. The mixture consists of compounds known to provide bio-energetic support, reduce oxidative stress and support tissue metabolism.

- Discovered that deep dermal laser debridement followed by autologous split-thickness skin grafting minimizes skin damage and permanent scarring from sulfur mustard exposure to the epidermis.
- Determined that partial thickness laser debridement with no skin grafting was not as effective as above but much better than no treatment.
- Improved a wetting solution for a reusable polyurethane sponge to decontaminate skin exposed to chemical warfare agents. Survival rates were up 13 fold for guinea pigs whose skins were wiped after epidermal soman exposure relative to non-treated animals.
- Determined that cholinesterase enzymes could be impregnated on the polyurethane sponge while maintaining a high percentage of activity for a long shelf life (1 year) at high temperatures (>80% at 25 degrees C and ~50% at 45 degrees C).
- Immunohistochemical analysis of hairless mouse skin from control animals revealed large amounts of IL-1 $\beta$  throughout the epidermis and dermis.
- NF $\kappa$ B, a ubiquitous transcription protein, is not upregulated in lung tissue following intravenous HD in rats.
- HD administered intravenously to rats resulted in a general low-level inflammatory response detected in broncholavage.
- Showed that leukocyte suppression seen in rats exposed to HD by inhalation was reversed by granulocyte colony stimulating factor (G-CSF) in 24-48 hours compared to 4 days in controls.
- Determined that neonatal mice fail to develop HD lesions even after 12 minute vapor cup HD exposure.
- Found that phosphorylation of DNA ligase I is through DNA-dependent protein kinase (DNA-PK).
- Generated images of basal cell  $\beta$ 4 integrin when viewed through the stratum corneum with a Multiphoton Laser Scanning Microscope.
- Showed gene transcriptional changes in rats exposed by inhalation to HD suggesting the presence of activity related to necrosis, not apoptosis or inflammation, 24 hours post exposure.
- A mathematical model of anaerobic glycolysis is being expanded to include regulatory mechanisms and side pathways.
- Demonstrated the upregulation of 4 major pathways involved in HD pathogenesis of human skin using gene induction studies in HEK with subtraction libraries.
- Developed an assay for quantification of interstrand DNA crosslinks induced by HD for use with HEK. Demonstrated a concentration response to *in vitro* HD exposure.
- Showed that benzamide protection against HD in HEK is related to inhibition of apoptosis and protease secretion as well as a decrease in cellular replication.
- Demonstrated that increased expression of the 80kD serine protease in HEK exposed to HD is a function of increased transcription.
- Found that the *in vitro* human skin epidermal model shows all the *in vivo* counterparts of the adhesion complexes relevant to HD studies.
- Developed a procedure for generation, isolation, and purification of the alcohol dehydrogenase metabolite of thiodiglycol. GC-MS studies demonstrate two products

(mol. wt. 118 & 120) consistent with a mono aldehyde and its cyclization product an oxothiane-one.

- Inhibited the release of IL-6 from HEK exposed *in vitro* to HD using Anti-IL-6 monoclonal antibody.
- Detected by ELISA leukotriene B4 (LTB4), known to induce epidermal proliferation, in cultures of human fibroblasts exposed *in vitro* to HD.
- Showed vitamin D3, a regulator of cytokine production, to have variable effects on IL-1 $\beta$  in HEK from different donors.
- Sixty-two (62) candidate medical countermeasures have been shown to provide significant reduction in HD-induced edema, histopathology, or both in the mouse ear assay.
- Nineteen (19) compounds with statistical reduction of injury in the mouse ear assay have been shown to produce greater than 50% reduction of edema or histopathology produced by HD exposure.
- Completed dose-response comparison of behavioral side effects of eight potential anticonvulsants (scopolamine, aprophen, atropine, azaprophen, benactyzine, biperiden, procyclidine, trihexyphenidyl) on learning and memory in rodents.
- Developed an assay method for simultaneous determination of acetyl-cholinesterase and butyrylcholinesterase levels in blood and tissue and advanced into high-throughput screening platform. Assay validation demonstrated significant improvements over current clinical cholinesterase assays (Cobas/Fara and Michel, the current Army standard, and the Test-Mate OP, the Army field standard), including turn around time, sensitivity, precision, and accuracy.
- Identified three new oximes that were more effective than 2-PAM against the fourth generation nerve agents that are the most resistant to 2-PAM/atropine treatment.
- Demonstrated in guinea pigs the ability of supplemental atropine and diazepam to increase the effectiveness of medical protection against slowly eliminated nerve agents.
- Demonstrated the ability of early administration of diazepam to enhance survival against nerve agents in guinea pigs and non-human primates.
- Demonstrated in guinea pigs the ability of oxime and atropine therapy to provide high level protection against Russian VX was demonstrated in guinea pigs.
- Developed an extraction method to quantify pyridostigmine bromide from animal tissues and plasma.
- Demonstrated that pyridostigmine bromide did not cross the blood brain barrier under normal and stress-induced conditions at levels less than 2 ng/mL or 2 ng/g tissue.
- Developed a method to rapidly generate enzyme immobilized OP decontamination sponges.
- Demonstrated that enzyme immobilized sponges containing AChE and BChE for OP decontamination are resistant for over 2 years to a wide variety of environmental assaults, including organic fumes generated by diesel engines and temperature extremes.
- Developed additives to the sponges to aid in the decontamination and extraction of OPs from skin and other biological surfaces.



- Demonstrated sponges with additives that decontaminate guinea pig skin of soman and protect the animals 7-fold better than the M291 decontamination kit (sponges yield an LD50 of 137 mg/kg while the M291 kit yield an LD50 of 18 mg/kg).
- Compared cotton fabrics of immobilized cholinesterases with polyurethane immobilized cholinesterases, and found the polyurethane procedure produces a far more robust and stable product.
- Developed a biosensor composed of immobilized cholinesterase, OPH, OPAA, or lactase in the field differentiation of the type of OP contamination.
- Validated accuracy and reproducibility of a noninvasive finger-cuff optical probe prototype monitor for measuring oxyhemoglobin, deoxyhemoglobin, methemoglobin, and carboxyhemoglobin.
- Determined maximum doses of the nerve agents sarin (GB), soman (GD), and VX that can be absorbed daily for up to 13 weeks without lethal effects or clinical signs of toxicity, thus establishing an upper limit for chronic low-dose chemical nerve agent studies.
- Established animal models for low-dose chemical warfare nerve agent exposures in order to evaluate potential for behavioral anomalies, CNS damage, cardiomyopathy and general organ pathology.
- Observed alterations in synaptic connections between isolated brain neurons in vitro following acute exposure to VX and sarin (GB) at concentrations consistent with low-level chemical agent exposures.

**Research Category: Reducing Reliance on the use of Animals as Subjects of Research**

- An *in vitro* model is being developed to evaluate the chronic effect of low dose exposure to nerve agents and other toxic compounds.
- An *ex vivo* neuronal model has been developed for rapid screening of neuroprotectants against seizures induced by organophosphate chemical warfare nerve agents, toxicity induced by excitatory amino acids, and EEG perturbations and seizures induced by NMDA.

**D.1.3 Advanced Development Products**

In advanced development, the goal is proof-of-principle and conducting all 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 nontoxic, nonirritating barrier film layer on skin.
- Augments Mission Oriented Protective Posture (MOPP).
- Protection against vesicant and nerve agents.

*Accomplishments:*

- Completed manufacturing development of the SERPACWA.
- Completed sweating and absorption studies requested by the FDA.
- Submitted a New Drug Application (NDA) to the FDA.
- FDA approved the NDA.



**Product: 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.
- Submitted a NDA to the FDA
- FDA issued an “approvable letter” on the NDA

## D.2 MEDICAL BIOLOGICAL DEFENSE RESEARCH PROGRAM

### D.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. Some of the materiel and non-materiel solutions are fully licensed and available for use while others are in investigational new drug (IND) status, which may only be used consistent with Executive Order 13139. A Prime Systems Contract under the Joint Vaccine Acquisition Program (JVAP), was activated to move 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 (licensed)
- Smallpox Vaccine (licensed)
- Botulinum Toxoid Vaccine, Pentavalent (IND #3723)
- Botulinum Type F Toxoid Vaccine (IND #5077)
- Botulinum Antitoxin, Heptavalent Equine (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 #5077)
- Q Fever Vaccine, Purified Whole Cell, CM Residue, Formalin Inactivated, Gamma Irradiated (IND #3516)
- Tularemia Vaccine (IND #157)
- New smallpox vaccine (Vaccinia Virus, Cell Culture-derived) (IND #4984)
- Venezuelan Equine Encephalitis Virus Vaccine, TC-83 (IND #142)
- 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 Bio-

logical Defense (JPO-BD) and JVAP are reported in Section D.2.3.

*Technical Information and Guidance:*

- Handbook “Medical Management of Biological Casualties,” 1998.
- CD-ROM on “Management of Biological Warfare Casualties,” 1999.
- NATO Handbook “Medical Aspects of NBC Defensive Operations, AMedP-6(B), Part II (Biological),” 1998.

## **D.2.2 Biological Defense Research and Development Accomplishments**

The biological defense research and development technical barriers and accomplishments during FY00 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). 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 FY00:

### **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.

*Accomplishments:*

Vaccines:

- Identified VNTR (Variable Number Tandem Repeat) analysis to be particularly promising method for genetic fingerprinting of plague strains.
- Developed an *in vitro* bioassay for V antigen (V) of *Yersinia pestis*, based on the lethal effects of V on macrophages and the protective neutralizing capacity of anti-V antibodies (Abs).
- Showed that *Y. pestis* induces apoptotic cell death in macrophages, and that anti-V Abs prevented cell death and restored the ability of the macrophages to phagocytose the bacterium.
- Showed that *in vitro* cell protection results against plague using rabbit polyclonal anti-V Abs and monoclonal anti-V Abs (MAbs, correlated with protective efficacy *in vivo*).
- Verified the biological activity of V in candidate component vaccines (*i.e.*, the LF-V fusion) and live plague vaccines (*i.e.*, C092 Pgm<sup>-</sup> Pla<sup>-</sup> strain).
- Identified at least 12 potential proteins of *Y. pestis* that interact with V antigen, and partially determined their DNA sequences. These antigens may contribute to the virulence of *Y. pestis*.
- Completed the construction, virulence/safety testing, and preliminary assessment of the immunogenicity of two potential live vaccine strains of attenuated *Y. pestis* in the African Green monkey.
- Confirmed secondary structural characteristics of the F1-V vaccine candidate by spectroscopic analysis. Determined higher-order structure of F1-V. Data will be used to characterize homogeneity of vaccine preparation.
- Completed a 9-month pre-clinical stability study for unformulated and formulated F1-V vaccine antigen.
- Performed single and double dose-ranging experiments for the F1-V vaccine candidate in the mouse using a bubonic plague challenge model.
- Conducted a challenge dose escalation study to optimize a potency assay and to compare the stability of different lots of F1-V vaccine.

- Evaluated F1-V immunogenicity by different vaccination routes (subcutaneous vs. intramuscular).
- Assessed protective efficacy of F1-V in the mouse model against aerosol exposure to both encapsulated (CO92) and non-encapsulated (C12) strains of virulent *Y. pestis* and found it protective.
- Performed surrogate efficacy studies in mice against aerosolized CO92 and C12 strains of virulent *Y. pestis*.
- Completed a pre-clinical safety study for F1-V vaccine candidate.
- Performed preliminary evaluation of recombinant YopD antigen alone, and in combination with V antigen, in its ability to protect mice against a non-encapsulated virulent strain of *Y. pestis* by aerosol challenge.
- Cloned two additional putative virulence determinants of *Y. pestis*, *yscC* and *tyeA*, in an *E. coli* expression system to evaluate as vaccine candidates.
- Isolated and characterized five anti-V monoclonal antibodies for potential therapeutic and diagnostic use.
- Demonstrated that serum levels of specific antibodies to the F1 antigen at the time of challenge represents a strong predictor of survival in mice against a lethal challenge with *Y. pestis*.
- Generated isogenic mutations in plague strains for testing in macrophage binding and physiological effects.
- Discovered that over 30 genes were changed in expression in human macrophages following plague infection. These genes may be involved in evasion of the host immune system by *Y. pestis*.
- Demonstrated that pulsed-field gel electrophoresis (PFGE) is superior to the previously published method of ribotyping and variable number tandem repeat analysis for differentiation of individual plague isolates.
- Established method for phylogenetic grouping of plague isolates by pulse field gel electrophoresis.
- Determined the DNA sequence of housekeeping genes from a diverse group of plague isolates and found that there is no nucleotide variation.
- Determined the entire sequence of the virulence plasmid of *Y. enterocolitica* strain 8081 to identify common virulence determinants shared between species of *Yersinia*.
- Constructed library of *Y. pestis* genes to be used in gene induction and macrophage survival studies with a plasmidless strain of *Y. pestis* (KIM pgm). Studies will help identify genes associated with virulence.
- Expanded studies to analyze the role of humoral immunity to *B. anthracis* and anthrax toxin in impeding the early stages of infection with *B. anthracis* spores.
- Showed that antibody to the protective antigen (PA) of anthrax toxin had two anti-spore activities, the stimulation of phagocytosis by macrophages of ungerminated spores; and the inhibition of spore germination *in vitro*.
- Found that *B. anthracis* spores were phagocytosed by, and germinate within, murine macrophages (primary and cell-line derivatives).
- Discovered that preincubation of ungerminated anthrax spores with antibody to PA antigen stimulated the rate of germination of spores after phagocytosis.

- Showed that anthrax spore germination was followed rapidly by macrophage killing.
- Performed bench-scale media trials to assess the suitability of several non-animal-based peptones in supporting the growth of *B. anthracis* vaccine strains for recombinant PA antigen production. These peptones will minimize the probability of contamination of the vaccine with adventitious agents.
- Evaluated efficacy of recombinant PA vaccine candidate from two sources. Found no statistical difference between survival at various doses of vaccine tested for *E. coli*-derived or *Bacillus*-derived PA.
- Demonstrated that CpG oligonucleotide adjuvants enhanced the protective effect of AVA in guinea pigs.
- Finished collating data on the protective efficacy of AVA in hamsters, guinea pigs, rabbits and monkeys against challenge by various strains of *B. anthracis*.
- Spores from over 30 different strains of *B. anthracis* are currently being grown and harvested for characterization studies.
- Demonstrated that anthrax lethal toxin did not induce macrophages to produce pro-inflammatory cytokines, suggesting a possible mechanism of virulence.
- Demonstrated that anthrax LF inhibits the ability of macrophages to produce cytokines in response to a strong stimulus such as lipopolysaccharide (LPS).
- Initiated characterization of the adherence receptor of the anthrax spore/bacilli.
- Determined that anthrax spores adhere to a pneumocyte cell line, suggesting a possible mechanism of virulence in the lung.
- Identified potential adherence genes that may contribute to the virulence of *B. anthracis* by sequence homology to other known bacterial adherence genes.
- Constructed recombinant plasmids to mutate these open reading frames in anthrax to determine their significance in the adherence and virulence in *B. anthracis*.
- Determined that live, vaccine strain *Brucella melitensis* WR201 was attenuated in monkeys, with nearly complete clearance at 16 weeks following oral administration and no clinical or pathologic evidence of disease, suggesting potential safety in humans.
- Preliminary efficacy trial with *B. melitensis* vaccine WR201 in monkeys indicated complete protection against aerosol challenge with a high dose of *B. melitensis* challenge strain 16M.
- Described microbiologic and pathologic characteristics of course of infection after aerosol and intragastric challenges with virulent *B. melitensis* strain 16M as well as attenuated strain WR201.
- Using novel gene array technology, found increases in messenger RNA expression for over 30 genes in murine spleen cells cultured with *Brucella* antigens. This approach has great promise for development of in vitro correlates of immunity for vaccine development.
- Developed two new double deletion mutants of *B. melitensis* as candidate live, attenuated vaccine strains.
- Found that a new double deletion mutant of *B. melitensis* was attenuated in mice and macrophages and shows promise as a live, attenuated vaccine candidate.

- Found that live, attenuated vaccine strain *B. melitensis* WR201 was attenuated in monkeys, with nearly complete clearance at 16 weeks following oral administration and no clinical or pathologic evidence of disease.
- On a preliminary efficacy trial with live, attenuated vaccine strain *B. melitensis* WR201 in monkeys, found that oral vaccination with WR201 led to complete protection against aerosol challenge with a high dose of *B. melitensis* strain 16M.
- Described microbiologic and pathologic characteristics of course of infection after aerosol and intragastric challenges with virulent *B. melitensis* strain 16M and live, attenuated vaccine strain *B. melitensis* WR201.
- Found that multiple doses of live vaccine candidate strain *B. melitensis* WR201 protected more than 90% of mice from respiratory challenge with virulent *B. melitensis* and that WR201 was effective at a 10-fold lower oral dose than used in other studies to date.
- Constructed green-fluorescent protein-expressing mutants of live vaccine candidate strains and used them to demonstrate cytotoxic effects of *Brucella* on macrophages.
- Found that rough strains of *Brucella* activated serum complement using the recently-described lectin pathway, and initiated construction of deletion mutants to determine the mechanism of complement-mediated bactericidal activity.
- Found that clearance of live vaccine candidate strain *B. melitensis* WR201 was enhanced by passive transfer of immune serum even in severely immunodeficient mice, supporting previous suggestions that the vaccine strain cannot replicate effectively intracellularly, even in non-immune hosts.
- Initiated studies on use of derivatives of live vaccine candidate strain *B. melitensis* WR201 as a platform for a multi-agent vaccine.
- Isolated identified and characterized outer membrane proteins from *Burkholderia mallei*, *Burkholderia thailandensis*, and *E. coli* bacteria by capillary electrophoresis to identify potential vaccine antigens.
- Identified severe primary pneumonia as the most important sequel after glanders infection.
- Quantified microorganisms in the blood, liver, spleen, and lungs in infected animal tissues.
- Found that sera from mice challenged with *B. mallei* strains contained high antibody levels which were broadly cross-reactive with other members of the *Burkholderia* genus.
- Showed that irradiation-killed *B. mallei* whole cells used as a vaccine gave an increased time to death after IP or aerosol challenge.
- Preliminary data suggests that administration of irradiation-killed *B. mallei* cellular vaccine in incomplete Freund's adjuvant (IFA), but not alum, enhanced survivability in mice challenged by aerosol.
- Sequenced the *B. mallei* capsule gene cluster and identified 30 genes. Mutations were constructed in 9 genes and the phenotypes of the corresponding mutants were analyzed by ELISA. Mutants will be used to identify vaccine antigens.
- Identified and characterized two novel *B. mallei* insertion sequences that could be used as vehicles to induce mutations in the genome.



Therapeutics:

- Characterized cellular and humoral immune response to *B. mallei* in the mouse model of glanders to identify potential targets for therapeutic intervention.
- Completed MICs and E-tests for 36 antibiotics against 13 *B. anthracis* strains.
- Tested three investigational antibiotics in vitro against *B. mallei*.
- Found that administration of CpG oligodeoxynucleotides either just before or just after respiratory challenge of mice with virulent *B. melitensis* led to a substantial reduction in the intensity of systemic infection.

**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 Barriers:*

- 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.

*Accomplishments:*

Vaccines:

- Developed bioprocess technologies necessary for product manufacturing for the vaccine candidates against botulinum neurotoxin (BoNT) serotypes types A, B, C<sub>1</sub>, and F.
- Completed lot release testing of vaccine candidate recombinant BONT/B(H<sub>C</sub>); 3-year stability testing is ongoing.
- Established a dendritic cell assay to access surrogate endpoints for human vaccine induced immune responses.
- Showed lymphocytes responses of transgenic mice with human MHC class II and human CD4 genes to SEs closely matched human responses.
- Produced final vial product for SE serotype B.
- Qualified strategic preclinical assays for biological potency, formulation, and stability studies to support SE vaccine effort.
- Completed dose escalation studies completed for variable amounts of alhydrogel adjuvant and fixed amount of SEB cGMP vaccine; variable doses of cGMP vaccine and fixed amount of alhydrogel; antibody titers and protection from lethal toxin challenge.
- Demonstrated that vaccine had a protective effect on SEB induced degradation in reaction times in a non-human primate behavioral model.
- Demonstrated that vaccine had a protective effect on SEB induced elevations in body temperature.
- Applied computational mutation analysis to the rational design of non-toxic, catalytically inactive mutants of ricin for vaccine development.
- Proof-of-concept efficacy, immunogenicity, potency, safety, and stability studies have been completed a chemically deglycosylated ricin A chain subunit vaccine.
- Initiated capability to generate aerosols with varying particle size and form for evaluation of vaccine efficacy.
- Completed ricin deposition studies in mice have been done using a 1 μm particle size.
- Developed vector components necessary to develop an effective SEB mutant vaccine delivered via oral route by *Lactobacillus casei*.
- Evaluated the feasibility of induction of protective immunity using an intranasal route for mucosal immunization against SEB with a cholera toxin adjuvant.
- Initiated studies to develop protective mucosal vaccine for staphylococcal enterotoxins using virus-like particles (VLPs).

Therapeutics:

- Botulinum neurotoxin (BoNT) type E was purified, and the protein was crystallized in the presence of a peptide from SNAP-25.
- Progress towards receptor identification included obtaining crystals of tetanus toxin C fragment (analogous to BoNT/E) grown in the presence of three different gangliosides as well as a new crystal for a complex with sialic acid.
- Established a model to evaluate channel forming activity of the purified BoNT heavy chain using evoked exocytosis of human growth hormone in PC-12 cells.
- Optimized the high-throughput assay therapeutic screening for BoNT type A and B.

- Expressed and purified biologically active recombinant light chain of BoNT/A and B.
- Cloned genes for the naturally occurring SNARES (i.e., SNAP-25, synaptobrevin, and syntaxin) to be used as target substrates in testing potential antagonists of BoNT.
- Identified structural characteristics on the neurotoxins using computational chemistry techniques critical to the development of high-affinity active-site inhibitors.
- Characterized salient structural requirements for isocoumarin inhibitors of botulinum neurotoxin B.
- Tested 26 isocoumarin compounds as potential antagonists of BoNT/B activity; 8 were selected for further evaluation.
- Determined apparent BoNT IC-50 values for a series of di- and tri-peptide tetanus toxin inhibitors generated using combinatorial libraries.
- Initiated a combinatorial chemistry effort to synthesize large numbers of peptidomimetics that will be tested for therapeutic activity against BoNT.
- Explored the inhibitory effect of BoNT/A on actin reorganization as an additional toxic mode of action.
- Completed “proof-of-concept” studies demonstrating “clostridial transport system” delivery of toxin resistant, biologically-active SNAP-25.
- Demonstrated ability to target delivery into cholinergic nerves using the non-toxic botulinum serotype A transporter.
- In mice, demonstrated protection against low lethal-dose challenges of BoNT A and B with whole monoclonal neutralizing antibodies.
- Cloned and expressed single-chain human MHC class II receptors with covalently linked peptide for use as biomarkers.
- Differential Display PCR analysis of human peripheral blood lymphoid revealed approximately 550 genes with altered expression in response to SEB.
- Identified tricyclodecan-9-yl as a potential therapeutic agent to counteract human T cell and monocyte response to SEB *in vitro*.
- Demonstrated transcriptional inhibition of SEB-induced cytokines by pentoxifylline in human peripheral blood mononuclear cells.
- Protein kinase C (PKC) inhibitors were found to block SEB-induced lethality in mice up to 3 hours after challenge.
- Showed SEA or SEB by intravenous or intratracheal routes to piglets induced the progression of disease comparable to that recorded for humans or rhesus monkeys.
- In a piglet model, demonstrated a single dose anti-emetic could blocked emesis, anorexia, malaise and temperature and blood pressure abnormalities.
- Isolated and characterized molecular clones of virulence factor genes that encode A and B exotoxins from Group A *Streptococcus* (GAS).
- Established methods for recombinant expression of targeted GAS and *Staphylococcus aureus* virulence factors.
- Confirmed validity of HLA-transgenic mouse model by demonstrating enhanced reactivity of T cells from HLA-DQ transgenic mice to GAS virulence factors.
- Established a cDNA macroarray system to correlate pathological changes observed over time after ricin exposure with changes observed in levels of mRNA expression.

- Monoclonal antibodies to ricin A chain, B chain, and holotoxin were characterized and hybridomas cloned into established cell lines.
- Established a cell culture-based cytotoxicity assay to screen anti-ricin hybridoma lines for neutralizing monoclonal antibodies.
- Demonstrated that peptide analogs of buforin require specific amino acid sequences and moieties to be effective botulinum B neurotoxin inhibitors.
- Performed pharmacokinetics on buforin I, the lead peptide that inhibits botulinum B neurotoxin, demonstrating that the half-life in vivo was, at a minimum, several hours.

### **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:*

- 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 epidemiological realities disallow the possibility of efficacy data from human clinical trials.
- Need for multivalent vaccines and compatible vaccine platforms to protect against an array of unrelated viral agents.
- Difficulty with some agents 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.

#### *Accomplishments:*

##### Vaccines:

- Compared gene expression profiles of primary human monocyte cultures infected with either Ebola-Reston, Ebola Zaire or Marburg Musoke virus, using either microarrays or ribonuclease protection assays, to identify potential mechanisms of virulence. Determined that the pattern of cellular gene expression observed in Ebola-Reston infected cells was very different from that observed in Ebola- Zaire infected cells, which may identify potential mechanisms of virulence.

- Determined that cytokines and chemokines are not strongly induced in primary human monocytes infected with Ebola-Reston virus, which may explain its lack of virulence in humans.
- Determined that Ebola-Zaire virus-infection of THP-1 cells, a continuous monocytic cell line, results in gene expression patterns similar to that observed in primary cells.
- Treatment of THP-1 monocytic cells with PGE2 or Dexamethazone inhibited elevated levels of chemokine RNA expression induced by Ebola- Zaire virus, but had no effect on virus replication.
- Initiated construction of poliovirus and mengovirus vectors expressing Ebola-GP, for evaluation as potential vaccine candidates for Ebola.
- Continued development of the Emerging and/or Genetically-Engineered Threat database and web portal including refinement of search interface and tools, automation of record downloads from Genbank, and standardization of language used for data exchange.
- Integrated NIH/DARPA sponsored Poxvirus Bioinformatics Resource Database into Emerging Threats Database.
- Monoclonal antibodies were generated and cloned for evaluation of protective efficacy against naturally-occurring Venezuelan equine encephalitis (VEE) virus isolates. Two IgG/IgA pairs of monoclonal antibodies to VEE virus were administered intraperitoneally and evaluated for protective efficacy against peripheral and mucosal virus challenge. Studies to evaluate the role of pre-existing antibody in interfering with induction of immunity by alphavirus vaccines have been initiated. Additional studies to evaluate the efficacy of alphavirus vaccine candidates were initiated. The lethal dose of wild-type Western equine encephalitis (WEE) virus strain CBA-87 and VEE IE strain 68U201 was determined by the aerosol route in two strains of mice. A vaccine dose-escalation study was initiated in mice using the W2102 and VEE IE 1150 cleavage site deletion mutants generated with the kanamycin resistance gene.
- Constructed a full length infectious clone of VEE-III A virus (Mucambo virus) by RT-PCR of purified viral genomic RNA. Clone will be evaluated as a potential vaccine candidate for III A strains of virus.
- Continued the development of a suitable rodent challenge model for the VEE-III A vaccine.
- Packaging and titering of VEE replicons expressing various VEE virus antigens was evaluated and found to be successful. These replicons will be evaluated for their efficacy as potential vaccines for VEE.
- Protective efficacy of VEE replicons expressing the 6KE1 and PE2 constructs of VEE virus was assessed in mice and shown to be protective. Attenuated vaccine candidates have been successfully identified for WEE virus and VEE-IE viruses. Effective immunizing doses have been determined by subcutaneous administration.
- Demonstrated that the VEE virus IE strain vaccine candidate VIE 1009 replicated in and was transmitted by *Ae. taeniorhynchus* mosquitoes at about the same rate as the virulent parent after intrathoracic inoculation into the mosquito. However, despite efficient transmission none of the hamsters died after being bit by the VIE 1150-infected mosquitoes. This indicates that replication in mosquitoes did not lead to reversion to virulence in this strain.

- Experiments to determine the duration of immunity to lethal aerosol/ subcutaneous challenge elicited by the VEE-IE and WEE vaccine candidates are on going.
- A full-length infectious clone of EEE virus has been prepared. The virulence of the resulting virus has been found to be identical to the parental virus. Mutagenesis of the clone has failed to yield attenuated candidates for further evaluation. An alternate strategy to prepare an attenuated mutant has been and is being investigated.
- Stability of WEE and VEE-IE vaccine candidates during *in vitro* propagation has been demonstrated.
- Demonstrated that immune serum from monkeys which had been vaccinated against Marburg virus (MBGV), and which survived challenges, did not confer protection to non-immune monkeys prior to challenge.
- Determined that a humanized monoclonal antibody to Marburg virus did not protect cynomolgus macaques from a lethal challenge.
- Evaluated the ability of the current VEE replicon vaccine candidate expressing the glycoprotein from the Musoke strain of Marburg virus to protect cynomolgus macaques from challenge with a divergent isolate. Data suggests that a MBGV vaccine may have to be multivalent to protect against multiple strains.
- Monoclonal antibodies to Marburg virus have been produced for evaluation of their ability to protect *in vivo*.
- Identified five protective epitopes on the Ebola virus (EBO) glycoprotein (GP). Monoclonal antibodies could be administered before viral challenge, or up to 2 days after challenge and still confer protection.
- Identified a protective cytotoxic T cell epitope for one mouse adapted strain of Ebola virus that could be incorporated into a vaccine.
- Compared genome sequences from 31 open reading frames (ORF) of three Variola virus strains (Bangladesh, India and Garcia), one Vaccinia virus strain (Copenhagen), Camelpox, Cowpox and Monkeypox viruses to identify virus-specific diagnostic probes.

Therapeutics:

- Evaluated cidofovir and its prodrug against 31 strains of Variola for potential resistant strains.
- Determined ability of cidofovir to inhibit Variola replication in multiple cell lines as a prelude to FDA licensure.
- Identified potentially orally-administered prodrug forms of cidofovir with improved antiviral activity against Variola.
- Identified 27 new drugs with activity against Variola, some with therapeutic indexes significantly greater than cidofovir.
- Evaluated several monkeypox virus strains isolated from humans for aerosol lethality in primates.
- Evaluated the aerosol lethality of the Yamada and Lee strains of Variola in macaques at the Centers for Disease Control (CDC).
- Transgenic mice were genetically altered to produce human antibodies (to Ebola-Zaire 76 GP or Marburg-Musoke GP for evaluation of protective efficacy against these viruses.

- Transgenic mice were genetically altered to produce human antibodies for known vaccinia envelope-associated antigens. These antibodies will be evaluated for protective efficacy against poxviruses.

### **Diagnostic Assays for Biological Warfare Threat Agents**

#### *Countermeasures:*

- Portable common diagnostic systems.
- 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 macro 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:*

- Developed the second generation battery-powered, portable system for rapid nucleic acid analysis.
- Designed an integrated specimen processing and gene amplification cartridge for the rapid identification of *B. anthracis* spores.
- Optimized rapid gene amplification assays for the identification of *B. anthracis* and *Yersinia pestis* for use on two different rapid nucleic acid analysis platforms.
- Demonstrated sensitive detection of *B. anthracis* and *Y. pestis* in animal models using specific immunodiagnostic and gene amplification assays.
- Established a collection 418 bacterial strains having clearly defined pedigree and definable characteristics for use as standards in future evaluation trials under strict regulatory guidelines.
- Produced high quality control nucleic acids from over 95 bacterial strains under strict regulatory controls for use as future international standards.
- Standardized and transitioned specific enzyme-linked immunosorbent assays and reagents for six agents to the non-medical detection program.
- Demonstrated improved agent specific enzyme-linked immunosorbent assays for the Venezuelan Equine Encephalitis virus, Orthopox viruses, Vaccinia virus, and botulinum neurotoxin serotypes A & B.
- Demonstrated the superior performance of electrochemiluminent assays compared to time resolved fluorescence and enzyme-linked immunosorbent assays for the detection

of SEB, ricin toxin, *C. botulinum* toxin, *Y. pestis* F1 antigen, *B. anthracis* PA antigen, and VEE virus.

- Demonstrated that the stability of the pre-coated enzyme-linked immunosorbent assay plates and for the detection of *B. anthracis* specific protective antigen is approximately 35 weeks at room temperature (25°C).
- Demonstrated an improved coated enzyme-linked immunosorbent assay format for antigen detection that uses stabilized pre-coated 16 well strips and requires only 100 minutes from acquisition of sample to results.
- Developed a novel protein expression vector, which include  $\kappa$  light chain variable gene ( $V_L$ ) and an enterokinase site upstream of a plasmid-based multiple cloning site, for simplified production and purification of diagnostic recombinant antigens.
- Demonstrated that unique peptides that bind to botulinum A neurotoxin with high affinity function most efficiently when in solution phase rather than in solid phase in selected diagnostic assays.
- Developed fluorescently-based, gene amplification reagents and assays to specifically detect *Rickettsia prowazekii* and *Rickettsia rickettsii* based rOmpB gene, 17-kDa gene and the protease IV gene.
- Demonstrated fluorescent probe-based gene amplification assays for the unique *Brucella* outer membrane porin gene (Omp2b) compatible with the Ruggedized Advanced Pathogen Identification Device (RAPID).
- Demonstrated a unique 5' fluorogenic nuclease assay that can detect all known strains of Marburg viruses.
- Developed nucleic acid analysis systems for the detection of both Ebola-Zaire and Ebola-Sudan viruses by using two distinctly labeled fluorescent probes.
- Demonstrated an integrated diagnostic systems that uses bacterial culture, nucleic acid amplification and identification, and immunoassays for in-theater confirmatory analysis by deployed laboratories.
- Demonstrated automated sample preparation methods for the rapid analysis of nucleic acid gene targets that allows a 3-fold increase in throughput during a 24 hour period.
- Demonstrated core micro-sonication technology for the integrated specimen processing cartridge that can lyse *B. anthracis* spores in 15 seconds compared to 1 hour using standard methods.
- Demonstrated that the effective sample size of unique DNA-binding papers for rapid gene amplification assays is less than or equal to 10  $\mu$ L.
- Demonstrated unique assays for the early recognition of host immune responses that couple quantitative reverse-transcriptase with fluorescent-based gene amplification detection of nonhuman primate cytokines (TNF-alpha, IL-1beta, IL-6, IL-10, IFN-alpha) and chemokines (IL-8, MIP-1 alpha).
- Developed a single nucleic acid-based assay for use in a clinical and field laboratories that can rapidly detect up to four different types of *Y. pestis* ciprofloxacin-resistant mutations.
- Evaluated five different hand held immunochromatographic assays for *Coxiella burnetii*, *Francisella tularensis*, *Y. pestis*, and *B. anthracis* protective antigen (PA) in animal studies for their effectiveness in analysis of diagnostic specimens.



- Demonstrated a hand-held, battery-powered instrument that uses advanced electrochemical gene-probe technology for the rapid detection of multiple genes or multiple species.
- Demonstrated that fluorescent probe hydrolysis gene amplification had a overall sensitivity of 78% while electrochemiluminescence-based PCR had an overall sensitivity of only 55% relative to culture methods.
- Analyzed 11 international isolates for genetic variability and found that *Y.pestis* is highly homogeneous in housekeeping gene sequences.
- Discovered one putative insertion sequence from genomic sequencing that may be useful for typing *Francisella tularensis*.
- Isolated and characterized 65 ciprofloxacin resistant *Y. pestis* mutants and showed they are similar to previously described *Escherichia coli* mutants in *gyrA*.
- Developed a single hybridization probe assay for the LightCycler that will detect all isolated ciprofloxacin resistant mutants of *Y. pestis*.

### **D.2.3 Advanced Development Accomplishments**

The Joint Program Office for Biological Defense (JPO-BD) is a DoD chartered agency 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 weaponized agents will be produced and stockpiled to fulfill a 1.2 million Troop Equivalent Doses (TEDs) requirement (Note: TED = the 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.

#### **D.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.

#### **D.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.

#### **D.2.3.3 Anthrax Vaccine Human Adsorbed**

- BioPort, the sole manufacturer of the Anthrax Vaccine is in the process of obtaining FDA approval for their renovated facility. There have been a series of issues that have

delayed efforts to resume full production. The FDA standards for sterility, potency, purity, filling and packaging are rigorous and BioPort has been striving to meet them. They have hired additional experts to assist them and they are making progress. FDA approval is expected during 2002.

#### **D.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 levels. 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.

#### **D.2.3.5 Botulism Immune Globulin F(ab')<sub>2</sub>, 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.

#### **D.2.3.6 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.

### **D.2.4 Joint Vaccine Acquisition Program (JVAP) Accomplishments**

#### **D.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, Q fever vaccine, Venezuelan equine encephalitis vaccine) and Vaccinia Immune Globulin.

#### **D.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, Q fever, VEE, EEE, and WEE vaccines.
- An assessment is being conducted to determine the FDA requirements for additional testing that would make this inventory ready for immediate use under a Presidential Executive Order.

#### **D.2.4.3 Advanced Development of the Tularemia Vaccine**

- The JVAP selected BioScience, Baltimore, Maryland, 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 Evaluation Research Agency (UK).

#### **D.2.4.4 Advanced Development of the Q-fever Vaccine**

- Continued efforts with CSL, Melbourne, Australia, to obtain FDA licensure for their commercial, licensed (Australia) Q fever vaccine.
- New seed material has been produced and is being characterized.
- New lot release assays are under development.
- New clinical assays are being investigated.
- A feasibility study for an expanded safety trial has been conducted.
- Renovation plans to bring the facility to FDA compliance have been developed, equipment needs have been identified, and several options are being considered.

#### **D.2.4.5 Advanced Development of the Smallpox Vaccine**

- The JVAP selected BioReliance Corporation, Rockville, MD, as the manufacturer of the new Smallpox vaccine. BioReliance began manufacturing efforts by establishing and characterizing master and working seed and cell banks for the vaccine, and identifying parameters to be investigated under process definition.
- Completed a clinical trial to evaluate the candidate vaccine administered by scarification. Preliminary clinical data indicate the candidate is immunogenic and merits further development. Clinical serum specimens are being evaluated for antibody response.
- 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 successfully obtained an IND (#9141) for a new VIG product for intravenous administration. Three lots have been manufactured by Massachusetts Biologics Laboratory, Boston, Massachusetts. A clinical trial currently is ongoing under the management of Quintiles at their Lenexa, KS, site and is scheduled to be completed in FY2001.
- 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 Advanced Biosciences Laboratory, Rockville, Maryland. Clinical specimens from the current VIG trial will be assayed once this method is validated.

#### **D.2.4.6 Venezuelan Equine Encephalitis Vaccine**

- Re-engineered the genetic constitution of the vaccine expression system to remove a problematic sequence.
- Addressed cGMP issues with a pilot lot manufacturer.

#### **D.2.4.7 Recombinant Botulinum Toxin Vaccine**

- Selected Covance, Cary, North Carolina, as the a subcontractor for manufacture and stockpiling of a multivalent (serotypes A, B, C, E, and F) recombinant botulinum toxin vaccine.
- Began manufacturing process development for production of a multivalent recombinant botulinum vaccine.

#### **D.2.4.8 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. Negotiations were initiated immediately.
- 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.

#### **D.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.

### **D.3 MEDICAL NUCLEAR (RADIOLOGICAL) DEFENSE RESEARCH PROGRAM**

#### **D.3.1 Fielded Products**

Appropriately applied, advances in medical science and biotechnology can significantly impact 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.

#### **D.3.2 Nuclear Defense Research and Development Accomplishments**

Technical barriers and accomplishments within the Medical Radiological Defense Research Program during FY00 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 soldier 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 soldier 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 both 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.

### **D.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.

# *Annex E*

## *NBC Defense Logistics Readiness Data*

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### **E.1 BREAKOUT OF SERVICE WAR REQUIREMENTS, STOCKS ON-HAND, AND PLANNED ACQUISITIONS**

The following tables display NBC defense equipment total Service requirements, their wartime requirements, stocks on-hand quantities to include FY00 quantities on contract, and FY01–02 planned procurements for each of the four Services and Defense Logistics Agency. As mentioned earlier in this chapter, 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 a 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 in general agree with the methodology and intent of the study, 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 specific 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 FY01 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.

**Table E-1a. Army Logistics Readiness Data -- Nonconsumables**

NOMENCLATURE	NSN	TOTAL SERVICE RQMTS	NO. REQUIRED FOR 2 MTW	STOCKS ON HAND TO INCLUDE FY00 DUE IN	PROJECTED DUE IN						
					FY01	FY02	FY03	FY04	FY05	FY06	FY07
<b>INDIVIDUAL PROTECTION COMMODITY AREA</b>											
<b>CB MASK</b>											
MASK, CB, M17A2	4240-01-143-2017-20	38,038	0	386,778	0	0	0	0	0	0	0
MASK, CB, M40/M40A1	4240-01-258-0061-63	1,172,956	610,506	724,093	0	0	0	0	0	0	0
MASK, M24, AVIATOR	4240-00-776-4384	0	0	9,337	0	0	0	0	0	0	0
MASK, M25A1, TANK	4240-00-994-8750-52	307	0	5,255	0	0	0	0	0	0	0
MASK, M42, TANK	4240-01-258-0064-66	140,313	69,015	62,148	0	0	0	0	0	0	0
MASK, M43, APACHE	4240-01-208-6966-69	3,887	0	5,881	0	0	0	0	0	0	0
MASK, M45, AVIATOR	4240-01-414-4034-35/-4051-52	40,921	18,909	6,867	0	0	0	0	0	0	0
MASK, M48, APACHE	4240-01-386-0198/-4686/-0201/-0207	3,877	1,609	0	0	0	0	0	0	0	0
<b>MISC PROTECTION</b>											
PATS, M41	4240-01-365-8241	9,621	3,763	6,161	0	0	0	0	0	0	0
<b>CONTAMINATION AVOIDANCE COMMODITY AREA</b>											
<b>NUCLEAR DETECTION EQUIPMENT</b>											
AN/PDR-75	6665-01-211-4217	6,039	5,445	6,955	0	0	0	0	0	0	0
AN/PDR-77	6665-01-347-6100	685	532	872	0	0	0	0	0	0	0
AN/UDR-13	6665-01-407-1237	26,901	26,901	14,067	0	0	0	0	0	0	0
AN/VDR-2	6665-01-222-1425	36,974	33,405	37,927	0	0	0	0	0	0	0
<b>BIOLOGICAL DETECTION EQUIPMENT</b>											
BIDS, M31	6665-01-392-6191	124	124	74	0	0	0	0	0	0	0
LR-BSDS, M94	6665-00-422-6605	24	24	0	0	0	0	0	0	0	0
<b>CHEMICAL DETECTION EQUIPMENT</b>											
ACADA, M22	6665-01-438-6963	28,839	28,839	5,161	0	0	0	0	0	0	0
ALARM, CAA, M8A1	6665-01-105-5623	28,000	28,000	21,958	0	0	0	0	0	0	0
CAM/ICAM	6665-01-357-8502	18,817	18,817	13,720	0	0	0	0	0	0	0
M21 RSCAAL	6665-01-324-6637	123	123	156	0	0	0	0	0	0	0
NBC RECON SYS, M93A1	6665-01-372-1303	123	123	50	0	0	0	0	0	0	0
<b>DECONTAMINATION COMMODITY AREA</b>											
DECON APPAR, M11	4230-00-720-1618	37,287	37,287	88,621	0	0	0	0	0	0	0
DECON APPAR, M13	4230-01-133-4124	226,800	111,125	168,916	0	0	0	0	0	0	0
DECON APPAR, PDDA, M12A1	4230-00-926-9488	682	129	1,266	0	0	0	0	0	0	0
L/WT DEC SYS, M17A1	4230-01-303-5225	2,516	2,516	2,223	0	0	0	0	0	0	0
<b>COLLECTIVE PROTECTION COMMODITY AREA</b>											
CP DEPMEDS (HUB, CP, M28)	4240-01-395-5179	23	23	12	0	0	0	0	0	0	0
SHELTER, CB PROTECT	5410-01-441-8054	572	572	125	31	26	38	37	45	0	0
SHELTER, CP, M20/M20A1	4240-01-166-2254	2,019	1,747		0	0	0	0	0	0	0
SHELTER, M51	4240-00-854-4144	0	0		0	0	0	0	0	0	0
<b>MEDICAL COMMODITY AREA</b>											
LITTER, DECONTAMINABLE	6530-01-380-7309	5,148	5,148	5,148	5,075	1,212	1,268	1,848	1,080	1,256	1,212

**Table E-1b. Army Logistics Readiness Data - Consumables**

NOMENCLATURE	NSN	TOTAL SERVICE RQMTS	NO. REQUIRED FOR 2 MTW	STOCKS ON HAND TO INCLUDE FY00 DUE IN	PROJECTED DUE IN	
					FY01	FY02
<b>INDIVIDUAL PROTECTION COMMODITY AREA</b>						
<b>OVERGARMENTS</b>						
CHEM PROT UNDERGARMENT TOP	8415-01-363-8692-00	728,718	0	5,456	0	0
CPU DRAWERS	8415-01-363-8683-91	728,718	431,564	5,127	0	0
ISLIST (ABDO) 45 DAYS	SEE NSNs IN TABLE E-5	3,300,000	2,900,000	617,605	165,435	181,125
SCALP (TAN AND GREEN)	8415-01-333-0987-89		0	2,135	0	0
	8415-01-364-3320-22	151,475	151,475	7,392	0	0
SUIT, CP CAMO (BDOs)	8415-01-137-1700-07	0	0	2,310,503	0	0
<b>OVERBOOTS/GLOVES</b>						
BLK/GRN VINYL O/BOOTS	8430-01-317-3374-85		0	1,995,444	0	0
	8430-01-049-0878-87	7,412,697	2,899,864	226,373	0	0
CPO FOOT COVERS	8430-01-021-5978	1,028,707	0	149,816	0	0
CP GLOVES 7 MIL	8415-01-138-2501-04	473,041	154,612	113,516	0	0
CP GLOVES 14 MIL	8415-01-138-2497-00	1,067,558	618,448	188,817	0	0
CP GLOVES 25 MIL	8415-01-033-3517-20	6,270,220	3,861,320	4,321,267	0	0
<b>MISC PROTECTION</b>						
2D SKIN, M40 SERIES	4240-01-413-1540-43	812,709	691,040	457,214	80,979	43,500
BATTERY, BA-5800 (PRO MASK)	6665-99-760-9742	61,052	61,052	5,769	0	0
CP HELMET COVER	8415-01-111-9028	1,605,279	1,605,279	2,900,074	0	0
FILTER CAN, C2A1	4240-01-361-1319	1,764,884	1,367,626	2,164,772	358,000	264,000
FILTER CAN, M10A1	4240-00-127-7186	196,464	0	96,564	0	0
FILTER ELEMENT, M13A2	4240-00-165-5026	584,511	0	353,307	0	0
HOOD, M40	4240-01-376-3152	3,534,562	1,703,570	1,470,629	334,500	204,000
HOOD, M5 (FOR M25A1)	4240-00-860-8987	46,316	0	54,020	0	0
HOOD, M6A2 (FOR M17)	4240-00-999-0420	733,910	0	315,053	0	0
HOOD, M7 (FOR M24)	4240-00-021-8695	44,172	0	30,593	0	0
<b>CONTAMINATION AVOIDANCE COMMODITY AREA</b>						
<b>CHEMICAL DETECTION EQUIPMENT</b>						
BATTERY, ACADA BA-5590	6135-01-036-3495	55,000	110,000	130,290	0	0
BATTERY, BA-3517	6135-00-450-3528	151,141	52,645	20,446	0	0
BATTERY, ICAM BA-5800	6665-99-760-9742	52,645	52,645	8,807	0	0
BATTERY, M42 BA3030	6135-00-930-0030	220,000	440,000			
DET KIT, M256A1	6665-01-133-4964	198,290	48,027	74,534	58,374	0
DET PAPER, M8	6665-00-050-8529	2,169,231	2,169,231	1,582,890	0	0
DET PAPER, M9	6665-01-226-5589	2,023,873	2,023,873	1,583,968	0	0
MAINT KITS, M293/M273	5180-01-379-6409	80,223	0	8,632	0	0
	5180-01-108-1729	41,106	41,106	17,599	0	0
NBC MARK SET, M274	9905-12-124-5955	38,733	9,906	20,571	15,229	0
WATER TEST KIT, M272A1	6665-01-134-0885	9,580	9,580	8,694	7,050	0
<b>DECONTAMINATION COMMODITY AREA</b>						
DECON KIT, M258A1	4230-01-101-3984	834,253	0	65,934	0	0
DECON KIT, M291	6850-01-276-1905	1,147,688	183,382	260,599	5,422	0
DECON KIT, M295	6850-01-357-8456	752,595	166,892	128,389	0	0
DS2, 1 1/3 QT	6850-00-753-4827	700,344	192,338	51,043	17,499	0
DS2, 5 GAL	6850-00-753-4870	4,865,259	226,163	253,320	0	0

**Table E-1b. Army Logistics Readiness Data – Consumables**

NOMENCLATURE	NSN	TOTAL SERVICE RQMTS	NO. REQUIRED FOR 2 MTW	STOCKS ON HAND TO INCLUDE FY00 DUE IN	PROJECTED DUE IN	
					FY01	FY02
DS2, M13 CAN	6850-01-136-8888	2,193,465	369,535	113,440	0	0
NITROGEN CYLINDERS	4230-00-775-7541	1,319,022	1,319,022	56,167	0	0
STB, 50 LB	6850-00-297-6653	10,628	10,628	2,691	0	0
<b>COLLECTIVE PROTECTION COMMODITY AREA</b>						
FILTER, CP, M12A2 (M14 GPFU)	4240-01-365-0981	12,816	12,816	6,727	463	0
FILTER, CP, M13 SERIES (M14 GPFU)	4240-00-368-6291	12,816	12,816	3,984	1,546	0
FILTER, CP, M18A1	4240-01-365-0982	60,580	60,580	21,247	1,036	0
FILTER, CP, M19	4240-00-866-1825	44,971	44,971	12,743	270	0
FILTER, GP, M48A1	4240-01-363-1311	15,930	15,930	11,398	8,262	0
FILTER SET FOR (M59, M56, SHIPBOARD)	4240-01-369-6533	1,167	1,167	5,427	6,836	0
<b>MEDICAL COMMODITY AREA</b>						
2-PAM CHLORIDE AUTOINJ	6505-01-125-3248	1,349,637	1,349,637	2,121,137	1,550	
ATROPINE AUTOINJ	6505-00-926-9083	1,874,828	1,874,828	986,450	26,310	12,760
CANA AUTOINJ	6505-01-274-0951	1,554,920	1,554,920	606,429	185,187	185,187
MED AEROS NERVE AG ANT (MANAA)	6505-01-332-1281	2,238	2,238	3,987		
NAAK, MKI	6705-01-174-9919	2,281,312	2,281,312	460,210	0	0
PYRIDOSTIGMINE TAB	6505-01-178-7903	1,317,309	1,317,309	185,948	14,813	14,813
PATIENT WRAPS	6530-01-383-6260	18,900	18,900	2,100	72	0
MES, CHEM AG PAT DECON	6545-01-176-4612	1,575	1,575	0	0	0
MES, CHEM AG PAT TREATMENT	6545-01-141-9469	2,238	2,238	0	0	0
<b>OTHER TREATMENTS</b>						
CIPROFLOXACIN	6505-01-272-2385		0	51,587	0	0
	6505-01-273-8650		0	27,546	0	23,806
	6505-01-333-4154	1,881,870	1,881,870	628	0	0
DOXYCYCLINE CAPS	6505-01-153-4335		0	0	0	0
ANTIDOTE TREATMENT KIT, CYANIDE	6505-01-143-4641	67,140	67,140	6402		
	6505-01-457-8901	22,380	22,380		1,637	

**Table E-2a. Air Force Logistics Readiness Data - Non-Consumables**

NOMENCLATURE	NSN	TOTAL SERVICE RQMTS	NO. REQUIRED FOR 2 MTW	STOCKS ON HAND TO INCLUDE FY00 DUE IN	PROJECTED DUE IN						
					FY01	FY02	FY03	FY04	FY05	FY06	FY07
<b>INDIVIDUAL PROTECTION COMMODITY AREA</b>											
<b>CB MASK</b>											
MASK, A/P22P2	NOT ASSIGNED	14,810	14,810	0	0	0	0	0	0	0	0
MASK, AERP	8475-01-339-9782(S)	32,864	32,864	33,800	0	0	0	0	0	0	0
MASK, CB, M17A2	4240-01-143-2017-20	5,132	5,132	2,216	0	0	0	0	0	0	0
MASK, MCU-2/P,	4240-01-415-4239-41	445,112		154,512	0	0	0	0	0	0	0
MASK, MCU-2A/P	4240-01-284-3615-17	106,382	354,188	82,432	0	0	0	0	0	0	0
MASK, MCU-2A/P (WR) USAF	4240-01-327-3299-01	39,978		52,395	0	0	0	0	0	0	0
<b>MISC PROTECTION</b>											
PATS, M41	4240-01-365-8241	1,500	1,208	228	0	0	0	0	0	0	0
<b>CONTAMINATION AVOIDANCE COMMODITY AREA</b>											
<b>NUCLEAR DETECTION EQUIPMENT</b>											
ADM 300 - A KIT	6665-01-363-6213NW	300	117	228	0	0	0	0	0	0	0
- B KIT	6665-01-342-7747NW	800	597	582	0	0	0	0	0	0	0
- C KIT	6665-01-320-4712NW	750	518	800	0	0	0	0	0	0	0
- E KIT	6665-01-426-5071NW	250	119	233	0	0	0	0	0	0	0
<b>CHEMICAL DETECTION EQUIPMENT</b>											
ACADA, M22	6665-01-438-6963	2,140	2,140	297	0	0	0	0	0	0	0
ALARM, CAA, M8A1	6665-01-105-5623	423	331	258	0	0	0	0	0	0	0
CAM/ICAM	6665-01-357-8502	125	108	165	0	0	0	0	0	0	0
	6665-01-199-4153	1,960	1,960	799	0	0	0	0	0	0	0
M90 CHEM WARFARE ALARM	6665-01-408-5108	65	58	144	0	0	0	0	0	0	0
<b>DECONTAMINATION COMMODITY AREA</b>											
A/E32U-8 DECON SYS	4230-01-153-8660	175	0	226	0	0	0	0	0	0	0
L/WT DEC SYS, M17	4230-01-251-8702	299	0	625	0	0	0	0	0	0	0
L/WT DEC SYS, M17A1	4230-01-303-5225	50	0	17	0	0	0	0	0	0	0
L/WT DEC SYS, M17A2	4230-01-349-1778	324	324	117	0	0	0	0	0	0	0
<b>COLLECTIVE PROTECTION COMMODITY AREA</b>											
KMU-450 SHEL MOD KIT	4240-01-044-7659	25	16	3	0	0	0	0	0	0	0
CHATH (HUB, CPE, M28)	NOT ASSIGNED	* 21	20	9	0	0	0	0	0	0	0
<b>MEDICAL COMMODITY AREA</b>											
LITTER, DECONTAMINABLE	6530-01-380-7309	26,770	26,770	14,335	0	0	0	0	0	0	0
* CHATH fielding currently being reevaluated by Air Force Medical Service											

Table E-2b. Air Force Logistics Readiness Data – Consumables

NOMENCLATURE	NSN	TOTAL SERVICE RQMTS	NO. REQUIRED FOR 2 MTW	STOCKS ON HAND TO INCLUDE FY00 DUE IN	PROJECTED DUE IN	
					FY01	FY02
<b>INDIVIDUAL PROTECTION COMMODITY AREA</b>						
<b>OVERGARMENTS</b>						
AIRCREWMAN CAPE	8415-01-040-9018	290,014	283,502	212,813	0	0
CLOTHING TEST KIT	6630-00-783-8192	200	167	5	0	0
CP UNDERCOVERALL	8415-01-040-3136-44	75,000	67,376	8,912	0	0
EOD HGU-65P HOOD	4240-01-338-1646	225	192	73	0	0
EOD M-3 TAP	8415-00-099-6962/68/70	312	176	52	0	0
	8415-01-105-2535		0	14	0	0
EOD TAP BOOTCOVER	8430-00-820-6295-6306	275	199	165	0	0
EOD TAP GLOVES	8415-00-753-6550-54	500	375	193	0	0
IMPREG UNDERGARMENT	8415-00-782-3242-5	5,000	5,000	125	0	0
ISLIST (ABDO) 45 DAYS	SEE NSNs IN TABLE E-5	1,504,203	1,224,369	247,042	66,174	72,450
M-2 APRON	8415-00-281-7813-16	225	198	2,227	0	0
M3 COOLING HOOD	8415-00-261-6443	350	308	1,260	0	0
M3 COOLING SUIT	8415-00-264-2929	200	170	44	0	0
SUIT, AIRCREW, CWU-66/77P	8475-01-328-3434-57	150,000	74,871	56,432	0	0
SUIT, CP CAMO (BDO)	8415-01-137-1700-07	801,167	801,167	517,374	0	0
SUIT, CP CAMO-DESERT 3 clr	8415-00-327-5347-53	13,878	13,878	44,471	0	0
SUIT, CP CAMO-DESERT 6 clr	8415-01-324-3084-91	23,656	23,656	94,522	0	0
<b>OVERBOOTS/GLOVES</b>						
BLK/GRN VINYL O/BOOTS BVO	8430-01-317-3374-85	1,006,127	0	913,498	0	0
GVO	8430-01-049-0878-87	6,000	992,103	44,957	0	0
CP FOOTWEAR COVERS	8430-01-118-8172		0	113,879	0	0
	8430-01-021-5978	154,802	0	17,597	0	0
CP GLOVES 7 MIL	8415-01-138-2501-04	464,534	464,534	207,907	0	0
CP GLOVES 14 MIL	8415-01-138-2497-00	1,834,565	1,257,871	1,110,070	0	0
CP GLOVES 25 MIL	8415-01-033-3517-20	90,000	23,051	29,856	0	0
CP SOCKS	8415-01-040-3169	200,056	170,768	248,961	0	0
DISP FOOTWEAR COVER	8430-00-580-1205-06	201,980	185,771	124,848	0	0
GLOVE INSERTS	8415-00-782-2809 (S)	2,245,876	1,688,335	1,164,072	0	0
<b>MISC PROTECTION</b>						
FILTER CAN, C2/C2A1	4240-01-119-2315	1,998,925	955,751	1,897,312	0	0
FILTER, GP	4240-01-161-3110	2,090	1,750	55,494	0	0
FILTER ELEMENT, M13A2	4240-00-165-5026	12,596	12,596	46,658	0	0
HOOD, M6A2 (FOR M17)	4240-00-999-0420	95,093	76,707	219,317	0	0
HOOD, MCU-2/P	4240-01-189-9423	2,225,189	700,774	1,470,294	0	0
<b>CONTAMINATION AVOIDANCE COMMODITY AREA</b>						
<b>CHEMICAL DETECTION EQUIPMENT</b>						
BATTERY, ACADA BA-5590	6135-01-036-3495	46,331	46,331	1,034	0	0
BATTERY, BA-3517	6135-00-450-3528	880	0	463	0	0
BATTERY, ICAM BA-5800	6665-99-760-9742	67,295	67,295	1,174	0	0
DET KIT, M18A2	6665-00-903-4767	100	0	2,927	0	0
DET KIT, M256A1	6665-01-133-4964	50,123	1,292	2,786	0	0



**Table E-2b. Air Force Logistics Readiness Data - Consumables**

NOMENCLATURE	NSN	TOTAL SERVICE RQMTS	NO. REQUIRED FOR 2 MTW	STOCKS ON HAND TO INCLUDE FY00 DUE IN	PROJECTED DUE IN	
					FY01	FY02
DET PAPER, M8	6665-00-050-8529	454,096	316,274	759,243	0	0
DET PAPER, M9	6665-01-049-8982	50,606	0	250,283	0	0
	6665-01-226-5589	355,994	355,994	28,453	0	0
MAINTENANCE KIT, M293	5180-01-379-6409	90	0	75,379	0	0
NBC MARK SET, M274	9905-12-124-5955	725	517	39,784	0	0
WATER TEST KIT, M272A1	6665-01-134-0885	764	764	5,979	0	0
<b>DECONTAMINATION COMMODITY AREA</b>						
CALCIUM HYPOCHLORITE	6810-00-255-0471	625	625	523	0	0
DECON KIT, M258A1	4230-01-101-3984	725,370	0	11,121	0	0
DECON KIT, M291	6850-01-276-1905	225,093	14,423	495,329	0	0
DECON KIT, M295	6850-01-357-8456	135,092	7,538	163,596	0	0
DRY SORBENT POWDER	6850-01-262-0484	1,150	100	1,781	0	0
SODIUM HYPOCHLORITE	6810-00-598-7316	100	0	98,085	0	0
STB, 50 LB	6850-00-297-6653	517	517	25,405	0	0
<b>COLLECTIVE PROTECTION COMMODITY AREA</b>						
FILTER, CP M13 SERIES (M14 GPFU)	4240-00-368-6291	0	0	1,162	0	0
FILTER, GP M48A1	4240-01-363-1311	0	8	0	0	0
FILTER SET FOR (M59, M56, SHIPBOARD)	4240-01-369-6333	0	0	3,110	0	0
<b>MEDICAL COMMODITY AREA</b>						
2-PAM CHLORIDE AUTOINJ	6505-01-125-3248	354,796	354,796	805,527	166,603	166,603
	6505-01-080-1986		0	19,676	4,747	4,747
ATROPINE AUTOINJ	6505-00-926-9083	354,796	354,796	822,695	167,682	167,682
	6505-00-299-9673		0	13,304	5,788	5,877
CANA AUTOINJ	6505-01-274-0951	113,323	113,323	286585	137,909	137,909
NAAK, MKI	6705-01-174-9919	2,947	0	257	0	0
PYRIDOSTIGMINE TAB	6505-01-178-7903	26,731	23,460	64,764	0	0
TETRACYCLINE	6505-00-655-8355	0	0	91,207	0	0
PATIENT WRAPS	6530-01-383-6260	0	0	10	0	0
<b>OTHER TREATMENTS</b>						
DOXYCYCLINE CAPS, 100s	6505-00-009-5060		0	1,396	0	0
500s	6505-00-009-5063		0	1,765	0	0
	6505-01-273-8650		0	66,233	0	0
CIPROFLOXACIN	6505-01-333-4154		33,515	18,822	0	0

**Table E-3a. Navy Logistics Readiness Data – Non-Consumables**

NOMENCLATURE	NSN	TOTAL SERVICE RQMTS	NO. REQUIRED FOR 2 MTW	STOCKS ON HAND TO INCLUDE FY00 DUE IN	PROJECTED DUE IN						
					FY01	FY02	FY03	FY04	FY05	FY06	FY07
<b>INDIVIDUAL PROTECTION COMMODITY AREA</b>											
<i>CB MASK</i>											
MASK, A/P22P2	NOT ASSIGNED										
MASK, MCU-2/P	4240-01-173-3443	50,000		228,944	0	0	0	0	0	0	0
MASK, MCU-2A/P	4240-01-284-3615/17	370,000	423,000	194,993	0	0	0	0	0	0	0
MASK, MCU-2A/P (WR) USN	4240-00-327-4148-50				0	0	0	0	0	0	0
<b>CONTAMINATION AVOIDANCE COMMODITY AREA</b>											
<i>NUCLEAR DETECTION EQUIPMENT</i>											
AN/PDR-27	6665-00-543-1435	1,607	1,607	1,712	0	0	0	0	0	0	0
AN/PDR-43	6665-00-580-9646	15,938	15,938	1,602	0	0	0	0	0	0	0
AN/PDR-56	6665-00-086-8060	89	89	140	0	0	0	0	0	0	0
AN/PDR-65	6665-01-279-7516	382	382	329	0	0	0	0	0	0	0
CP-95	6665-00-526-8645	685	685	543	0	0	0	0	0	0	0
PP-4276	6665-00-489-3106	942	942	712	0	0	0	0	0	0	0
IM-143	6665-00-764-6395	10,800	10,800	13,575	0	0	0	0	0	0	0
DT-60	6665-00-978-9637	145,300	145,300	195,142	0	0	0	0	0	0	0
<i>BIOLOGICAL DETECTION EQUIPMENT</i>											
IBAD	NOT ASSIGNED	0	0	15	0	0	0	0	0	0	0
<i>CHEMICAL DETECTION EQUIPMENT</i>											
ACADA, M22	6665-01-438-6963	535	535	62	0	0	0	0	0	0	0
ALARM, CAA, M8A1	6665-01-105-5623	98	98	102	0	0	0	0	0	0	0
CAPDS	6665-01-294-2556	145	145	232	0	0	0	0	0	0	0
CHEM AGENT MONITOR/ICAM	6665-01-199-4153	250	1,008	158	0	0	0	0	0	0	0
CWDD, AN/KAS-1	5855-01-147-4362	386	386	630	0	0	0	0	0	0	0
IMP POINT DETECTION SYSTEM	6665-LL-HAL-5532	254	254	289	28	45	43	40	38	0	0
M21 RSCAAL	6665-01-382-1968	0	0	27	0	0	0	0	0	0	0
<b>DECONTAMINATION COMMODITY AREA</b>											
DECON APPAR, M11	4230-00-720-1618	144	144	602	0	0	0	0	0	0	0
L/AWT DEC SYS M17A3 DIESEL	4230-01-346-3122	137	137	15	0	0	0	0	0	0	0
<b>COLLECTIVE PROTECTION COMMODITY AREA</b>											
SHELTER, CP, M20/M20A1	4240-01-166-2254	7,311	7,311	1,796	0	0	0	0	0	0	0
<b>MEDICAL COMMODITY AREA</b>											
LITTER, DECONTAMINABLE	6530-01-380-7309	1,200	1,200	216	1,212	1,268	1,848	1,080	1,256	1,212	0

**Table E-3b. Navy Logistics Readiness Data - Consumables**

NOMENCLATURE	NSN	TOTAL SERVICE RQMTS	NO. REQUIRED FOR 2 MTW	STOCKS ON HAND TO INCLUDE FY00 DUE IN	PROJECTED DUE IN	
					FY01	FY02
<b>INDIVIDUAL PROTECTION COMMODITY AREA</b>						
<b>OVERGARMENTS</b>						
APRON, TAP	8415-00-281-7813-16	72	72	159	0	0
IMPREG UNDERGARMENT	8415-00-782-3242-5	240	240		0	0
ISLIST (ABDO) 45 DAYS	SEE NSNs IN TABLE E-5	1,606,073	1,217,478	241,767	66,164	72,450
SUIT, CP CAMO (BDO)	8415-01-137-1700-07	0	0		0	0
SUIT, TAP 3	8415-00-099-6962/68/70	42	42	250	0	0
	8415-01-105-2535	0	0		0	0
SUIT, CP, OGMK3*	8415-01-214-8289-92	0	0	178,305	0	0
<b>OVERBOOTS/GLOVES</b>						
BLK/GRN VINYL O/BOOTS BVO	8430-01-317-3374-85	28,606	28,606	72,080	0	0
GVO	8430-01-049-0878-87	0	0		0	0
CP FOOTWEAR COVERS	8430-01-118-8172	0	0		0	0
	8430-01-021-5978	490,000	490,000	255,565	0	0
CP GLOVES 14 MIL	8415-01-138-2497-00	58,160	58,160	124,398	0	0
CP GLOVES 25 MIL	8415-01-033-3517-20	490,000	490,000	301,884	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	490,000	490,000	236,600	0	0
<b>MISC PROTECTION</b>						
CP HELMET COVER	8415-01-111-9028	450	450	147	0	0
FILTER CAN, C2/C2A1	4240-01-119-2315	796,000	796,000	288,623	0	0
HOOD, MCU-2/P	4240-01-189-9423	1,977	1,977	362	0	0
<b>CONTAMINATION AVOIDANCE COMMODITY AREA</b>						
<b>CHEMICAL DETECTION EQUIPMENT</b>						
DET KIT, M256A1	6665-01-133-4964	10,235	159	4,126	0	0
DET PAPER, M8	6665-00-050-8529	91,567	80,924	52,206	0	0
DET PAPER, M9	6665-01-226-5589	82,357	82,357	13,717	0	0
NBC MARK SET, M274	9905-12-124-5955	522	22	756	0	0
TUBE PHOSGENE	6665-01-010-7965	1,280	1,280	1,809	0	0
WATER TEST KIT, M272A1	6665-01-134-0885	421	131	196	0	0
<b>DECONTAMINATION COMMODITY AREA</b>						
CALCIUM HYPOCHLORITE	6810-00-255-0471	10,626	10,626	17,863	0	0
DECON KIT, M258A1	4230-01-101-3984	3,339	3,339	6,782	0	0
DECON KIT, M291	6850-01-276-1905	124,410	3,233	166,643	0	0
DECON KIT, M295	6850-01-357-8456	1,645	1,645	4,763	0	0
DS2, 5 GAL	6850-00-753-4870	0	0	101	0	0
SODIUM HYPOCHLORITE	6810-00-598-7316	12	12	12	0	0
STB, 50 LB	6850-00-297-6653	1,525	1,525	1,037	0	0

**Table E-3b. Navy Logistics Readiness Data – Consumables**

NOMENCLATURE	NSN	TOTAL SERVICE RQMTS	NO. REQUIRED FOR 2 MTW	STOCKS ON HAND TO INCLUDE FY00 DUE IN	PROJECTED DUE IN	
					FY01	FY02
<b>COLLECTIVE PROTECTION COMMODITY AREA</b>						
FILTER, GP, M48A1	4240-01-363-1311	293	293		0	0
FILTER SET FOR (M59, M56, SHIPBOARD)	4240-01-369-6533	6,800	6,800	14	0	0
PRE-FILTER, SHIPBOARD CPE	4240-01-348-8785	17,905	17,905	702	0	0
<b>MEDICAL COMMODITY AREA</b>						
2-PAM CHLORIDE AUTOINJ	6505-01-125-3248	1,236,000	1,236,000	297,116		
ATROPINE AUTOINJ	6505-00-926-9083	1,236,000	1,236,000	315,724		
CANA AUTOINJ	6505-01-274-0951	436,000	436,000	5,892		
NAAK, MKI	6705-01-174-9919	113,051	113,051	35,712	3,477	
PYRIDOSTIGMINE TAB	6505-01-178-7903	436,000	436,000	65,431		
TETRACYCLINE	6505-00-655-8355	1,212,205	1,212,205			
PATIENT WRAPS	6530-01-383-6260	0	0	2,100	72	
<b>OTHER TREATMENTS</b>						
CIPROFLOXACIN	6505-01-273-8650		0	27,546	0	0
	6505-01-333-4154	100,472	100,472	628	0	0
DOXYCYCLINE CAPS, 100s	6505-00-009-5060		0		0	0
500s	6505-00-009-5063		0	51	0	0

\* 2 MTW Requirement included in JSLIST total

**Table E-4a. Marine Corps Logistics Readiness Data - Non-Consumables**

NOMENCLATURE	NSN	TOTAL SERVICE RQMTS	NO. REQUIRED FOR 2 MTW	STOCKS ON HAND TO INCLUDE FY00 DUE IN	PROJECTED DUE IN							
					FY01	FY02	FY03	FY04	FY05	FY06	FY07	
<b>INDIVIDUAL PROTECTION COMMODITY AREA</b>												
<i>CB MASK</i>												
MASK, A/P2P2	NOT ASSIGNED			18	0	0	0	0	0	0	0	0
* MASK, CB, M40/M40A1	4240-01-258-0061-63	227,069	197,058	193,811	42,029	7,999	0	0	0	0	0	0
MASK, CB, M17A2	4240-01-143-2017-20	0	0	12,560	0	0	0	0	0	0	0	0
MASK, M24, AVIATOR	4240-00-776-4384	0	0	603	0	0	0	0	0	0	0	0
MASK, M25A1, TANK	4240-00-994-8750-52	0	0	0	0	0	0	0	0	0	0	0
* MASK, M42, TANK	4240-01-258-0064-66	4,788	8,659	2,136	0	0	0	0	0	0	0	0
MASK, MCU-2/P, -2A/P	4240-01-284-3615-17	0	0	164	0	0	0	0	0	0	0	0
<i>MISC PROTECTION</i>												
MASK COMM ADAPTOR	5996-01-381-9012	50,000	50,000	11,386	0	0	0	0	0	0	0	0
PATS, M41	4240-01-365-8241	469	469	437	0	0	0	0	0	0	0	0
<b>CONTAMINATION AVOIDANCE COMMODITY AREA</b>												
<i>NUCLEAR DETECTION EQUIPMENT</i>												
AN/PDR-75	6665-01-211-4217	1,203	1,203	872	0	0	0	0	0	0	0	0
AN/VDR-2	6665-01-222-1425	1,182	1,182	2,029	0	0	0	0	0	0	0	0
<i>CHEMICAL DETECTION EQUIPMENT</i>												
ACADA, M22	6665-01-438-6963	762	762	47	245	120	312	0	0	0	0	0
ALARM, CAA, M8A1	6665-01-105-5623	28	28	0	0	0	0	0	0	0	0	0
CAM 1.5	6665-01-359-9006	1,854	1,565	* 1,852	0	0	0	0	0	0	0	0
CAM 2.0	6665-99-725-9996	1,528	875	* 875	0	0	0	0	0	0	0	0
M21 RSCAAL	6665-01-382-1968	151	151	96	0	0	0	0	0	0	0	0
NBC RECON SYS, M93	6665-01-372-1303	10	10	0	0	0	0	0	0	0	0	0
<b>DECONTAMINATION COMMODITY AREA</b>												
DECON APPAR, M11	4230-00-720-1618	21,050	7,235	38,575	0	0	0	0	0	0	0	0
DECON APPAR, M13	4230-01-133-4124	16,913	16,913	4,731	0	0	0	0	0	0	0	0
DECON APPAR, PDDA, M12A1	4230-00-926-9488	0	0	0	0	0	0	0	0	0	0	0
L/WT DEC SYS, M17A1	4230-01-303-5225	344	0	285	0	0	0	0	0	0	0	0
L/WT DEC SYS, M17A3	4230-01-346-3122	1,570	1,570	428	0	0	0	0	0	0	0	0
<b>COLLECTIVE PROTECTION COMMODITY AREA</b>												
** SHELTER, CP, PORTABLE	4240-01-346-2564			13	0	0	0	0	0	0	0	0
<b>MEDICAL COMMODITY AREA</b>												
LITTER, DECONTAMINABLE	6530-01-380-7309	0	0	0	0	0	0	0	0	0	0	0

\* 984 CAM 1.5 currently unserviceable, 668 CAM 2.0 currently unserviceable

\*\* - Note: The Marine Corps is using the Portable Collective Protection System for training purposes.

**Table E-4b. Marine Corps Logistics Readiness Data – Consumables**

NOMENCLATURE	NSN	TOTAL SERVICE RQMTS	NO. REQUIRED FOR 2 MTW	STOCKS ON HAND TO INCLUDE FY00 DUE IN	PROJECTED DUE IN	
					FY01	FY02
<b>INDIVIDUAL PROTECTION COMMODITY AREA</b>						
<b>OVERGARMENTS</b>						
JSLIST (ABDO) 45 DAYS	SEE NSNs IN TABLE E-5	853,176	687,606	123,521	33,087	36,225
SUIT, CP CAMO (BDO)	8415-01-137-1700-07	0	0	14,413	0	0
SUIT, CP, SARATOGA	8415-01-333-7573-76	596,131	596,131	538,117	0	0
SUIT, CP SARATOGA-DESERT	8415-01-333-7577-80	50,000	50,000	33,414	0	0
<b>OVERBOOTS/GLOVES</b>						
BLK/GRN VINYL O/BOOTS BVO	8430-01-317-3374-85		0	344,850		
GVO	8430-01-049-0878-87	654,000	651,146	34,405	0	0
CP FOOT COVERS	8430-01-021-5978		0	259,818	0	0
CP GLOVES 25 MIL	8415-01-033-3517-20	792,154	792,154	1,027,096	0	0
<b>MISC PROTECTION</b>						
2D SKIN, M40 SERIES	4240-01-413-1540-43	277,069	183,684	146,359	0	0
CP HELMET COVER	8415-01-111-9028	571,001	571,001	0	0	0
FILTER CAN, C2/C2A1	4240-01-119-2315		0	387,008		
	4240-01-361-1319	554,246	359,930	24,643	0	0
FILTER CAN, M10A1	4240-00-127-7186	2,468	0	757	0	0
FILTER ELEMENT, M13A2	4240-00-165-5026	27,766	0	30,061	0	0
HOOD, M40	4240-01-376-3152	343,869	343,869	67,109	0	0
HOOD, M5 FOR M25A1	4240-00-860-8987	867	0	2,134	0	0
HOOD, M6A2 FOR M17	4240-00-999-0420	25,973	0	6,493	0	0
HOOD, M7 (FOR M24)	4240-01-021-8695	323	0	2,074	0	0
HOOD, MCU-2/P	4240-01-189-9423		0	0	0	0
<b>CONTAMINATION AVOIDANCE COMMODITY AREA</b>						
<b>CHEMICAL DETECTION EQUIPMENT</b>						
BATTERY, BA-3517	6135-00-450-3328		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	616	0	0
DET KIT, M256A1	6665-01-133-4964	30,547	30,547	4,636	0	0
DET PAPER, M8	6665-00-050-8529	272,770	272,770	25,076	0	0
DET PAPER, M9	6665-01-049-8982		0	5,286		
	6665-01-226-5589	380,949	380,949	63,212	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	437	0	0
WATER TEST KIT, M272A1	6665-01-134-0885	3,159	1,115	494	0	0
<b>DECONTAMINATION COMMODITY AREA</b>						
DECON KIT, M258A1	4230-01-101-3984	201,568	0	6,200	0	0
DECON KIT, M291	6850-01-276-1905	408,220	33,067	155,133	0	0
DECON KIT, M295	6850-01-357-8456	29,244	29,244	3	0	0
DS2, 1 1/3 QT	6850-00-753-4827	21,231	1,006,813	12,328	0	0
DS2, 5 GAL	6850-00-753-4870	253,837	2,919	7,603	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	9,254	0	0
STB, 50 LB	6850-00-297-6653	7,410	1,264	3,377	0	0

**Table E-4b. Marine Corps Logistics Readiness Data - Consumables**

NOMENCLATURE	NSN	TOTAL SERVICE RQMTS	NO. REQUIRED FOR 2 MTW	STOCKS ON HAND TO INCLUDE FY00 DUE IN	PROJECTED DUE IN	
					FY01	FY02
<b>COLLECTIVE PROTECTION COMMODITY AREA</b>						
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	0	0	0
FILTER, CP, M18A1	4240-01-365-0982	3,236	3,236	353	0	0
FILTER, CP, M19	4240-00-866-1825	1,674	1,674	132	0	0
FILTER, GP, M48A1	4240-01-363-1311	644	644	0	0	0
FILTER SET FOR (M59, M56, SHIPBOARD)	4240-01-369-6533		0	0	0	0
<b>MEDICAL COMMODITY AREA</b>						
2-PAM CHLORIDE AUTOINJ	6505-01-125-3248	500,505	500,505	258,176	500	5,000
ATROPINE AUTOINJ	6505-00-926-9083	500,505	500,505	320,549	0	2,000
CANA AUTOINJ	6505-01-274-0951	142,481	142,481	58,401	6,000	0
NAAK, MKI	6705-01-174-9919	405,446	405,446	0		
PYRIDOSTIGMINE TAB	6505-01-178-7903	289,075	289,075	11,313	18,250	0

**Table E-5. Defense Logistics Agency Logistics Readiness Data - Consumables**

NOMENCLATURE	NSN	STOCKS ON HAND TO INCLUDE FY00 DUE IN	PROJECTED DUE IN FY01	FY02
<b>INDIVIDUAL PROTECTION COMMODITY AREA</b>				
<b>OVERGARMENTS</b>				
CAPE, AIRCREWMAN	8415-01-040-9018			
CP UNDERCOVERALL	8415-01-040-3141			
CHEM PROT UNDERGARMENT TOP	8415-01-363-8692-00	24,497	15,029	
CPU DRAWERS	8415-01-363-8683-91			
EOD TAP BOOTCOVER	8430-00-820-6295-6306			
IMPREG UNDERGARMENT	8415-00-782-3243			
ISLIST SUITS *		* 1,299,935	* 330,860	* 362,250
Wood - Coat	8415-01-444-1163/-1169/-1200/38/49/65/70			
Wood Trousers	8415-01-444-1435/39/-1613-/2308/10/25/38			
Desert Coat	8415-01-444-5902/05/13/26/-6116/31/38			
Desert Trousers	8415-01-444-5417/5504/06/-5892/93/98/-5900			
SCALP (TAN AND GREEN)	8415-01-333-0987	59,205		
	8415-01-364-3320			
SUIT, AIRCREW, CWU-66/77P	8475-01-328-3454(S)		14,000	
SUIT, CP CAMO (BDO)	8415-01-137-1700-07		0	0
SUIT, CP CAMO-DESERT - 3 color	8415-00-327-5347-53		0	0
SUIT, CP CAMO-DESERT - 6 color	8415-01-324-3084-91		0	0
SUIT, CP, OG MK3	8415-00-214-8289-92		0	0
SUIT, CP, SARATOGA	8415-01-333-7573-76		0	0
<b>OVERBOOTS/GLOVES</b>				
BLK/GRN VINYL O/BOOTS	8430-01-317-3374-85	398,659	442,420	0
CPO FOOT COVERS	8430-01-021-5978			0
CP GLOVES 7 MIL	8415-01-138-2501-04	45,954	90,000	0
CP GLOVES 14 MIL	8415-01-138-2497-00	309,000	500,000	0
CP GLOVES 25 MIL	8415-01-033-3517-20	542,000	135,000	0
CP SOCKS	8415-01-040-3169			0
DISP FOOTWEAR COVER	8430-00-580-1205-06			0
<b>MISC PROTECTION</b>				
HOOD, MCU-2A/P	4240-01-189-9423		0	0
CP HELMET COVER	8415-01-111-9028			0
<b>CONTAMINATION AVOIDANCE COMMODITY AREA</b>				
<b>CHEMICAL DETECTION EQUIPMENT</b>				
BATTERY, BA3517	6135-00-450-3528	11,623	13,672	13,672
MAINT KITS, M273/M293	5180-01-108-1729			0
	5180-01-379-6409	1,762	0	0
TUBE, DET, PHOSGENE GAS	6665-01-010-7965	15	40	40
<b>DECONTAMINATION COMMODITY AREA</b>				
CALCIUM HYPOCHLORITE	6810-00-255-0471	63,718	27,190	54,380
DRY SORBENT POWDER	6850-01-262-0484	31	0	0
STB, 50 LB	6850-00-297-6653	863	0	0



**Table E-5. Defense Logistics Agency Logistics Readiness Data - Consumables**

NOMENCLATURE	NSN	STOCKS ON HAND TO INCLUDE FY00 DUE IN	PROJECTED DUE IN	
			FY01	FY02
<b>COLLECTIVE PROTECTION COMMODITY AREA</b>				
PRE-FILTER, SHIPBOARD CPE	4240-01-348-8785			
<b>MEDICAL COMMODITY AREA</b>				
2-PAM CHLORIDE, AUTOINJ	6505-01-125-3248	2,993,000	121,390	121,390
ATROPINE AUTOINJ	6505-00-926-9083	2,609,000	225,000	225,000
CANA AUTOINJ	6505-01-274-0951	1,027,000	475,000	475,000
NAAK, MKI	6705-01-174-9919	1,005,000	200,000	0
PYRIDOSTIGMINE TABLETS	6505-01-178-7903	230,000	50,000	50,000
LITTER, DECONTAMINABLE	6530-01-380-7309	1,228	1,420	2,220
MES CHEM ACT PAT TR	6545-01-141-9469	60	60	60
MES CHEM AG PAT DECON	6545-01-176-4612	60	60	60

\* 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. The quantities of suits are shown in the corresponding Service tables.

## **E.2 FIELDDED 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:

- Contamination Avoidance
- Individual Protection
- Collective Protection
- Decontamination
- Medical

### **E.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 much

lower. Collectively, 61% of their total inventory of CAM/ICAM 1.5 and CAM/ICAM 2.0 is currently at the Marine Corps Logistics Base in Albany, GA awaiting repair. At present, the repairs are unfunded.

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.

## **E.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.

### **E.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 FY03, the services have sufficient protective suits to meet requirements as projected for the average two MTW requirements. However, beginning in FY05, the number of suits on hand will fall below total Service requirements, as the service life of older protective suits, such as BDOs, expires in large quantities. These calculations include the approximately \$58 million Quadrennial Defense Review plus-up per year allocated to purchasing protective suits, which began in FY98, and the quantities of defective BDOs removed from inventory in FY00.

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, 14, and 25-mil chemical protective gloves on-hand for contingency use. Recent DoD surveillance tests have validated the protective qualities of the existing butyl rubber glove stocks. The results from calculating the number projected to be on hand for FY05 exceeds the projected average MTW requirement. 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.

### E.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) and M49 (general aviation) 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 60 percent of requirements on hand by FY04. 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, M49 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.

### **E.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 will be 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 4QFY01. 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 will initiate 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.

#### **E.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 low risk. Although there are sufficient quantities on-hand of the M12A1, the maintenance requirements, due to the age of this item, limit its full utilization and may increase 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 is currently undergoing 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 the XE-555 resin components. True Tech Inc. is blending the components to make the XE-555 resin. Alternatives to producing a kit that does not use the XE-555 resin are being studied, including novel sorbent decontaminants. There are also a number of options being explored to retain this "at risk" technology.

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.

### **E.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) saw their risk increase because of the recalculated requirement for consumables. 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 2-13 in Chapter 2 of this report.

JPO-BD continued support to the sole domestic supplier of anthrax vaccine to achieve FDA certification of their renovated facility. 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 the Department of Defense 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 F*

## *DoD Joint Service Chemical and Biological (CB) Defense Program Funding Summary*

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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. Military Construction, Defense Wide appears for the first time in the program in FY 2002. These budget submissions provide a detailed account of prior year accomplishments and planned activities for the budget request period. Table F-1 (and Figure F-1) provides a summary of appropriated and requested funding from FY 1996 – FY 2002. Detailed funding request for FY 2003-2007 are provided separately in the President's FY2002 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 F-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 F-2 will be updated in following years to show total expenditures of appropriated funds.

**Table F-1. Chemical and Biological Defense Program Appropriations Summary**

Program Element (PE) (\$ millions)	FY96‡	FY97‡	FY98‡	FY99‡	FY00*	FY01*	FY02*
0601384BP - Basic Research	26.492	28.372	25.263	28.505	42.827	39.532	39.066
0602384BP - Applied Research	68.571	70.823	69.632	62.301	90.557	81.061	125.481
0603384BP - Advanced Tech. Dev.	33.727	41.693	43.517	59.186	44.705	59.905	69.249
<b>Science &amp; Technology Base Subtotal</b>	<b>128.790</b>	<b>140.888</b>	<b>138.412</b>	<b>149.992</b>	<b>178.089</b>	<b>180.498</b>	<b>233.796</b>
0603884BP - Demonstration/Validation	29.184	44.747	49.465	61.409	67.456	84.992	82.636
0604384BP - EMD	87.229	97.468	123.045	103.159	112.908	102.707	159.943
0605384BP - Management Support	6.954	17.936	21.137	25.099	25.787	23.686	31.276
0605502BP - Management Support/Small Business Innovative Research (SBIR)	0.000	0.000	5.612	5.638	5.938	0.000	0.000
<b>RDT&amp;E, Defense-Wide (D-W) Subtotal</b>	<b>252.157</b>	<b>301.039</b>	<b>337.671</b>	<b>345.297</b>	<b>390.178</b>	<b>391.883</b>	<b>507.651</b>
<b>0208384BP - Procurement, D-W Subtotal</b>	<b>135.647</b>	<b>232.952</b>	<b>233.943</b>	<b>295.189</b>	<b>379.927</b>	<b>475.718</b>	<b>348.709</b>
<b>MILCON (Military Construction)</b>	<b>0.000</b>	<b>0.000</b>	<b>0.000</b>	<b>0.000</b>	<b>0.000</b>	<b>0.000</b>	<b>0.700</b>
<b>CB Defense Program Total</b>	<b>387.804</b>	<b>533.991</b>	<b>571.614</b>	<b>640.486</b>	<b>770.105</b>	<b>867.601</b>	<b>857.060</b>

‡ Total Obligation Authority (TOA)

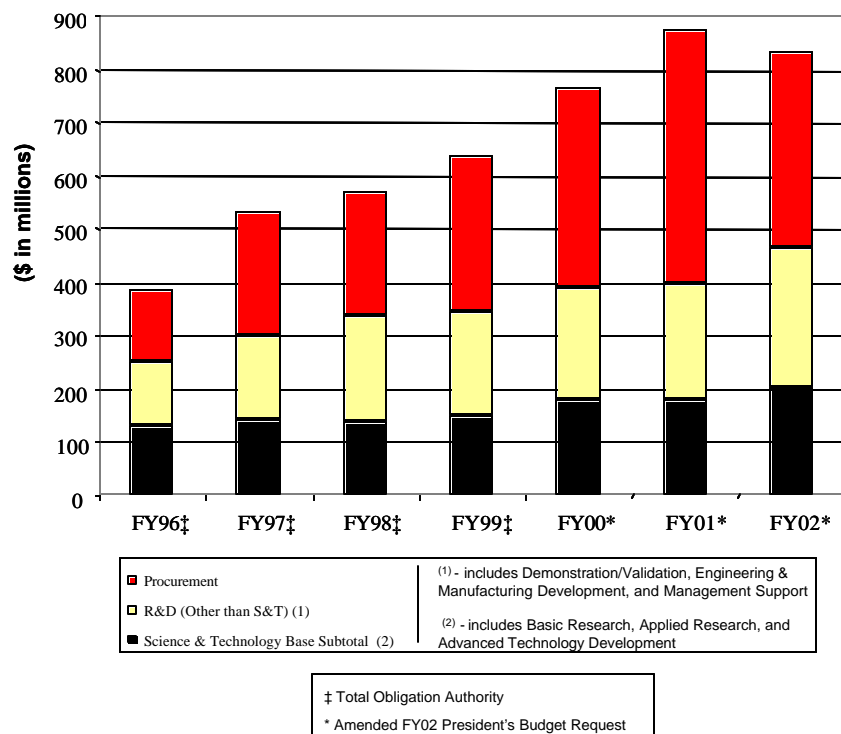
\* Amended FY02 President's Budget Request

**Table F-2. Chemical and Biological Defense Program Expenditures Summary**

Program Element (PE) (\$ millions)	FY96‡	FY97‡	FY98‡	FY99‡	FY00‡
RDT&E, Defense-Wide	241.096	269.429	299.879	301.990	83.592
Procurement, Defense-Wide	125.803	199.476	206.723	228.267	34.391
<b>CB Defense Program Total</b>	<b>366.899</b>	<b>468.905</b>	<b>506.602</b>	<b>530.257</b>	<b>117.983</b>

‡ Expenditures as of September 30, 2000.

**Figure F-1. Chemical and Biological Defense Program Appropriations Summary**



# *Annex G*

## *Department of Defense Chemical and Biological Defense Program FY 2001 Performance Plan*

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### **1.0 INTRODUCTION**

This annex provides a performance plan for the DoD CBDP. This performance plan demonstrates full compliance with the requirements of the Government Performance and Results Act (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 assessing 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.

This is the first performance plan prepared for the CBDP. The plan serves the purpose of providing targets (*i.e.*, both planned and actual accomplishments) for the current assessed year, (FY2000) and the next two planning years (FY2001 and 2002). *The data collection period for this report was September 2000 through February 2001.*

The methodology to develop targets and accomplishments primarily was to use the latest version budget. FY2000 targets were compared to the FY2001 Presidential Budget Submission, submitted in February 2000. In some cases, targets were not met, and an explanation is required. In the development of our procurement metrics and metrics for the percentage of fill for two nearly simultaneous major theaters of war (2MTW%), the latest version of the 2MTW Requirements versus Fill Chart provided by the Secretariat, Joint NBC Defense Board was used. Procurement quantities were extracted from the latest P-forms.

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## 1.1 OVERVIEW OF PERFORMANCE PLAN

The Department of Defense (DoD) Chemical and Biological Defense Program (CDBP) has prepared this performance plan to align itself more closely with the tenets of the Government Performance and Results Act (GPRA). The OSD CB Defense Steering Committee prepared this performance plan in order to provide targets—both planned and actual—for the current assessed year (FY2000) and the next two planning years (FY2001 & 2002). Specifically, the plan:

- Establishes explicit and outcome-oriented goals linked to warfighters' ability to survive, fight, and win in a CB environment;
- Identifies quantitative and/or qualitative performance measures that can be used to assess progress towards goal achievement;
- Describes how performance data is validated;
- Describes how RDT&E activities of participating DOD and non-DOD organizations are coordinated to achieve program goals; and
- Identifies human capital, financial, and resource challenges or external factors that limit the ability of the program to achieve its goals.

The performance plan draws on information and consolidates data from reports and plans already being prepared, including (1) the Modernization Plan, (2) the Research, Development, and Acquisition (RDA) Plan, (3) the Logistics Support Plan, (4) the Joint Warfighting Science and Technology Plan, (5) the Defense Technology Area Plan, (6) Joint Service Chemical/Biological Information System (JSCBIS) materiel fact sheets, and (7) the Annual Report to Congress. In addition, the performance plan draws on current data contained in documents prepared in support of the PPBS, including Defense Planning Guidance, the CDBP Program Strategy Guidance, the Program Objectives Memorandum, the President's Budget and supporting detailed information in the RDT&E and Procurement Congressional Justification Books.

## 1.2 CDBP MISSION, GOALS, AND VALUES

DoD has developed a vision statement, mission statement, and corporate-level goals that reflect critical steps in the execution of the national security strategy. To support and relate to the DoD plan, the CDBP has developed supporting mission, vision and corporate goals.

### **DoD Vision:**

- Fields the best trained, best equipped, best-prepared fighting force in the world.
- Supports alliances and security relationships that protect and advance U.S. security interests
- Advances national interests by working effectively with other federal agencies, congress, and the private sector.
- Serves as a model of effective, efficient, innovative management and leadership.

### **1.2.1 Chemical/Biological Defense Program Vision:**

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.

**DoD Mission:**

Support and defend the Constitution of the United States; to provide for the common defense of the United States, its citizens, and its allies; and to protect and advance U.S. interests around the world.

**1.2.2 Chemical/Biological Defense Program Mission:**

*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—from peacetime contingency missions through two nearly simultaneous major theater wars across the entire spectrum of conflict—in battlespace environments contaminated with chemical or biological warfare agents.*

**1.2.3 Chemical/Biological Defense Program Values**

Values are the principles, standards, and qualities the CBDP organization follows to accomplish the mission, achieve the goals and attain the vision. They direct the size, focus, and coordination of the program—not program outcomes. The values provide statements that identify both the ways and means of the program and also consequences of the program that may result from the successful accomplishment of program goals and missions.

- ***Deter the use of chemical and biological warfare agents.***
  - Deny the advantage of the potential effective use of chemical or biological warfare agents by an initiator through a system of capabilities to avoid, protect against, and sustain operations in a contaminated environment—with only minimal performance degradation from either the effects of the agents or any protective equipment or medical countermeasures.
- ***Ensure all capabilities provided respond to validated threats.***
  - Provide capabilities that address the highest priority CB agent threats, from immediate and validated threats through potential far term or emerging threats. Intelligence efforts must emphasize preparation of tailored intelligence documents that identify and assess threats from the full spectrum of potential chemical and biological warfare agents, and include collection and analysis of nations’ “dual-use” chemical and biological industrial capabilities and the indications and warning of adversarial use of dual-use capabilities. Tailored intelligence documents are essential for assessing, developing and updating requirements for CB defense programs.
- ***Provide capabilities to ensure that the warfighter can survive in a chemical or biological environment and complete all operational and support missions.***
  - Provide capabilities that support the prioritized needs of the warfighter and requirements outlined in the Defense Planning Guidance and National Military Strategy.
- ***Maintain technological advantage over any potential adversaries and prevent technological surprise.***
  - Evaluate and leverage continuous improvements in the state-of-the-art in sciences and technologies.

- ***Emphasize a Joint Service approach to chemical and biological defense research, development, and acquisition.***
  - Eliminate unnecessary redundancies among the Services and Defense Agencies, leverage common technologies and requirements, and provide capabilities for Service-unique missions. Ensure coordination among U.S. government agencies and among U.S. allies to field the best available chemical and biological defense capabilities.
- ***Participate in international cooperative and collaborative efforts to leverage technology development and to achieve commonality, interoperability, and systems integration among U.S. allies and coalition partners.***
- ***Provide the most up-to-date doctrine and tactics, techniques, and procedures to solve deficiencies and for the employment of newly developed materiel.***
  - Provide guidance to the warfighter on proper operating procedures utilized in a chemical and/or biological environment.
- ***Provide the best training opportunities to ensure the readiness of the Force to fight in an asymmetric environment.***
  - Ensure that the development of new equipment includes embedded simulation and training capabilities.
- ***Complete critical RDT&E and acquisition of improved chemical and biological detection, identification and warning systems, individual and collective protection systems, medical support and decontamination systems.***
  - Ensure that the warfighter's needs are met in a timely fashion by improving the capabilities of existing equipment and technologies.
- ***Provide for a responsive medical modernization strategy to prevent CB casualties or treat them when prevention is impossible so they can return to duty.***
  - Develop effective medical countermeasures to include prophylaxes/pretreatments, diagnostics, therapeutics, and vaccines.

#### **DoD Corporate-Level Goals**

- Shape the international environment and respond to the full spectrum of crises by providing appropriately sized positioned and mobile forces.
- Prepare now for an uncertain future by pursuing a focused modernization effort that maintains U.S. qualitative superiority in key warfighting capabilities. Transform the force by exploiting the Revolution in Military Affairs, and reengineer the Department to achieve a 21<sup>st</sup> century infrastructure.

#### ***1.2.4 Chemical/Biological Defense Program Corporate-Level Goals***

Develop, acquire and field NBC defense equipment that meets warfighter requirements while reducing acquisition costs and time of development. Equipment will be developed that permits the warfighters to:

- ***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)*

### **1.3 ORGANIZATION OF THE PERFORMANCE PLAN**

The major portions of this performance plan link performance goals with performance measurements in terms of those systems and programs, which support the warfighter requirements and goals. **Section 2** analyzes performance goals and measurements that support the advanced development and acquisition phases of CB defense systems. **Section 3** analyzes the science and technology base of the program to include basic and applied research and advanced technology development, which support essential capabilities meeting warfighter requirements. Performance goals, which support each corporate level goal of the CBDP, establish a measurable path to incremental achievement of specific goals. These performance goals are supported and evaluated by measurable outputs, which are assessed using performance measures. Performance measures quantify the output of the CB defense program for key measures associated with providing a ready force, capable of surviving on a CB battlefield.

## **2.0 ADVANCED DEVELOPMENT AND ACQUISITION PERFORMANCE GOALS AND MEASURES**

The following sections provide near and mid-term performance goals, performance measures, and targets which support program corporate level goals. For the purpose of this strategy plan, FY2000 is the current assessment year, for which actual performance can be assessed; FY 2001 and FY 2002 are the future assessment years for which targets are established, but cannot be assessed for actual performance until the future. For purposes of mid-term planning, the POM period, FY 2002–2007 contains targets as well. Future material solutions refer to those that will be addressed during all years cited, some of which may be in the technology base.

### **2.1 Metric Description**

Research, Development and Acquisition programs within the DoD CDBP aim to ensure that U.S. forces are provided with the best equipment, which will ensure survivability and mission accomplishment on any future battlefield where chemical or biological agents are employed. The increased complexity of modern warfare demands that our CB defense equipment be fielded in the most cost effective and expeditious manner possible. Specific materiel solutions are identified which support numerous Commander-In-Chief (CINC) requirements. Each materiel solution's progress is measured by monitoring specific performance goals and targets in the planning years. Each of these metrics supports the ultimate objective; that of fielding new and improved CB defense equipment to our warfighting forces.

### **2.2 Verification and Validation (V&V) of Metrics**

V&V is accomplished through a number of processes. First and foremost, the Planning, Programming, and Budgeting System (PPBS) is the key process employed by the DoD CDBP and is used to ensure that program performance goals and targets are implemented into its budget. Through the PPBS, the program apportions resources annually in support of the goals articulated in the planning process.

Each year the Deputy Assistant to the Secretary of Defense of Chemical/Biological Defense, DATSD(CBD), issues detailed planning guidance in the DoD CDBP Program Strategy Guidance, which is used by the Joint NBC Defense Board (JNBCDB) in formulating and preparing the Program Objective Memorandum (POM). This document serves as a strategic planning document, and provides a framework for assessment of the POM and how well it meets stated goals and targets. In conjunction with the publication of the POM, the Joint NBC Board develops an assessment of how well the goals are met. The OSD staff in turn assesses these goals, as the POM is reviewed and adjusted through the summer review process. Preparation of the Budget Estimate Submission (BES) in the fall, begins a new review process, culminating in the finalization of the President's Budget for the DoD CDBP. This PPBS process is an effective mechanism for the DATSD(CBD) to match corporate CB defense goals and targets with the appropriate budgetary resources in a fiscally constrained environment.



In addition to the annual PPBS process, the DoD CDBP relies on an oversight process which permits reviews of program status on a monthly basis through staff review of JSCBIS Information Sheets. System PMs and item managers prepare quarterly system summary sheets, which are reviewed by the OSD staff. Selected systems are then selected for review at quarterly In-Process-Reviews held for senior leadership of the DoD CDBP.

Another V&V mechanism used by the CDBP is the Annual Report to Congress. During preparation of the report, the CB defense community reports annual progress within the various facets of the program. Annual accomplishment and plans for the future, as well as issues and factors that limit the ability of the program to achieve its goals, are documented and summarized along with the President's Budget.

### 2.3 CDBP Corporate Goals and Supporting Performance Goals

This section identifies each Corporate Goal and supporting performance goals. Corporate Goals are key operational objectives of the warfighters, which are identified as CINC Requirements in *The Joint Service NBC Defense RDA Plan*. Performance goals are key objectives or capabilities that, if achieved, will support attainment of the Corporate Goals. Performance goals are not specific projects or programs. Because the CDBP is established to coordinate and integrate RDA programs for chemical and biological defense within the Department, the key performance measures for the performance goals are specific projects and programs, including the cost and schedule of key programs, as well as the performance of the systems in achieving the objective and required performance parameters as defined in requirements documents and the number of systems fielded. Based on the specific system identified, there are some projects and systems that may support multiple performance goals or corporate goals. These performance measures are similar to performance measures used in other DoD GPRA performance plans.

Additional performance measures include non-material solutions for achieving goals. Non-material solutions include, among other things, training, doctrine, and sustained logistics capabilities. These additional efforts may be included as performance measures in future performance plans. Information and specific data on these efforts may be found in the Annual CDBP Report in Chapter 3 (Logistics) and Chapter 4 (Doctrine, Training, and Readiness). For purposes of this initial performance plan, performance measures focus on the core effort of the CDBP—that is, RDA programs and systems. The success of the CDBP is measured based on the ability to provide systems and capabilities to the U.S. forces so that they may achieve their operational objectives in a contaminated environment. For each performance goal the current materiel solution and the projected future materiel solution is listed. These systems are assessed for progress towards meeting targets. In some cases, current materiel solutions are legacy systems, which means that all planned procurement is complete and these systems will not have any procurement targets to assess.

The following tables provide a summary of all Corporate Goals and their supporting performance goals. (Note: the goal numbers are provided for reference purpose and may not indicate priority.)

### 2.3.1 Corporate Goal 1

#### **Corporate Goal 1: View NBC Warfare Agents within the Theater Area of Operations**

##### **Supporting Performance Goals:**

- 1.1 Detect, identify, and range all CW agents at a distance to provide early warning of hazards.
- 1.2 Detect and identify all BW agents at a distance to provide early warning of hazards.

### 2.3.2 Corporate Goal 2

#### **Corporate Goal 2: Dominate the Battlespace through Reconnaissance, Surveillance, and Target Acquisition (NBC Reconnaissance)**

##### **Supporting Performance Goals:**

- 2.1 Recon battlespace for potential NBC contamination hazards in a deployable and survivable military vehicle.
- 2.2 Maintain surveillance of potential BW agent presence at fixed sites within the theater of operations.

### 2.3.3 Corporate Goal 3

#### **Corporate Goal 3: Enhance the Situational Awareness of Unit Battlespace**

##### **Supporting Performance Goals:**

- 3.1 Provide tactical ground units and ships with near-real time BW agent detection and identification capability.
- 3.2 Provide tactical units and vehicles with automatic CW vapor agent detection and identification capability.

### 2.3.4 Corporate Goal 4

#### **Corporate Goal 4: Provide Real-Time Hazard Information to Influence Current Operations (NBC Battle Management and Modeling & Simulation)**

##### **Supporting Performance Goal:**

- 4.1 Enable rapid communication of NBC hazards and data related to NBC defense (specialized forces, operational and logistics planning information) throughout the theater without burdening personnel or resources.

### 2.3.5 Corporate Goal 5

#### **Corporate Goal 5: Enhance Personnel and Equipment Survivability (Individual Detection/Protection/Decon)**

##### **Supporting Performance Goals:**

- 5.1 Provide general warfighters with individual protective ensembles that protect against all NBC hazards.
- 5.2 Provide general warfighters with individual protective masks that protect against all NBC hazards.
- 5.3 Provide individual chemical detection equipment that allows manual identification of immediate CW hazards.
- 5.4 Provide aviators with individual protective ensembles that protect against all NBC hazards.
- 5.5 Provide aviators (fixed and rotary-wing) with individual protective masks that protect against all NBC hazards.
- 5.6 Provide units with inherent capability to test and adjust protective mask fits for its warfighters.
- 5.7 Provide warfighters with lightweight protective masks and ensembles for short-term exposure to NBC agents.
- 5.8 Provide individuals with immediate decontamination capability to reduce life-threatening NBC hazard risk.
- 5.9 Provide individuals and medics with medical pretreatments for exposure to CW agents.
- 5.10 Provide individuals and medics with medical post treatments for CW agents.
- 5.11 Provide individuals and medics with medical pre-treatments for BW agents.
- 5.12 Provide individuals and medics with medical post-treatments for BW agents

**2.3.6 Corporate Goal 6**

**Corporate Goal 6: Maintain Ground, Air and Maritime Operational Tempo (Operational Decon/Collective Protection)**

**Supporting Performance Goal:**

- 6.1 Provide crewmembers with a limited capability to reduce the level of contamination on vehicles and weapon systems.
- 6.2 Provide an operational capability to reduce the level of contamination on vehicles and weapon systems.
- 6.3 Ensure vehicles, vans and ships have a protected environment that keeps NBC hazards out.
- 6.4 Provide a hazard-free environment for mobile command and control operations.

**2.3.7 Corporate Goal 7**

**Corporate Goal 7: Sustain Operations, Recovery and Reconstitution Efforts (Thorough Decontamination, Fixed Site Collective Protection, Medical Diagnosis and Treatment, Training, and Readiness)**

**Supporting Performance Goals:**

- 7.1 Provide units with a capability to eliminate all contamination on vehicles and weapon systems.
- 7.2 Provide units with a capability to eliminate all contamination on terrain and fixed sites.
- 7.3 Provide units with a capability to eliminate all contamination on sensitive equipment and avionics.
- 7.4 Provide units with a capability to eliminate all contamination on vehicle/aircraft interiors.
- 7.5 Monitor the presence/absence of CW agent contamination after decon.
- 7.6 Monitor the presence/absence of CW agent contamination in water.
- 7.7 Provide a hazard-free environment for long-term command and control operations.
- 7.8 Provide a hazard-free environment for forward tactical medical operations.
- 7.9 Provide a hazard-free environment for long-term rear-area medical operations.
- 7.10 Develop medical identification and diagnosis device capable of identifying multiple BW agents in clinical and environmental sources.

**2.4 CORPORATE GOAL 1: VIEW NBC WARFARE AGENTS WITHIN THE THEATER AREA OF OPERATIONS (STAND-OFF DETECTION OF NBC AGENTS)**

**2.4.1 Performance Goal 1.1 – Detect, identify, and range all CW agents at a distance to provide early warning of hazards.**

<b>Current Materiel Solutions</b>	<b>Future Materiel Solutions</b>
M21 Remote Sensing Chemical Agent Alarm (RSCAAL) (Legacy System) AN/KAS-1, Chemical Warfare Directional Detector (Legacy System)	Joint Service Lightweight Standoff Chemical Agent Detector (JSLSCAD) Joint Service Chemical Warning and Identification LIDAR Detector (JSWILD), <i>program also called ARTEMIS</i> Chemical Imaging Sensor SAFEGUARD

**2.4.2 Materiel Solutions Performance Measurements.**

**2.4.2.1 Current Research & Development (R&D) Targets – JSLSCAD**

<b>FY 2000 Targets</b>	<b>Actual Performance</b>
<ul style="list-style-type: none"> <li>- Conduct Critical Design Review and evaluated issues through EDT</li> <li>- Complete test methodology development</li> <li>- Purchase long lead items for 47 Production Qualification/Initial Operational Test &amp; Evaluation (PQT/IOT&amp;E) test articles</li> <li>- Prepare program documents</li> </ul>	<ul style="list-style-type: none"> <li>- Met all stated targets, with the following exceptions:                             <ul style="list-style-type: none"> <li>• Purchased 40 long lead items for PQT/IOT&amp;E</li> </ul> </li> </ul>

FY 2000 Targets	Actual Performance
<ul style="list-style-type: none"> <li>- Complete fabrication of 15 Engineering Design Test articles</li> <li>- Conduct engineering tests for ruggedization</li> <li>- Support integration for test platforms</li> </ul>	

**2.4.2.2 Future R&D Targets – JSLSCAD**

FY 2001 Targets	FY 2002 Targets
<ul style="list-style-type: none"> <li>- Complete integration for JSLNBCRS, CH-53 helicopters, and C-130 fixed wing test platforms.</li> <li>- Fabricate 40 PQT/IOT&amp;E test articles</li> <li>- Initiate PQT/IOT&amp;E</li> <li>- Prepare tech data package and documentation for JS MS III decision in FY02</li> </ul>	<ul style="list-style-type: none"> <li>- Complete PQT/IOT&amp;E</li> <li>- Complete technical data package and acquisition documentation for MS III</li> <li>- Complete review/preparation of technical manuals, logistics support, and training materials</li> </ul>

**2.4.2.3 Current R&D Targets – JSWILD (Artemis)**

FY 2000 Targets	Actual Performance
<ul style="list-style-type: none"> <li>- Complete fabrication of brassboard system</li> <li>- Initiate Analysis of Alternatives for technologies that meet requirements</li> <li>- Complete planning for demonstration</li> </ul>	<ul style="list-style-type: none"> <li>- All targets met, with the following exception:                             <ul style="list-style-type: none"> <li>• Completion of brassboard slipped to FY01</li> </ul> </li> </ul>

**2.4.2.4 Future R&D Targets – JSWILD (Artemis)**

FY 2001 Targets	FY 2002 Targets
<ul style="list-style-type: none"> <li>- Demonstrate brassboard system</li> <li>- Complete Analysis of Alternatives</li> <li>- Transition technology to ARTEMIS (Active Standoff CW Detection System)</li> </ul>	<ul style="list-style-type: none"> <li>- Complete performance specification and update Acquisition Program Baseline and C<sup>4</sup>ISR Support Plan.</li> <li>- Finalize Systems Architecture and Systems Specification through a Joint Systems Engineering IPT. Analyze the ORD and develop performance specifications for prototype development. Conduct risk analyses.</li> <li>- Update Simulation Based Acquisition Strategy and Simulation Support Plan to identify the effective use of modeling and simulation throughout the system life cycle. Update/validate the virtual prototype model to support design of early prototype system. Update cost model to reflect new system architecture. Evaluate infrared spectra scene generator equipment in support of virtual testing.</li> <li>- Conduct a supportability analysis. Conduct initial Joint Training Planning Process Methodology and develop initial Joint System Training Plan. Develop acquisition logistics support plan for Milestone B through a Joint Logistics/Product Support IPT.</li> <li>- Develop test methodology in support of the test strategy and finalize initial Test &amp; Evaluation Master Plan for Milestone B through a Joint Test &amp; Evaluation IPT.</li> <li>- Further develop components of LIDAR system for a systems architecture and to reduce overall risk by utilizing Advance Component Development. Perform testing on high-risk components to validate performance.</li> </ul>

### 2.4.2.5 Current R&D Targets – Chemical Imaging Sensor and SAFEGUARD

FY 2000 Targets	Actual Performance
- Programs in technology base	See section 3.0: S&T Performance Goals & Measures

### 2.4.3 Performance Goal 1.2 – Detect and identify BW agents at a distance to provide early warning of hazards.

Current Materiel Solutions	Future Materiel Solutions
Long Range- Biological Standoff Detection System (LR-BSDS)	Joint Biological Standoff Detection System (JBSDS)

### 2.4.4 Materiel Solutions Performance Measurements.

#### 2.4.4.1 Current Procurement Targets – LR-BSDS

System	FY00		FY01	FY02
	Target	Actual	Target	Target
Long Range- Biological Standoff Detection System (LR-BSDS)	0 Note: 3 systems/24 requirements fielded	0	<i>Program cancelled in FY 00 due to change of user requirement</i>	<i>Program cancelled in FY00 due to change of user requirement</i>

#### 2.4.4.2 Current R&D Targets – JBSDS

FY 2000 Targets	Actual Performance
- Program in technology base	See section 3.0: S&T Performance Goals & Measures

#### 2.4.4.3 Future R&D Targets – JBSDS

FY 2001 Targets	FY 2002 Targets
- Program in technology base	- Program in technology base

## 2.5 CORPORATE GOAL 2: DOMINATE THE BATTLESPACE THROUGH RECONNAISSANCE, SURVEILLANCE, AND TARGET ACQUISITION (NBC RECONNAISSANCE)

### 2.5.1 Performance Goal 2.1 – Recon battlespace for potential NBC contamination hazards in a deployable and survivable military vehicle.

Current Materiel Solutions	Future Materiel Solutions
M93A1 NBC Recon System (Block I) Biological Integrated Detection System	M93A1 NBC Recon System (Block II) Joint Light NBC Recon System (HMMWV/LAV)

### 2.5.2 Materiel Solutions Performance Measurements.

**2.5.2.1 Current Procurement Targets – NBCRS (Block I) and BIDS**

Systems	FY00		FY01	FY02
	Target	Actual	Target	Target
M93A1 NBC Recon System (Block I)	11 73/133 procured	7 66/133 procured	13 79/133 procured	5 85/133 procured
Biological Integrated Detection System	20 86/124 procured	20 86/124 procured	0 86/124 procured	0 86/124 procured

**2.5.2.2 Current R&D Targets – NBC Reconnaissance System, Block II (M93A1)**

FY 2000 Targets	Actual Performance
<ul style="list-style-type: none"> <li>- Awarded Engineering, Design, and Test contract</li> <li>- Complete concept design and trade off studies</li> </ul>	<ul style="list-style-type: none"> <li>- All targets met</li> <li>- In addition:                             <ul style="list-style-type: none"> <li>• Purchased developmental detectors and component parts for integration</li> <li>• Started NBC sensor suite software development</li> </ul> </li> </ul>

**2.5.2.3 Future R&D Targets – NBC Reconnaissance System, Block II (M93A1)**

FY 2001 Targets	FY 2002 Targets
<ul style="list-style-type: none"> <li>- Continue NBCRS sensor suite engineering development</li> <li>- Initiate plan for Developmental Test and Evaluation and finalize Test and Evaluation Master Plan</li> <li>- Continue software development</li> <li>- Assemble and integrate developmental detectors into vehicles</li> </ul>	<ul style="list-style-type: none"> <li>- Conduct modeling and simulation of human factors for integration of detectors into vehicles</li> <li>- Continue NBCRS sensor suite engineering and development and refurbish prototypes</li> <li>- Continue integrating developmental detectors into vehicles</li> <li>- Begin warfighter operational capability assessment</li> </ul>

**2.5.2.4 Current R&D Targets – Joint Lightweight NBC Reconnaissance System, HMMWV/LAV variants (JSLNBCRS)**

FY 2000 Targets	Actual Performance
<ul style="list-style-type: none"> <li>- Start integration of HMMWV variant</li> <li>- Conduct Developmental Test and Operational Test</li> <li>- Started Technical Data Package</li> <li>- Conduct MS II</li> </ul>	<ul style="list-style-type: none"> <li>- All targets met, with the following exception:                             <ul style="list-style-type: none"> <li>• Conduct of MSII slipped to FY01</li> </ul> </li> </ul>

**2.5.2.5 Future R&D Targets – JSLNBCRS**

FY 2001 Targets	FY 2002 Targets
<ul style="list-style-type: none"> <li>- Complete technical data package and requisite acquisition documentation for Milestone III review.</li> <li>- Complete Operational Testing.</li> </ul>	<ul style="list-style-type: none"> <li>- Initiate Toxic Industrial Chemicals and Toxic Industrial Materials detector software development for CBMS transition to JSLNBCRS procurement.</li> </ul>

**2.5.3 Performance Goal 2.2 – Maintain surveillance of potential BW agent presence at fixed sites within the theater of operations.**

Current Materiel Solutions	Future Materiel Solutions
Portal Shield	Joint Biological Point Detection System (JBPDS)—Block I, and II

## 2.5.4 Materiel Solutions Performance Measurements.

### 2.5.4.1 Current Procurement Targets – Portal Shield

Systems	FY00		FY01	FY02
	Target	Actual	Target	Target
Portal Shield ACTD	70 previously procured with R&D funding under ACTD	0	97	0
Procurement targets were reached per directed buy schedule in response to two urgent need requirements. Rapidly executed via sole source contract.	70	70	97/97 Procured	

### 2.5.4.2 Current R&D Targets – Joint Biological Point Detection System

FY 2000 Targets	Actual Performance
<p>BLOCK I PROGRAM:</p> <ul style="list-style-type: none"> <li>- Complete Biological Agent Warning Sensor design and integration</li> <li>- Complete initial integration and ruggedization of collection, trigger/detection, and identification components and initial operating software into a fully automated biosuite</li> <li>- Complete Engineering Design Test</li> <li>- Conduct Low Rate Initial Production (LRIP) decision</li> <li>- Complete Pre-production Qualification Testing for shipboard, fixed-site, man-portable, and shelter variants</li> <li>- Complete Logistics Analysis Records, Provisioning Database, Technical Manuals, Drawings, and Performance Specifications</li> <li>- Participate in the Joint Field Trials</li> <li>- Complete early user assessment and operational evaluation</li> </ul>	- All targets met

### 2.5.4.3 Future R&D Targets – Joint Biological Point Detection System

FY 2001 Targets	FY 2002 Targets
<p>BLOCK I PROGRAM:</p> <ul style="list-style-type: none"> <li>- Award LRIP Contract Lot 1 – 1Qtr</li> <li>- Perform First Article Testing</li> <li>- Conduct Operational Assessment</li> </ul> <p>BLOCK II PROGRAM:</p> <ul style="list-style-type: none"> <li>- Initiate design studies to define performance specifications, design concepts and reduce risk to EMD program.</li> <li>- Prepare request for proposal for BLK II EMD contract</li> </ul>	<p>BLOCK II PROGRAM:</p> <ul style="list-style-type: none"> <li>- Initiate component hardware selection, bread board design and evaluation</li> <li>- Component hardware selection, fabrication and evaluation</li> <li>- Initiate software development and documentation. Develop advanced algorithms to enhance background discrimination and not sacrifice sensitivity to bio agents</li> <li>- Initiate Integrated Logistics support</li> <li>- Initiate system level hardware development, integration, evaluation and documentation</li> </ul>

**2.6 CORPORATE GOAL 3: ENHANCE THE SITUATIONAL AWARENESS OF UNIT BATTLESPACE – (AUTOMATIC POINT DETECTION OF NBC AGENTS)**

**2.6.1 Performance Goal 3.1 – Provide tactical ground units and ships with near-real time BW agent detection and identification capability.**

Current Materiel Solutions	Future Materiel Solutions
None	Joint Biological Point Detection System (JBPDS)

**2.6.2 Materiel Solutions Performance Measurements – (JBPDS) (see 2.5.4.2)**

**2.6.3 Performance Goal 3.2 – Provide tactical units and vehicles with automatic CW vapor agent detection and identification capability.**

Current Materiel Solutions	Future Materiel Solutions
M8A1 Chemical Agent Alarm (Legacy) M22 ACADA Improved (CA) Point Detection System (IPDS)	Joint Chemical Agent Detector (JCAD)

**2.6.4 Materiel Solutions Performance Measurements**

**2.6.4.1 Current Procurement Targets – M22 ACADA and IPDS**

Systems	FY00		FY01	FY02
	Target	Actual	Target	Target
M22 ACADA	4,759	4,890	6721	Replaced by JCAD
	12,155/46,875 procured to date	12,286/46,875 procured to date	19,007/46,875 procured	
Improved (CA) Point Detection System (IPDS)	90	52	0	0
	283/234 procured to date	245/234 procured to date	245/234 procured	245/234 procured

**2.6.4.2 Current R&D Targets – JCAD**

FY 2000 Targets	Actual Performance
<ul style="list-style-type: none"> <li>- Continue EMD test units hardware and software development</li> <li>- Continue application development, testing, and evaluation</li> <li>- Continue systems integration</li> <li>- Continue technology development options in preparation for repeatability between Engineering Test &amp; Evaluation prototypes</li> </ul>	<ul style="list-style-type: none"> <li>- All targets met</li> </ul>

**2.6.4.3 Future R&D Targets – JCAD**

FY 2001 Targets	FY 2002 Targets
<ul style="list-style-type: none"> <li>- Complete EMD program planning and execution of project management functions and prepare MSIII program documentation</li> <li>- Complete hardware and software test units development</li> <li>- Complete development of the prototype detectors</li> <li>- Complete developmental, preliminary</li> </ul>	<ul style="list-style-type: none"> <li>- Complete hardware and software for production representative units delivery and reports.</li> <li>- Complete systems engineering, manufacturing, and logistics development for final production representative units.</li> <li>- Complete system integration on final MSIII representative units</li> </ul>



FY 2001 Targets	FY 2002 Targets
qualification tests and field tests; initiate operational test and evaluation - Complete systems integration on the final developmental units to be delivered	- Complete Phase II engineering test and evaluation, production qualification tests, and operation tests.

## 2.7 CORPORATE GOAL 4: PROVIDE REAL-TIME HAZARD INFORMATION TO INFLUENCE CURRENT OPERATIONS (NBC BATTLE MANAGEMENT)

A strategy for modeling and simulation (M&S) research, development, and acquisition is being developed. This strategy will support this corporate goal. Performance goals for modeling and simulation are not included in this performance plan, yet they will be included in the future following the completion of an M&S strategy. An assessment of modeling and simulation needs has identified the following preliminary supporting performance goals, which may be incorporated in future plans:

- Develop NBC hazard prediction capabilities using data that reflects NBC agent behavior in the environment.
- Develop modeling and simulation tools that support training of military personnel.
- Develop modeling and simulation tools that support decision makers analysis of NBC defense equipment under development (simulation-based acquisition).

### 2.7.1 Performance Goal 4.1 – Enable rapid communication of NBC hazards and data related to NBC defense (specialized forces, operational and logistics planning information) throughout the theater without burdening personnel or resources.

Current Materiel Solutions	Future Materiel Solutions
Joint Warning and Reporting Network (JWARN) Block I (Interim Standardization)	JWARN Block II JWARN Block III

## 2.7.2 Materiel Solutions Performance Measurements

### 2.7.2.1 Current Procurement Targets – JWARN Block I

Systems	FY00		FY01	FY02
	Target	Actual	Target	Target
Joint Warning and Reporting Network (JWARN) Block I	0, End procurement of Block I, Phase I  128/2874 procured to date	0, End procurement of Block I, Phase I  128/2874 procured to date	516, Begin Procurement Block I, Phase II  644/2874 procured	Replaced by Block II  644/2874 procured

### 2.7.2.2 Current R&D Targets – JWARN – Block II and III

FY 2000 Targets	Actual Performance
- Conduct Block II development and integration - Conduct Developmental Testing/Operational Testing on Block II - Complete MSII and award EMD contract for Block II and start integration - Initiate follow-on development of Block III	- All targets met, with the following exception: <ul style="list-style-type: none"> <li>• Initiation of Block II slipped to FY01</li> </ul>

**2.7.2.3 Future R&D Targets – JWARN – Block II and III**

FY 2001 Targets	FY 2002 Targets
<ul style="list-style-type: none"> <li>- Continue Block II integration of NBC legacy and future detector systems</li> <li>- Develop NBC warning and reporting modules and battlespace management modules for uses by Joint Services C4I systems</li> <li>- Start incremental development of Block II C4I software modules and interfaces for NBC legacy and future detector systems</li> </ul>	<ul style="list-style-type: none"> <li>- Continue Block II integration of NBC legacy and future detectors systems and development of NBC warning and reporting software</li> <li>- Prepare integrated logistic support technical data</li> <li>- Conduct Block II modeling and simulation</li> <li>- Conduct Block II system Test and Evaluation</li> </ul>

**2.8 CORPORATE GOAL 5: ENHANCE PERSONNEL AND EQUIPMENT SURVIVABILITY – (INDIVIDUAL DETECTION/PROTECTION/DECON)**

**2.8.1 Performance Goal 5.1 – Provide general warfighters with individual protective ensembles that protect against all NBC hazards.**

Current Materiel Solutions	Future Materiel Solutions
Battledress Overgarment (Legacy System) Saratoga, JS Lightweight Integrated Suit Technology (JSLIST) Black Vinyl Overboots (Service O&M responsibility) 7, 14, 25-mil Gloves (Service O&M responsibility)	JSLIST Joint Aviation Ground Glove (JAGG)

**2.8.2 Materiel Solutions Performance Measurements**

**2.8.2.1 Current Procurement Targets – JSLIST**

Systems	FY00		FY01	FY02
	Target	Actual	Target	Target
JS Lightweight Integrated Suit Technology (JSLIST)	359,166	359,166	330,871	361,024
	1,208,356/4,872,333 procured to date	1,208,356/4,872,333 procured to date	1,539,227/4,872,333 procured	1,900,251 /4,872,333 procured

**2.8.2.2 Current R&D Targets – JSLIST JAGG**

FY 2000 Targets	Actual Performance
<ul style="list-style-type: none"> <li>- JSLIST Glove procure prototype glove candidates for testing</li> <li>- JSLIST Glove Conduct laboratory chemical agent tests</li> <li>- JSLIST Glove conduct user wear test and developmental testing</li> <li>- JSLIST Glove prepare technical data input for materials and patterns production specification</li> </ul>	<ul style="list-style-type: none"> <li>- All targets met</li> </ul>

**2.8.2.3 Future R&D Targets – JSLIST JAGG**

FY 2001 Targets	FY 2002 Targets
<ul style="list-style-type: none"> <li>- JSLIST Glove initial operational testing</li> <li>- JSLIST Glove Block I MSIII</li> </ul>	<ul style="list-style-type: none"> <li>- Initiate engineering and design of an integrated glove for Developmental and Operational Testing to meet air and ground usage requirements.</li> <li>- JSLIST/JAGG prepare MS C documentation</li> </ul>

### 2.8.3 Performance Goal 5.2 – Provide general warfighters with individual protective masks that protect against all NBC hazards.

Current Materiel Solutions	Future Materiel Solutions
M40/M40A1 Mask M42 Tank Mask (Legacy) MCU-2A/P Mask (Legacy)	Joint Service General Purpose Mask (JSGPM)

### 2.8.4 Materiel Solutions Performance Measurements

#### 2.8.4.1 Current Procurement Targets – M40/M40A1 Mask

Systems	FY00		FY01	FY02
	Target	Actual	Target	Target
M40/M40A1 Mask	102,281	100,394		
	329,828/888,854 procured to date	327,941/888,854 procured to date		

#### 2.8.4.2 Current R&D Targets – JSGPM

FY 2000 Targets	Actual Performance
<ul style="list-style-type: none"> <li>- Award PDRR contract for mask design and 250 prototypes</li> <li>- Continue preparation of documentation to support MSII decision</li> <li>- Continue Developmental Test and Evaluation</li> <li>- Conduct sustainment study to investigate options for prime vendor or direct and vendor delivery or contractor logistics support</li> </ul>	<ul style="list-style-type: none"> <li>- All targets met</li> <li>- In addition, PDRR contract award for 500 prototypes</li> </ul>

#### 2.8.4.3 Future R&D Targets – JSGPM

FY 2001 Targets	FY 2002 Targets
<ul style="list-style-type: none"> <li>- Conduct MSII decision</li> <li>- Continue development contract for mask design and fabrication of prototypes and award EMD option</li> <li>- Conduct Engineering Design Test</li> <li>- Continue sustainment study for logistics support</li> </ul>	<ul style="list-style-type: none"> <li>- Conduct Engineering and Manufacturing Development, including system support packages for Initial Operational Testing and Evaluation.</li> <li>- Delivery of 5,000 prototypes</li> <li>- Prepare documentation to support MSIII decision</li> <li>- Execute logistics support plan</li> <li>- Initiate documentation and planning of DT/OT</li> </ul>

### 2.8.5 Performance Goal 5.3 – Provide individual chemical detection equipment that allows manual identification of immediate CW hazards.

Current Materiel Solutions	Future Materiel Solutions
M8 paper (Service O&M responsibility) M9 paper (Service O&M responsibility) M256A1 Detector Kit (Service O&M responsibility)	Joint Chemical Agent Detector (JCAD)

### 2.8.6 Materiel Solutions Performance Measurements: JCAD (see 2.6.4.3)

**2.8.7 Performance Goal 5.4 – Provide aviators with individual protective ensembles that protect against all NBC hazards.**

<b>Current Materiel Solutions</b>	<b>Future Materiel Solutions</b>
Aircrew Uniform Integrated Battledress (AUIB) (Legacy system) Chemical Protective Undercoverall (Service O&M responsibility) CWU-66/77 Aircrew Ensemble (Legacy system)	Joint Protective Aviator Ensemble (JPACE)

**2.8.8 Materiel Solutions Performance Measurements**

**2.8.8.1 Current R&D Targets – JPACE**

<b>FY 2000 Targets</b>	<b>Actual Performance</b>
<ul style="list-style-type: none"> <li>- Conduct MSI/II</li> <li>- Develop and fabricate 25 initial prototype ensembles for Developmental Testing</li> </ul>	<ul style="list-style-type: none"> <li>- MSI/II conducted, however development program altered to complete the following in FY00:</li> <li>- Begin developmental testing on 30 candidate materials to down-select to 6 best</li> <li>- Identify performance specification for system, materials, and components leveraging from the JSLIST program</li> <li>- Begin development of patterns for fabrication of system</li> <li>- Begin planning, systems engineering, and system logistics efforts to support development and transition to production</li> </ul>

**2.8.8.2 Future R&D Targets – JPACE**

<b>FY 2001 Targets</b>	<b>FY 2002 Targets</b>
<ul style="list-style-type: none"> <li>- Complete initial prototype development and fabrication for Developmental Testing.</li> <li>- Developmental Testing: Conduct simulant, human factor, compatibility, environmental, and live agent testing of initial prototypes. Various sizes of prototypes will be tested.</li> <li>- Manufacture 100 improved prototypes for Operational Testing.</li> </ul>	<ul style="list-style-type: none"> <li>- Complete Developmental Testing IIA material swatch testing and downselect to best six candidate materials. Initiate Developmental Testing IIB testing on the six candidates to verify system level performance requirements have been met.</li> <li>- Fabricate 75 prototype ensembles of each of the six selected candidates for use in DT IIB.</li> <li>- Complete development of patterns for use in fabrication. Continue developing and updating program, logistics, and technical documentation required to support development and fielding.</li> </ul>

**2.8.9 Performance Goal 5.5 – Provide aviators (fixed-wing and rotary wing) with individual protective masks that protect against all NBC hazards.**

<b>Current Materiel Solutions</b>	<b>Future Materiel Solutions</b>
Aircrew Eye/Respiratory Protective Mask (AERP)- Legacy System CB Respiratory System M45 Aviation Protective Mask M48 Apache Mask (Legacy System)	Joint Service Aviation Mask (JSAM)

## 2.8.10 Materiel Solutions Performance Measurements

### 2.8.10.1 Current Procurement Targets – CB Respiratory System and M45

Systems	FY00		FY01	FY02
	Target	Actual	Target	Target
CB Respiratory System	1,234	1,234	687	666
	3620/7919 procured to date	3620/7919 procured to date	4307/7919 procured	4973/7919 procured
M45 Aviation Protective Mask	6290	6290	125	400
	13,454/37,590 procured to date	13,454/37,590 procured to date	13,579/37,590 procured	13,979/37,590 procured

### 2.8.10.2 Current R&D Targets – Joint Service Aviation Mask (JSAM)

FY 2000 Targets	Actual Performance
<ul style="list-style-type: none"> <li>- Conduct MSI</li> <li>- Award PDRR contracts</li> <li>- Initiate government test working group activities</li> </ul>	- All targets met

### 2.8.10.3 Future R&D Targets – Joint Service Aviation Mask (JSAM)

FY 2001 Targets	FY 2002 Targets
<ul style="list-style-type: none"> <li>- Continue prototype development and contractor developmental testing</li> <li>- Begin prototype fabrication</li> </ul>	<ul style="list-style-type: none"> <li>- Conduct MSII</li> <li>- Initiate EMD contracts</li> <li>- Complete government test working group activities</li> </ul>

### 2.8.11 Performance Goal 5.6 – Provide units with inherent capability to test and adjust protective mask fits for its warfighters.

Current Materiel Solutions	Future Materiel Solutions
M41 Protective Assessment Test System (PATS)	JS Mask Leakage Tester

## 2.8.12 Materiel Solutions Performance Measurements

### 2.8.12.1 Current Procurement Targets – M41 PATS

Systems	FY00		FY01	FY02
	Target	Actual	Target	Target
M41 PATS	1088	1088		
	3081/7019 procured to date	3081/7019 procured to date		

**2.8.12.2 Current R&D Targets – JS Mask Leakage Tester**

FY 2000 Targets	Actual Performance
- <i>New start</i>	- <i>New start</i>

**2.8.12.3 Future R&D Targets – JS Mask Leakage Tester**

FY 2001 Targets	FY 2002 Targets
- Finalization of Joint Operational Requirements Document (ORD) for the commercial off the shelf system	- Award contract

**2.8.13 Performance Goal 5.7 Provide warfighters with lightweight protective masks and ensembles for short-term exposure to NBC agents**

Current Materiel Solutions	Future Materiel Solutions
None (interim measure-use of M40 series/MCU-2/P) None (interim measure-use of JSLIST)	JS Chemical Environment Survivability Mask (CESM) JS Chemical Environment Survivability Suit (CESS)

**2.8.14 Materiel Solutions Performance Measurements**

**2.8.14.1 Current R&D Targets – CESM and CESS**

FY 2000 Targets	Actual Performance
- <i>New start</i> - Conduct review of the draft Joint ORD for the CESM	- <i>New start</i>

**2.8.14.2 Future R&D Targets – CESM and CESS**

FY 2001 Targets	FY 2002 Targets
- Initiate CESM program-chose best market survey candidate for COTS/NDI mask. - CESM- conduct limited technical tests and operational evaluation - CESM- initiate limited procurement for SOCOM - Initiate CESS program- down select candidate suit technology - CESS- conduct limited technical tests and operational evaluation - CESS- conduct MS III	- CESM- initial full system development of objective system - CESS- initiate procurement for SOCOM

**2.8.15 Performance Goal 5.8 Provide individuals with immediate decontamination capability to reduce life-threatening NBC hazard risk.**

Current Materiel Solutions	Future Materiel Solutions
M291 skin decon kit (Service O&M responsibility) M295 individual equipment decon kit (Service O&M responsibility)	M291 skin decon kit (Sorbent based) M295 individual equipment Decon kit (Sorbent based)

## 2.8.16 Materiel Solutions Performance Measurements

### 2.8.16.1 Current R&D Targets – M291 and M295 Decon Kits

FY 2000 Targets	Actual Performance
<ul style="list-style-type: none"> <li>- Develop and support MSIII documentation for operator spray down system</li> <li>- Develop Tech Data Package for operator spray down system</li> <li>- Build Engineering Design Test hardware for operator spray down system</li> <li>- Conducted producibility studies for operator spray down systems</li> <li>- Develop engineering change proposal for the M295 individual decon kits</li> </ul>	<ul style="list-style-type: none"> <li>- All targets met</li> </ul>

### 2.8.16.2 Future R&D Targets – M291 and M295 Decon Kits (Sorbent based)

FY 2001 Targets	FY 2002 Targets
<ul style="list-style-type: none"> <li>- Produce prototype hardware of the M291 skin decon kits with sorbent</li> <li>- Develop support for MSIII decision for operator spray down system</li> <li>- Conduct MSIII for operator spray down system</li> <li>- Develop end item design using carbon cloth technology to facilitate absorption of the contaminant from the skin</li> <li>- Conduct toxicity testing of sorbent for skin decon</li> <li>- Conduct EDT/IOT for skin decon system</li> <li>- Develop engineering change proposal to incorporate sorbent into the M291 skin decon kit</li> </ul>	<ul style="list-style-type: none"> <li>- None</li> </ul>

## 2.8.17 Performance Goal 5.9 Provide individuals and medics with medical pretreatments for exposure to CW agents.

Current Materiel Solutions	Future Materiel Solutions
Nerve Agent Pyridostigmine Pretreatment (NAPP) (Service O&M responsibility)	Topical Skin Protectant (TSP) Improved NAPP Active Topical Skin Protectant (aTSP) CW Agent Prophylaxis Cyanide Pretreatment

## 2.8.18 Materiel Solutions Performance Measurements

### 2.8.18.1 Current R&D Targets – TSP and Improved NAPP

FY 2000 Targets	Actual Performance
<ul style="list-style-type: none"> <li>- Initiate surrogate validation, 2-year clinical bioequivalence study, and 2-year studies to define pharmacology of NAPP</li> <li>- Initiate and complete a user acceptability study for the TSP</li> <li>- Produce two lots of TSP for validation studies</li> <li>- Conducted durability and stability studies of TSP</li> </ul>	<ul style="list-style-type: none"> <li>- All targets met</li> </ul>

### 2.8.18.2 Future R&D Targets – TSP and Improved NAPP

FY 2001 Targets	FY 2002 Targets
<ul style="list-style-type: none"> <li>- Complete 2-year clinical bioequivalence study on NAPP</li> <li>- Continue 2-year studies to define pharmacology of NAPP</li> </ul>	<ul style="list-style-type: none"> <li>- Continue storage and stability testing of NAPP and conduct FDA required studies</li> </ul>

FY 2001 Targets	FY 2002 Targets
<ul style="list-style-type: none"> <li>- Conduct storage and stability testing of NAPP and submit support documentation for FDA licensure</li> <li>- Prepare sample packaging and validate manufacturing procedures for TSP</li> </ul>	

**2.8.18.3 Current R&D Targets – Active Topical Skin Protectant and CW Agent Prophylaxis**

FY 2000 Targets	Actual Performance
<ul style="list-style-type: none"> <li>- Initiate Phase 0 studies for efficacy and safety of best candidate reactive moieties for aTSP</li> <li>- Initiate Phase 0 studies for efficacy and safety of lead CW Agent Prophylaxis</li> <li>- Select lead candidate CW Agent Prophylaxis for <i>in vivo</i> and <i>in vitro</i> screens</li> </ul>	<ul style="list-style-type: none"> <li>- All targets met</li> <li>- Both identified as Defense Technology Objectives</li> </ul>

**2.8.18.4 Future R&D Targets – Active Topical Skin Protectant and CW Agent Prophylaxis**

FY 2001 Targets	FY 2002 Targets
<ul style="list-style-type: none"> <li>- Demonstrate the efficacy of aTSP candidate formulations in two animal species</li> <li>- Examine CW Agent Prophylaxis scavengers derived from human proteins for immune response</li> <li>- Select best CW Agent Prophylaxis nerve agent bioscavengers candidates</li> </ul>	<ul style="list-style-type: none"> <li>- Complete aTSP formulation studies and demonstrate efficacy against estimated battlefield levels of CWAs</li> <li>- Select the best aTSP candidates for transition to Advanced Development</li> </ul>

**2.8.18.5 Current R&D Targets – Cyanide Pretreatment**

FY 2000 Targets	Actual Performance
<ul style="list-style-type: none"> <li>- Conduct safety review and additional animal testing for cyanide pretreatment</li> <li>- Initiate validation of animal efficacy model of cyanide pretreatment to support human effectiveness</li> <li>- Initiate manufacturing scale-up and process validation of cyanide pretreatment</li> </ul>	<ul style="list-style-type: none"> <li>- Identified unanticipated toxicity in non-human primates, suspended advanced development, and returned effort to technology base for more studies</li> </ul>

**2.8.19 Performance Goal 5.10 Provide individuals and medics with medical post treatments for CW agents.**

Current Materiel Solutions	Future Materiel Solutions
Nerve Agent Antidote Kit (NAAK) (Service O&M responsibility) Convulsant Antidote Nerve Agent (CANA) (Service O&M responsibility) Sodium thiosulfate/nitrate (Service O&M responsibility)	Multi-chamber Autoinjector Improved CANA Vesicant Agent Countermeasures Advanced Anticonvulsant



## 2.8.20 Materiel Solutions Performance Measurements

### 2.8.20.1 Current R&D Targets – Multi-Chamber Autoinjector, Improved CANA and Vesicant Agent Countermeasures

FY 2000 Targets	Actual Performance
<ul style="list-style-type: none"> <li>- Conduct MSIII of Multi-chamber Autoinjector</li> <li>- Continue multi-year stability study of the Multi-chamber Autoinjector</li> <li>- Conduct MSI of Improved CANA</li> <li>- Prepare countermeasures for vesicant agents supporting documentation for MS0</li> <li>- Select candidate countermeasures for vesicant agents from <i>in vivo</i> to <i>in vitro</i> screens performed at a Contractor-Owned/Contractor-Operated facility</li> <li>- Acquire vesicant agent drugs and compounds in forms acceptable for testing</li> </ul>	<ul style="list-style-type: none"> <li>- All targets met, with the following exception:               <ul style="list-style-type: none"> <li>• MSII for the Multi-chamber Autoinjector delayed until FY01</li> </ul> </li> <li>- Justification: Pending FDA approval of New Drug Application</li> </ul>

### 2.8.20.2 Future R&D Targets – Multi-Chamber Autoinjector, Improved CANA (changed to Advanced Anticonvulsant), and Vesicant Agent Countermeasures

FY 2001 Targets	FY 2002 Targets
<ul style="list-style-type: none"> <li>- Submit support documentation for FDA licensure for the Multi-chamber Autoinjector</li> <li>- Conduct MSIII for the Multi-chamber Autoinjector</li> <li>- Produce current Good Manufacturing Practice (cGMP) pilot lots of Improved CANA</li> <li>- Conduct preclinical efficacy study of Improved CANA in nonhuman primates</li> <li>- Initiate toxicology studies with the Improved CANA</li> <li>- For additional countermeasures to vesicant agents, see section 3.0: S&amp;T Performance Goals &amp; Measures</li> </ul>	<ul style="list-style-type: none"> <li>- Conduct FDA required additional studies for licensure of Multi-chamber Autoinjector</li> <li>- Assess candidate agents in suitable animal models of soman-induced state epilepticus for efficacy in saving vulnerable neurons and improving neurobehavioral outcome</li> <li>- Ocular Vesicant Agent Countermeasures: Develop criteria for evaluating neuronal salvage after state epilepticus. Determine the essential ingredients for a rinse solution to optimally treat HD-induced ocular injury. Evaluate improved animal models for screening candidate combination therapies.</li> <li>- Continue multi-year toxicology studies with the Advanced Anticonvulsant</li> <li>- Complete two-year preclinical efficacy study of the Advanced Anticonvulsant in nonhuman primates</li> <li>- Formulate advanced anticonvulsant for planned clinical studies</li> <li>- For additional countermeasures to vesicant agents, see section 3.0: S&amp;T Performance Goals &amp; Measures</li> </ul>

### 2.8.21 Performance Goal 5.11 Provide individuals and medics with pre-treatments for BW agents.

Current Materiel Solutions	Future Materiel Solutions
Anthrax vaccine Smallpox vaccine	Biological Defense Vaccines, <i>e.g.</i> , Multivalent Equine Encephalitis, Plague, Ricin and Next Generation Anthrax vaccine

## 2.8.22 Materiel Solutions Performance Measurements

### 2.8.22.1 Current R&D Targets – Biological Defense Vaccines

FY 2000 Targets	Actual Performance
- Continue Phase II for Q fever vaccine	- Initiated assay development and IND preparation for Q-fever vaccine
- Continue Phase II for Botulinum Pentavalent Toxoid	- Continued Phase 2b clinical trial for Bot Pentavalent Toxoid
- Continue Phase I effort for Tularemia	- Demonstrated improved tularemia vaccine potency and consistency
- Continue Phase I effort for Recombinant Botulinum vaccines	- Performed process and assay development for recombinant Botulinum
- For Brucella, Plague, and VEE vaccines, see section 3.0: S&T Performance Goals & Measures	- Programs in technology base.
- Complete Phase I of Smallpox vaccine and transition to Phase II EMD	- Completed phase 2a trial and continued process definition of smallpox.

### 2.8.22.2 Future R&D Targets – Biological Defense Vaccines

FY 2001 Targets	FY 2002 Targets
- Reevaluate Q fever vaccine development strategy	- Continue Phase II for Q fever pending reevaluation
- Continue serologies and data analysis of the Bot Tox booster study to validate surrogate marker concept	- Complete serologies and data analysis of the Pentavalent Bot Tox booster study and prepare final report for submission to the FDA
- Transition to initiate Phase II effort for Smallpox vaccine	- Initiate Phase II for Smallpox vaccine. Continue consistency lot manufacture and conduct stability testing.
- Continue Phase I effort for Tularemia	- Continue Phase I effort for Tularemia. Begin pilot lot manufacture and stability testing.
- Continue Phase I effort for Recombinant Botulinum vaccine	- Continue Phase I effort for recombinant Botulinum vaccine.
- Transition Recombinant Botulinum serotype E to advanced development	- Complete Recombinant Botulinum manufacturing process development and assay development
- Initiate Phase I for Next Generation Anthrax Vaccine	- Continue process definition studies for the Next Generation Anthrax Vaccine including stability and formulation studies
- Initiate Phase I for Multivalent Equine Encephalitis (MEE)	- Complete process development studies for VEE 1A component of the MEE and manufacture cGMP pilot lots.
- Initiate Phase I effort for Staphylococcal Enterotoxin B	- Manufacture pilot and consistency lots of Staphylococcal Enterotoxin B
- For Brucella, Plague, VEE vaccines, see section 3.0: S&T Performance Goals & Measures	- For additional vaccines, see section 3.0: S&T Performance Goals & Measures
- Initiate Phase I for Ricin vaccine	- Manufacture pilot and consistency lots of Ricin vaccine.

### 2.8.23 Performance Goal 5.12 Provide individuals and medics with post-treatments for BW agents.

Current Materiel Solutions	Future Materiel Solutions
Antibiotics (Service O&M responsibility)	Broad spectrum antibiotics Antitoxins Anti-viral drugs

## 2.8.24 Materiel Solutions Performance Measurements

### 2.8.24.1 Current R&D Targets

FY 2000 Targets	Actual Performance
- Technology base efforts	- Technology base efforts Described in Section 3.0 (Projects TB2 and TB3)

### 2.8.24.2 Future R&D Targets

FY 2001 Targets	FY 2002 Targets
- Technology base efforts	- Technology base efforts

## 2.9 CORPORATE GOAL 6: MAINTAIN GROUND, AIR AND MARITIME OPERATIONAL TEMPO (*OPERATIONAL DECON/COLLECTIVE PROTECTION*)

### 2.9.1 *Performance Goal 6.1* Provide crewmembers with a limited capability to reduce the level of contamination on vehicles and weapon systems.

Current Materiel Solutions	Future Materiel Solutions
M11 Decon App, Portable (Legacy system) M13 Decon App, Portable (Legacy system) (both with DS-2)	XM100 Sorbent Decon System (SDS)

## 2.9.2 Materiel Solutions Performance Measurements

### 2.9.2.1 Current R&D Targets – XM100 Sorbent Decon Kits

FY 2000 Targets	Actual Performance
- Conduct MSIII	- Target met

### 2.9.2.2 Current Procurement Targets – XM100 Sorbent Decon System

Systems	FY00		FY01	FY02
	Target	Actual	Target	Target
XM100 Sorbent Decon System	0	0	40,000  Total requirement not yet validated	120,000  Total requirement not yet validated

### 2.9.3 *Performance Goal 6.2* Provide an operational capability to reduce the level of contamination on vehicles and weapon systems.

Current Materiel Solutions	Future Materiel Solutions
M17A2 Lightweight Decon System (Legacy System)	M21 Decontaminant Pumper M22 High Pressure Washer, components of the Modular Decon System (MDS)

## 2.9.4 Materiel Solutions Performance Measurements

### 2.9.4.1 Current Procurement Targets – M21 Decontaminant Pumper, M22 High Pressure Washer, MDS

Systems	FY00		FY01	FY02
	Target	Actual	Target	Target
M21 Decontaminant Pumper	75	71	130	27
	Total requirement not yet validated	Total requirement not yet validated	Total requirement not yet validated	Total requirement not yet validated
M22 High Pressure Washer	150	142	260	54
	Total requirement not yet validated	Total requirement not yet validated	Total requirement not yet validated	Total requirement not yet validated

### 2.9.5 Performance Goal 6.3 Ensure vehicles, vans and ships have a protected environment that keeps NBC hazards out.

Current Materiel Solutions	Future Materiel Solutions
Various Gas-Particulate Filter Unit (GPFU) configurations (Legacy systems) Modular Collective Protection Equip. (Legacy systems) Selected Area CPS, Ship CPE, (Legacy systems) Ship CPS Backfit	Joint CP Equipment (JCPE) Shipboard Collective Protection Equipment (SCPE)

## 2.9.6 Materiel Solutions Performance Measurements

### 2.9.6.1 Current Procurement Targets – Ship CPS Backfit

Systems	FY00		FY01	FY02
	Target	Actual	Target	Target
Ship CPS Backfit (protective zones backfitted)	5	5	6	6
	5/40 procured to date	5/40 procured to date	11/40 procured	17/40 procured

### 2.9.6.2 Current R&D Targets – Joint Collective Protection (CP) Equipment

FY 2000 Targets	Actual Performance
<ul style="list-style-type: none"> <li>- Complete a tradeoff analysis of M48A1 and M56 filtration systems</li> <li>- Modify M28 Liner for small shelters</li> <li>- Complete survey/tradeoff analysis of motor-blower units</li> <li>- Develop and test Recirculation Filter Unit Acceptance Tester used on Modular CP Equipment and CPDEPMEDS</li> <li>- Redesign and test Fixed Installation Filter to reduce production costs</li> <li>- Begin development of improved 200 cubic feet per minute particulate filter to extend filter life</li> <li>- Begin development of lightweight Environmental Control Unit for the PCPS</li> </ul>	<ul style="list-style-type: none"> <li>- All targets met</li> </ul>

### 2.9.6.3 Future R&D Targets – Joint Collective Protection (CP) Equipment

FY 2001 Targets	FY 2002 Targets
<ul style="list-style-type: none"> <li>- Begin development of improved pleatable carbon/HEPA filters to extend service life and reduce production costs</li> <li>- Complete prototype development and test improved 200 cubic feet per minute and Fixed Installation Filter filters</li> <li>- Begin development and test of improved motor-blowers to improve efficiency, reliability, size, and weight</li> <li>- Continue development and testing of lightweight Environmental Control Unit for transportable CP systems</li> <li>- Procure lightweight Environmental Control Unit</li> <li>- Modify and test M28 Liner for small shelters</li> </ul>	<ul style="list-style-type: none"> <li>- Initiate development and testing of two improved HEPA filters to extend filter life and improve performance. Test ten improved M48A1 and M56 carbon filters with live agents to complete qualification of filter design.</li> <li>- Complete development of a single pleatable charcoal/HEPA bonded filter to replace two CB filters used in collective protection systems to reduce installation time, logistics, and cost.</li> <li>- Conduct testing of RFU acceptance tester. RFU is designed to eliminate low level contamination brought into collective protection systems by personnel or equipment.</li> <li>- Increase efficiency of CPS supply fans by developing a variable speed air supply system to allow the CPS system to operate at peak performance over the entire range of filter loading. Complete development and testing of FFA 400-100 and M93 candidate motorblowers for CB shelter systems to improve efficiency, reliability, size and weight.</li> <li>- Complete development of the universal NBC ECU adapter that can apply a transportable cooling coil to the FFA 580 blower and other FFA blower configurations. Initiate development of a new USAF shelter configuration which combines a medium size shelter between two small shelters using an M28 protection liner.</li> </ul>

### 2.9.6.4 Current R&D Targets – Shipboard Collective Protection (SCPE)

FY 2000 Targets	Actual Performance
<ul style="list-style-type: none"> <li>- Initiate testing the V-cell Limited Production HEPA filter</li> <li>- Initiate land-based testing of improved CPS fan</li> <li>- Complete verification testing to validate 4-yr performance of improved prefilters and HEPA filters</li> </ul>	<ul style="list-style-type: none"> <li>- All targets met</li> </ul>

### 2.9.6.5 Future R&D Targets – Shipboard Collective Protection (SCPE)

FY 2001 Targets	FY 2002 Targets
<ul style="list-style-type: none"> <li>- Complete land-based and initiate shipboard testing of improved CPS fan and develop fan performance specs.</li> <li>- Complete 2<sup>nd</sup> year of verification testing to validate 4-yr performance of improved prefilters and HEPA filters.</li> <li>- Complete testing of V-cell LP HEPA filter</li> <li>- Initiate shock and vibration testing on COTS LP HEPA filter.</li> <li>- Transition COTS LP HEPA filter to JCPE</li> </ul>	<ul style="list-style-type: none"> <li>- Continue shipboard testing of improved CPS fans.</li> <li>- Complete 3<sup>rd</sup> yr of verification testing to validate 4-yr performance of improved prefilters and HEPA filters</li> <li>- Continue evaluation of potential HEPA filter performance degradation after toxic industrial chemical/material (TIC/TIM)</li> <li>- Continue development and testing of electronic differential pressure gauges.</li> <li>- Initiate transition of selected efforts to JCPE</li> </ul>

**2.9.7 Performance Goal 6.4 Provide a hazard-free environment for mobile command and control operations.**

Current Materiel Solutions	Future Materiel Solutions
M20A1 SCPE (Legacy system) Portable CPS (Legacy system)	Joint Transportable Collective Protection Shelter (JTCOPS) Joint CP Equipment

**2.9.8 Materiel Solutions Performance Measurements**

**2.9.8.1 Current R&D Targets – Joint Transportable Collective Protection Shelter**

FY 2000 Targets	Actual Performance
- <i>New start</i>	- <i>New start</i>

**2.9.8.2 Future R&D Targets – Joint Transportable Collective Protection Shelter**

FY 2001 Targets	FY 2002 Targets
<ul style="list-style-type: none"> <li>- Conduct MSI</li> <li>- Initiate system design and prototype fabrication</li> <li>- Update program documentation, obtain engineering support</li> <li>- Conduct program management activities</li> </ul>	<ul style="list-style-type: none"> <li>- Award development contract for Block I.</li> <li>- Conduct the entire design phase of the contract and begin the prototype fabrication phase.</li> </ul>

**2.9.8.3 Current & Future R&D Targets: Joint CP Equipment (see 2.9.6.2 and 2.9.6.3)**

**2.10 CORPORATE GOAL 7: SUSTAIN OPERATIONS, RECOVERY AND RECONSTITUTION EFFORTS (RESTORATION OPERATIONS)**

**2.10.1 Performance Goal 7.1 Provide units with a capability to eliminate all contamination on vehicles and weapon systems.**

Current Materiel Solutions	Future Materiel Solutions
M12 Power-Driven Decon Apparatus (Legacy system)	M21 Decontaminant Pumper M22 High Pressure Washer, components of the Modular Decon System (MDS)

**2.10.2 Materiel Solutions Performance Measurements**

**2.10.2.1 Current & Future Procurement Targets – M21/22 Modular Decon System (see 2.9.4)**

**2.10.3 Performance Goal 7.2 Provide units with a capability to eliminate all contamination on terrain and fixed sites.**

Current Materiel Solutions	Future Materiel Solutions
M12 Power-Driven Decon Apparatus (Legacy system)	Joint Service Fixed Site Decontamination System (JSFXD)- Block I, II, and III

## 2.10.4 Materiel Solutions Performance Measurements

### 2.10.4.1 Current R&D Targets – Joint Service Fixed Site Decontamination System (JSFXD)

FY 2000 Targets	Actual Performance
<ul style="list-style-type: none"> <li>- Conduct technology definition and assessment of COTS and NDI decon equipment and decontaminants for Block III</li> <li>- Prepare MSI documentation for Block II</li> <li>- Conduct MSI for Block I</li> <li>- Prepare engineering change proposals for DT/OT</li> <li>- Prepare procurement package for family of decontaminants and award contract for Block I</li> <li>- Conduct DT/OT on family of decontaminants</li> </ul>	<ul style="list-style-type: none"> <li>- All targets met, with the following exception:               <ul style="list-style-type: none"> <li>• Conduct DT/OT on family of decontaminants slipped to FY01</li> <li>• Conduct of MSI for Block I slipped to FY01</li> </ul> </li> </ul>

### 2.10.4.2 Future R&D Targets – Joint Service Fixed Site Decontamination System (JSFXD)

FY 2001 Targets	FY 2002 Targets
<ul style="list-style-type: none"> <li>- Conduct MSII for Block I</li> <li>- Initiate Developmental Testing/Operational Testing for Block I</li> <li>- Initiate Block II prototype testing</li> <li>- Conduct MSIII for Block I</li> </ul>	<ul style="list-style-type: none"> <li>- Continue toxicology testing and other evaluations necessary for FDA approval to support down select of Block III skin/casualty decontaminants</li> <li>- Award PDRR contract(s) for Block II family of applicators system to develop prototype applicator and containment system for evaluation</li> <li>- Perform early Operational Assessment and initiate Developmental Testing for Block II family of applicator systems</li> <li>- Complete DT/OT on family of decontaminants for Block I.</li> <li>- Complete MS C for Block I</li> <li>- Incorporate lessons learned from OT into logistics support documentation for Block I family of decontaminants.</li> <li>- Prepare documentation and test reports, conduct downselect of medical/skin decontaminant in support of Block III EMD contract award</li> </ul>

### 2.10.5 Performance Goal 7.3 Provide units with a capability to eliminate all contamination on sensitive equipment and avionics.

Current Materiel Solutions	Future Materiel Solutions
None	Joint Service Sensitive Equipment Decon System (JSSEDS) Block I

**2.10.6 Materiel Solutions Performance Measurements**

**2.10.6.1 Current R&D Targets – JSSEDS Block I**

<b>FY 2000 Targets</b>	<b>Actual Performance</b>
<ul style="list-style-type: none"> <li>- Incorporate neutralization processes into supercritical fluid extraction and non-ozone depleting fluorocarbon systems</li> <li>- Demonstrate validity of the techniques for Block I down-selection</li> <li>- Complete Block I concept exploration</li> <li>- Optimize solution decontaminants under evaluation and prepare for demonstration phase</li> <li>- Initiate studies using oxidative approaches</li> </ul>	<ul style="list-style-type: none"> <li>- All targets met, also completed an Analysis of Alternatives and supported studies to determine the fate of agents adsorbed on surfaces at fixed sites</li> </ul>

**2.10.6.2 Current R&D Targets – JSSEDS Block I**

<b>FY 2001 Targets</b>	<b>FY 2002 Targets</b>
<ul style="list-style-type: none"> <li>- Conduct Block I MSI</li> <li>- Competitively award Block I prototype contract</li> <li>- Evaluate Block I prototype</li> </ul>	<ul style="list-style-type: none"> <li>- Award Block I competitive prototype contract</li> <li>- Evaluate Block I prototypes during competitive “shoot off” to determine efficacy</li> </ul>

**2.10.7 Performance Goal 7.4 Provide units with a capability to eliminate all contamination on vehicle/aircraft interiors**

<b>Current Materiel Solutions</b>	<b>Future Materiel Solutions</b>
None	Joint Service Sensitive Equipment Decon System (JSSEDS)- Blocks II and III

**2.10.8 Materiel Solutions Performance Measurements**

**2.10.8.1 Current R&D Targets – JSSEDS Blocks II and III**

<b>FY 2000 Targets</b>	<b>Actual Performance</b>
<ul style="list-style-type: none"> <li>- Technology base efforts</li> </ul>	<ul style="list-style-type: none"> <li>- Technology base efforts Described in Section 3.0</li> </ul>

**2.10.8.2 Current R&D Targets – JSSEDS Blocks II and III**

<b>FY 2001 Targets</b>	<b>FY 2002 Targets</b>
<ul style="list-style-type: none"> <li>- Technology base efforts</li> </ul>	<ul style="list-style-type: none"> <li>- Technology base efforts</li> </ul>

**2.10.9 Performance Goal 7.5 Monitor the presence/absence of CW agent contamination after decon.**

<b>Current Materiel Solutions</b>	<b>Future Materiel Solutions</b>
Chemical Agent Monitor (CAM) (Legacy system) Improved CAM (ICAM)	Joint Chemical Agent Detector



## 2.10.10 Materiel Solutions Performance Measurements

### 2.10.10.1 Current Procurement Targets – ICAM

Systems	FY00		FY01	FY02
	Target	Actual	Target	Target
ICAM	2,984	3,502	3,003	
	9,956/28,758 procured to date	10,474/28,758 procured to date	13,477/28,758 procured	

### 2.10.10.2 Current & Future R&D Targets – JCAD (See section 2.8.6)

### 2.10.11 Performance Goal 7.6 Monitor the presence/ absence of CW agent contamination in water.

Current Materiel Solutions	Future Materiel Solutions
M272A1 Water Test Kit (Service O&M responsibility)	Joint CB Agent Water Monitor (JCBAWM)

## 2.10.12 Materiel Solutions Performance Measurements

### 2.10.12.1 Current R&D Targets – Joint CB Agent Water Monitor (JCBAWM)

FY 2000 Targets	Actual Performance
- Technology base efforts	- Technology base efforts Described in Section 3.0

### 2.10.12.2 Future R&D Targets – Joint CB Agent Water Monitor (JCBAWM)

FY 2001 Targets	FY 2002 Targets
- Technology base efforts	- Technology base efforts

### 2.10.13 Performance Goal 7.7 Provide a hazard-free environment for long-term command and control operations.

Current Materiel Solutions	Future Materiel Solutions
Fixed Site CPS (Legacy system)	Joint CP Equipment Joint Transportable CP Shelter (JTCOPS)

## 2.10.14 Materiel Solutions Performance Measurements

### 2.10.14.1 Current & Future R&D Targets – Joint CP Systems and Improvements (see 2.9.6.2)

### 2.10.14.2 Current & Future R&D Targets – Joint Transportable Collective Protection (CP) Shelter (JTCOPS) (see 2.9.8.1)

**2.10.15 Performance Goal 7.8 Provide a hazard-free environment for forward tactical medical operations.**

Current Materiel Solutions	Future Materiel Solutions
M51 Shelter (Legacy system) CB Protective Shelter (CBPS)	Joint CP Equipment Joint Transportable Collective Protection System (JTCOPS) CBPS P3I

**2.10.16 Materiel Solutions Performance Measurements**

**2.10.16.1 Current Procurement Targets – CBPS**

Systems	FY00		FY01	FY02
	Target	Actual	Target	Target
CB Protective Shelter (CBPS)	32	0	26	32
	98/1224 procured to date	66/1224 procured to date	89/1224 procured	121/1224 procured

**2.10.16.2 Current and Future R&D Targets – Joint CP Equipment (see 2.9.6.2 and 2.9.6.3)**

**2.10.16.3 Current and Future R&D Targets – JTCOPS (see 2.9.8)**

**2.10.16.4 Current R&D Targets – CBPS P3I**

FY 2000 Targets	Actual Performance
-n/a (FY02 start)	

**2.10.16.4 Future R&D Targets – CBPS P3I**

FY 2001 Targets	FY 2002 Targets
-n/a (FY02 start)	<ul style="list-style-type: none"> <li>- Initiate and manage CBPS P3I program</li> <li>- Develop design concept for CBPS airborne and heavy versions</li> <li>- Coordinate with user and field representatives on requirements and logistics supportability</li> <li>- Award a three phase contract for design and fabrication of a self-powered Environmental Support System (ESS)</li> <li>- Award phase I in FY02 to develop an ESS that will meet requirements for CBPS-light, heavy and airborne versions</li> <li>- Fabricate one prototype and conduct initial performance and reliability testing</li> </ul>

**2.10.17 Performance Goal 7.9 Provide a hazard-free environment for long-term rear-area medical operations.**

Current Materiel Solutions	Future Materiel Solutions
CP DEPMEDS/CHATH	Joint Transportable Collective Protection System (JTCOPS)

## 2.10.18 Materiel Solutions Performance Measurements

### 2.10.18.1 Current Procurement Targets – CP DEPMEDS/CHATH

Systems	FY00		FY01	FY02
	Target	Actual	Target	Target
CP DEPMEDS/ CHATH	4	3	8	3
	4/23 procured to date	3/23 procured to date	11/23 procured	15/23 procured

### 2.10.18.2 Current and Future R&D Targets – JTCOPS (see 2.9.8)

### 2.10.19 Performance Goal 7.10 Develop medical identification and diagnosis device capable of identifying multiple BW agents in clinical and environmental sources.

Current Materiel Solutions	Future Materiel Solutions
None (interim measure- manual medical diagnoses and Theater Army Medical Labs)	Joint Biological Agent Identification and Diagnostic System (JBAIDS)

## 2.10.20 Materiel Solutions Performance Measurements

### 2.10.20.1 Current R&D Targets – JBAIDS

FY 2000 Targets	Actual Performance
- Technology base efforts	- Technology base efforts Described in Section 3.0

### 2.10.20.2 Current R&D Targets –JBAIDS

FY 2001 Targets	FY 2002 Targets
- Technology base efforts	- Technology base efforts

## CHEMICAL AND BIOLOGICAL DEFENSE PROGRAM PERFORMANCE PLAN SCIENCE AND TECHNOLOGY BASE PERFORMANCE GOALS AND MEASURES

### 3.0 OVERVIEW

The science and technology base (S&T) of the Chemical and Biological Defense Program provides essential capabilities to develop technological advantage over any potential adversaries and prevent technological surprise. Within S&T there are three budget activities and three research areas, and project funding codes for each. (See Table 1.)<sup>1</sup>

**Table 1. CBDP Science and Technology Base Project Funding Codes**

Budget Activity (Program Element)	Research Area		
	Non-Medical S&T	Medical S&T	
	CB Defense	Chemical Defense	Biological Defense
BA1 - Basic Research (0601384BP)	CB1	TC1	TB1
BA2 - Applied Research (0602384BP)	CB2	TC2	TB2
BA3 - Advanced Technology Development (0603384BP)	CB3 and CP3	TC3	TB3

The approach for identifying and developing quantitative performance goals and measures on an annual basis is not always well suited for evaluating the progress of S&T efforts. The long term nature of many of these efforts makes the identification of quantitative measures on an annual basis meaningless (for example, how many breakthroughs in basic science were made last year.) However, using an approach similar to those used in the performance plans of other federal research centers—including the National Academies of Science, the National Institutes of Health, and the National Science Foundation—there are a variety of qualitative and quantitative performance measures that may be used to demonstrate progress of S&T efforts towards outcomes, which fulfills the requirements of the GPRA.

The basic performance measure established for S&T efforts is the independent expert panel review. The CBDP has adopted this practice using an independent panel of scientists from outside the Department to provide an assessment of the funding and research areas within the program. This process, known as the Technology Area Review and Assessment (TARA), has been conducted annually by the CBDP. The TARA panel provides a presentation of their findings and recommendations to the Defense Science and Technology Advisory Group, the senior leaders within the Department responsible for S&T within DoD.

### 3.1 CB DEFENSE S&T PLANNING

To ensure U.S. military preeminence in the long term, the Department must continue to focus investments on new generations of defense technologies. The Defense Science and Technology Strategy, with its supporting Basic Research Plan, Joint Warfighting Science and Technology Plan, and Defense Technology Area Plan, is the foundation of the science and technology (S&T) program. The Office of the Secretary of Defense, the Joint Staff, the military departments, and the defense agencies collaboratively develop the S&T program. Objectives of S&T planning are to:

<sup>1</sup> Biological Warfare Defense programs funded under DARPA project BW-01 are not addressed in this performance plan except for those projects identified as Defense Technology Objectives.

- reduce undesired duplication of effort,
- ensure collaborative planning and execution of the S&T program,
- identify gaps in existing defense and commercial research,
- ensure projects support warfighter requirements,
- provide the basis for independent expert panel reviews.

### 3.2 DOD CB DEFENSE SCIENCE AND TECHNOLOGY BASE PROGRAM

This section provides the objectives and metrics for the overall CB defense S&T program. An overall assessment is provided below. Actual and planned performance on specific projects is detailed in the following sections on S&T.

#### 3.2.1 CB Defense Science and Technology Outcome Measure

CB Defense S&T is...	
...minimally effective when...	... successful when...
<ul style="list-style-type: none"> <li>• All major commodity areas are rated GREEN and no sub-areas are rated RED by the TARA panel.</li> <li>• Research efforts contribute to increased knowledge regarding CB threats and science and technologies to defend against these threats.</li> <li>• Projects support goals and timelines stated in planning documents, specifically the <i>Joint Warfighting Science and Technology Plan</i> and the <i>Defense Technology Area Plan</i>.</li> </ul>	<ul style="list-style-type: none"> <li>• All commodity areas are rated GREEN by the TARA panel.</li> <li>• New capabilities are successfully demonstrated and transition to advanced development.</li> </ul>

**3.2.1.1 Metric Description.** The metric for science and technology base projects is a qualitative assessment of the results of basic research, applied research, and advanced technology development compared to their intended purposes. This qualitative methodology for measuring the outcomes of the science and technology base is allowed by the GPRA (31 USC 1115(b)) as an alternative to the quantitative performance measures. The approach for identifying and developing quantitative performance goals and measures on an annual basis is not always well suited for evaluating the progress of research efforts. The long term nature of many of these efforts makes the identification of quantitative measures on an annual basis meaningless (for example, how many breakthroughs in basic science were made last year.) This approach is similar to those used in the performance plans other federal research centers—including the National Academies of Science, the National Institutes of Health, and the National Science Foundation. Qualitative performance measure are provided for each of the projects listed in table 1. Qualitative performance measures are assessed by an independent panel as well as by the accomplishment of specific project targets identified and detailed in each of the project areas below. The assessment includes an evaluation of the information provided to determine whether it is sufficient information to allow for an accurate, independent determination of the program activity’s performance. An important element of the research efforts—especially for basic and applied research—is the evaluation and elimination of unsuccessful technologies. While not always identified as a specific target, the scientific method contributes to increased knowledge by eliminating efforts that will not contribute to project objectives.

**3.2.1.2 Validation and Verification Methodology.** The basic performance measure established for S&T efforts is the *independent expert panel review*.<sup>2</sup> This is in keeping with White House guidance to ensure that independent assessments of research programs evaluate both the quality of programs and progress of research towards stated goals.<sup>3</sup> The CDBP has adopted this practice using an independent panel of scientists from outside the Department to provide an assessment of the funding and research areas within the program. This process, known as the Technology Area Review and Assessment (TARA), is conducted annually by the CDBP. The TARA panel provides a presentation of their findings and recommendations to Defense Science and Technology Advisory Group, the senior leaders within the Department responsible for S&T within DoD. Table 2 provides a summary of the assessment of each of the commodity areas within the CDBP, and table 3 provides the assessment by the TARA Panel of each of the DTOs presented during the FY2000 review.

**Table 2. 2000 TARA Assessment of CB Defense S&T Commodity Areas**

CB Defense Science and Technology Commodity Area	TARA Rating
DETECTION	GREEN
– Chemical Detection	GREEN
– Biological Detection	GREEN
– Modeling and Simulation	YELLOW
PROTECTION	GREEN
– Non-Medical	GREEN
– Individual Protection	GREEN
– Collective Protection	GREEN
– Medical	GREEN
– Medical Chemical Defense	GREEN
– Medical Biological Defense	GREEN
DECONTAMINATION	GREEN

### 3.2.2 Assessment of CB Defense Science and Technology Outcome Measure

Overall, the DoD CDBP science and technology base has been effective. All areas, with the exception of modeling and simulation, have been rated green by the TARA panel. While modeling and simulation was rated yellow, the TARA panel noted that there was progress in this area over the previous year. In addition, there were several technologies that completed successful demonstrations over the past year, and as detailed in the following sections, there are several examples of technology transitions to advanced development.

## 3.3 DEFENSE TECHNOLOGY OBJECTIVES

The Department's commitment to transforming U.S. military forces requires robust and stable funding for the S&T program. S&T expenditures support basic research as well as focused investments guided by defense technology objectives (DTOs). DTOs provide a framework for S&T efforts by identifying:

<sup>2</sup> *Evaluating Federal Research Programs: Research and the Government Performance and Results Act*, Washington, D.C: National Academy Press, 1999.

<sup>3</sup> See memorandum from The White House, Neal Lane and Jacob J. LE, "Follow-On Guidance for FY 2001 Interagency Research and Development Activities," June 8, 2000.

- What specific technologies will be developed and/or demonstrated.
- What specific milestones are to be reached, using what approaches.
- Which customers will benefit.
- What specific benefits the customers will gain.
- What level of funding will be programmed and from what sources.
- What quantitative metrics will indicate progress.

Within the CBDP, DTOs fund approximately 40% of S&T efforts in FY01. DTOs are the building blocks of the Defense S&T Program. They represent only high priority Service and Defense Agency programs, consistent with the Defense Planning Guidance and the Defense S&T Strategy. DTOs are one of the key S&T planning tools. They are used to assist in planning and programming S&T funds, they help in articulating key efforts and goals, and they provide a key performance measure for contribution of the S&T effort to warfighter needs. All updates, changes, and approvals of DTOs are made by the Defense Science and Technology Advisory Group (DSTAG), the senior S&T advisory body within the Department. Assessments of DTO performance are provided annually by the TARA.

The CBDP S&T efforts continue to demonstrate new capabilities for the warfighter. Progress of DTOs is shown in the following tables. Progress in other portions of S&T is shown in section 3.4.

<b>3.3.1 Performance Indicator – Status of Defense Technology Objectives as Judged by Technology Area Review Assessments</b>				
	FY1999		FY2001	FY2002
	Goal	Actual	Goal	Goal
Percent of DTOs Judged Green (on track)	80	82*	80	80
Total Number of DTOs	14 of 17*	14 of 17		

\*1 rated red, 1 rated yellow, 2 rated green/yellow (counted as 0.5)

**Table 3. 2000 TARA Assessment of Chemical and Biological Defense DTOs**

DTO No.	DTO Title	TARA Rating
I.02	Joint Biological Remote Early Warning System Advanced Concept Technology Demonstration (ACTD)	GREEN
I.03	Restoration of Operations (RestOps) ACTD	**
L.12	Force Medical Protection (Chemical Biological Individual Sampler, CBIS) ACTD	RED
L.07	Terrorist CB Countermeasures	GREEN
CB.06	Advanced Lightweight Chemical Protection	GREEN
CB.07	Laser Standoff Chemical Detection Technology	GREEN/YELLOW
CB.08	Advanced Adsorbents for Protection Applications	YELLOW
CB.09	Enzymatic & Catalytic Decontamination	GREEN
CB.19	Chemical Imaging Sensor	GREEN
CB.20	Biological Sample Preparation System for Biological Identification	GREEN
CB.22	Medical Countermeasures (CM) for Vesicant Agents	GREEN
CB.23	Medical CM for Staphylococcal Enterotoxin B	GREEN
CB.24	Medical CM for Encephalitis Viruses	GREEN
CB.25	Multiagent Vaccines for Biological Threat Agents	GREEN

DTO No.	DTO Title	TARA Rating
CB.26	Common Diagnostic Systems for Biological Threats and Endemic Infectious Disease	GREEN
CB.27	Therapeutics Based on Common Mechanisms of Pathogenesis	GREEN/YELLOW
CB.28	Chemical Agent Prophylaxis II	GREEN
CB.29	Active Topical Skin Protectant	GREEN
CB.30	Medical Countermeasures for Vesicant Agents II	**
CB.31	Medical Countermeasures for Brucellae	**
CB.32	Alternate (Needle-less) Delivery Methods for Recombinant Protein Vaccines	**
CB.33	Recombinant Protective Antigen (rPA) Anthrax Vaccine Candidate	**
CB.34	Recombinant Plague Vaccine	**
CB.35	Standoff Biological Aerosol Detection	**
CB.36	Universal End-of-Service-Life Indicator for NBC Mask Filters	**
CB.37	CB Agent Water Monitor	**
CB.38	Activity Based Detection and Diagnostics	**
CB.39	CW/BW Agent Screening and Analysis	**
CB.40	Immune building program	**
CB.41	Biosensors	**

\*\* New DTOs in FY2001. Not assessed at the 2000 TARA.

**3.3.1.1 Metric Description.** Table 3 lists specific DTOs assessed during 2000. Appendix A to this section provides complete descriptions of the DTOs. Each DTO is reviewed annually by an independent peer review panel, called the Technology Area Review and Assessment (TARA) panel. The goal is to have at least 80% of the DTOs rated green. The total number of DTOs varies per year based on new DTO assignments and completion of DTO efforts. Total DTO funding varies per year and may represent between 25%–50% of total science and technology base funds. During the 2000 TARA, four DTOs were given a rating other than green. Following is a summary explanation for these ratings.

**Table 4. Summary of Explanations for Selected 2000 TARA CB Defense DTOs**

DTO	TARA Rating	Summary Explanation of TARA Rating
L.12, Force Medical Protection (CBIS) ACTD	RED	<ul style="list-style-type: none"> <li>• Lack of a concept of operations makes defining technological approach to the problem impossible.</li> <li>• The proposal and project timeline is naïve in both technical and policy matters. The material solution concept was to modify proven technology with no plan nor timeline adjustment for revalidation. Without a residual life monitor for the sensor, false negatives become a major risk. Since the demonstration will involve “research” involving human subjects, 32 CFR 219 applies and human use review must be obtained. Health care policy issues have not been fully addressed by the program (e.g., what happens when there is a positive detection?)</li> <li>• Findings and recommendations of National Academy of Sciences study need to be addressed in plan. (McKone, T.E. et al. (2000). <i>Strategies to Protect the Health of Deployed U.S. Forces: detecting, characterizing, and documenting exposures</i>, Washington, D.C.: National Academies Press.)</li> </ul>
CB.07, Laser Standoff Chemical Detection Technology	GREEN/YELLOW	<ul style="list-style-type: none"> <li>• Meeting all milestones for chemical detection</li> <li>• Unlikely to be able to meet goals for bioaerosol identification; goals should be re-written to clarify focus is on detection of chemicals, aerosols and particulate (not biological agents.)</li> </ul>



DTO	TARA Rating	Summary Explanation of TARA Rating
CB.08, Advanced Adsorbents for Protection Applications	YELLOW	<ul style="list-style-type: none"> <li>• Technology objectives are not clear and need to be re-written.</li> <li>• Progress since last year appears to be limited. Effort appears to be a technology watch effort. Guidance is need from users as basis for re-scoping DTO or reverting to a basic science effort.</li> <li>• Current efforts appear to focus on compounds chemically similar to carbon. Focus on new materials (e.g., dendritic polymers) should be undertaken if the DTO is continued. There is still no evidence of discovery of innovative approaches as alternatives to carbon. Limited evidence of material discovery process. More collaboration with research organizations could be beneficial.</li> </ul>
CB.27, Therapeutics Based on Common Mechanisms of Pathogenesis	GREEN/ YELLOW	<ul style="list-style-type: none"> <li>• Broad effort not yet focused. During FY01, DTO should be repackaged and targeted on reasonable transitions of technology.</li> <li>• In order to support an integrated Force Health Protection posture for biological defense, more of DARPA's Biological Warfare Defense efforts could be packaged into DTOs.</li> </ul>

**3.3.1.2 V&V Methodology.** Each TARA team includes about 10 to 12 members, at least two-thirds of whom come from outside DoD. The non-DoD members include experts in relevant fields from other U.S. government agencies, private industry, and academia. S&T stakeholders (e.g., senior S&T officials, the Joint Staff, and technology customers) attend the reviews as observers. TARA teams assess DTOs in terms of three factors—budget, schedule, and technical performance—and assign the programs a Red, Yellow, or Green rating based on how well they are progressing toward their goals. This method of peer review is accepted and endorsed by the S&T stakeholders. Adjustments are made to program plans and budgets based on the ratings awarded. The following criteria are used in assigning ratings:

- Green – Progressing satisfactorily toward goals.
- Yellow – Generally progressing satisfactorily, but some aspects of the program are proceeding more slowly than expected.
- Red – Doubtful that any of the goals will be attained.

The DTO ratings are semi-quantitative metrics, reflecting the opinions of independent experts. The DTOs contain quantitative metrics, which provide a basis for determining progress of that effort towards a warfighter payoff.

### 3.4 BASIC RESEARCH (PROGRAM ELEMENT 0601384BP)

This program element (PE) funds the Joint Service core research program for chemical and biological (CB) defense (medical and non-medical). The basic research program aims to improve the operational performance of present and future Department of Defense (DoD) components by expanding knowledge in militarily relevant fields for CB defense. Moreover, basic research supports a Joint force concept of a lethal, integrated, supportable, highly mobile force with enhanced performance by the individual soldier, sailor, airman, or marine. Specifically, the program promotes theoretical and experimental research in the chemical, biological, and medical sciences. Research areas are determined and prioritized to meet Joint Service needs as stated in mission area analyses and Joint operations requirements, and to take advantage of scientific opportunities. Basic research is executed by academia, industry, and government research laboratories. Funds directed to these laboratories and research organizations capitalize on scientific talent, specialized and uniquely engineered facilities, and technological breakthroughs. The work in this program element is consistent with the Joint Service Nuclear, Biological, and Chemical (NBC) Defense Research, Development, and Acquisition (RDA) Plan. Management of funding resources leads to expeditious transition of the resulting knowledge and technology to the applied research (PE 0602384BP) and advanced technology development (PE 0603384BP) activities. This project also covers the conduct of basic research efforts in the areas of real-time sensing and diagnosis and immediate biological countermeasures. The projects in this PE include basic research efforts directed toward providing fundamental knowledge for the solution of military problems and therefore are correctly placed in this Budget Activity.

#### 3.4.1 CB Defense Basic Research (Project CB1)

This project funds basic research in chemistry, physics, mathematics and life sciences, fundamental information in support of new and improved detection technologies for biological agents and toxins; new and improved detection technologies for chemical threat agents; advanced concepts in individual and collective protection, new concepts in decontamination and information on the chemistry and toxicology of threat agents and related compounds.

**3.4.1.1 CB1 Performance Goal (Outcome).** The goal of the CB defense non-medical basic research program is to increase scientific understanding of the mechanisms and processes involved in the detection, protection against, and decontamination of chemical and biological warfare agents.

#### 3.4.1.2 CB1 Outcome Measure

CB1 is minimally effective when	CB1 is successful when
<ul style="list-style-type: none"> <li>• The results provide fundamental information in support of new and improved defensive systems, including information on               <ul style="list-style-type: none"> <li>–biosensors,</li> <li>–aerosol sciences,</li> <li>–chemistry and toxicology of bioactive compounds,</li> <li>–man portable thin film technology,</li> <li>–integrated detection of energetic and hazardous materials,</li> <li>– optical recognition technologies,</li> <li>– new detection technologies.</li> </ul> </li> <li>• The results of research are published in peer-reviewed journals or presented at scientific conferences</li> </ul>	<ul style="list-style-type: none"> <li>• Information, technologies, or processes are transitioned to applied research or advanced technology development</li> </ul>

CB1 is minimally effective when	CB1 is successful when
<ul style="list-style-type: none"> <li>Key research efforts are reviewed by an independent panel of experts and the quality and relevance of the efforts are assessed</li> </ul>	

### 3.4.1.3 CB1 Actual and Planned Performance

FY2000 Targets	Actual Performance
<p><u>Biosensors</u> - Deliver purified oligomer recognition elements for the detection of <i>Bacillus anthracis</i> (anthrax) and <i>Yersinia pestis</i> (plague). Completed conjugate synthesis and integration of specific fluorescent polymer/binding agent complexes. Completed synthesis of antibody/dendrimer tag complexes and began work on the demonstration of separation/identification of dendrimer bound antibody/antigen couples via capillary electrophoresis.</p> <p><u>Aerosol Science</u> - Validate the new back scattering theorem through laboratory experiments to compare projections with actual scattering data. Make adjustments to the computer code.</p> <p><u>Chemistry and Toxicology of Bioactive Compounds</u> - Complete project on cytotoxicity screening methods and transition the work to routine use throughout the toxicology program. Make a selection of the coating technology to be used in the molecular imprinting technique for the Individual Passive Chemical Agent Detector project. Expand rate studies on the percarbonate based decontaminant formulation to include work with surety materials. Investigate other methods of peroxide activation with promise for greater pH range efficacy. Begin project to create a filtration performance model based upon an understanding of adsorption equilibria and rate processes; begin with development of data base of adsorption equilibrium measurements. Begin project to study pharmacokinetics and pharmacodynamics of novel threat materials.</p> <p><u>Man Portable Thin Film Technology</u> - Continue development and refinement of semiconductor metal-oxide (SMO) thin film technology with controlled architecture to detect chemical agents (e.g., nerve, blister, blood) and interferent species (e.g., volatile hydrocarbons, water, and other battlefield interferents) as dictated by Joint Service requirements. Development will optimize films for both point and cumulative exposure detection applications. Conduct laboratory testing to optimize the sensitivity, selectivity, and stability of SMO sensor elements and arrays as a function of gas environments.</p> <p><u>The Integrated Detection of Energetic and Hazardous Materials</u> - Conduct a multidisciplinary project which develops integrated detection systems for sensing the presence of CB warfare agents. This effort consists of the following sub-tasks: ion trap mass spectrometry analytical techniques, micro-sensors for CB warfare agents, and analytical detection in biosystems.</p> <p><u>Optical Recognition Technologies</u> - Develop improved and more cost-effective techniques for the recognition of chemical agents in the atmosphere. Chemometrics are used to design sophisticated multi-layered optical filters to test against simulants and interferents.</p>	<ul style="list-style-type: none"> <li>Targets met</li> <li>Targets met</li> <li>Targets met</li> <li>Targets met</li> <li>Targets met</li> <li>Targets met</li> </ul>

### 3.4.1.4 CB1 Future Targets

FY 2001 Targets	FY 2002 Targets
<p><u>Aerosol Science</u> - Complete confirmation of the scattering model theorem by demonstrating imaging of biological cluster particles. Transition the technology to the applied research program for further development.</p> <p><u>Biosensors</u> - Perform Deoxyribose Nucleic Acid (DNA) sequencing of the recognition elements to anthrax agents</p>	<p><u>Biosensors</u> - Sequence Venezuelan Equine Encephalitis (VEE) aptamers and incorporate all aptamers into Multiplex Electronic/Photonic Sensor (MEPS). Accelerate completion of the MEPS project to establish whether this approach will be a viable approach for a transition to 6.2. Complete optimization and miniaturization of the</p>

FY 2001 Targets	FY 2002 Targets
<p>sequencing of the recognition elements to anthrax spores and Staphylococcal enterotoxin B. Complete conjugate synthesis and chip integration of specific DNA/ fluorescent polymer conjugates. Demonstrate separation/ identification of dendrimer bound antibody/antigen couples via capillary electrophoresis.</p> <p><i>Chemistry and Toxicology of Bioactive Compounds</i> - Continued studies of the percarbonate based decontaminant formulations by determining reaction product distributions and correlate equilibrium concentrations with solvent properties. Complete measurement of requisite adsorption rate data and begin development of a continuous adsorption model for filter performance. Establish new project to understand the toxicological mechanisms of one or two members of a class of potential new threat agents.</p>	<p>capillary electrophoresis detection system and demonstrate concept.</p> <p><i>Chemistry and Toxicology of Bioactive Compounds</i> - Develop "film badge" package to be used in the molecular imprinting technique for the Individual Passive Chemical Agent Technologies. Conduct determination of rate laws for other organic oxidations using the new peroxide formulations. Develop and validate filter model incorporating adsorption equilibria and dynamic behavior. Initiate a project to model concepts for individual protection systems. Expand pharmacokinetic and pharmacodynamic investigation to include additional new threat materials, thereby reducing the risk of incorrect conclusions based upon a non-representative sample set.</p> <p><i>New Detection Technologies</i> - Initiated research on methods of combining chemical and biological agent detection on surfaces into one platform. Include a variety of spectroscopic techniques focusing on portions of the electromagnetic spectrum not previously utilized for Chemical and Biological (CB) agent detection.</p>

**3.4.1.5 Assessment of CB Defense Basic Research.** Basic research efforts in FY2000 for project CB1 are at least minimally effective. Extensive research continues to be conducted in several research areas supporting several major operational goals detailed in Section 2 of the performance plan. Several new research projects also were initiated in FY2000.

### 3.4.2 Medical Biological Defense Basic Research (Project TB1)

This project funds basic research on the development of vaccines and therapeutic drugs to provide effective medical defense against validated biological threat agents including bacteria, toxins, viruses, and other agents of biological origin. This project also funds basic research employing biotechnology to rapidly identify, diagnose, prevent, and treat disease due to exposure to biological threat agents. Categories for this project include the current Science and Technology Plans in medical biological defense (bacterial therapeutics, bacterial vaccines, viral therapeutics, viral vaccines, toxin therapeutics, toxin vaccines, and diagnostic technology), Defense Technology Objectives, and Congressionally Funded Programs.

**3.4.2.1 TB1 Performance Goal (Outcome).** The goal of medical biological defense basic research is to increase scientific understanding of the mechanisms and processes involved in the pathogenesis of diseases caused by biological warfare (BW) agents, and the preventive, therapeutic, and diagnostic sciences underlying the technologies to counter these threats.

#### 3.4.2.2 TB1 Outcome Measure

TB1 is minimally effective when	TB1 is successful when
<ul style="list-style-type: none"> <li>• The results provide fundamental information in support of new and improved defensive systems, including information on                             <ul style="list-style-type: none"> <li>– Bacterial Therapeutics,</li> <li>– Bacterial Vaccines,</li> <li>– Toxin Therapeutics,</li> <li>– Toxin Vaccines,</li> <li>– Viral Therapeutics,</li> <li>– Viral Vaccines,</li> <li>– Diagnostic Technologies,</li> <li>– Laboratory-based and Analytical Threat Assessment Research.</li> </ul> </li> <li>• The results of research are published in peer-reviewed journals or presented at scientific conferences</li> <li>• Key research efforts are reviewed by an independent panel of experts and the quality and relevance of the efforts are assessed</li> </ul>	<ul style="list-style-type: none"> <li>• Information, technologies, or processes are transitioned to applied research or advanced technology development</li> </ul>

#### 3.4.2.3 TB1 Actual and Planned Performance

FY2000 Targets	Actual Performance
<p><u>Bacterial Therapeutics</u> - Establish and validate a method for determining antibiotic susceptibilities for BW agents to accepted international standards; evaluate 28 antibiotics on 11 strains of <i>Burkholderia mallei</i> (<i>B. mallei</i>) (causative agent of glanders), and 1 strain of <i>Bacillus anthracis</i> (<i>B. anthracis</i>) (anthrax) to identify the most effective compounds; establish agreements to test 15 additional novel (investigational) antibiotics developed by outside drug companies.</p> <p><u>Bacterial Vaccines</u> - Identify an expression system for multivalent Brucella vaccine; continued studying pathogenesis, host immune responses, virulence factors, strain diversity, molecular pathogenesis, and correlates of immunity for organisms responsible for plague (<i>Y. pestis</i>), glanders (<i>B. mallei</i>), and anthrax (<i>B. anthracis</i>). Refine and optimize aerosol exposure animal models for glanders required to address Food and Drug Administration (FDA) regulatory requirements.</p> <p><u>Toxin Therapeutics</u> - Identify molecular biology and target mechanisms of action of botulinum toxin and staphylococcal enterotoxin (SE) for exploitation in investigating therapeutic approaches to toxin exposure. Perform structural studies for toxins and critical enzymes using x-ray crystallography and other cutting-edge analytical meth-</p>	<ul style="list-style-type: none"> <li>• Targets met</li>   <li>• Targets met</li>   <li>• Targets met</li> </ul>

FY2000 Targets	Actual Performance
<p>odologies. Develop and refine computational chemistry techniques for use in screening massive chemical databases for compounds as potential inhibitors of toxin activity. Develop biosensor-based method to measure SE-receptor interactions for screening inhibitory molecules. Develop recombinant, enzymatically-active light chain for botulinum toxin serotype A as a reagent for efforts focused on therapeutic countermeasures to botulinum neurotoxins. Demonstrate <i>in vitro</i> functional efficacy of replacement of cleaved botulinum target with botulinum-resistant SNAP-25 via protein/DNA technologies. Initiate efforts to evaluate the anaerobic bacterial origins of saxitoxin.</p> <p><u>Toxin Vaccines</u> - Complete <i>in vitro</i> experiments establishing delivery of recombinant vaccines using mouse mesenchymal stem cells that differentiate into antigen presenting cells <i>in vivo</i>. Establish mouse/human CD4 and human leukocyte antigen (HLA)-DR1, DR3, DQ6, and DQ8 transgenic colonies in class II-deficient mice. Show that lymphocytes obtained from humanized mice and humans reacted similarly to various BW agents. Initiate mucosal immunization studies using <i>Streptococcus gordonii</i>, cholera toxin, and hepatitis virus-like particles as delivery platforms.</p> <p><u>Viral Therapeutics</u> - Investigate mechanisms of Ebola and Marburg virus pathogenesis in nonhuman primate models for potential targets for therapeutic intervention; define apoptosis as the mechanism for lymphocyte death.</p> <p><u>Viral Vaccines</u> - Demonstrate and define the protective contribution of antibody specific for Ebola virus glycoproteins in the mouse model. Define immunogens (glycoprotein and nucleocapsid protein) that induce protection against Musoke isolate of Marburg virus in animal models and that can serve as vaccine antigens.</p> <p><u>Diagnostic Technologies</u> - Identify alternative immunological targets and gene sequences for <i>B. anthracis</i>, <i>Y. pestis</i>, <i>Francisella tularensis</i>, <i>Brucella sp.</i>, alpha-viruses, filoviruses, and botulinum toxins that will enhance the depth and diversity of the current capability. Identify rapid medical specimen processing approaches compatible with portable nucleic acid identification of biological threat agents that will improve post-exposure treatment and force protection. Assess biotechnical innovations such as the development of molecular probes and recombinant antibodies and antigens and to provide rapid diagnostic capabilities that support enhanced warfighter medical care and force protection.</p> <p><u>Laboratory-based and Analytical Threat Assessment Research</u> - Expand investment between DoD, DOE, and academia in development of a genetic information database for threat agents to &gt;100,000 agent records, merged database with DOE efforts, and create tools and access for secure website use by key customers. Initiate development of a proteomics-based system for identifying novel threats based on structural motif. Initiate pathophysiology studies to determine the molecular basis for virus transmission of mosquito-borne agent Venezuelan Equine Encephalitis (VEE) and evaluate real-time imaging of other BW threat agents in hosts. Determine basic values of aerosol lethality of selected number of snake toxins that represent potential threats. Develop new assays to detect brevetoxins and genetically modified (engineered) superantigen toxins. Demonstrate concept of using serum peptide patterns as a marker of host infection with specific threat agents and perform molecular fingerprint analyses of <i>Brucella</i> and <i>Yersinia</i> strains. Initiate basic studies of the common structural motifs of staphylococcal and streptococcal superantigens. Identify common mechanisms of macrophage infection by bacterial pathogens and host lymphocyte gene response patterns to VEE viruses. Evaluate host cellular gene response profiles following infection with <i>Yersinia</i> and administration of streptococcal pyogenic exotoxins.</p>	<ul style="list-style-type: none"> <li>• Targets met</li>   <li>• Targets met</li>   <li>• Targets met</li>   <li>• Targets met</li>   <li>• Targets met</li> </ul>

## 3.4.2.4 TB1 Future Targets

FY 2001 Targets	FY 2002 Targets
<p><u>Bacterial Therapeutics</u> - Study host cellular and sub-cellular responses to BW threat agents (<i>B. anthracis</i>, <i>B. mallei</i>, <i>Y. pestis</i>) exposure to identify likely molecular targets for intervention by "next generation" (i.e., beyond present day) novel therapeutic strategies; evaluate possible generic intervention points in agent-induced pathophysiology. Assess broad spectrum therapeutic strategies for exposures to multiple BW threat agents. These strategies will focus on intervention in disease pathogenesis at the molecular level, and identify common host cellular targets for the pathogenic response. Develop methodologies utilizing biochemical (metabolic) processes for assaying in vivo antibiotic activity. Develop infection models in rodent species to evaluate antibiotic therapeutic indices.</p> <p><u>Bacterial Vaccines</u> - Investigate pathogenesis (cellular and molecular) and host immune responses; characterize additional virulence factors; define strain diversities; establish correlates of immunity for the causative agents of plague (<i>Y. pestis</i>), glanders (<i>B. mallei</i>), and anthrax (<i>B. anthracis</i>).</p> <p><u>Toxin Therapeutics</u> - Identify sites of molecular action and mechanisms of intervention for therapies for botulinum toxin and SE threats; develop models for therapeutic intervention. Define endpoints for in vivo assessment of efficacy of therapeutic intervention for botulinum toxin and SE and surrogate endpoints of human clinical efficacy. Initiate high-output generation of candidate therapeutic moieties for botulinum and SE toxins using combinatorial chemistry.</p> <p><u>Toxin Vaccines</u> - Initiate studies to identify potential neutralizing epitopes in the translocation domains of the botulinum neurotoxins. Investigate the variability of clostridium botulinum strains in terms of their neurotoxic isoforms and the presence of other toxins produced by various strains. Initiate structural and biophysical characterization studies of recombinant protein vaccines antigens. Construct genetically engineered mutations of wild-type ricin A gene for the purpose of reducing enzymatic activity and solubility. Initiate evaluation of adjuvants that may enhance the host immune response to aerosol-administered vaccines and assess delivery vehicles that may enhance the uptake of aerosol-administered vaccines.</p> <p><u>Viral Therapeutics</u> - Humanize mouse monoclonal antibodies specific for Ebola virus to test as an immunotherapeutic. Investigate mechanisms of filovirus transcription and replication focusing on polymerase as potential target for antiviral therapy.</p> <p><u>Viral Vaccines</u> - Investigate the protective contribution of cytotoxic T cells in the Ebola virus mouse model.</p>	<p><u>Bacterial Therapeutics</u> - Evaluate therapeutic indices for new (investigational) antibiotic agents identified by in vitro assays in suitable animal models. Study the effect of immunomodulators on the host response to <i>B. mallei</i> and <i>Y. pestis</i> candidate vaccines; identify those modulators that are effective in enhancing candidate vaccines.</p> <p><u>Bacterial Vaccines</u> - Obtain genetic sequencing data from a panel of validated threat agents; establish genetic sequences into a database; evaluate sequence data for the potential for genetic engineering and genetic modification of the pathogens; determine genetic fingerprints (genetic identifiers) of various isolates of the organism responsible for plague (<i>Y. pestis</i>), glanders (<i>B. mallei</i>), and anthrax (<i>B. anthracis</i>). Perform animal studies on selected live attenuated strains of <i>Y. pestis</i>, <i>B. mallei</i>, and <i>B. anthracis</i> to assess their utility as potential vaccine candidates or platforms. Identify genes from various agents that are selectively expressed in vivo as likely novel virulence factors. Expand and characterize strain collections of all bacterial threat agents; identify strains of various agents that may be resistant to existing vaccines and/or those under advanced development.</p> <p><u>Toxin Therapeutics</u> - Refine and standardize in vivo screening models for assessment of efficacy of therapeutic intervention in botulinum toxin and SE intoxication and standardize in vitro assays for neutralizing activity of lead inhibitors. Conduct high-output generation of candidate therapeutic moieties for botulinum and SE toxins using combinatorial chemistry. Evaluate inhibitor delivery strategies and demonstrate in vitro proof-of-concept. Begin high-throughput screening technology to investigate therapeutic candidates for exposure to ricin toxin.</p> <p><u>Toxin Vaccines</u> - Complete experiments involving the crystallization of vaccine candidates for structural studies and biophysical characterization of vaccines and toxins. Complete assessment of novel adjuvants and delivery vehicles for aerosol-administered vaccines.</p> <p><u>Viral Therapeutics</u> - Determine the therapeutic potential of candidate drugs for treatment of disease for filovirus or orthopox infections. Characterize filovirus polymerases as potential antiviral drug targets and incorporate into in vitro assays.</p> <p><u>Viral Vaccines</u> - Continue investigating poxvirus immunity to determine if it is feasible to replace VIG with monoclonal antibodies and to construct a safe and effective vaccine to replace vaccinia virus vaccine for variola.</p> <p><u>Diagnostic Technologies</u> - Investigate new medical diagnostic technologies based upon state-of-the-art biotechnological approaches for the enhanced</p>

<b>FY 2001 Targets</b>	<b>FY 2002 Targets</b>
<p>Investigate poxvirus immunity to determine if it is feasible to replace vaccinia immune globulin (VIG) with monoclonal antibodies and to construct a safe and effective vaccine to replace vaccinia virus vaccine for variola.</p> <p><i>Diagnostic Technologies</i> - Investigate new medical diagnostic technologies based upon state-of-the-art biotechnological approaches for the enhanced recognition of infections by validated biological threats (bacteria, viruses, and toxins) of military interest.</p>	<p>biotechnological approaches for the enhanced recognition of infections by potential biological threats (bacteria, viruses, and toxins) of military interest.</p>

**3.4.2.5 Assessment of Medical Biological Defense Basic Research.** Basic research efforts in FY2000 for project TB1 are at least minimally effective. Extensive research continues to be conducted in several research areas supporting several major operational goals detailed in Section 2 of the performance plan. Several new research projects and studies also were initiated in FY2000.



### 3.4.3 Medical Chemical Defense Basic Research (Project TC1)

This project emphasizes understanding of the basic action mechanisms of nerve, blister (vesicating), blood, and respiratory agents. Basic studies are performed to delineate mechanisms and site of action of identified and emerging chemical threats to generate required information for initial design and synthesis of medical countermeasures. In addition, these studies are further designed to maintain and extend a science base.

**3.4.3.1 TC1 Performance Goal (Outcome).** The goal of medical chemical defense basic research is to increase scientific understanding of the mechanisms, processes, and effects of chemical warfare (CW) agents and the science involved in the detection, protection against, and decontamination of CW agents.

#### 3.4.3.2 TC1 Outcome Measure

TC1 is minimally effective when	TC1 is successful when
<ul style="list-style-type: none"> <li>The results provide fundamental information in support of new and improved defensive systems, including information on               <ul style="list-style-type: none"> <li>Toxicology of exposures to low level of chemical warfare agents,</li> <li>Pretreatments for chemical agent exposures,</li> <li>Therapeutics for chemical agent exposures,</li> <li>Novel threats (4<sup>th</sup> generation agents).</li> </ul> </li> <li>The results of research are published in peer-reviewed journals or presented at scientific conferences</li> <li>Key research efforts are reviewed by an independent panel of experts and the quality and relevance of the efforts are assessed</li> </ul>	<ul style="list-style-type: none"> <li>Information, technologies, or processes are transitioned to applied research or advanced technology development</li> </ul>

#### 3.4.3.3 TC1 Actual and Planned Performance:

FY2000 Targets	Actual Performance
<p><i>Low Level</i> - Initiate mechanistic studies of nerve agent toxicity at low doses. Continue building a scientific database relevant to the underlying pathological effects of low-level exposures to nerve agents. Identify information gaps in nerve agent exposures.</p> <p><i>Pretreatments</i> - Develop necessary knowledge for molecular modeling and site-directed mutagenesis to optimize next generation pretreatments to nerve agent poisoning.</p> <p><i>Therapeutics</i> - Explored potential for new technologies to intervene or serve as biomarkers in the mustard injury cascade. Identified 12 oximes that are superior to 2-PAM for efficacy against novel threat agents.</p>	<ul style="list-style-type: none"> <li>Targets met</li> <li>Targets met</li> <li>Targets met</li> </ul>

#### 3.4.3.4 TC1 Future Targets

FY 2001 Targets	FY 2002 Targets
<p><i>Low Level</i> - Begin filling identified data gaps on the pathological and behavioral effects of low-level CW nerve agent exposures. Investigate possible cellular mechanisms of low-level CW agent injury. Develop highly sensitive, forward deployable assay techniques to determine exposure to low levels of CW agents and subsequent physiological and toxicological effects.</p> <p><i>Novel Threats (Fourth Generation Nerve Agents)</i> -</p>	<p><i>Low Level</i> - Continue studies on identification of chronic pathological and behavioral effects of low-level CW agent exposures. Investigate putative mechanisms of low level toxicity.</p> <p><i>Novel Threats (Fourth Generation Nerve Agents)</i> - Develop strategies to improve efficacy of current medical countermeasures against novel threat agents.</p>

FY 2001 Targets	FY 2002 Targets
<p>Determine mechanism by which novel threat agents produce toxicity that is not responsive to current nerve agent countermeasures.</p> <p><u>Pretreatment</u> - Complete evaluation of catalytic scavengers designed by site-directed mutagenesis. Develop candidate next generation pretreatments using knowledge gained from studies in molecular modeling and site-directed mutagenesis. Identify new candidate compounds with potential as pretreatment for vesicant injury based on current research strategies.</p> <p><u>Therapeutics</u> - Develop science base to identify specific factors leading to and/or preventing neuronal death in status epilepticus caused by nerve agents. Identify potential synergistic interactions of midazolam with anticholinergic drugs in rodent species. Define the optimal hypochlorite concentration for use in decontaminating chemical agent exposed skin and agent contaminated wounds.</p>	<p><u>Pretreatments</u> - Complete evaluation of organophosphates anhydrolase catalytic scavengers.</p> <p><u>Therapeutics</u> - Identify target sites for neuroprotection. Identify therapeutic targets for candidate compound combination therapies</p>

**3.4.3.5 Assessment of Medical Chemical Defense Basic Research.** Basic research efforts in FY2000 for project TC1 are at least minimally effective. While there was no work completed in basic research to investigate novel threat agents in FY2000, several studies have been initiated that will be continued through the next few years. Extensive research continues to be conducted in several research areas supporting several major operational goals detailed in Section 2 of the performance plan. Several new research projects and studies also were initiated in FY2000.

### 3.5 APPLIED RESEARCH (PROGRAM ELEMENT 0602384BP)

The use of chemical and biological (CB) weapon systems in future conflicts is a steadily increasing threat. Funding under this PE sustains a robust defense which reduces the danger of a CB attack and enables U.S. forces to survive and continue operations in a CB environment. The medical program focuses on development of vaccines, pretreatment and therapeutic drugs, and on casualty diagnosis, patient decontamination, and medical management. In the non-medical area, the emphasis is on continuing improvements in CB defense materiel, including contamination avoidance, decontamination, and protection systems. Maintaining state-of-the-art CB defensive systems is critical for force protection and CB weapons deterrence. This program also provides for conduct of applied research in the areas of real-time sensing and immediate biological countermeasures. The work in this PE is consistent with the Joint Service NBC Defense Research, Development, and Acquisition (RDA) Plan. Efforts under this PE transition to and provide risk reduction for Advanced Technology Development (PE 0603384BP), Demonstration/Validation (PE 0603884BP), and Engineering/Manufacturing Development (PE 0604384BP). This project includes non-system specific development directed toward specific military needs and therefore is correctly placed in Budget Activity 2.

#### 3.5.1 Chemical and Biological Defense Applied Research (Project CB2)

This project addresses the urgent need to provide all services with defensive materiel to protect individuals and groups from threat chemical-biological (CB) agents in the areas of: detection; identification and warning; contamination avoidance through reconnaissance; individual and collective protection and decontamination. It also provides for special investigations into CB defense technology to include CB threat agents, operational sciences, modeling, CB simulants, and nuclear, biological, chemical (NBC) survivability. This project focuses on horizontal integration of CB defensive technologies across the Joint Services. The tech base uses Defense Technology Objectives (DTOs) as a means to shape the development of selected technologies.

**3.5.1.1 CB2 Performance Goal (Outcome).** The goal of the CB defense non-medical applied research program is to increase scientific understanding of the mechanisms and processes involved in chemical and biological warfare (CBW) agents and potential applications of this information for the development of advanced technologies for the detection, protection against, and decontamination of CBW agents.

#### 3.5.1.2 CB2 Outcome Measure

<b>CB2 is minimally effective when</b>	<b>CB2 is successful when</b>
<ul style="list-style-type: none"> <li>• The results provide fundamental information in support of new and improved defensive systems, including information on               <ul style="list-style-type: none"> <li>– biosensors for point detection and early warning,</li> <li>– critical reagents for biological agent detection &amp; identification,</li> <li>– aerosol sciences,</li> <li>– threat agents,</li> <li>– agent dispersion and fate modeling,</li> <li>– advanced materials for individual protection,</li> <li>– advanced methods and materials for decontamination,</li> <li>– chemistry and toxicology of bioactive compounds,</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Information, technologies, or processes are transitioned to applied research or advanced technology development</li> <li>• All DTOs are rated GREEN by the TARA Panel.</li> </ul>



FY2000 Targets	Actual Performance
<p>of microbial pathogens and toxins associated with food and water. Develop base for rapid antibody optical BW sensor. Develop non-woven CB protective clothing with enhanced protection and comfort. Develop rapid methods to perform large surface CB decontamination.</p> <p><u>Biological Point Detection</u> - Complete antibody-based biosensor hardware for the Force Amplified Biosensor (FABS). Demonstrate FABS sensor sensitivity enhancement of 100 fold using ultrafiltration membrane. Initiate automation of sample preparation/processing for FABS. Initiate joint effort with DOE's CB Non-proliferation Program to collect into a single database ambient background data from multiple US and international sources.</p> <p><u>Biological Early Warning Detection</u> - Initiate effort to enhance reliability (false detection reduction) and increase discrimination capability of optical analyzers by adding shape/size analysis. Initiate examination of pyrolysis- gas chromatography-ion mobility spectrometry (Py-GC/IMS) as technology to provide improved biological discrimination for early warning and system triggering functions. These approaches are being pursued as candidate technology solutions for implementation in arrayed detector networks and stand-alone configurations.</p> <p><u>Biological Genetic Technology</u> - Complete assessment of revised human superlibrary as approach to recombinant antibody development which are determined to be inferior to biased animal approaches. Develop recombinant antibody assays for several high priority agents; demonstrate performance exceeds currently available monoclonal antibodies. Initiate evaluation of combinatorial peptides as alternative recognition molecules. Transition successful antibodies to Critical Reagents Program for validation.</p> <p><u>Modeling and Simulation</u> - Develop High-Level Architecture (HLA) compliant version of Nuclear, Chemical, Biological and Radiological (NCBR) Simulator for application in Simulation Based Acquisition (SBA) for Joint Service CB defense equipment, and demonstrate capability to support several hardware development programs in distributed simulations of military worth evaluations. Complete Version 3 of the Vapor, Liquid and Solid Tracking (VLSTRACK) Model, which includes advanced secondary evaporation methodology for chemical agents and the capability to ingest full resolution mesoscale meteorological data fields to more accurately drive atmospheric dispersion. Transition coupled CB environment/meteorological model for use with forward-deployed weather forecast operations in Navy's Tactical Environmental Support System (TESS). Demonstrate Initial Operational Capability (IOC) of the Simulation, Training and Analysis for Fixed Sites (STAFFS) model for simulation of CBW effects on operations at a fixed site (AF fighter base).</p> <p><u>Scanning Airborne Fourier Emission for Gaseous Ultraspectral Analysis &amp; Radiometric Detection (SAFEGUARD)</u> - Upgrade sensors and initiated software and airborne platform integration in support for Advanced Concept Technology Demonstration (ACTD).</p> <p><u>Chemical Early Warning Detection</u> - Initiate feasibility studies to develop concepts for use and evaluate cost to benefit for use of non-traditional chemical biological (disparate) sensors to cue for early warning. Preliminary data shows this effort has a higher payoff for biological early warning than chemical and recommends combining with the biological early warning detection area.</p> <p><u>Chemical Point Detection</u> - Complete market survey and downselection of technology for capabilities needed the detection of contaminants in potable water systems (water monitor). Initiate breadboard design and build for water monitor.</p> <p><u>Low Level Chemical Agent Operational Studies</u> - Complete baseline for comparison of historical data for sarin on rats using new methodology and collect extended data</p>	<ul style="list-style-type: none"> <li>• Targets met</li>   <li>• Targets met</li>   <li>• Targets met</li>   <li>• Targets met</li>   <li>• Targets met</li>   <li>• Targets met</li>   <li>• Targets met</li> </ul>

FY2000 Targets	Actual Performance
<p>to six hour exposure times with lethality as the endpoint. Initiate planning for determining the potency ratio of the second generation nerve agents using sarin as the basis. Initiate planning for miosis threshold studies for sarin over extended exposure durations. Initiate planning for multi-species animal studies for studying toxicological effects of extended exposure duration and low concentration exposures to validate and verify alarm and warning levels/thresholds for detector systems.</p> <p><u>Man-portable Detectors</u> - Develop and optimize polymer coated Surface Acoustic Wave (SAW) and chemiresistive conducting devices which are sensitive and selective to nerve, blister, and blood agent simulants as well as toxic industrial chemicals. Develop impedance and fluorescence-based biosensors employing immunological and DNA detection probes. Integrated hybrid sensor array devices and electronics, neural networks, and other data acquisition and display hardware/ software into a prototype detection system for chemical agents. Demonstrate an integrated prototype detector system for CBW agents and toxic industrial chemicals under laboratory and field conditions. The goal of these efforts is directed toward developing a man transportable detector with low power and no field maintenance requirements.</p> <p><u>The Integrated Detection of Energetic and Hazardous Materials (IDEHM)</u> - Program is a multidisciplinary project, which develops integrated detection systems for sensing the presence of CBW agents, and explosives. This effort consists of the following sub-tasks: ion trap mass spectrometry hardware miniaturization, electromagnetic detection (short range standoff detection of explosives), neutron based detection, and integrated detection systems involving selected systems from ion trap mass spectrometry and analytical detection in biosystems.</p> <p><u>Individual Protection</u> - Complete a Front-End Analysis and prepare Master Plan for Individual Protection to help focus investment in technologies for meeting warfighter needs. Complete the computational fluid dynamics model of the mass/energy transport through protective clothing. Determine dominant factors controlling high permeability from membrane structural and chemical studies. Complete a comparison of the finite element/computational fluid dynamic analysis model and the thermal manikin results. Assess the ability of nano-fibers to reduce aerosol penetration when applied to the outer-surface of a permeable protective garment. Blend catalysts (enzyme organophosphorus acid anhydrolase) and reactive oxides (MgO) with polymers, and evaluate their efficacy as decontaminants. Assess the percutaneous threat of Toxic Industrial Chemicals (TIC) to the warfighter. Evaluate improved seals and closures employed in the Advanced CB Protection (DTO) garment. Update and finalize the Respiratory Encumbrance Model. Evaluate integrated near-term Mask/Helmet Concepts for interface and human factors. Complete the evaluation of the Joint Service Aviation Mask (JSAM) early prototype and developed design guidelines. Surveyed technologies for application to mask filter End of Service Life Indicators, and developed initial concepts.</p> <p><u>Collective Protection</u> - Conduct side-by-side testing of candidate Residual Life Indicator (RLI) sensors with simulants, and initiated agent testing. Initiate testing of candidate immobilized bed materials to identify the critical properties of those materials. Measure breakthrough and equilibrium data of selected TIC. Evaluate candidate adsorbents for use in regenerative filtration applications. Conduct a downselect of best low cost tentage materials. Produce and evaluate a prototype shelter fabricated of the best candidate materials and seals. Transition the low cost tentage effort to the Joint Transportable Collective Protection System (JTCOPS).</p> <p><u>Decontamination</u> - Incorporate solid adsorbents into the supercritical fluid and non-ozone depleting fluorocarbon solvent systems being developed for sensitive equipment decontamination in order to capture and neutralize removed chemical agents. Demonstrate validity of the techniques for technical transfer into the Joint Service</p>	<ul style="list-style-type: none"> <li>• Targets met</li>   <li>• Targets met</li>   <li>• Targets met</li>   <li>• Targets met</li>   <li>• Targets met</li> </ul>

FY2000 Targets	Actual Performance
<p>Sensitive Equipment Decontamination System (JSSED) Block I development program. Perform an Analysis of Alternatives as part of the acquisition process. Identify promising approaches to solve JSSED Block II and Block III requirements, such as thermal processes and spot-cleaning technologies. Initiate a new decontamination approach based on oxidative processes. Continue on-going efforts using micro-emulsions with peracid oxidants. Initiate a further study in the material technology area to expand the capacity of hyperbranched dendrimeric systems based on mono-ethanolamine to perform decontamination operations. Continue efforts in zeolites and high surface area reactive solids as part of the next generation of solid decontaminants. Expand the scope of this area to include novel reactive nano-particle technology. Conduct studies directed at determining the fate of agents adsorbed on surfaces commonly found at fixed site facilities.</p>	

### 3.5.1.5 CB2 Future Targets

FY 2001 Targets	FY 2002 Targets
<p><u>Supporting Science and Technology</u> - Complete first toxicology study using highly toxic powder in the new (first and only in the US) nose-only exposure chamber for extremely hazardous aerosols. Measure quantitative performance of candidate aerosol collectors for advanced point biodetection technology. Demonstrate a new aerosol collector using mini-scale manufacturing technology which reduces power consumption at least a factor of 4 (perhaps 10) below JBPDS with high collection efficiency (&gt;80%) over the particle size range from 1-10 micrometers diameter and operates at the Joint Service low temperature requirement (-28°F). Continue to provide controlled biosimulant aerosol challenges for Joint Service, DARPA, and DOE experimental equipment in preparation for the JFT.</p> <p><u>Biological Point Detection</u> - Complete analysis of accumulated ambient data and identify gaps for further study as indicated by analysis. Continue generation and screening of recombinant antibodies against select bioagents using Biased libraries. Incorporate into Enzyme Linked Immuno Sorbent Assay (ELISA), biosensors for test and transition best candidates to Critical Reagent Program.</p> <p><u>Early Warning Detection</u> - Initiate development of enhanced discrimination algorithms for optical fluorescence/shape analysis and pyrolysis-gas chromatography-ion mobility spectrometry through use of chamber and/or field tests with bioagent simulants. Complete initial analysis and utility assessment of radar multimission sensor as CB event queuing approach. Identify other disparate sensors capable of providing or enhancing battlefield awareness of CB events and initiate utility assessment in validated model.</p> <p><u>Modeling and Simulation</u> - Continue model development for simulation of CBW effects on joint force operations for incorporation into advanced simulations like [Joint Conflict and Tactical Simulation (JCATS), Joint Simulation System (JSIMS), Joint Modeling and Simulation</p>	<p><u>Supporting Science and Technology</u> - Continue work begun in FY01 Leap Ahead task on: assessment of data gaps in threat agent data and needs for improved simulants in CB defense materiel development, a simulant data base for selecting appropriate simulants in materiel development, establishing a repository for chemical simulants, and a standard biosimulant laboratory. Based on the emerging results of the threat agent data gaps assessment, initiate a program of synthesis and toxicology screening of new threat materials identified as urgent needs while continuing the assessment of long term needs. Measure chemical and biological properties for the new threat materials to fill identified data gaps for established threats. Initiate development of improved simulants for chemical aerosols, microencapsulated viruses, stabilized bacteria, and proteinaceous and nonproteinaceous toxins/bioregulators. Continue to measure quantitative performance of candidate aerosol collectors for advanced point biodetection technology. Initiate the design of a new generation of aerosol concentrators and collectors using micro-machining technology to reduce the size, power consumption, and weight of aerosol components in order to meet the requirements for advanced systems such as the Joint Service Modular Chemical Biological Detector (JSMCBD). Initiate design of advanced aerosol inlets to meet Joint Service requirements for high collection efficiency over the particle size range from 1-10 micrometer diameter and wind speeds of 2-60 mph. Continue to provide controlled biosimulant aerosol challenges for Joint Service, DARPA, and DOE experimental equipment in preparation for the JFT.</p> <p><u>Biological Point Detection</u> - Reduce size and logistic burden of optical fluorescence/shape analysis and Py-GC-IMS sensors. Test against expanded set of biosimulants and interferants. Initiate exploration of new concepts for small, combined chem and bio identifiers. Develop and test concepts toward</p>

FY 2001 Targets	FY 2002 Targets
<p>System (JMASS), and Joint Warfare System (JWARS)]. Continue development of coupled CB environment/meteorological models for incorporation of CBW hazard prediction/tracking into forward-deployed meteorological forecast/nowcast operations. Continue development of advanced CBW environment models for more accurate, higher-resolution atmospheric transport and fate predictions in complex and urban terrain for battlespace awareness and contamination avoidance. Continue development of models for Joint Service CB defense equipment for application in SBA. Continue development of the Simulation, Training and Analysis for Fixed Sites (STAFFS) model for simulation of CBW effects on operations at Aerial Ports of Debarkation (APOD) and Sea Ports of Debarkation (SPOD).</p> <p><u>Low Level Chemical Agent Operational Studies</u> - Complete sarin data analysis on rats. Initiate miosis threshold studies using sarin over extended exposure durations. Initiate potency ratio studies of second generation nerve agents for toxicological effects of extended exposure duration and low concentration exposures to validate and verify alarm and warning levels/thresholds for detector systems</p> <p><u>Chemical Point Detection</u> - Complete breadboard design with integration of both chemical and biological contaminant detection capabilities. Continue the breadboard hardware build and initiate planning for demonstration of the water monitor.</p> <p><u>Biological Standoff Detection</u> - Initiate analysis of existing data to identify top candidates for further evaluation to provide improved bio standoff capability. Identify and develop key performance requirements to meet biological standoff capability.</p> <p><u>Leap Ahead Technologies</u> - Investigate advanced respiratory and percutaneous protection technologies (FY00 Individual Protection, Front End Analysis) to reduce thermal load and breathing resistance. Break technology barriers in developing simulants for emerging agents. Complete Force Amplified Biosensor (FAB). Refine discrimination algorithms and chamber test optical fluorescence/shape analysis and pyrolysis-gas chromatography-ion mobility spectrometry. These approaches are candidates for Joint Modular Chemical and Biological Detector System (JMCBDS), capable of downsizing and providing classification among bio particles. Complete initial analysis of radar multi-mission sensor and identify other disparate sensors. Initiate assessment of data gaps in threat agent data and needs for improved simulants in CB defense materiel development. Institute a simulant data base for selecting appropriate simulants in materiel development and establish a repository for chemical simulants and a standard biosimulant laboratory.</p>	<p>automation of chip-based phylogenetic analysis of biological materials.</p> <p><u>Modeling and Simulation of CBW Environment</u> - Expand development of advanced CBW environment models (lagrangian particle and complex fluid dynamics methodologies) for more accurate, higher-resolution atmospheric transport and fate predictions in complex and urban terrain for battlespace awareness and contamination avoidance. Further development of high-altitude CB agent behavior for application in Tactical Ballistic Missile (TBM) intercept analysis. Begin development of the capability to accurately model the interaction (evaporation and persistence) of chemical agents with materials and the reaerosolization of biological agents.</p> <p><u>Modeling and Simulation of Joint Operability</u> - Expand model development for simulation of CBW effects on joint force operations for incorporation into advanced simulations. Continue the development of the STAFFS model for simulation of CBW effects on operations at APODs and SPODs.</p> <p><u>Modeling and Simulation of CB Defense Equipment Research, Development and Acquisition/Simulation Based Acquisition (SBA)</u> - Continue development of models for Joint Service CB defense equipment for application in SBA, training, distributed simulations, war-gaming and military worth evaluations.</p> <p><u>Detection of Contaminants on Surfaces</u> - Initiate an enhanced program to develop technology to detect the presence of contaminants on surfaces for use from vehicular and handheld platforms. Initial studies will focus on active and passive optical technologies that could be employed on or from a vehicular platform.</p> <p><u>Chemical Point Detection</u> - Complete breadboard fabrication and demonstrate technology for transition to 6.3 for brass-board design and build of the water monitor.</p> <p><u>Biological Detection Technology</u> - Initiate bio-background data collection efforts to fill data gaps previously identified. Continue generation and screening of recombinant antibodies against select bio-agents. Evaluate bio-sensors and transition best candidates to Critical Reagents Program. Survey and evaluate combinatorial peptides as biorecognition elements. Develop database of multiple gene targets for bio-agents. Identify and initiate exploration of other concepts for multiplexed identification/analysis of broad spectrum of bio-agents.</p> <p><u>Low Level Chemical Agent Operational Studies</u> - Complete miosis threshold studies for sarin over extended exposure durations. Continue second generation nerve agents potency ratio studies on rats. Initiate multi-</p>



FY 2001 Targets	FY 2002 Targets
<p><u>Individual Protection</u> - Select and evaluate permselective membranes to validate the novel permselective membrane model. Investigate mechanisms for more durable nanofibers, and fabricate and test samples of those materials. Investigate nanofiber bonding/ integration methods, and conduct aerosol and challenge tests. Identify methodology for evaluation of suits against TICs. Construct a parametric skeleton model of candidate helmet/mask concepts to help identify those with most potential for long term solutions. Construct and evaluate proof of principle End of Service Life Indicator (ESLI) model.</p> <p><u>Collective Protection</u> - Conduct a Front-End Analysis and prepare a Master Plan to help focus investment in Collective Protection technologies and to ensure war-fighter needs are met. Complete Residual Life Indicator (RLI) sensor side-by-side testing, and complete simulant, TIC, and agent testing of candidate sensors. Produce and test immobilized beds for selected applications using optimized materials and processes. Complete the acquisition of breakthrough and equilibrium data of current adsorbents against TICs and assess adsorptive/ chemisorptive properties. Conduct lab scale testing to validate the Pressure Swing Adsorption model and to help in optimizing the bed/system performance of regenerative filtration systems. Produce and evaluate optimized hermetic seals for shelters, and transition to Joint Transportable Collective Protection System (JTCOPS).</p> <p><u>Decontamination</u> - Complete demonstration of sensitive equipment decontamination methodology and finalize transition of technology for Block I of the JSSED program. Select technologies to be demonstrated for sensitive interiors (JSSED Block II) focusing on thermal approaches. Evaluate approaches for operational decontamination of sensitive equipment and interiors on the move (JSSED Block III). Augment enzymatic decontamination program using alternative academic based approaches to improve efficiency of V-agent enzymes and transfer this technology into the DTO for evaluation. Broaden the scope of enzymatic decontamination processes evaluating potential systems for non-traditional agents. Validate oxidative processes in aqueous and mixed/aqueous/organic solvent systems as either solutions, emulsions or microemulsions. Examine dendritic assembly systems incorporating mono-ethanol amine functionality and perform preliminary agent challenges. Focus solution based approaches on developing formulations using the best combinations of technical approaches. Continue evaluation of novel solid matrices. Initiate an effort to determine the fundamental limitations of solid based approaches. Evaluate the possibility of combining these novel solid materials into other application systems. Complete participation in the</p>	<p>species animal studies for second generation nerve agents. Initiate planning for third generation nerve agents studies in rats. Initiate efforts for physiological modeling to understand the interaction on the route of exposure and toxicological effects from low concentration and extended duration exposures to nerve agents.</p> <p><u>Early Warning Detection</u> - Demonstrate concept and technology prior to entrance in an ACTD with a test representative Radar system. Initiate feasibility study to prioritize requirements and needs to enhance battlespace management capabilities.</p> <p><u>Individual Protection</u> - Fabricate concept garments using aerosol threat mediation techniques and test. Identify and incorporate color transition materials into nano-fiber membranes and test for response to agent simulants. Evaluate fielded and developmental clothing materials for the protection they provide against TICs. Produce trial membranes using ion implantation techniques, and test to characterize material physical properties and agent protection capabilities. Conduct a study of adsorbent fabric placement in semi-permeable membrane garments for added vapor and aerosol protection. Fabricate and evaluate a proof of concept model of the helmet/mask concept identified using the parametric skeleton model. Construct and evaluate prototype mask end of service life indicators. Initiate development of advanced concepts in mask air filtration/purification.</p> <p><u>Collective Protection</u> - Determine Toxic Industrial Chemical breakthrough and equilibrium data for advanced and novel adsorbents. Conduct prototype (large diameter bed) regenerative filter bed testing to demonstrate bed improvements and to update the performance model. Develop novel single pass filter concepts using nano-materials and identify adsorbents to support that concept. Produce prototype shelters using technologies identified to facilitate rapid deployment and evaluate.</p> <p><u>Decontamination</u> - Continue developmental efforts to address JSSED block II and III approaches focusing on thermal technology and spot cleaning methodology. Develop solutions approaches for the Superior Decontamination Systems using advance formulation approaches combining novel chemical and biochemical technologies into a unified approach. Complete the evaluation determining the physical limitations of novel solid technology and implement findings into the program. Determine best future uses for these materials. Assemble a database on agent fate on surfaces incorporating prior year's findings. Complete reaerosolization studies.</p>

FY 2001 Targets	FY 2002 Targets
working group revising North American Treaty Organization (NATO) Triptych D.102 on Decontamination. Continue efforts to determine the fate of agent on common environmental surfaces associated with fixed site facilities. Conduct study to evaluate the hazard posed by potential reaerosolization of BW materials. Determine an approach to use coating technology to address decontamination and protection of materiel items.	

**3.5.1.6 Assessment of Chemical and Biological Defense Applied Research.** Applied research efforts in FY2000 for project CB2 are effective. Many areas of CB defense applied research were successful. The assessment for success is based on two factors: (1) all but one DTO in this area was rated green by the TARA. The one DTO rated yellow (advanced adsorbents for protection applications) has expanded the scope of its research efforts to address the concerns expressed by the TARA regarding materials used in research. (2) Several technologies successfully transitioned to advanced development, including reagent development, modeling and simulation, and collective protection materials. Extensive research continues to be conducted in several research areas supporting several major operational goals detailed in Section 2 of the performance plan. Several new research projects and studies also were initiated in FY2000.

### 3.5.2 Medical Biological Defense Applied Research (Project TB2)

This project funds applied research (pre-Milestone 0) on the development of vaccines, therapeutic drugs and diagnostic capabilities to provide an effective medical defense against validated biological threat agents including bacteria, toxins, viruses, and other agents of biological origin. Innovative biotechnological approaches and advances will be incorporated to obtain medical systems designed to rapidly identify, diagnose, prevent, and treat disease due to exposure to biological threat agents. Categories for this project include the current Science and Technology Plans in medical biological defense (bacterial therapeutics, bacterial vaccines, viral therapeutics, viral vaccines, toxin therapeutics, toxin vaccines, and diagnostic technology), Defense Technology Objectives (DTO), and Congressionally Funded Programs, which are displayed last.

**3.5.2.1 TB2 Performance Goal (Outcome).** The goal of CB defense medical biological defense applied research is to increase scientific understanding of the mechanisms and processes involved in the pathogenesis of BW agents in order to develop preventive and therapeutic protection and diagnostic technologies for BW agents.

#### 3.5.2.2 TB2 Outcome Measure

TB2 is minimally effective when	TB2 is successful when
<ul style="list-style-type: none"> <li>• The results provide fundamental information in support of new and improved defensive systems, including information on               <ul style="list-style-type: none"> <li>– Bacterial Therapeutics,</li> <li>– Toxin Vaccines,</li> <li>– Bacterial Vaccines,</li> <li>– Toxin Therapeutics,</li> <li>– Viral Therapeutics,</li> <li>– Viral Vaccines,</li> <li>– Diagnostic Technologies, and</li> <li>– Protocols to Enhance Biological Defense.</li> </ul> </li> <li>• The results of research are published in peer-reviewed journals or presented at scientific conferences</li> <li>• Key research efforts are reviewed by an independent panel of experts and the quality and relevance of the efforts are assessed</li> </ul>	<ul style="list-style-type: none"> <li>• Information, technologies, or processes are transitioned to applied research or advanced technology development</li> <li>• All DTOs are rated GREEN by the TARA Panel.</li> </ul>

**3.5.2.3 Metric Description.** The metric for TB2 is described in Section 3.2.1.1. Applied research also includes several specific projects that are identified as Defense Technology Objectives (DTOs), which are detailed and assessed separately (See section 3.3). DTOs funded under this project include the following:

- CB.24, Medical Countermeasures for Encephalitis Viruses
- CB.25, Multiagent Vaccines for Biological Threat Agents
- CB.26, Common Diagnostic Systems for Biological Threats and Endemic Infectious Diseases
- CB.27, Therapeutics Based on Common Mechanisms of Pathogenesis
- CB.31, Medical Countermeasures for Brucellae
- CB.32, Alternate (Needleless) Delivery Methods for Recombinant Staphylococcal Enterotoxin (SE) Vaccines

- CB.33, Recombinant Protective Antigen (rPA) Anthrax Vaccine Candidate
- CB.34, Recombinant Plague Vaccine

**3.5.2.4 TB2 Actual and Planned Performance:**

FY2000 Targets	Actual Performance
<p><u>Bacterial Therapeutics</u> - Evaluate selected antimicrobial compounds for treatment of respiratory infection caused by <i>B. mallei</i>, the causative agent of glanders. Initiate study on cellular mediators (cytokines, chemokines, and cell surface receptors) during glanders infection and immunomodulation as a potential countermeasure approach.</p>	<ul style="list-style-type: none"> <li>• Targets met</li> </ul>
<p><u>Toxin Vaccines</u> - Complete vaccine candidate cloning of botulinum toxin serotypes D and G in anticipation of future requirements for vaccine candidates. Initiate studies focused on increasing the immunogenicity for botulinum toxin serotype vaccines for E and F. Characterize candidate vaccines for staphylococcal enterotoxins (SEs) C1 and D. Demonstrate that the T-lymphocyte assay is useful in predicting the probability of survival in rhesus monkeys vaccinated with recombinant SEB vaccine and challenged by the aerosol route. Develop new surrogate immune assay based on dendritic cell cultures for evaluating human immune responses.</p>	<ul style="list-style-type: none"> <li>• Targets met</li> </ul>
<p><u>Bacterial Vaccines</u> - Further characterize selected plague virulence factors as vaccine antigen candidates; identify two surrogate markers of protection against plague in an animal model; establish the correlation of surrogate markers of immunity with efficacy of the candidate plague vaccine in the mouse model; establish an improved animal (rabbit) model for anthrax.</p>	<ul style="list-style-type: none"> <li>• Targets met</li> </ul>
<p><u>Toxin Therapeutics</u> - Develop approaches to the generation of therapeutics (peptides and synthetic compounds) for SEs, botulinum neurotoxin, and ricin toxin based on rational drug design and molecular structure of the toxins. Synthesize a short polypeptide that is the most potent inhibitor known (2 uM) for type A botulinum neurotoxin. Develop high-throughput assays, suitable for screening large numbers of compounds for inhibitors of botulinum toxin proteolytic activity. Complete therapeutic proof-of-concept experiments in nonhuman primate and mouse SE incapacitation models.</p>	<ul style="list-style-type: none"> <li>• Targets met</li> </ul>
<p><u>Viral Therapeutics</u> - Develop at the Centers for Disease Control &amp; Prevention, an aerosol variola nonhuman primate model for future bridging studies to monkeypox as a surrogate model in support of the U.S. Government Research Plan for smallpox. Demonstrate protection from lethal challenge in the Ebola virus mouse model using antibody therapy.</p>	<ul style="list-style-type: none"> <li>• Targets met</li> </ul>
<p><u>Viral Vaccines</u> - Refine and expand the nonhuman primate model for filoviruses.</p>	<ul style="list-style-type: none"> <li>• Targets met</li> </ul>
<p><u>Diagnostic Technologies</u> - Prepare new diagnostic reagents by using recombinant biotechnologies and design devices that will enhance the diversity and depth of the medical diagnostic capability. Optimize processing methods for selected clinical specimen formats, including swabs, whole blood, sera, and tissues that will enhance current capabilities for the rapid recognition of infections by biological threat agents. Prepare evaluation criteria and standardized reagents that are compatible with regulatory guidelines prior to comprehensive evaluation trials of portable nucleic acid analysis systems for the identification of biological threat agents in clinical laboratories. Optimize new medical diagnostic approaches, reagents, and devices for the rapid recognition of infections by <i>B. anthracis</i>, <i>Y. pestis</i>, <i>F. tularensis</i>, <i>Brucella</i> sp., alphaviruses, filoviruses, and orthopox viruses that will enhance medical care and force protection. Evaluate preclinical models for assessing diagnostic approaches that will enhance identification of anthrax and alphavirus infections prior to transition to regulatory-compliant medical laboratories.</p>	<ul style="list-style-type: none"> <li>• Targets met</li> <li>• Targets met</li> </ul>

FY2000 Targets	Actual Performance
<p><u>Protocols to Enhance Biological Defense</u> - Congress directed scientifically rigorous and programmatically relevant advanced research to be conducted on emerging threats and rapid detection of Biological Warfare agents through the detection of early cellular responses.</p>	<ul style="list-style-type: none"> <li>• Targets met</li> </ul>

### 3.5.2.5 TB2 Future Targets

FY 2001 Targets	FY 2002 Targets
<p><u>Bacterial Therapeutics</u> - Optimize animal models for therapeutic indices; evaluate in vivo activity of selected antimicrobials in established in vitro biochemical assays. Evaluate next generation antibiotics for therapeutic efficacy against bacterial threat agents.</p> <p><u>Bacterial Vaccines</u> - Evaluate previously identified virulence factors as vaccine candidates for <i>Y. pestis</i>. Optimize the animal model for aerosol exposure to <i>B. mallei</i> (glanders) for use in assessing vaccine candidates. Complete research on existing surrogate markers of protection against plague; identify surrogate markers for anthrax and additional markers for plague.</p> <p><u>Toxin Therapeutics</u> - Standardize assays for high-throughput screening of small molecule inhibitors of botulinum and SE toxin ligand-receptor interaction.</p> <p><u>Toxin Vaccines</u> - Express recombinant vaccine candidates for botulinum toxin serotypes D and G in the <i>Pichia</i> yeast system and initiate efficacy studies.</p> <p><u>Viral Therapeutics</u> - Develop a rabbitpox-rabbit animal model for analysis and characterization of candidate antiviral compounds for therapeutic activity. Investigate mechanisms of Ebola and Marburg virus (MBGV) pathogenesis in nonhuman primate models to define likely targets in agent pathogenesis and identify potential mediators of shock.</p> <p><u>Viral Vaccines</u> - Explore the addition of cytokine gene co-delivery with Ebola viral genes to achieve protective immunity. Determine the components required in a vaccine that will protect against the most divergent isolates of MBGV.</p> <p><u>Diagnostic Technologies</u> - Prepare new diagnostic reagents and devices compatible with emerging immunological platforms and rapid nucleic acid analysis systems for enhanced recognition of infections with validated biological threats. Evaluate medical diagnostic technologies and specimen-processing methods compatible with a comprehensive integrated medical diagnostic system for the rapid recognition of infections by validated biological threats (bacteria, viruses, and toxins) of military interest. Identify field sites for the comprehensive validation of rapid diagnostic methods that will provide performance data prior to transitioning to advanced development</p>	<p><u>Bacterial Therapeutics</u> - Optimize and correlate in vitro assays with animal models for selected antibiotic and non antibiotic therapeutics for bacterial threat agents; examine effects of selected therapies on multiple agent exposures in an animal model.</p> <p><u>Bacterial Vaccines</u> - Optimize in vitro correlate assays for candidate vaccines against various bacterial threat agents; evaluate the efficacy of additional novel component vaccine candidates (i.e., fusion proteins and antigen cocktails). Optimize formulation and dosage regime of selected vaccine candidates in animals.</p> <p><u>Toxin Therapeutics</u> - Initiate structural stabilization and formulation studies on lead inhibitors of botulinum and SE toxin activity. Refine in vivo and standardize in vitro screening models for botulinum toxin and SE intoxication.</p> <p><u>Toxin Vaccines</u> - Determine whether the recombinant fragment C vaccine candidates can elicit protective immunity in mice against all toxins produced by various strains of <i>C. botulinum</i>.</p> <p><u>Viral Therapeutics</u> - Assess the potential for immunotherapy against Ebola virus in nonhuman primate models. Complete investigation of mechanisms of Ebola and Marburg virus pathogenesis in nonhuman primate models to characterize promising surrogate markers of efficacy for therapies.</p> <p><u>Viral Vaccines</u> - Define the correlates of immunity (i.e., neutralizing antibody, cytotoxic T cells) that protect against disease from MBGV. Develop assays to measure "surrogate markers" to validate the efficacy of vaccine candidates in established model systems for MBGV.</p> <p><u>Diagnostic Technologies</u> - Prepare diagnostic reagents that will enhance the depth and diversity of current approaches for the rapid recognition of infection by potential biological threat agents. Evaluate preclinical models and standards for evaluating medical diagnostic systems prior to transition to the regulatory-compliant medical laboratory.</p>

**3.5.2.6 Assessment of Medical Biological Defense Applied Research.** Applied research efforts in FY2000 for project TB2 are effective. Many areas of medical biological defense applied research were successful. The assessment for success is based on the assessment of the TARA panel that all DTOs in this area were rated green. Extensive research continues to be conducted in several research areas supporting several major operational goals detailed in Section 2 of the performance plan. Several new research projects and studies also were initiated in FY2000.

### 3.5.3 Medical Chemical Defense Applied Research (Project TC2)

This project funds medical chemical defense applied research, and emphasizes the prevention of chemical casualties through application of pharmaceuticals for prevention and treatment of the toxic effects of nerve, blister, respiratory, and blood agents. This project supports applied research of prophylaxes, pretreatments, antidotes, skin decontaminants, and therapeutic compounds that will counteract the lethal, physical, and behavioral toxicities of chemical agents. It also supports development of medical chemical defense materiel that ensures adequate patient care, field resuscitation, and patient management procedures.

**3.5.3.1 TC2 Performance Goal (Outcome).** The goal of medical chemical defense applied research is to increase scientific understanding of the mechanisms of action and effects of CW agents in order to demonstrate and develop technologies for preventive and therapeutic protection and diagnostics.

#### 3.5.3.2 TC2 Outcome Measure

TC2 is minimally effective when	TC2 is successful when
<ul style="list-style-type: none"> <li>• The results provide fundamental information in support of new and improved defensive systems, including information on                             <ul style="list-style-type: none"> <li>– diagnostics,</li> <li>– low-level toxicology,</li> <li>– pre-treatments,</li> <li>– therapeutics,</li> <li>– novel threats,</li> <li>– optical recognition technologies,</li> <li>– new detection technologies.</li> </ul> </li> <li>• The results of research are published in peer-reviewed journals or presented at scientific conferences</li> <li>• Key research efforts are reviewed by an independent panel of experts and the quality and relevance of the efforts are assessed</li> </ul>	<ul style="list-style-type: none"> <li>• Information, technologies, or processes are transitioned to applied research or advanced technology development</li> <li>• All DTOs are rated GREEN by the TARA Panel.</li> </ul>

**3.5.3.3 Metric Description.** The metric for TB2 is described in Section 3.2.1.1. Applied research also includes several specific projects that are identified as Defense Technology Objectives (DTOs), which are detailed and assessed separately (See section 3.3). DTO funded under this project is CB.29, Active Topical Skin Protectant.

#### TC2 Actual and Planned Performance:

FY2000 Targets	Actual Performance
<p><u>Diagnostics</u> - Evaluate potential treatments in mice using a lung injury model for measuring phosgene toxicity. Identify promising analytical procedures for diagnosis of vesicant-induced inflammation. Assess the efficacy of far-forward, rapid diagnostic tests for blister and nerve agents for real-time analysis of clinical samples on the battlefield.</p> <p><u>Low Level</u> - Identify pharmacological, physiological, or toxicological methods for monitoring long-term, low-level effects of CW agents. Develop animal models and exposure limits for chronic exposures to CW nerve agents. Investigate physiological markers for long-term neuroanatomical effects of exposures to CW nerve agents.</p> <p><u>Pretreatments</u> - Estimate achievable protection by existing countermeasures to novel threat agents.</p>	<ul style="list-style-type: none"> <li>• Targets met</li>   <li>• Targets met</li>   <li>• Targets met</li> </ul>

FY2000 Targets	Actual Performance
<p><u>Therapeutics</u> - Identify a highly effective wetting solution for a reusable polyurethane sponge that significantly increased survival rates for guinea pigs whose skin was wiped after epidermal organophosphate exposure. Determine whether cholinesterase enzymes could be impregnated on the polyurethane sponge and maintain activity for 1 year at 37 degrees C. Determine if triamcinolone/cefazolin combination provides considerable protection against sulfur mustard (HD)-induced ocular damage. Identify a therapeutic mixture (Varma mixture) as a promising treatment for HD-induced ocular injury.</p>	<ul style="list-style-type: none"> <li>• Targets met</li> </ul>

**TC2 Future Targets**

FY 2001 Targets	FY 2002 Targets
<p><u>Diagnostics</u> - Evaluate commercial off-the-shelf diagnostics for applicability as medical chemical defense.</p> <p><u>Low Level</u> - Determine pharmacological, physiological, and toxicological effects of long-term, low-level chemical warfare agents. Investigate new sensitive biochemical and histological assay technologies for use in low level chemical warfare agent exposures. Investigate the use of biological markers to indicate prior low-dose chemical warfare agent exposure.</p> <p><u>Novel Threats (Fourth Generation Nerve Agents)</u> - Assess the efficacy of countermeasures currently fielded, in advanced or exploratory development for efficacy against nerve agents.</p> <p><u>Pretreatments</u> - Extend molecular modeling and site-directed mutagenesis research to develop next generation nerve agent bioscavenger.</p> <p><u>Therapeutics</u> - Optimize formulations for sponges, towelettes, and surgical pads containing scavenger enzymes for use in wound decontamination.</p>	<p><u>Diagnostics</u> - Modify currently fielded cholinesterase testing kit to test a large sample load more efficiently.</p> <p><u>Low Level</u> - Study biological markers for indicating prior low-dose exposures and investigate selectivity of the markers for chemical warfare agents.</p> <p><u>Novel Threats (Fourth Generation Nerve Agents)</u> - Assess the efficacy of new proposed nerve agent countermeasures.</p> <p><u>Pretreatments</u> - Develop animal models to test scavenger candidates efficacy. Conduct characterization studies. Begin preliminary efficacy studies with next generation nerve agent scavengers.</p> <p><u>Therapeutics</u> - Assess candidate agents in suitable animal models of soman-induced status epilepticus for efficacy in saving vulnerable neurons and improving neurobehavioral outcome. Develop criteria for evaluating neuronal salvage after status epilepticus. Determine the essential ingredients for a rinse solution to optimally treat HD-induced ocular injury. Evaluate improved animal models for screening candidate combination therapies.</p>

**3.5.3.4 Assessment of Medical Chemical Defense Applied Research.** Applied research efforts in FY2000 for project TC2 are effective. Many areas of medical chemical defense applied research were successful. The assessment for success is based on the assessment of the TARA panel that all DTOs in this area were rated green. Additionally, the successful assessment is based on the transition of two DTO efforts successfully transitioning to advanced technology development. These DTOs include Medical Countermeasures to Vesicant Agents and Medical Chemical Agent Prophylaxes. Extensive research continues to be conducted in several research areas supporting several major operational goals detailed in Section 2 of the performance plan. Several new research projects and studies also were initiated in FY2000.



### 3.6 ADVANCED TECHNOLOGY DEVELOPMENT (PROGRAM ELEMENT 0603384BP)

This program element demonstrates technologies that enhance the ability of U.S. forces to defend against, and survive chemical and biological warfare (CBW). This PE funds advanced technology development for Joint Service and Service-specific requirements in both medical and non-medical CB defense areas. The medical program aims to produce drugs, vaccines, and medical devices as countermeasures for CB threat agents. Specific areas of medical investigation include: prophylaxis, pretreatment, antidotes and therapeutics, personnel and patient decontamination, and medical management of casualties. In the non-medical area, the focus is on demonstrations of CB defense technologies, including biological detection, chemical detection, and decontamination. These demonstrations, conducted in an operational environment with active user and developer participation, integrate diverse technologies to improve DoD CBW defense. These demonstrations are leveraged by the Counterproliferation Support Program and include remote biological detection. Work conducted under this PE transitions to and provides risk reduction for Demonstration/Validation (PE 0603884BP) and Engineering/Manufacturing Development (EMD) (PE 0604384BP) activities. The work in this PE is consistent with the Joint Service NBC Defense Research, Development, and Acquisition (RDA) Plan. This PE also provides for the conduct of advanced technology development in the areas of real-time sensing, accelerated BW operational awareness, and the restoration of operations following a CBW attack. This program is dedicated to conducting proof-of-principle field demonstrations and tests of system-specific technologies to meet specific military needs.

#### 3.6.1 Chemical and Biological Defense Advanced Technology Development (Project CB3)

This project demonstrates technology advancements for Joint Service application in the areas of: agent detection and identification, decontamination, and individual/collective protection which will speed maturing of advanced technologies to reduce risk in system-oriented Demonstration and Validation. This project funds the Integrated Biodetection Advanced Technology Demonstration (ATD). This ATD will fabricate, demonstrate and integrate advanced point and standoff biodetection technologies. This project is the only DoD program demonstrating new technologies to counter biological warfare threats and improving current developmental biodetection systems. This program also funds the Small Unit Biological Detector (SUBD) in support of consequence management against terrorist-initiated NBC incidents by demonstrating and developing state-of-the-art sensor technology. This project funds the Joint Service Fixed Site Decontamination (JSFXD) Program, the Joint Service Warning and Identification LIDAR (Light Detection And Ranging) Detector (JSWILD) Program, the Joint Service Sensitive Equipment Decontamination (JSSED) Program, the Joint Chemical/Biological Agent Water Monitor (JCBAWM), and the Chemical/Biological Individual Sampler (CBIS).

**3.6.1.1 CB3 Performance Goal (Outcome).** The goal of the CB defense non-medical advanced technology development program is to increase scientific understanding and demonstrate advanced capabilities of the mechanisms and processes involved in the detection, protection against, and decontamination of CBW agents.

### 3.6.1.2 CB3 Outcome Measure

CB3 is minimally effective when	CB3 is successful when
<ul style="list-style-type: none"> <li>• The results provide fundamental information and demonstrate improved capabilities in support of new and improved defensive systems, including information and capabilities for:                             <ul style="list-style-type: none"> <li>– Advanced materials for individual protection,</li> <li>– Detection of chemical and biological contamination,</li> <li>– Decontamination of sensitive equipment,</li> <li>– Early warning chemical and biological detection capabilities</li> </ul> </li> <li>• The results of research are published in peer-reviewed journals or presented at scientific conferences</li> <li>• Key research efforts are reviewed by an independent panel of experts and the quality and relevance of the efforts are assessed</li> </ul>	<ul style="list-style-type: none"> <li>• Information, technologies, or processes are transitioned to applied research or advanced technology development</li> <li>• All DTOs rated GREEN by the TARA panel</li> </ul>

**3.6.1.3 Metric Description.** The metric for CB3 is described in Section 3.2.1.1. Advanced technology development also includes several specific projects that are identified as Defense Technology Objectives (DTOs), which are detailed and assessed separately (See section 3.3). DTOs funded under this project include the following:

- Joint Biological Remote Early Warning System ACTD
- Laser Standoff Chemical Detection Technology (JSWILD)
- Force Medical Protection (CBIS) ACTD

### 3.6.1.4 CB3 Actual and Planned Performance:

FY2000 Targets	Actual Performance
<p><i>MONOPAK and Residual Life Initiatives</i> - Transition a candidate monopak material to the Joint Protective Aircrew Ensemble program as a candidate material. Complete the technology survey and identify the four best technical approaches to develop residual life indicators for protective clothing.</p> <p><i>JSSSED</i> - Conduct a formal analysis of alternatives validating the three-block approach to solve JSSSED requirements. Complete required acquisition documentation and prepared statements of work for acquisition contracts. Initiate an effort to transfer Block I technology approach into a suitable candidate for Block III operational decontamination. Examine potential use of combined thermal/steam approaches to address JSSSED Block II decontamination.</p>	<ul style="list-style-type: none"> <li>• Targets met</li>   <li>• Targets met</li> </ul>

### 3.6.1.5 CB3 Future Targets

FY 2001 Targets	FY 2002 Targets
<p><i>JSSSED</i> - Conduct development of sensitive equipment/items decontamination technologies (Block I) with emphasis on the advanced development of technologies for interior decontamination (block II/III). Support the Defense Systems Acquisition Management Program which provides acquisition and transition management for the JSSSED program.</p> <p><i>Detection Technologies</i> - Evaluate and support accelerated efforts to meet entrance criteria of high potential technologies to address high priority Commander in Chief (CINC) needs being planned in various Advanced Concept Technology Demonstrations (ACTD) and upcoming mature programs. The effort will</p>	<p><i>Reagent Development</i> - Develop advanced recognition reagents and alternative bio simulants for transition to the Critical Reagents Program.</p> <p><i>Small Chem/Bio Detection Technologies</i> - Initiate evaluation of technologies from all sources [e.g., DARPA Biological Warfare Defense (BWD), Department of Energy (DOE) Chemical and Biological Non-Proliferation (CBNP)/National Labs (NL), DoD Joint Service) for feasibility in application to military requirements for small multi-agent chem and bio detectors with reduced logistics burden. The effort will focus on performance characterization and chamber test with identification of technological shortfalls. This effort will</p>

FY 2001 Targets	FY 2002 Targets
<p>involve hyperspectral imaging, a test representative Radar system to provide cueing and early warning capabilities, and a hybrid LIDAR concept for a potential man-portable sized short range biological detection system which is similar to but more logistically/maintainable in comparison to the CP SR-BSDS being evaluated in the Joint Biological Remote Early Warning System (JBREWS) ACTD.</p>	<p>be the first stages in establishing plans to integrate technology for potential transition to DOD efforts.</p> <p><i>Detection Technologies</i> - Complete evaluation of the hyperspectral imaging technology and establish transition points for the highest potential payoff capabilities. Complete and transition the test representative Radar capability to the Joint Multimission Advanced NBC System (JMANS) ACTD for an operational utility evaluation. Complete the evaluation of the technology and system design to meet the requirements of the CINC needs for a bio standoff capability. Initiate the brassboard build and planning needed to transition technology to EMD.</p> <p><i>JSSD</i> - Concentrate on the development of block II/III systems. Perform agent chamber/panel tests to validate performance of candidate technologies on a variety of surfaces. Address material compatibility issues. Initiate documentation of technology findings to support transition to development.</p>

### 3.6.1.6 Assessment of Chemical and Biological Defense Advanced Technology

**Development.** Advanced Technology Development efforts in FY2000 for project CB3 were effective. Many areas of CB defense advanced technology development were successful. The assessment for success is based on the assessment of the TARA panel that all DTOs in this area were rated green. Additionally, the successful assessment is based on the fielding of systems from the Air Base/Port Biodetection ACTD to airbases at several locations in Northeast and Southwest Asia. Extensive development continues to be conducted in several research areas supporting several major operational goals detailed in Section 2 of the performance plan. Several new research projects and studies also were initiated in FY2000.

### 3.6.2 Counterproliferation Support Advanced Technology Development (Project CP3)

The mission of the Counterproliferation Program (CP) is to address shortfalls in the DoD deployed capability to defend against and counter the proliferation of WMD. By focusing on near term results, the CP accelerates delivery of new tools, equipment, and procedures to combat forces. Under the passive defense pillar, CP enhances the efforts of the Chemical and Biological Defense Program. This project funds a variety of programs to defend our forces against WMD, such as the Biological Detection (BIODET), Biological Non-Systems (BIO Non Sys) efforts, Critical Reagents Program (CRP), and Restoration Operations (RestOps).

**3.6.2.1 CP3 Performance Goal (Outcome).** The goal of the counterproliferation support advanced technology development program is to demonstrate advanced capabilities and concepts involved in the detection, protection against, and decontamination of CBW agents.

#### 3.6.2.2 CP3 Outcome Measure

CP3 is minimally effective when	CP3 is successful when
<ul style="list-style-type: none"> <li>• The results provide fundamental information and demonstrate improved capabilities in support of new and improved defensive systems, including information and capabilities for:                             <ul style="list-style-type: none"> <li>– Biological detection systems.</li> <li>– Critical reagents for biological detection and identification.</li> </ul> </li> <li>• The results of research are published in peer-reviewed journals or presented at scientific conferences</li> <li>• Key research efforts are reviewed by an independent panel of experts and the quality and relevance of the efforts are assessed</li> </ul>	<ul style="list-style-type: none"> <li>• Information, technologies, or processes are transitioned to applied research or advanced technology development</li> <li>• All DTOs are rated GREEN by the TARA</li> </ul>

**3.6.2.3 Metric Description.** The metric for CP3 is described in Section 3.2.1.1. Advanced technology development also includes several specific projects that are identified as Defense Technology Objectives (DTOs), which are detailed and assessed separately (See section 3.3). DTOs funded under this project includes the Restoration of Operations (RestOps) ACTD.

#### 3.6.2.4 CP3 Actual and Planned Performance:

FY2000 Targets	Actual Performance
<p><i>BIODET</i> – Initiate development of biological identification system using nucleic acids to allow for a less expensive and broader biological detection capability. Completed first generation of Biological Time-of-Flight Mass Spectrometer for transition to field testing. Transition upconverting phosphor technology development for immunoassays as a potential replacement to traditional hand held assays for sensitivity improvements.</p> <p><i>CRP</i> – Initiate development of recombinant reagents that will increase specificity/sensitivity and lower production costs.</p> <p><i>BIO Non Sys</i> – Initiate development of automated sample preparation technology for Polymerase Chain Reaction (PCR) devices. Initiate development and evaluation of a generic detector, Time of Flight Mass Spec/Mass Spec (TOF MS/MS), multiplexed assays and associated reagents, and investigate Red Team recommendations. Support the development of a small, portable, single assay, PCR detector for testing in Joint Field Trials</p>	<ul style="list-style-type: none"> <li>• Target met</li> <li>• Target met</li> <li>• Target met</li> </ul>

### 3.6.2.5 CP3 Future Targets

FY 2001 Targets	FY 2002 Targets
<p><u>BIODET</u> - Produce nucleic acid primer libraries for testing and continue development of a biological detection capability using nucleic acids.</p> <p><u>CRP</u> - Continue to develop reagents (antibodies and antigens) that are critical to the development, testing, and support of CP Biological Detection Systems.</p> <p><u>BIO Non Sys</u> - Continue development and evaluation of generic detectors (UV) and associated algorithms to provide increased warning time for tactical battlefield applications. Continue development, testing, and evaluation of automated sample preparation technology and protocols for Polymerase Chain Reaction (PCR) devices to improve identification specificity and sensitivity in future biological systems</p>	<p><u>BIODET</u> - Continue to develop and initiate live agent testing of nucleic acid identification systems for development of biological detection capability</p> <p><u>BIO Non Sys</u> - Initiate development and testing of improved UV detectors, UV micro-lasers, and algorithms. Initiate prototype development and testing of an optical-based detector using high-affinity nucleic acid aptamer chips. Initiate system protection development and testing using Red Teams. Initiate development and testing of a new improved collector/concentrator and pre-separator devices for filtering and cleaning environment air samples.</p> <p><u>BIO Non Sys</u> - Continue development and evaluation of generic detectors (UV) and associated algorithms to provide increased warning time for tactical battlefield applications. Continue development, testing, and evaluation of automated sample preparation technology and protocols for Polymerase Chain Reaction (PCR) devices to improve identification specificity and sensitivity in future biological systems.</p>

### 3.6.2.6 Assessment of Counterproliferation Support Advanced Technology Development.

Advanced Technology Development efforts in FY2000 for project CP3 were somewhat successful. Upconverting Phosphors (UCP) technology migrated from DARPA to JPO-BD in an attempt to use in hand held assays. The original medium for demonstrating UCP technology, flow cytometer, was intended for JBPDS, yet flow cytometry was removed from the block upgrade plan for JBPDS. The flow cytometer could be useful in a Theatre Army Medical Lab like system, however CP funding will no longer be applied in this area. The Time of Flight Mass Spectrometer was moved from DARPA over to JPO-BD for Joint Field Trial. The TOF MS was lacking a trigger and needs substantially more engineering development. No further CP funding is intended for this effort. The effort was moved back to the tech base program.

### 3.6.3 Medical Biological Defense Advanced Technology Development (Project TB3)

This project funds preclinical development (pre-Milestone (MS) 1 activities) of safe and effective prophylaxes and therapies (vaccines and drugs) for pre- and post-exposures to biological threat agents. This project also supports the advanced technology development of diagnostic devices to rapidly diagnose exposure to biological agents in clinical samples. A broad range of technologies involved in the targeting and delivery of prophylactic and therapeutic medical countermeasures and diagnostic systems is evaluated so that the most effective countermeasures are identified for transition to Advanced Development (post- MS 1). Transitioning candidate vaccines, therapeutics and diagnostic technologies to Advanced Development requires the development of scientific/regulatory technical data packages to support the MS I decision, the Food and Drug Administration (FDA) Investigational New Drug (IND) process, and DoD acquisition regulations. Categories for this project include the current Science and Technology Plans (STEPS) in medical biological defense (bacterial therapeutics, bacterial vaccines, viral therapeutics, viral vaccines, toxin therapeutics, toxin vaccines, and diagnostic technology), Defense Technology Objectives (DTOs), and Congressionally Funded Programs.

**3.6.3.1 TB3 Performance Goal (Outcome).** The goal of the medical biological defense advanced technology development program is to increase scientific understanding and demonstrate advanced capabilities of the mechanisms and processes involved in the preventive and therapeutic countermeasures and diagnostics for BW agents.

#### 3.6.3.2 TB3 Outcome Measure

TB3 is minimally effective when	TB3 is successful when
<ul style="list-style-type: none"> <li>• The results provide fundamental information and demonstrates advanced capabilities in support of new and improved defensive systems, including:                             <ul style="list-style-type: none"> <li>– Bacterial Therapeutics,</li> <li>– Toxin Vaccines,</li> <li>– Bacterial Vaccines,</li> <li>– Toxin Therapeutics,</li> <li>– Viral Therapeutics,</li> <li>– Viral Vaccines,</li> <li>– Diagnostic Technologies, and</li> <li>– Protocols to Enhance Biological Defense.</li> </ul> </li> <li>• The results of research are published in peer-reviewed journals or presented at scientific conferences</li> <li>• Key research efforts are reviewed by an independent panel of experts and the quality and relevance of the efforts are assessed</li> </ul>	<ul style="list-style-type: none"> <li>• Information, technologies, or processes are transitioned to applied research or advanced technology development</li> <li>• All DTOs are rated GREEN by the TARA</li> </ul>

**3.6.3.3 Metric Description.** The metric for TB3 is described in Section 3.2.1.1. Advanced technology development also includes several specific projects that are identified as Defense Technology Objectives (DTOs), which are detailed and assessed separately (See section 3.3). DTOs funded under this project include the following:

- Common Diagnostic Systems.
- Medical Countermeasures for Encephalitis Viruses
- Medical Countermeasures for Staphylococcal Enterotoxins

- Multiagent Vaccines for Biological Threat Agents

**3.6.3.4 TB3 Actual and Planned Performance:**

FY2000 Targets	Actual Performance
<p><u>Bacterial Therapeutics</u> - Correlate in vitro antibiotic sensitivity results on B. mallei (glanders) with a case study, and recommend a treatment regime for human glanders based on these data.</p>	<ul style="list-style-type: none"> <li>• Targets met</li> </ul>
<p><u>Bacterial Vaccines</u> - Compare currently licensed anthrax vaccine with an investigational E. coli recombinant anthrax vaccine in the rabbit model; complete transitional studies to facilitate movement of the plague vaccine candidate into advanced development.</p>	<ul style="list-style-type: none"> <li>• Targets met</li> </ul>
<p><u>Toxin Therapeutics</u> - Evaluate efficacy of licensed drugs (e.g., pentoxifylline) that inhibit staphylococcal enterotoxin (SE)-induced pro-inflammatory cytokines and are protective after a lethal SEB exposure.</p>	<ul style="list-style-type: none"> <li>• Targets met</li> </ul>
<p><u>Toxin Vaccines</u> - Finalize preparation of scientific, technical, and regulatory documentation in accordance with FDA and DoD acquisition requirements (transition documentation) supporting the MS I transition of the recombinant multivalent vaccine candidate for botulinum neurotoxins. Make transition recommendation for the chemically deglycosylated ricin A-chain vaccine candidate. Produce genetically engineered antigen candidates using computational design. Develop model systems to evaluate subunit inactivation.</p>	<ul style="list-style-type: none"> <li>• Targets met</li> </ul>
<p><u>Viral Therapeutics</u> - Compare efficacy in cell culture of candidate antiviral drugs against more than 40 different isolates of variola at the CDC. Show protection of candidate drugs in the lethal aerosol cowpox-mouse model.</p>	<ul style="list-style-type: none"> <li>• Targets met</li> </ul>
<p><u>Viral Vaccines</u> - Determined that protection from one Musoke isolate of Marburg virus (MBGV) could protect from Ravn isolate in nonhuman primates.</p>	<ul style="list-style-type: none"> <li>• Targets met</li> </ul>
<p><u>Diagnostic Technologies</u> - Compare performance characteristics of new medical diagnostic approaches, reagents, and devices for the rapid recognition of infections caused by B. anthracis, Y. pestis, F. tularensis, Brucella sp., alphaviruses, and filoviruses in laboratory-based studies. Compare technical options, enzyme-linked immunosorbent, electrochemiluminescence, and time resolved fluorescence assays for more sensitive immunodetection of bacterial antigens and toxins in laboratory-based studies.</p>	<ul style="list-style-type: none"> <li>• Targets met</li> </ul>
<p><u>Bioadhesion Research/Counterterrorism Research</u> - Congress directed scientifically rigorous and programmatically advanced technology development in the use of DNA microarrays to identify diagnostic signature transcriptional profiles for host response to BW agents and the exploitation of bioadhesion technology.</p>	<ul style="list-style-type: none"> <li>• Targets met</li> </ul>

**3.6.3.5 TB3 Future Targets**

FY 2001 Targets	FY 2002 Targets
<p><u>Bacterial Therapeutics</u> - Test selected immunomodulators in appropriate animal models for protection against plague and glanders.</p> <p><u>Bacterial Vaccines</u> - Explore laboratory formulations of candidate glanders, plague, and anthrax vaccines using various adjuvants to enhance immunogenicity.</p> <p><u>Toxin Therapeutics</u> - Begin stability testing of the recombinant ricin A-chain that is being used for enzymatic activity studies.</p>	<p><u>Bacterial Therapeutics</u> - Evaluate in animal models, selected immunomodulators in combination with efficacious antibiotics for protection against bacterial threat agents.</p> <p><u>Bacterial Vaccine</u> - Validate correlates of immunity for protection against B. anthracis; evaluate vaccine candidates and correlates of immunity for B. mallei.</p> <p><u>Toxin Therapeutics</u> - Optimize formulation and pharmacodynamics of lead candidate licensed drugs that</p>

FY 2001 Targets	FY 2002 Targets
<p><u>Toxin Vaccines</u> - Complete the process development (60 L scale-up) for vaccine botulinum toxin serotypes C1 and E in the Pichia yeast system and complete efficacy studies. Initiate formulation studies on a combinatorial recombinant pentavalent botulinum toxin vaccine. Develop reagents and assays to determine the quality and quantity of botulinum toxin, SE, and ricin vaccines during process development. Initiate preparation of technical data package in support of IND submission to the FDA for SE vaccine candidate.</p> <p><u>Viral Therapeutics</u> - Determine dose and schedule for lead antiviral drug candidate for intravenous treatment of smallpox. Develop formulations or prodrugs to overcome problems with metabolism, bioavailability, or pharmacokinetics of compounds with otherwise acceptable antiviral profiles for orthopox and filoviruses.</p> <p><u>Viral Vaccines</u> - Test prime-boost vaccine candidates for Ebola virus in nonhuman primate models. Test VEE replicon-based vaccines packaged in different glycoproteins for immunogenicity and protection against Ebola virus.</p> <p><u>Diagnostic Technologies</u> - Compare alternative medical diagnostic technologies and specimen processing methods compatible with a comprehensive integrated medical diagnostic system for the rapid recognition of infections by validated biological threats (bacteria, viruses, and toxins) in laboratory-based and field-based studies. Exploit promising technologies transitioned from Defense Advanced Research Projects Agency (DARPA).</p>	<p>also inhibit SE-induced intoxication.</p> <p><u>Toxin Vaccines</u> - Complete formulation studies on a combinatorial recombinant pentavalent botulinum toxin vaccine. Initiate formulation studies on a combinatorial SE vaccine. Complete development of reagents and assays to determine the quality and quantity of recombinant botulinum and SE vaccines during process development. Initiate the process development (60 L scale-up) for botulinum toxin serotypes D and G in the Pichia yeast system and complete efficacy studies. Initiate the process development for SE serotype A and complete efficacy studies. Initiate in vivo concept model systems for assessment of vaccine efficacy and surrogate endpoints of human clinical efficacy for botulinum toxin and SE intoxication. Prepare technical data package to support submission of an IND application for recombinant SEB vaccine.</p> <p><u>Viral Therapeutics</u> - Continue evaluating formulations or prodrugs to overcome problems with metabolism, bioavailability, or pharmacokinetics of compounds with otherwise acceptable antiviral profiles for orthopox and filoviruses.</p> <p><u>Viral Vaccines</u> - Determine optimal dose and schedule for vaccination against MBGV. Demonstrate in pivotal animal studies that the vaccine candidate is efficacious against aerosol infection with MBGV.</p>

**3.6.3.6 Assessment of Medical Biological Defense Advanced Technology Development.**

Advanced technology development efforts in FY2000 for project TB3 are effective. Many areas of medical biological defense applied research were successful. The assessment for success is based on the assessment of the TARA panel that all DTOs in this area were rated green. Extensive research continues to be conducted in several research areas supporting several major operational goals detailed in Section 2 of the performance plan. Several new research projects and studies also were initiated in FY2000.



### 3.6.4 Medical Chemical Defense Advanced Technology Development (Project TC3)

This project supports the investigation of new medical countermeasures to include antidotes, pretreatment drugs, and topical skin protectants to protect U.S. forces against known and emerging CW threat agents. Capabilities are maintained for reformulation, formulation, and scale-up of candidate compounds using current good laboratory practices. Analytical stability studies and safety and efficacy screening, in addition to preclinical toxicology studies, are performed prior to full-scale development of promising pretreatment or treatment compounds.

**3.6.4.1 TC3 Performance Goal (Outcome).** The goal of the medical chemical defense advanced technology development program is to increase scientific understanding and demonstrate advanced capabilities of the mechanisms and processes involved in the preventive and therapeutic countermeasures and diagnostics for CW agents.

#### 3.6.4.2 TC3 Outcome Measure

TC3 is minimally effective when	TC3 is successful when
<ul style="list-style-type: none"> <li>• The results provide fundamental information and demonstrate advanced capabilities in support of new and improved defensive systems, including information on               <ul style="list-style-type: none"> <li>– chemical agent therapeutics,</li> <li>– chemical agent prophylaxes,</li> <li>– chemical agent diagnostics,</li> <li>– novel threat agents,</li> <li>– low level operational toxicology.</li> </ul> </li> <li>• The results of research are published in peer-reviewed journals or presented at scientific conferences</li> <li>• Key research efforts are reviewed by an independent panel of experts and the quality and relevance of the efforts are assessed</li> </ul>	<ul style="list-style-type: none"> <li>• Information, technologies, or processes are transitioned to applied research or advanced technology development</li> <li>• All DTOs are rated GREEN by the TARA.</li> </ul>

**3.6.4.3 Metric Description.** The metric for TB3 is described in Section 3.2.1.1. Advanced technology development also includes several specific projects that are identified as Defense Technology Objectives (DTOs), which are detailed and assessed separately (See section 3.3). DTOs funded under this project include the following:

- CB.28, Chemical Agent Prophylaxes II
- CB.29, Active Topical Skin Protectant
- CB.30, Medical Countermeasures for Vesicant Agents II

#### 3.6.4.4 TC3 Actual and Planned Performance:

FY2000 Targets	Actual Performance
<p><i>Diagnostics</i> - Modify commercial off-the-shelf prototype monitor for oxyhemoglobin, deoxyhemoglobin, methemoglobin, and carboxyhemoglobin via a noninvasive finger-cuff optical probe. Develop an analytical procedure that measures sulfur mustard (HD)/DNA adducts for diagnosis of HD exposure in the warfighter for up to 7 days after exposure. Develop a gas chromatography/mass spectrometry procedure that measures HD/albumin adducts in plasma with a limit of detection at 1 nM HD exposure, potentially detecting HD levels up to 30 days after exposure.</p>	<ul style="list-style-type: none"> <li>• Target met</li> </ul>
<p><i>Low Level</i> – Investigate the effects of sarin, pyridostigmine, botulinum toxins, and</p>	<ul style="list-style-type: none"> <li>• Target met</li> </ul>

FY2000 Targets	Actual Performance
<p>pesticides, in monkeys. Study long-term effects of nerve agent exposure to humans.</p> <p><u>Pretreatments</u> – Complete bioscavenger proof-of-concept studies; complete Milestone 0 In Process Review (IPR).</p> <p><u>Therapeutics</u> - Determine the efficacy of midazolam against nerve agent seizures in guinea pigs and rhesus monkeys. Determine therapeutic levels of diazepam and midazolam required for anticonvulsant effect. Transition midazolam to Advanced Development. Determine whether deep dermal laser debridement followed by autologous split-thickness skin grafting minimized skin damage and permanent scarring from HD exposure to the epidermis. Select lead candidate countermeasures from in vivo and in vitro screens</p>	<ul style="list-style-type: none"> <li>• Target met</li> <li>• Target met</li> </ul>

**TC3 Future Targets**

FY 2001 Targets	FY 2002 Targets
<p><u>Diagnostics</u> - Evaluate modified advanced development equipment or technologies for far-forward screening and confirmation of exposure to blister and nerve agents; conduct surveys of existing commercial technologies and test suitability of these items. Develop a matrix-assisted laser desorption ionization time-of-flight mass spectrometry method to measure HD in the warfighter.</p> <p><u>Novel Threats</u> - Select best countermeasures to novel threats based on comparison of protection against lethality, pathology, physiological dysfunction, and behavioral incapacitation.</p> <p><u>Pretreatments</u> - Conduct safety and efficacy studies of bioscavenger candidates.</p> <p><u>Therapeutics</u> - Evaluate the efficacy of lead vesicant countermeasure compounds identified in earlier screening efforts using a drug decision approach (decision tree network). Begin vesicant candidate safety and efficacy studies in two animal models. Evaluate the optimal treatment strategy for mustard-induced ocular injury using steroid/antibiotic combinations. Evaluate commercially available off-the-shelf wound healing products to treat HD-induced injuries..</p>	<p><u>Diagnostics</u> - Test a prototype noninvasive monitor that measures oxyhemoglobin, deoxyhemoglobin, methemoglobin, and carboxyhemoglobin via finger, ear, or toes.</p> <p><u>Novel Threats (Fourth Generation Nerve Agents)</u> - Define best countermeasure(s) against novel threats.</p> <p><u>Pretreatments</u> - Produce and test transgenic nerve agent scavengers for safety and efficacy.</p> <p><u>Therapeutics</u> - Determine optimal midazolam – anti-cholinergic drug combination and order of administration to obtain maximal anticonvulsant effect against seizures in a nonhuman primate model. Conduct studies directed at obtaining Food and Drug Administration (FDA) approval for an ocular rinse that optimally treats mustard-induced injuries. Select combination therapy approaches that provide highest level of protection in animal models for safety and efficacy advanced screening. Conduct pharmacokinetics and formulation studies of vesicant countermeasure candidates. Study efficacy and safety of vesicant countermeasure candidates. Determine window of opportunity for administration of therapy(s) for HD exposure</p>

**3.6.4.5 Assessment of Medical Chemical Defense Advanced Technology Development.**

Advanced technology development efforts in FY2000 for project TC3 are effective. Many areas of medical chemical defense applied research were successful. The assessment for success is based on the assessment of the TARA panel that all DTOs in this area were rated green. Extensive research continues to be conducted in several research areas supporting several major operational goals detailed in Section 2 of the performance plan. Several new research projects and studies also were initiated in FY2000.

# Appendix G-1

## FY2000-2001

### Chemical/Biological Defense Defense Technology Objectives

<b>DTO No.</b>	<b>DTO Title</b>
I.02	Joint Biological Remote Early Warning System ACTD.
I.03	Restoration of Operations ACTD.
CB.07	Laser Standoff Chemical Detection Technology
CB.08	Advanced Adsorbents for Protection Applications
CB.09	Enzymatic Decontamination
CB.19	Chemical Imaging Sensor
CB.20	Biological Sample Preparation System for Biological Identification
CB.24	Medical Countermeasures for Encephalitis Viruses
CB.25	Multiagent Vaccines for Biological Threat Agents
CB.26	Common Diagnostic Systems for Biological Threats and Endemic Infectious Diseases
CB.27	Therapeutics Based on Common Mechanisms of Pathogenesis
CB.28	Chemical Agent Prophylaxes II
CB.29	Active Topical Skin Protectant
CB.30	Medical Countermeasures for Vesicant Agents II
CB.31	Medical Countermeasures for Brucellae
CB.32	Needle-less Delivery Methods for Recombinant Protein Vaccines
CB.33	Recombinant Protective Antigen Anthrax Vaccine Candidate
CB.34	Recombinant Plague Vaccine
CB.35	Standoff Biological Aerosol Detection
CB.36	Universal End-of-Service-Life Indicator for NBC Mask Filters
CB.37	CB Agent Water Monitor
CB.38	Activity-Based Detection and Diagnostics
CB.39	CW/BW Agent Screening and Analysis
CB.40	Immune Building Program
CB.41	Biological Warfare Defense Sensor Program
L.07	Terrorist Chemical/Biological Countermeasures
L.12	Force Medical Protection/Dosimeter ACTD

**I.02 Joint Biological Remote Early Warning System ACTD.**

**Objectives.** Evaluate the military utility of remote early warning for biological warfare (BW) attacks against U.S. forces, and develop the operational procedures and doctrine associated with that capability. An additional objective is to provide the CINCs with an interim residual capability to detect and provide automated warning, reporting, and presumptive identification to promptly alert those forces that may be exposed to BW agents. The ACTD will demonstrate tactically deployed sample and identification detectors, and a standoff active laser detector. All the detectors will be connected to a warning and reporting system that enables the command authority to promptly alert forces who are downwind of BW agents. Extensive simulation has been conducted in parallel to evaluate the operational utility of the remote early warning system for employment during early entry, buildup, defensive, offensive, and consolidation phases. Preliminary modeling of BW attack against U.S. forces during a proposed buildup phase shows that an early warning system could significantly reduce casualties.

**Payoffs.** In FY00, the standoff laser biodetection system demonstrated a capability to autonomously discriminate biological from nonbiological aerosols in an operational scenario. The command and control mode of JBREWS was also successfully demonstrated. A capability for military users to set up, operate, and maintain the integrated system, with minimal training required, was demonstrated in May 2000.

**Challenges.** Technical barriers include the demonstration of sufficiently miniaturized detection technologies and effective, eyesafe, active laser-biodetection technology. The demonstration of military utility of the integrated systems remains with acceptable false-alarm rates and reliability of components the most critical characteristics.

**Milestones/Metrics.**

**FY2001:** Provide sustainment of demonstrated equipment at selected locations.

**I.02 S&T Funding**  
(Dollar Amounts in Millions)

PE	Project	FY01	FY02
0603750D	P523	2.0	0.0
	<b>DTO Total</b>	<b>2.0</b>	<b>0.0</b>

**I.02 Non-S&T Funding**  
(Dollar Amounts in Millions)

PE	Project	FY01	FY02
0603884BP	CP4	4.3	0.0
	<b>DTO Total</b>	<b>4.3</b>	<b>0.0</b>

### I.03 Restoration of Operations ACTD.

**Objectives.** Demonstrate those mitigating actions taken before, during, and after an attack to protect against and immediately react to the consequences of a CB attack. These actions aim to restore operating tempo (OPTEMPO) in mission execution and the movement of individuals and materiel to support combat operations at a fixed site.

**Payoffs.** Potential payoffs include an improved understanding of the effectiveness of CB technologies, coupled with improved Concept of Operations (CONOPS), for fixed site CB defense operations. The ultimate payoff will be the improved ability of fixed sites worldwide to better prepare for and recover from CB attacks.

**Challenges.** The primary challenge is the development of the assessment plan and tools to accurately measure the effectiveness of the functions of a fixed site and their interdependencies in accomplishing the fixed-site mission in a CB environment. Technical challenges include the effective integration of situational awareness tools with CB sensors and then with the USAF Wing's command and control system.

#### Milestones/Metrics.

**FY2001:** Complete joint chemical field trials and technology assessments. Develop and conduct the baselining exercise. Refine methodology for operational capability assessment and plan for technology transition. Measure and establish the baseline for performance degradation of operations.

**FY2002:** Conduct preliminary demonstrations. Achieve improved RestOps from the baseline measured during the baseline exercise.

**FY2003:** Final demonstrations and military assessments. Achieve greater improved RestOps from the baseline and preliminary demonstration.

**FY2004:** Conclude interim capability support period.

#### I.03 Non-S&T Funding (Dollar Amounts in Millions)

PE	Project	FY01	FY02
0603750D	P523	1.0	2.0
0603884BP	CP4	10.0	9.8
	<b>DTO Total</b>	<b>11.0</b>	<b>11.8</b>

**CB.07 Laser Standoff Chemical Detection Technology.**

**Objectives.** Demonstrate capability to detect agents at a distance of 20 km and evaluate sensitivity for "dusty" chemical agent detection.

**Payoffs.** This DTO will provide a standoff laser detection technology for protection of fixed sites against chemical warfare agents, reconnaissance, and other battlefield applications; provide first-time ability for standoff detection of chemical agent aerosols (particulates and liquid) and vapors in real time; and provide first-time capability for up to a 20 km range and precise ranging information.

**Challenges.** Demonstration of the existing laser standoff chemical detector (LSCD) in joint service scenarios requires expansion of current azimuth and elevation scanning limits (low risk), and enhanced information display (low risk). Minimization of system response time will require upgrading to a real-time algorithm or display (low to moderate risk). Maximization of system ranges requires upgrading to a larger telescope (low risk) and higher-energy, tunable CO<sub>2</sub> laser (moderate risk). The feasibility of adding improved mustard detection capabilities depends on developing and demonstrating 8-μm laser technology (high risk). The feasibility of adding dusty agent detection capabilities requires the characterization of optical properties of such particles (low to moderate risk) and modeling of LIDAR performance (low risk). In addition, substantiation of the theoretical analysis on dusty agent detection capabilities depends on the generation and testing of an appropriate simulant (moderate risk).

**Milestones/Metrics.**

**FY2001:** Demonstrate brassboard capabilities in field testing with sufficient laser power and detector sensitivity to detect chemical agents at a distance of 20 km (a 400% increase from the FY96 baseline); evaluate sensitivity for dusty chemical agent detection.

**CB.07 S&T Funding  
(Dollar Amounts in Millions)**

PE	Project	FY01	FY02
0603384BP	CB3	1.3	0.0
	<b>DTO Total</b>	<b>1.3</b>	<b>0.0</b>

**CB.08 Advanced Adsorbents for Protection Applications.**

**Objectives.** Develop advanced adsorbent bed materials and compositions (e.g., layered adsorbents) to enhance the chemical agent filtration capabilities of current single-pass filters and regenerative filtration systems under development; and reduce the size, weight, encumbrance, and cost of existing filtration systems.

**Payoffs.** Advanced adsorbent bed compositions for use in nuclear/biological/chemical (NBC) filters will result in smaller, lighter-weight filtration systems with reduced logistical requirements, improved protection against toxic industrial materials (TIMs), and reduced combustibility. Smaller, lighter-weight filters are especially desirable to address respirator needs for (1) improved face seal (less filter weight improves mask-to-face bond), and (2) improved weapons sighting (reduced filter size improves man-to-weapon interface). Development of noncombustible adsorbent beds is desirable to eliminate the possibility of a filter fire in the event of overheating resulting from malfunctioning of system components or exposure to exothermic materials. In FY99, adsorbent materials and combinations of materials exhibiting the desired properties and performance were prepared. An agent sorption assessment was initiated. In FY00, candidate impregnation formulations for several TIMs were identified, 25 adsorbent materials for desorption rate enhancement were screened, and large-pore silica materials were identified as most favorable for purge time reduction. Also, a study of nanotubes and dendrimeric materials as adsorbents was initiated.

**Challenges.** For single-pass filters, adsorbent beds that improve kinetics of agent removal are needed to address the goal of smaller, lighter-weight filters; also, specific impregnant formulations are needed owing to the diversity of the TIMs. For regenerable filters, adsorbent beds that readily release adsorbed agent during the purge cycle are needed to minimize size and energy requirements. The identification of noncombustible adsorbents with high levels of agent removal at all humidity conditions has proven to be an especially difficult challenge. Adsorbent bed compositions need to address recent approved requirements for NBC protection systems (e.g., Joint Service General Purpose Mask (JSGPM)), including capability for protection against TIMs, which is not adequately provided by current NBC filters.

**Milestones/Metrics.**

**FY2000:** Identify and validate impregnant formulations capable of addressing TIMs from the ITF-25 report "A list". Identify materials that will increase the purge rate for regenerative filtration systems by a factor of two. Assess material approaches to meet JTCOPS filtration requirements and identify most opportune system designs. Develop initial approaches to requirements and identify most opportune system designs. Develop initial approaches to address JSGPM performance envelope according to its performance and size requirements.

**FY2001:** Identify at least one adsorbent bed composition that requires at least 20% less volume than for 12 x 30 mesh ASZM-TEDA carbon in meeting the agent filtration requirements of JSGPM. For temperature swing adsorption (TSA) system development, identify at least one adsorbent bed composition that demonstrates at least a doubling of the rate of desorption over that provided by BPL carbon for 2-hexanol (simulant for agent GB).

**FY2002:** Modify ASZM-TEDA Carbon formulation to include minimum protection at the 40,000 mg-min/m<sup>3</sup> Ct level for at least one of the five "hard-to-remove" threshold TICs for the JSGPM program. For TSA system development, identify a hydrophobic adsorbent bed

composition offering a 25% reduction in energy required for regeneration in an 80% relative humidity environment.

**FY2003:** Identify at least one adsorbent bed composition that provides the level of protection required by the JTCOPS program for all agents and at least 90% of the threshold TICs. Provide at least one adsorbent bed composition that provides for effective TSA system performance (at the level stated in JTCOPS requirements) for all chemical warfare agents and all high-priority TICs.

**CB.08 S&T Funding**  
(Dollar Amounts in Millions)

PE	Project	FY01	FY02
0602384BP	CB2	0.9	1.1
	<b>DTO Total</b>	<b>0.9</b>	<b>1.1</b>



### CB.09 Enzymatic Decontamination.

**Objectives.** Develop and demonstrate a new generation of enzyme-based decontaminants that are nontoxic, noncorrosive, environmentally safe, and lightweight (freeze-dried concentrate).

**Payoffs.** Enzyme-based systems have the potential to reduce the logistical burden by 25- to 50-fold. High-activity G-agent enzymes have been identified, characterized, and demonstrated to be effective in NATO-sponsored agent trials. Several V-agent enzymes and H-agent reactive polymers have been identified, but their activity will need to be improved in order to reduce the quantities required. Enzyme-based materials may also have applications in some nonaqueous systems (sorbent, sensitive equipment decontamination) as well as personnel and casualty decontamination. Enzyme-based CW decontaminants can be mixed with a variety of naturally occurring and other mild biocidal materials to deal with BW agents as well. In FY99, enzymes for V- and H-agents were evaluated. Reactive polymers and other materials for enhanced H-agent hydrolysis/oxidation and compatibility with nerve agent enzymes were also evaluated. In FY00, enzyme activity against VX was increased 11-fold by site-directed mutagenesis and several new enzymes with V-agent activity identified. The production levels of recombinant G- and V-agent enzymes were increased significantly (3- to 5-fold).

**Challenges.** The major technical challenge is to identify appropriate enzymes and enzyme-compatible chemicals that are (1) reactive with all nerve and blister agents; (2) genetically engineered for large-scale production; and (3) nontoxic, noncorrosive, and environmentally safe.

#### Milestones/Metrics.

**FY2001:** Optimize formulations of V-agent enzymes and H-agent reactive materials for application in dispersion systems such as foams, detergent solutions, or other types of dispersion systems.

**FY2002:** Demonstrate the efficacy and stability of enzyme/chemical decontamination systems for G-, H-, and V-type agents in foams, detergent solutions, or other types of dispersions systems.

**CB.09 S&T Funding  
(Dollar Amounts in Millions)**

PE	Project	FY01	FY02
0602384BP	CB2	0.8	0.9
	<b>DTO Total</b>	<b>0.8</b>	<b>0.9</b>

**CB.19 Chemical Imaging Sensor.**

**Objectives.** Demonstrate a lightweight, wide-area, passive standoff imaging detection system capable of rapidly detecting chemical agent vapors for the purpose of contamination avoidance, reconnaissance, and facilities evaluation. The final system will operate at 360 Hz with a 256 x 256 focal plane array (FPA), and is scheduled for transition to development in FY03. This DTO will focus on development of ultra-high-speed interferometers, integration of off-the-shelf FPAs, and development of a signal processing algorithm.

**Payoffs.** The chemical imaging sensor (CIS) will allow rapid evaluation of large areas for chemical warfare (CW) contamination, and provide detailed information as to the position of a CW agent cloud. Current single-pixel designs have an extremely limited field of view (typically 26 m at a distance of 1 km). In addition, they cannot scan at sufficient speeds for proposed high-speed applications (i.e., tactical helicopter, high-speed aircraft, and hemispherical scanning applications). The CIS will be capable of operating at fields of view at least 250 times greater than current systems. In addition, scan speeds will be increased by almost two orders of magnitude for extremely high-speed applications. The potential deployments include fixed sites, ground vehicles, unmanned aerial vehicles, helicopters, high and low aircraft, and even low-Earth-orbit configurations. In FY99, real-time operation at 30 Hz was demonstrated. In FY00, a 16-pixel spectrometer at 100 Hz with offline data processing was demonstrated.

**Challenges.** Proposed deployment of the CIS includes many ground and airborne scenarios that require high-speed operation. Speeds of at least 360 scans per second are required in many airborne operations in order not to “blur” the data. A significant effort is required to run an imaging spectrometer at these high speeds. The proposed spectrometer will contain (at the least) a low-density array of 9 to 16 pixels with higher density arrays being incorporated as they become available. The most significant current challenges are signal processing hardware and software, high-density FPA development, and high-speed interferometry. Commercially available interferometers typically operate at a few scans per second, with ten being a typical number. A CIS operating at 360 Hz with a 256 x 256 FPA will require about 1 TFLOP of computing power. Extrapolating current speed increases of high-speed computers into future signal processing hardware that can handle the CIS is expected to be available commercially in about 5 years.

**Milestones/Metrics.**

**FY2001:** Demonstrate real-time operation at 100 Hz.

**FY2002:** Demonstrate 16-pixel spectrometer at 360 Hz.

**CB.19 S&T Funding  
(Dollar Amounts in Millions)**

PE	Project	FY01	FY02
0602384BP	CB2	2.2	2.4
	<b>DTO Total</b>	<b>2.2</b>	<b>2.4</b>

## **CB.20 Biological Sample Preparation System for Biological Identification.**

**Objectives.** Develop and demonstrate an advanced, automated Biological Sample Preparation System (BSPS) for incorporation with genetic and mass spectrometric detection and identification systems. The BSPS represents an essential enabling technology for the success of these systems in field conditions. The final products of this effort are intended to transition as candidates to Joint Biological Point Detection System Block II.

**Payoffs.** When incorporated with genetic and mass spectrometric biological detection technologies, the technology being developed will expand the scope of detectable and identifiable biological agents, shorten the time required for sample analysis, ensure that a maximum and properly prepared sample load is analyzed, and reduce the associated logistics burden as well as overall footprint associated with these detection technologies. The development of these technologies will permit more rapid and reliable response at a lower overall implementation investment to biological threats on the battlefield as well as in applications related to domestic preparedness, intelligence gathering, and treaty verification issues. In FY99, methodologies to reduce time for disruption of spores and viral particles to 20 min at sensitivities corresponding to one agent-containing particle per liter air, as measured using DNA detection on gene probe sensors and protein biomarkers in mass spectrometry, were demonstrated. In FY00, construction of automated concept BSPS systems was initiated, with testing scheduled for Joint Field Trial-6 in Jan 2001.

**Challenges.** Specific biological identification platforms requiring the development of this technology include gene probe sensors, which provide highly specific and sensitive detection, and biological mass spectrometry, which provides broad spectrum coverage. Major technical challenges include the removal of environmental/biological materials that may diminish performance of these platforms, rapid preconcentration of samples, rapid and efficient extraction of nucleic materials or proteins, automation of the entire sample treatment process to permit fully unattended operation, and the development and incorporation of microscale (MEMS-level) components where possible while maintaining overall sensitivity and response time.

### **Milestones/Metrics.**

**FY2001:** Incorporate microscale approaches to reduce size of BSPS by 35% while maintaining overall sensitivity on both platforms against eight bacterial and viral materials for which assays and databases are being developed. Demonstrate reduction of detection time, including sample preparation time to 15 min.

**CB.20 S&T Funding  
(Dollar Amounts in Millions)**

PE	Project	FY01	FY02
0602384BP	CB2	2.8	0.0
	<b>DTO Total</b>	<b>2.8</b>	<b>0.0</b>

## CB.24 Medical Countermeasures for Encephalitis Viruses.

**Objectives.** Develop medical countermeasures against the biological warfare (BW) threat of the equine encephalitis viruses. Recombinant vaccine technology will be exploited to provide effective vaccine candidates.

**Payoffs.** Equine encephalitis viruses can cause disorientation, convulsions, paralysis, and death. They are important BW threats because of aerosol infectivity and relative stability. Clinical illnesses associated with Venezuelan, Eastern, and Western equine encephalitides (VEE, EEE, and WEE, respectively) include headaches, fever, chills, nausea, vomiting, mental confusion, sleepiness, and sometimes seizures and other neurological signs and symptoms. Mosquito vectors normally transmit these alphaviruses to birds, horses, and humans; however, alphaviruses are very stable when freeze-dried and have the potential to be used as a biological weapon. Safe and effective vaccines are needed to protect warfighters. Current vaccines for alphaviruses causing encephalitis are inadequate. For example, current vaccines do not provide protection across the full spectrum of VEE strains, and the VEE investigational vaccine has unacceptable adverse effects. Improved vaccines would decrease the threat of BW and enhance strategic mobility. Under this DTO, vaccine candidates for EEE and WEE analogous to a VEE vaccine have been constructed.

**Challenges.** Major technical challenges include development of appropriate animal model systems for investigational purposes, and determining expression vectors for recombinant products.

### Milestones/Metrics.

**FY2001:** Complete safety and efficacy testing of VEE IE, VEE IIIA, EEE, and WEE in nonhuman primate models. Complete potency and stability studies on all vaccine candidates. Complete definition of surrogate protection markers.

**FY2002:** Complete formulation and vaccine interference studies. Transition VEE multivalent vaccine (VEE IA/B, VEE IE, VEE IIIA).

**FY2003:** Complete technical data package to support a Milestone 1 transition (advanced development). Transition combined VEE/EEE/WEE vaccine.

**CB.24 S&T Funding  
(Dollar Amounts in Millions)**

PE	Project	FY01	FY02
0602384BP	TB2	0.7	0.2
0603384BP	TB3	0.6	0.8
	<b>DTO Total</b>	<b>1.3</b>	<b>1.0</b>

### CB.25 Multiagent Vaccines for Biological Threat Agents.

**Objectives.** Produce a vaccine or vaccine delivery approach that could be used to concurrently immunize an individual against a range of biological warfare (BW) threats. Bioengineered and recombinant vaccine technologies (naked DNA vaccines or replicon vaccines) will be exploited to achieve multivalent vaccines that are directed against multiple agents, yet use the same basic construct for all of the agents.

**Payoffs.** Vaccines currently being developed for biological threat agents are univalent with respect to the threat itself (e.g., separate vaccines against agents such as anthrax, plague, botulinum toxins, and smallpox). Multiagent vaccines to be demonstrated through this DTO would be analogous to such commercial vaccines as the combined diphtheria-pertussis-tetanus vaccine and the measles-mumps-rubella vaccine. The possibility of achieving protective immunity against multiple BW threat agents with a much reduced requirement for the number of vaccines or immunization schedules means greater flexibility and fewer time constraints in fielding a force protected against the threats. Another potential benefit includes decreased cost of production. Due to the nature of some of the threat agents and lack of commercial viability for such a combined product, there is no other commercial or foreign source through which to procure such products. In FY99, animal models were developed for evaluating single and potential combined vaccines.

**Challenges.** Major technical challenges include development of appropriate model systems for investigational purposes, and evaluation of immunogenicity, efficacy, and possible interference effects of a multiagent vaccine candidate.

#### Milestones/Metrics.

**FY2001:** Test efficacy of both individual and combined products.

**FY2002:** Demonstrate multiagent vaccine platform proof-of-principle with a vaccine delivery platform containing up to three vaccine components.

**CB.25 S&T Funding  
(Dollar Amounts in Millions)**

PE	Project	FY01	FY02
0602383E	BW-01	1.0	1.0
0602384BP	TB2	0.5	0.3
0603384BP	TB3	1.5	1.7
	<b>DTO Total</b>	<b>3.0</b>	<b>3.0</b>

**CB.26 Common Diagnostic Systems for Biological Threats and Endemic Infectious Diseases.**

**Objectives.** Develop state-of-the-art technologies (platforms/devices) capable of diagnosing infectious disease and biological warfare (BW) agents in clinical specimens. The devices will be used by preventive medicine personnel for disease surveillance and monitoring, and by medical laboratory personnel for the diagnosis of disease due to natural and BW threat agents. Efforts will focus on an immunologically based membrane device to rapidly detect host immune responses to etiologic agents or the antigens or products of the agents themselves, and on miniaturized polymerase chain reaction technology for detection and identification of nucleic acids of natural infectious disease and BW agents.

**Payoffs.** The ability to quickly identify exposure to specific BW and infectious disease agents and rapidly treat warfighters is critical to maintaining the strength of the force and to giving commanders the ability to provide specific protective measures to yet unexposed warfighters. Many BW agent-induced illnesses have early symptoms that are flu-like and indistinguishable from each other and other less harmful pathogens. The ability to detect infection immediately after exposure would be extremely helpful in determining whether a BW attack has occurred and how many warfighters were exposed and in need of treatment. Early diagnosis is key to providing effective therapy. An effective broad diagnostic capability is important in locating the correct therapeutics and getting them moved in-theater in a timely manner. Collaborations with industrial/biotechnology entities, government, and academic centers of excellence will be developed to leverage continuing advances in biotechnology and industry. In FY99, an immunologically based membrane platform for malaria was transitioned to advanced development (program definition and risk reduction phase.) by the Military Infectious Disease Research Program.

**Challenges.** Requisite technologies require adaptation for clinical use and for detection of specific infectious disease or BW agents. Challenges include development of appropriate antibodies, elimination of interference from substances contained in clinical samples, and selection of appropriate nucleic acid probes. The diagnostic system must be able to distinguish these diverse pathogens both from each other and from those common natural infections that may begin with similar signs and symptoms. Current diagnostic systems also require manual sample collection and preparation, which is labor intensive and time consuming, especially when large numbers of clinical samples must be collected in the field.

**Milestones/Metrics.**

**FY2001:** Transition to concept exploration a portable device capable of detecting and identifying nucleic acids from a broad range of natural infectious and BW agents in clinical specimens.

**FY2002:** Transition to advanced development a portable device capable of detecting and identifying nucleic acids from a broad range of natural infectious diseases and BW agents in clinical specimens.

**CB.26 S&T Funding  
(Dollar Amounts in Millions)**

PE	Project	FY01	FY02
0602383E	BW-01	1.0	0.0
0602384BP	TB2	0.6	0.6
0603384BP	TB3	1.0	1.0
	<b>DTO Total</b>	<b>2.6</b>	<b>1.6</b>

**CB.27 Therapeutics Based on Common Mechanisms of Pathogenesis.**

**Objectives.** Develop a suite of medical countermeasures against broad classes of biological pathogens (bacterial, viral, bioengineered, etc.) that share common mechanisms of pathogenesis.

**Payoffs.** Effective pathogen countermeasures may not eliminate the threat of biological warfare (BW) by a determined adversary, but they can provide a significant disincentive to its use. Program success will provide vaccine and therapeutic countermeasures that will reduce the threat of biological warfare and its operational impact through the development of new broad-spectrum antivirals and antibacterials. These will be particularly important for emerging and bioengineered threats for which there are no current countermeasures.

**Challenges.** The exploitation of modern genetic engineering by adversaries to develop ``super pathogens`` or to disguise agents is of concern. This emerging capability puts an even greater stress on our ability to detect and combat the medical consequences of exposure and infection. In addition, some potential operational environments could cause generalized immunosuppression, further increasing both the risk from biological threats and the need for robust immune defenses.

**Milestones/Metrics.**

**FY2001:** Develop novel therapeutics targeting the common pathways of pathogenesis.

**FY2002:** Demonstrate efficacy of candidate therapeutics in laboratory and animal models.

**FY2003:** Develop testing and evaluation architectures for operational force protection efficacy.

**CB.27 S&T Funding  
(Dollar Amounts in Millions)**

PE	Project	FY01	FY02
0602383E	BW-01	30.0	25.0
	<b>DTO Total</b>	<b>30.0</b>	<b>25.0</b>

**CB.28 Chemical Agent Prophylaxes II.**

**Objectives.** Continue development (Phase 0) of a prophylactic that can detoxify nerve agents at a sufficient rate to protect the warfighter from exposure to up to five median lethal doses (5LD50) of nerve agents.

**Payoffs.** This technology objective would provide a capability for extended protection against a wide spectrum of nerve agents without causing side effects, behavioral effects, or the need for extensive post-exposure therapy. The successful application of this technology could reduce the reliance on mission-oriented protective posture gear by the warfighter.

**Challenges.** Major technical challenges include developing effective prophylactics devoid of side effects, developing circulating scavengers with extended half-lives, developing suitable animal models for these studies, producing sufficient material for safety and efficacy studies, and extrapolating efficacy test results from animals to man.

**Milestones/Metrics.**

**FY2001:** Complete the evaluation of human protein catalytic scavengers. Determine the 3D x-ray crystallographic structure of human CaE and PON-1. Determine through discussions with the FDA the type(s) of data required for submission with an Investigational New Drug application for a human recombinant catalytic protein.

**FY2002:** Complete development/validation of a transgenic animal model capable of producing sufficient amounts of recombinant enzyme scavenger material for clinical trials. Determine safety and efficacy of scavenger candidates in two animal species. Transition to Advanced Development a chemical warfare agent prophylactic that will protect the warfighter for a period greater than 8 hours against exposure to 5LD50 of nerve agent.

**CB.28 S&T Funding  
(Dollar Amounts in Millions)**

PE	Project	FY01	FY02
0602384BP	TC2	1.2	1.0
0603384BP	TC3	0.7	1.0
	<b>DTO Total</b>	<b>1.9</b>	<b>2.0</b>



### CB.29 Active Topical Skin Protectant.

**Objectives.** Increase the protection offered by the Skin Exposure Reduction Paste against Chemical Warfare Agents (SERPACWA), the licensed topical skin protectant (TSP), by incorporating an active moiety that will neutralize nerve agents and sulfur mustard. This active moiety must be compatible with SERPACWA and not be irritating to the skin.

**Payoffs.** Nerve agents and sulfur mustard are significant threats to U.S. forces. While pretreatment and treatment compounds are available for nerve agents, no specific countermeasure has been developed for sulfur mustard. An active TSP would either augment the protection afforded by the protective overgarments or, ideally, redefine and reduce the circumstances requiring mission-oriented protective posture levels. The rapid action of sulfur mustard suggests that a pre-exposure skin protection system offers the best opportunity to prevent the serious consequences from percutaneous exposure to this agent. This approach also reduces the risks from skin exposure to nerve agents. An effective active TSP would deter the use of chemical agents by an enemy and increase the ability of U.S. and allied forces to sustain operational tempo.

**Challenges.** Major technical challenges include: (1) developing active moieties that are not irritating to the skin, (2) developing active moieties that are catalytic and not limited by stoichiometry, (3) developing suitable evaluation models, and (4) extrapolating efficacy test results from animals to humans.

#### Milestones/Metrics.

**FY2001:** Initiate efficacy studies of candidate active TSP formulations challenged with estimated battlefield levels of nerve agents and sulfur mustard as liquids or vapors in two animal species.

**FY2002:** Complete formulation studies. Perform acute eye and skin irritation safety evaluations. Complete efficacy studies of active TSP formulations challenged with estimated battlefield levels of nerve agents and sulfur mustard as liquids or vapors. Select best formulation candidate(s) for transition to development. Transition active TSP formulation(s) capable of protecting against anticipated battlefield levels of nerve agents and sulfur mustard with minimal adverse effects.

**CB.29 S&T Funding  
(Dollar Amounts in Millions)**

PE	Project	FY01	FY02
0603384BP	TC3	1.3	1.3
	<b>DTO Total</b>	<b>1.3</b>	<b>1.3</b>

**CB.30 Medical Countermeasures for Vesicant Agents II.**

**Objectives.** Demonstrate a safe and effective pharmacological countermeasure to prevent or decrease by 80% the severity of blister injuries caused by vesicant chemical agents, focusing principally on sulfur mustard. Compounds or combinations of compounds will be evaluated against one another to determine the best therapy for transition to advanced development.

**Payoffs.** Currently, medical management of the injuries produced by blister agents is limited to immediate decontamination followed by conventional treatment of the resulting blisters or burns. This work will yield a vesicant agent countermeasure that will substantially reduce the degree of injury among exposed soldiers, with concomitant reductions in the medical logistic burden.

**Challenges.** Challenges include developing therapeutic measures with minimal adverse effects, demonstrating safety and efficacy, developing formulations, and extrapolating test results from animals to humans.

**Milestones/Metrics.**

**FY2001:** Determine in vivo efficacy of candidate therapies using two animal models. Initiate test(s) for safety. Begin downselect process.

**FY2002:** Determine the maximum time after sulfur mustard exposure that the therapy is still effective.

**FY2003:** Perform preclinical studies of selected candidate compounds (Milestone 1). Complete downselection. Transition candidate vesicant countermeasure to development (Milestone 1). Prepare Transition Information Package that addresses FDA Investigational New Drug requirements.

**CB.30 S&T Funding  
(Dollar Amounts in Millions)**

PE	Project	FY01	FY02
0602384BP	TC2	4.0	3.0
0603384BP	TC3	1.0	2.0
	<b>DTO Total</b>	<b>5.0</b>	<b>5.0</b>

### CB.31 Medical Countermeasures for Brucellae.

**Objectives.** Develop medical countermeasures for Brucellae. Specifically, develop a genetically characterized live, attenuated vaccine that elicits cellular and humoral immunity against the four pathogenic species of Brucella and protects 90% of individuals against disease after aerosol challenge.

**Payoffs.** Brucella melitensis, B. abortus, and B. suis are closely related validated biological warfare threat agents that are highly infectious by aerosol and cause severely incapacitating illness. B. canis can also cause disease, but is less threatening. Protective strategies that rely on antibiotic prophylaxis or treatment may not be adequate: a multi-drug resistant strain of B. abortus is known to exist. Live attenuated vaccines have proven highly successful in controlling brucellosis in livestock, but none is suitable for human testing. A candidate live, attenuated vaccine developed by USAMRMC between 1993 and 1999 is attenuated in mice and non-human primates (NHP) and highly efficacious in a pulmonary challenge model in mice. A vaccine that is efficacious against aerosol challenge in NHPs should protect humans against infection with all pathogenic species of Brucella. Such a vaccine would benefit warfighters at risk of exposure to this biological threat agent. Additionally, a live, attenuated Brucella vaccine may have future value as a vector to deliver antigens to protect against a number of biological threat agents.

**Challenges.** Major technical challenges include defining the most appropriate in vitro correlates of protective immunity and defining the best criteria for demonstration of efficacy. The approach to resolving challenges and determining if the vaccine candidate(s) result in stated payoffs involves ongoing testing in animal models and assessment of humoral and cellular immune responses in response to specific Brucellae antigens.

#### Milestones/Metrics.

**FY2001:** Determine B. melitensis aerosol lethality; determine relative efficacy of vaccine candidates in NHP challenge model using B. melitensis; establish fermentation conditions for live, attenuated vaccine strain; prepare seed stocks.

**FY2002:** Test most efficacious vaccine candidate(s) from FY2001 studies against B. canis, B. abortus and B. suis, perform pre-IND animal studies with pilot lot of candidate vaccine.

**FY2003:** Test candidate vaccine pilot lot in NHP aerosol challenge model for protective efficacy against all four pathogenic species of Brucella; prepare technical data package to support Milestone 1 transition and FDA's Investigational New Drug (IND) process.

**CB.31 S&T Funding  
(Dollar Amounts in Millions)**

PE	Project	FY01	FY02
0602384BP	TB2	0.4	0.4
0603384BP	TB3	1.4	1.6
	<b>DTO Total</b>	<b>1.8</b>	<b>2.0</b>

### CB.32 Needle-less Delivery Methods for Recombinant Protein Vaccines.

**Objectives.** Develop alternatives to the injection of recombinant protein-based vaccines that result in mucosal and systemic immunity to these agents.

**Payoffs.** Significant mortality and morbidity are associated with inhalation exposure to threat agents such as staphylococcal enterotoxins (SE), *Bacillus anthracis* (anthrax), and *Yersinia pestis* (plague). Protection against lethality is considered a minimal requirement of a medical countermeasure. Recombinant proteins that have been used as vaccine antigens are available for each of these agents and studies in rhesus monkeys demonstrate the parenterally administered vaccines are effective against an inhalational challenge. SEs are also incapacitants in human subjects. Although parenterally administered SE vaccine candidates protected rhesus monkeys from lethal SE type B challenges, a number of the animals experienced incapacitating signs after toxin challenge. Existing data suggest mucosal and systemic immunity are required to prevent lethality as well as incapacitation caused by SE exposure. Mice immunized intranasally with SE vaccines were protected from inhalation and intraperitoneal toxin challenges and demonstrated levels of mucosal antibodies significantly higher than in mice immunized intramuscularly. A mucosal respiratory immune response may improve vaccine efficacy by providing immunity at the portal of agent entry. Potential CRADA partners have been identified that can share expertise in technologies for delivery of biological factors. This will facilitate rapid transition of candidate products. Needle-less administration of vaccines avoids health risks involved with the use of needles. Intranasal, transdermal, inhalation, or oral immunization strategies may be safer and more efficacious methods for stimulating mucosal and systemic immunity. These strategies will be useful for the administration of a significant number of vaccines currently planned to obtain total force protection.

**Challenges.** Major technical challenges include defining quantifiable immunological end-points indicative of protection, producing stable vaccine formulations, selecting practical and efficacious route(s) of administration, and protecting vaccinated individuals from lethal and incapacitating toxin challenges.

#### Milestones/Metrics.

**FY2001:** Establish protocols and framework for studies. Identify/standardize assays to quantitate toxin-specific antibodies/other indicators of immunity. Identify commercial or proprietary devices for vaccine delivery. Standardize animal models.

**FY2002:** Optimize system components. Define relationships between toxin-specific antibodies/other indicators of immunity. Determine optimal mode of vaccine delivery. Evaluate formulations for intranasal/inhalation and transdermal application.

**FY2003:** Demonstrate efficacy of needle-less monovalent vaccines. Propose formulations for intranasal/inhalation and transdermal delivery. Conduct baseline studies in animal models.

**FY2004:** Demonstrate efficacy of needle-less combination vaccines. Propose formulations of combination vaccines for intranasal/inhalation and transdermal delivery. Conduct baseline studies of combination vaccines in animal models.

**FY2005:** Complete studies required supporting product transition. Demonstrate proof of concept and complete technical data package to support a Milestone 1 transition.

**CB.32 S&T Funding**  
(Dollar Amounts in Millions)

PE	Project	FY01	FY02
0602384BP	TB2	0.6	0.6
0603384BP	TB3	0.9	1.2
	<b>DTO Total</b>	<b>1.5</b>	<b>1.8</b>

### CB.33 Recombinant Protective Antigen Anthrax Vaccine Candidate.

**Objectives.** Characterize (biochemically and immunologically) a recombinant protective antigen (rPA) anthrax vaccine, including preliminary development of an appropriate in vitro correlate of PA-induced protective immunity against *Bacillus anthracis* aerosol exposure.

**Payoffs.** This vaccine candidate should facilitate the characterization of the major protective component of Anthrax Vaccine Absorbed (AVA) and will provide the basis for a next generation anthrax vaccine suitable for licensure by the FDA. Preliminary efficacy experiments in a rabbit model have already demonstrated that protection is afforded by rPA produced from either *B. anthracis* or *E. coli*. To date, an in vitro correlate in humans to vaccine-induced immunity against anthrax does not exist. Circulating anti-PA antibody from mice, rabbits, or monkeys can be evaluated as a surrogate marker for efficacy by passive immunization followed by aerosol challenge, to determine if the animals are protected. Demonstrating proof-of-concept for anti-PA antibody as a surrogate marker should facilitate development of an assay for predicting protective immunity in humans after immunization with rPA. Definition of a surrogate marker will facilitate FDA licensure of the vaccine candidate.

**Challenges.** Challenges are to expand animal efficacy studies comparing AVA with rPA, and demonstrate surrogate efficacy against *B. anthracis* aerosol challenge with antibody to rPA alone.

#### Milestones/Metrics.

**FY2001:** Perform comparative biochemical/biophysical characterization of rPA and AVA; perform comparative efficacy studies in animal models with rPA with AVA; conduct rPA- and AVA-immune passive transfer studies with homologous sera in mice and rabbits, and complete technical data package supporting a Milestone 1 transition.

**FY2002:** Evaluate efficacy of rPA in non-human primates; perform passive transfer studies with human sera (AVA) in mice and rabbits; initiate study employing human sera passively transferred to monkeys.

**CB.33 S&T Funding  
(Dollar Amounts in Millions)**

PE	Project	FY01	FY02
0602384BP	TB2	0.5	0.5
0603384BP	TB3	0.8	1.5
	<b>DTO Total</b>	<b>1.3</b>	<b>2.0</b>

**CB.34 Recombinant Plague Vaccine.**

**Objectives.** Complete the pre-clinical development of the recombinant F1-V fusion protein plague vaccine candidate.

**Payoffs.** Infection induced by inhalation of *Yersinia pestis* represents a serious biological warfare threat. The resultant disease, pneumonic plague, is associated with an incubation period of 2–5 days and an untreated mortality of nearly 100% within 1–3 days after onset of illness. The previously licensed plague vaccine is no longer available and provides poor protection against aerosolized *Y. pestis*. The recombinant F1-V fusion protein has shown excellent protection against aerosolized *Y. pestis* in rodents and partial protection in a preliminary non-human primate (NHP) study. Additional preclinical studies in animals will be required to define optimal dosing schedules, long-term immunogenicity, and duration of protection. Additionally, in vitro correlates of protective immunity must be established for FDA licensure. A strong correlate of immunity with an associated assay could potentially replace older animal-based efficacy testing for vaccine potency. The vaccine candidate should also be assessed against a variety of strains of virulent *Y. pestis*. Well-established mouse and non-human primate aerosol models will facilitate completion of these goals. An effective FDA-licensed vaccine against aerosolized plague will enhance force protection and strategic mobility.

**Challenges.** Major technical challenges include identification of the most appropriate in vitro correlates of protective immunity against aerosolized plague, establishment of a surrogate efficacy model for F1-V immunity, and the time required to assess the duration of protection offered by the F1-V vaccine candidate.

**Milestones/Metrics.**

**FY2001:** Complete studies and activities associated with Phase 0 Exit Criteria and complete a technical data package to support a Milestone 1 transition.

**FY2002:** Continue expanded animal studies for immunogenicity and efficacy including the evaluation of long-term immunity in NHPs; continue to optimize formulation and determine the range of protection of the vaccine candidate against other virulent strains of *Y. pestis*.

**CB.34 S&T Funding**  
(Dollar Amounts in Millions)

PE	Project	FY01	FY02
0602384BP	TB2	0.2	0.2
0603384BP	TB3	0.7	0.9
	<b>DTO Total</b>	<b>0.8</b>	<b>1.2</b>

### CB.35 Standoff Biological Aerosol Detection.

**Objectives.** Develop and demonstrate technology by the end of FY04 for an advanced, wide-area, standoff biological detection capability to both detect and discriminate biological aerosol clouds at operationally significant concentrations.

**Payoffs.** The development of this technology would permit the rapid detection, discrimination, and location of biological aerosol clouds. This technology would also be capable of being used on various platforms for the purpose of air or ground biological reconnaissance and contamination avoidance. Technology developed under this effort is intended to address operational requirements of the Joint Biological Standoff Detection System, for which essential target parameters are a range (threshold) of 25 km, sensitivity (threshold) of 15 agent-containing particles per liter of air (ACPLA), and real-time detection.

**Challenges.** Significant progress has been made recently in both active and passive standoff detection arenas with respect to biological detection. Despite this, significant challenges remain. In addition to size, weight, and power, challenges exist with respect to both sensitivity and specificity leading to hybrid technology concepts (use of two or more technologies) for the final system design.

#### Milestones/Metrics.

**FY2001:** Identify potential technology solutions to the biological standoff challenge and sources of data relevant to assessing these solutions. Collect or develop technical information on potential system performance, define quantitative metrics, and identify potential use concepts. This objective will be accomplished by using expertise from the user community (via JSIG), the materiel developer community (JPO-BD, JSMG), and internal and external technical experts (e.g. DoD, DOE, academia, and industry).

**FY2002:** Coordinate with JSIG to establish system performance parameters (e.g., required range, detection time) and conduct downselection among potential technology solutions based on weighted criteria. Downselect will be supported by experimental investigations to develop requisite fundamental data to validate the potential of top-ranked technologies and to identify strengths and weaknesses of the top-rated technologies against quantitative metrics identified in FY01.

**FY2003:** Construct and characterize breadboards based on the results of the downselect and user input. Evaluate final breadboards via field test (extends to FY04).

**FY2004:** Optimize overall system performance based on field test results and demonstrate against Milestone 0 metrics. Transition to advanced development.

**CB.35 S&T Funding  
(Dollar Amounts in Millions)**

PE	Project	FY01	FY02
0602384BP	CB2	0.2	1.8
	<b>DTO Total</b>	<b>0.2</b>	<b>1.8</b>

**CB.36 Universal End-of-Service-Life Indicator for NBC Mask Filters.**

**Objectives.** Develop a low-cost, universal end-of-service-life indicator (ESLI) for use in NBC protective mask filters that will indicate the presence of a broad range of chemical warfare agents and toxic industrial chemical vapors/gases. This will be achieved through an extensive technology survey, identifying best candidate solutions, developing an ESLI design concept, and demonstrating the efficacy of the design concept with target challenge agents.

**Payoffs.** Presently there are no means to determine the residual life of fielded filters. Development of a universal ESLI will greatly enhance serviceman safety by alerting the user to replace the filter before its gas life capacity has expired. Other benefits include reduced cost and logistical burden since current change-out doctrine is conservative and results in the premature replacement and excess stockpiling of filters in the field. This DTO addresses a desired requirement for the Joint Service General Purpose Mask. The technology developed will also have direct application to commercial respirator filters used in the workplace. A universal ESLI will have valuable dual-use application as a residual life indicator for collective protection filters and chemical protective clothing used in the military and industry for protection against hazardous industrial vapors/gases.

**Challenges.** Development of a "universal" colorimetric ESLI to detect such a wide range of contaminants is considered moderate to high risk. Although state-of-the-art passive technologies such as colorimetric indicators exist for detecting specific contaminants, most rely on specific reaction chemistry and, thus, are not suitable as universal (i.e., multi-contaminant) indicators. Realistically no single indicator is expected to achieve such nonspecificity; however, it is feasible that a combination of different nonspecific colorimetric indicator technologies could be used to target key organic vapor and acid gas contaminants of concern. This DTO will focus on passive indicator technologies capable of detecting a select range of key chemical warfare and toxic industrial agents.

**Milestones/Metrics.**

**FY2001:** Identify best candidate passive indicator technologies for organic vapor and acid gas contaminant. Conduct initial screening evaluations; optimize indicator formulation to enhance response; select best candidate ESLI approaches for each application.

**FY2002:** Develop baseline data characterizing the performance of the most promising ESLI technologies. Assess performance parameters such as reaction time, range of detection, and effects of temperature and humidity using carbon bed test cells; select best candidate technologies based on baseline data.

**FY2003:** Incorporate best candidate technologies into viable ESLI mask filter prototypes. ESLI prototypes will be evaluated with modified military or commercial mask filters using a variety of representative contaminant challenges; enhance design and determine optimum location of ESLI.

**FY2004:** Conduct demonstration testing of ESLI filter prototype(s) to validate achievement of performance goals. Demonstrate ESLI design prototype(s) that is effective against a select range of organic vapor/acid gas chemical warfare and toxic industrial agents and capable of indicating when 80 +/- 10% of the filter gas life capacity is depleted. Assessments will include determining the effects of common environmental factors (heat, humidity, ozone, etc.) that may impact ESLI performance and evaluating the effects of rough handling and long-term storage.

**CB.36 S&T Funding**  
(Dollar Amounts in Millions)

PE	Project	FY01	FY02
0602384BP	CB2	0.7	0.8
	<b>DTO Total</b>	<b>0.7</b>	<b>0.8</b>



**CB.37 CB Agent Water Monitor.**

**Objectives.** Develop system concepts and technologies to meet the service requirement for a Joint Chemical Biological Agent Water Monitor. The desired capability is for the detection and identification of hazardous chemical and biological agents in potable water. The system will be capable of processing both source (ponds, lakes, rivers, etc.) and treated water (purified and distribution systems). It is unlikely that a single technology will be able meet this objective. Therefore, the system will most likely consist of two or more integrated technologies that have been optimized to meet a specific challenge.

**Payoffs.** The only system currently fielded for the detection of agents in water is the M272 Water Test Kit. This kit has several drawbacks, including an inability to detect biological agents and a relatively long response time. This kit is difficult to use when in a protective posture and is incapable of autonomous operation, requiring a user to interpret the results. The water monitor developed in this effort will be capable of detecting both chemical and biological agents. In addition, it will be capable of real-time, autonomous operation, which will allow the system to be used as a true water monitor.

**Challenges.** The challenges associated with this DTO are numerous. The system will be required to operate under a variety of environmental conditions, ranging from extremely turbid source water to chemically treated “clean” water. Experience shows that this will pose a significant challenge in terms of both agent sensitivity and specificity. The system will also be required to operate in near real time (less than ten minutes). While this may or may not be a significant factor for chemical agents, it is extremely challenging for biological agents. Current biological detection technologies rely on analytical techniques, which range in processing times from hours to days. Sensitivity requirements also pose a significant challenge. In addition, an understanding of the actual threat in water is not clear. Chemical agents, for instance, undergo chemical changes in water much more quickly than in air. Factor such as hydrolysis will be significant. Biological agents will no doubt undergo changes as well, making the detection problem somewhat dynamic.

**Milestones/Metrics.**

**FY2001:** Complete design of integrated CB water monitor based on the most mature technology currently available using an open architecture to ensure that new and improved technology can be used to update the overall system with minimal effort. Develop test protocols for testing system. Develop transition plan for Milestone 0 decision.

**FY2002:** Complete the construction of initial breadboard. Complete testing to identify shortfalls.

**CB.37 S&T Funding  
(Dollar Amounts in Millions)**

PE	Project	FY01	FY02
0602384BP	CB2	1.3	2.0
	<b>DTO Total</b>	<b>1.3</b>	<b>2.0</b>

**CB.38 Activity-Based Detection and Diagnostics.**

**Objectives.** Demonstrate engineering of cells and tissues that is directed toward the development of activity detection systems for biological and chemical threats, and develop metrics for system performance in detection applications to include environmental sensing and advanced diagnostics for critical defense needs.

**Payoffs.** The successful demonstration of cell and tissue activity detection systems could provide dramatic new capabilities for sensing the activity of existing, emerging, and engineered biological and chemical warfare threats or hazards. These detection systems could also be used as monitors for toxins related to operational exposures in deployment toxicology and could provide rapid surveillance tools for epidemiologic surveillance of environmental or medical samples. Successful demonstration of cell- and tissue-based detection systems could also be used as high-throughput screening tools for drug discovery.

**Challenges.** The program approach is based on robust extraction of cell and tissue signatures of agent response. The first task will focus on the generation of these signatures and the use of pattern recognition tools to robustly extract signatures of activity and response. This task will also include the reduction of critical risk parameters associated with the design and fabrication of working prototype cell- or tissue-based activity detectors. These include sample collection and preparation, extended cell and tissue performance and shelf life, optimized fluidics, and data acquisition and analysis tools. The second task is dedicated to testing and validating the system prototypes that include hand-held and small footprint benchtop systems. The most significant issues that must be addressed are: (1) Cell/Tissue Response and System Prototype Development--populate library of key cell and tissue responses to chemical and biological agents of interest to DoD that could be monitored in environmental and diagnostic samples; demonstrate extended performance of cells and tissues to enable the recording of agent response for an operationally relevant timeframe (21 days); and develop a sample collection and preparation module suitable for cell and tissue detector systems threats; (2) System Testing and Validation--incorporate cell/tissue signatures into prototype systems; test and validate prototype detection systems; and develop metrics for specific operational use.

**Milestones/Metrics.**

**FY2001:** Transfer specific cell- and tissue-based assays to existing detection systems.

**FY2002:** Define critical parameters of tissue reactors. Demonstrate 21-day performance. Develop data acquisition and analysis tools. Develop sample collection and preparation module. Develop metrics for cell- and tissue-based system. Test and validate working cell- and tissue-based prototypes.

**FY2003:** Define trigger detection system application for working detection system. Demonstrate stable tissue reactor system. Demonstrate dry storage stability.

**CB.38 S&T Funding  
(Dollar Amounts in Millions)**

PE	Project	FY01	FY02
0602383E	BW-01	27.0	20.0
	<b>DTO Total</b>	<b>27.0</b>	<b>20.0</b>

**CB.39 CW/BW Agent Screening and Analysis.**

**Objectives.** Provide the technology required to meet DoD requirements under CWC and BWC: (1) Agent and Byproduct Extraction--effectively and rapidly isolate of target compounds from treaty-obtained environmental samples; (2) Agent and Byproduct Screening Technology--develop hand-held real-time, simple-to-operate screening methods for field operations; (3) Agent and Byproduct Determinative Analysis--increase equipment throughput and speed, improve instrument portability and ruggedness, and develop target compound-specific instrumentation not otherwise required by industry; and (4) Remote and Nondestructive Evaluation Techniques--develop highly portable, noninvasive interrogation methods for agents and byproducts within containers of all shapes and configurations.

**Payoffs.** This DTO promotes national security and protect confidential business information while implementing arms control treaties in the most cost-effective manner. Current technologies and infrastructure are not timely and sufficiently cost effective to protect U.S. equities.

**Challenges.** Current technology equipment size, portability, and detection limits do not meet the desires of U.S. policy makers. These technologies must also be developed in such a manner that ITAR requirements and reciprocity concerns are alleviated.

**Milestones/Metrics.**

**FY2001:** Develop new hand-held sensor technologies specific to CW degradation products. Assess and explore proof of concept for BW hand-held detector technologies.

**FY2002:** Deploy test versions of Advanced NDE Analysis System and two hand-held systems. Produce study on extraction and analysis of biological materials for field use.

**FY2003:** Finish development of portable, miniaturized BW detection system based on agent virulence. Field test biological tissue detection assays for BW and CW.

**FY2004:** Explore CW detection limits in the parts-per-billion range with hand-portable equipment in complex matrices (soil, water, air, and biological samples). New BW technologies will be developed to speed detection of virulence, bioactivity, and dispersion in real time.

**FY2005:** Complete prototype of NDE system for analysis of chemical mixtures.

**FY2006:** Complete V.5 of the OPCW sample preparation method for GC Mass Spec analysis.

**CB.39 S&T Funding  
(Dollar Amounts in Millions)**

PE	Project	FY01	FY02
0603711BR	BI	11.5	11.4
	<b>DTO Total</b>	<b>11.5</b>	<b>11.4</b>

**CB.40 Immune Building Program.**

**Objectives.** Develop and demonstrate technologies and systems to allow military buildings to actively respond to attack by agents of chemical or biological warfare so as to (1) protect the 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.

**Payoffs.** 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.

**Challenges.** These objectives will be achieved through a mix of passive and active modifications and augmentations to building infrastructure. ``Passive`` modifications are those in use continually and include, for example, highly efficient filtration; ``active`` augmentations are those used only in the presence of the threat and include real-time control of airflow or real-time neutralization of aerosolized agent. Active response requires networked surveillance systems. Such systems require the development of a number of component technologies in areas like filtration, neutralization, and decontamination. In addition, the implementation of a complex system of this type requires that a number of systems-level issues be resolved, including the design, implementation, and optimization of systems architectures. As proof that all issues have been appropriately addressed, the program will conclude with a full-scale demonstration of a functioning system at a military installation.

**Milestones/Metrics.**

**FY2001:** Design of full-scale testbed for testing systems architectures.

**FY2002:** Buildout and implementation of testbed and installation of components necessary to implement building protection.

**FY2003:** Evaluation of strategies and architectures in full-scale testbed. Results lead to design and optimization of complete building protection systems.

**FY2004:** System design and optimization for demonstration at a military installation.

**FY2005:** Full-scale demonstration at military installation.

**CB.40 S&T Funding**  
(Dollar Amounts in Millions)

PE	Project	FY01	FY02
0602383E	BW-01	10.0	19.0
	<b>DTO Total</b>	<b>10.0</b>	<b>19.0</b>

### **CB.41 Biological Warfare Defense Sensor Program.**

**Objectives.** Develop a fully integrated, well-characterized sensor system for the effective real-time detection of biological warfare (BW) agents to enable pre-exposure detection and discrimination.

**Payoffs.** This DTO will provide military personnel with advanced warning of specific active exposure to BW agents, and an ``all clear`` assessment after the use of appropriate decontamination/neutralization countermeasures.

**Challenges.** The critical challenge is to produce sensor systems that are sufficiently fast and selective to permit an accurate low-false-alarm, high-probability-of-detection decision to be made in a sufficiently timely manner to permit proactive protection of military personnel. As part of accomplishing this task, the fabrication of the first-generation automated time-of-flight mass spectrometer and its characterization for a limited number of BW agents and backgrounds will be completed in FY01. In FY02, the characterization will be extended to more species and strains of threat agents, and the optimization of the system to minimize the false-alarm rate will be investigated.

#### **Milestones/Metrics.**

**FY2001:** Complete detailed characterization of the biological agent's time of flight (BioTOF) for BW agent detection against a key threat agent from each class: spore, virus, toxin and vegetative cell.

**FY2002:** Complete detailed characterization of the BioTOF, including (1) an extended evaluation of false alarms, (2) an evaluation of selectivity against sub-species of threats, and (3) an evaluation of novel chemical agent threats.

**CB.41 S&T Funding  
(Dollar Amounts in Millions)**

<b>PE</b>	<b>Project</b>	<b>FY01</b>	<b>FY02</b>
0602383E	BW-01	8.0	7.0
	<b>DTO Total</b>	<b>8.0</b>	<b>7.0</b>

**L.07 Terrorist Chemical/Biological Countermeasures.**

**Objectives.** Develop effective countermeasures for detecting and identifying chemical/biological (CB) agents and toxic industrial chemicals (TICs) deployed in terrorist weapons.

**Payoffs.** The development of enhanced countermeasures will improve the capabilities of military and civilian units responding to terrorist threat incidents.

**Challenges.** Key challenges include the development of lightweight systems to detect and identify a wide range of CB and TIC threats in an urban environment while overcoming system complexity, operability, and affordability issues, and the development of systems capable of standoff nonintrusive detection and identification of improvised terrorist devices containing CB threats.

**Milestones/Metrics.**

**FY2001:** Demonstrate lightweight (30% weight reduction) chemical point detector in the laboratory with capability to detect and identify a wide range of chemical threat agents and priority TIC threat agents. Demonstrate enhanced aerogel-based biological agent sample collection capability.

**FY2002:** Demonstrate enhanced aerogel-based chemical agent sample collection capability. Demonstrate in the laboratory a hand-held chemical point detector with the capability to reliably detect and quantify chemical warfare agents and selected TICS at levels below Immediate Dangerously to Life and Health (IDLH). Publish surface sampling strategy and guidelines for the detection and identification of biological agent for a commercial building environment.

**FY2003:** Demonstrate in the field lightweight chemical detection systems having less than a 2% false-alarm rate and the capability of detecting a wide range of terrorist threat agents in urban environments at levels below IDLH.

**L.07 S&T Funding**  
(Dollar Amounts in Millions)

PE	Project	FY01	FY02
0603122D	P484	3.8	0.4
	<b>DTO Total</b>	<b>3.8</b>	<b>0.4</b>

## L.12 Force Medical Protection/Dosimeter ACTD.

**Objectives.** Develop an individually worn environmental sampler that can continuously measure and archive chemical and biological agent exposures. Phase I development will emphasize passive collection and archiving of chemical agent exposures and non-real-time chemical analysis. Phase II development will emphasize real-time alarming for chemical agent exposures and individual, active collection and archiving of biological agents for non-real-time analysis. An extensive concept of operations (CONOPS) encompassing diverse operational forces and scenarios will also be developed.

**Payoffs.** Improved detection and identification capabilities will provide greater awareness of immediate chemical exposure risk and more precise identification of exposures across a boarder range of agents. The architecture for routine monitoring and analysis will improve risk assessments and record keeping. Additional payoffs will include the communication of exposure information to command centers and increased battlefield awareness and intelligence. This ACTD leverages activities in the Terrorist Chemical/Biological Countermeasures program and DARPA efforts in pathogen detection/identification.

**Challenges.** Specific challenges include developing technologies to collect, analyze, and differentiate between agents, interferents, and naturally occurring compounds; and 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 a CONOPS to include use of a sampler will require modeling, experimentation, and field testing to improve capabilities and increase utility.

### Milestones/Metrics.

**FY2001:** Deliver residual capability to selected units for further user testing and development.

**FY2002:** Conclude interim capability support period.

**L.12 S&T Funding**  
(Dollar Amounts in Millions)

PE	Project	FY01	FY02
0603384BP	CB3	2.0	0.0
	<b>DTO Total</b>	<b>2.0</b>	<b>0.0</b>

**INTENTIONALLY BLANK.**



# *Annex H*

## *Statement Regarding Chemical and Biological Defense Programs Involving Human Subjects*

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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**

<b>November 25, 1969</b>	– Human biological agent testing ended
<b>July 28, 1975</b>	– Human chemical agent testing ended
<b>Since 1969/1975</b>	– 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*

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<p style="text-align: center;"><b>Text of Public Law Mandating Report on The Department of Defense Chemical and Biological Defense Program</b></p>
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**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

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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  
CTTI – 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 United 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 Assays  
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 Upgrade  
 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  
 JMCDRDP – 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<sub>50</sub> – 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 accreditation

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)

**(INTENTIONALLY BLANK.)**



