Department of Defense
Chemical and Biological Defense Program
Annual Report to Congress
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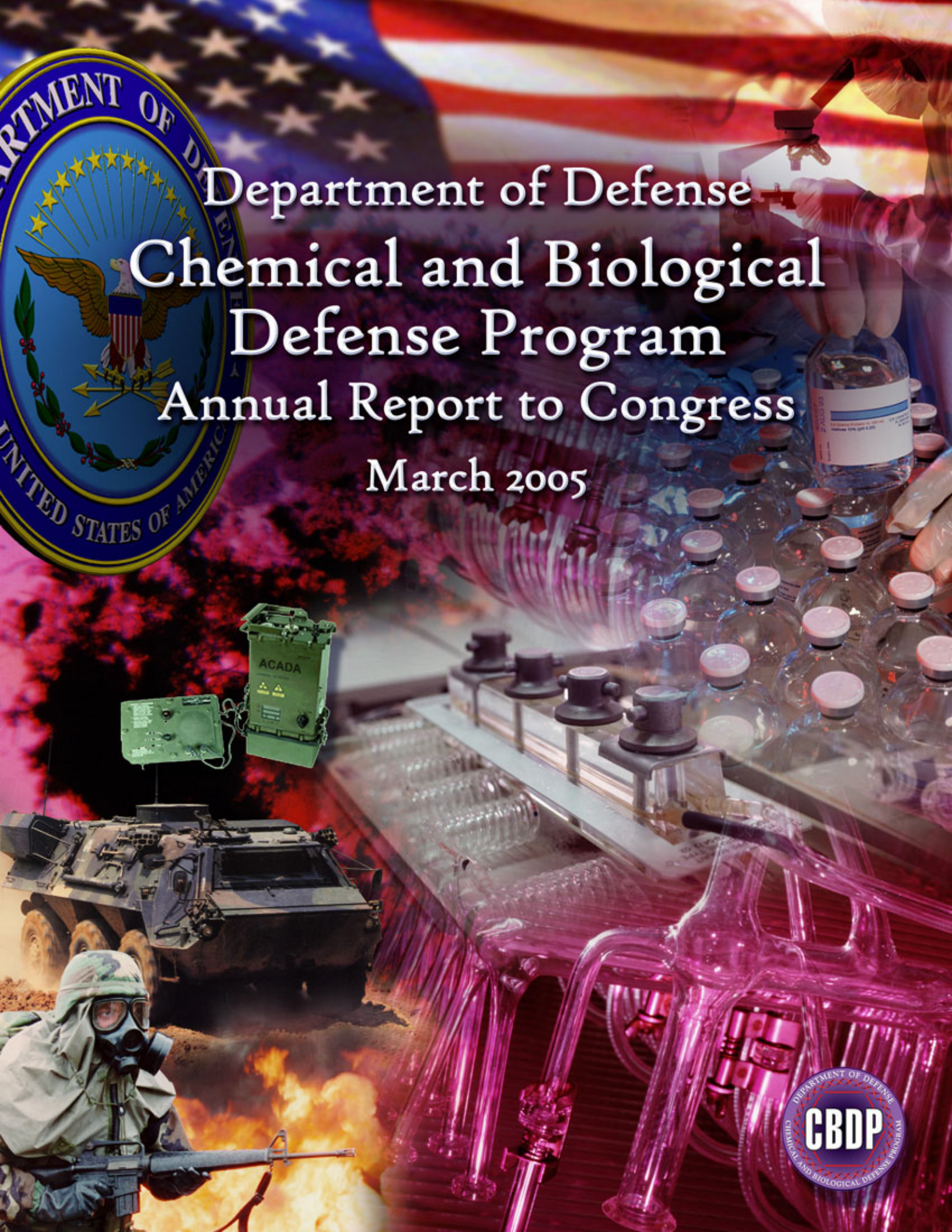

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Executive Summary

This Annual Report of the Department of Defense (DoD) Chemical and Biological Defense Program (CBDP) provides information in response to several reporting requirements. First, this report is provided in accordance with 50 U.S. Code Section 1523. (The complete reporting requirement is detailed at annex K.) This report is intended to assess:

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

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

This report supplements the DoD CBDP FY06 President's Budget, February 2005, which has been submitted to Congress.[1] A performance plan for FY04–06 is provided under a separate cover. This performance plan demonstrates compliance with the Government Performance and Results Act (GPRA), and provides detailed information demonstrating linkage between research, development, and acquisition (RDA) programs and the operational missions of the warfighter. The performance plan accomplishes this by demonstrating the linkage between the program investment (and accomplishment) and the vision of the program (see figure 1) and the corresponding operational goals and objectives supporting the vision.

Combat weapons of mass destruction through a strong chemical and biological defense program.

Figure 1. Chemical and Biological Defense Program Vision

The DoD CBDP is a key part of a comprehensive national strategy to counter the threat of CB weapons as outlined in *The National Strategy to Combat Weapons of Mass Destruction (WMD),* December 2002. The national strategy is based on three pillars:

(1) Counterproliferation to Combat WMD Use;
(2) Strengthened Nonproliferation to Combat WMD Proliferation; and,
(3) Consequence Management to Respond to WMD Use.

The DoD CBDP provides RDA programs primarily to support the first and third pillars. In support of counterproliferation, the DoD CBDP provides operational capabilities tailored to the unique characteristics of the various CB weapons, including emerging threats, in support of passive defense, force protection, and consequence management missions. These capabilities provide U.S. forces the ability to rapidly and effectively mitigate the effects of a CB attack against our deployed forces. In support of counterproliferation, the DoD CBDP provides capabilities to respond to the effects of WMD use against our forces deployed abroad, and in the homeland. In addition, the DoD CBDP supports the "1-4-2-1" force planning construct

[1] Annex H details the CBDP budget and expenditures. For FY06, the total budget request is $1.549 billion, of which $0.651 billion is for procurement, and $0.898 billion is for research, development, test, and evaluation.

articulated in the *Department of Defense Annual Report to the President and the Congress*, September 2002, to accomplish the following:

- "The United States will maintain sufficient military forces to protect its people, territory, and critical defense-related infrastructure against attacks from outside its borders, as U.S. law permits." (that is, **1**);
- "Deter aggression in four critical theaters: Europe, Northeast Asia, the Asian littorals, and the Middle East/Southeast Asia" (that is, **4**);
- "Swiftly defeat aggression in any two theaters of operation in overlapping timeframes" (that is, **2**); and,
- "Decisively defeat an adversary in one of the two theaters, including the ability to occupy territory or set the conditions for a regime change" (that is, **1**).

During 2004, the Secretary of Defense provided direction to enhance the CB defense posture. The Joint Requirements Office for Chemical, Biological, Radiological, and Nuclear Defense led the Combating WMD Enhanced Planning Process (EPP) that generated several options for increased CBDP investment based on the new requirements and accompanying risk. The EPP supplemented the standard planning, programming, budgeting process and was based on guidance from the Secretary of Defense for military forces to be able to protect the homeland, deter forward, swiftly defeat and win decisively. The EPP used an analytical basis for defining requirements for each Service and for the total requirement for the Joint force

Based on the EPP findings, senior leaders increased the investment for the WMD countermeasures by $2.1 billion from FY06–11. In coordination with the DoD CBDP, this increase includes $0.8 billion in military construction funding included in the Defense Health Program for a renovation of the facilities at the U.S. Army Medical Institute of Infectious Diseases (USAMRIID), of which $64.0 million is included in the FY06 President's Budget Submission. The EPP increase also includes $1.3 billion for the CBDP—bringing the total CBDP investment to $9.1 billion from FY06–11. This investment strategy begins with $1.549 billion requested in the FY06 President's Budget. As a result of the EPP and related efforts, following is a summary of key activities (including dollars in millions) that were increased and are included in the FY06 CBDP budget request. These increases include activities to enhance warfighter defense capabilities to include building a new test chamber for non-traditional agents ($18.0M); upgrading test and evaluation facilities ($68.0M); enhancing research and development efforts in areas of agent detection ($9.6M); early warning and battle management ($59.2M); decontamination ($7.8M); individual and collective protection ($16.1M); medical countermeasures ($34.5M); and research and development of countermeasures to emerging threats ($117.9M).

The FY06 President's Budget Submission for the DoD CBDP builds on the existing capabilities fielded to protect U.S. forces against CB threats. The CBDP budget provides a *balanced investment strategy* that includes investment in procurement of capabilities to protect U.S. forces in the near-term (FY06), investment in advanced development to protect U.S. forces in the mid-term (FY07–11), and investment in basic research and the science and technology base to protect U.S. forces through the far term (FY12–19) and beyond. In addition, the FY06 budget supports an increased investment in the test and evaluation infrastructure necessary to maintain the technological advantage against emerging threats. The investment in

the science and technology base and the supporting infrastructure will yield advanced capabilities that will continue to be fielded throughout the far term.

The capabilities for CB defense are necessary to counter the complex and varied threats from CB weapons. Chemical weapons include nerve, blood, blister, and choking agents, toxic industrial chemicals, and novel threat agents. Biological weapons include viral, bacterial, rickettsial, and toxic agents, and potentially novel or genetically engineered agents. The threat is complicated by the numerous potential means of delivering these weapons, including bombs, spray devices, missiles, or novel delivery devices. The unique physical, toxicological, destructtive, and other properties of each type of CB threat requires that operational and technological responses be tailored to the threat or developed to counter multiple threats. CB defense capabilities must also support the diverse requirements of military operations supporting national security and homeland security missions.

Chapter 2 provides modernization tables for each commodity area—contamination avoidance, battlespace management, individual and collective protection, decontamination, medical systems, and consequence management—summarizing planned progress through the far-term as a result of the RDA investment. The FY06 CBDP budget provides a *balanced investment* that provides the comprehensive array of systems, capabilities, and T&E investments balanced among the operational capabilities to ***Sense*** (Reconnaissance, Detection, and Identification), ***Shape*** (Battlespace Management), and ***Shield*** (Individual & Collective Protection), and ***Sustain*** (Decontamination and Restoration) U.S. forces for passive defense, force protection, and consequence management missions.

The CBDP funds research to exploit leading edge technologies to ensure that U.S. forces are equipped with state-of-the-art capabilities to defend against CB threats through the far term. This budget includes support of a comprehensive *science and technology base* program to ensure continued advances in CB defense capabilities. CBDP Basic Research provides core capabilities to ensure U.S. technological advantages through the far term, including research into advanced CB detection systems, advanced materials for improved filtration systems and protection systems, advanced decontaminants, investigations into the environmental fate of chemical warfare agents, advanced information technologies, T&E technologies and supporting scientific data, medical biological defense research (including novel biodefense initiatives that focus on interrupting the disease cycle before and after exposure, as well as addressing the bioengineered threat), diagnostics, therapeutics, and vaccines for viral, bacterial, toxin, and novel threat agents), and medical chemical defense (including investigations of low level chemical warfare agent exposures, diagnostics, therapeutics, pretreatments for classical chemical warfare threats and novel threat agents).

The CBDP also supports numerous Defense Technology Objectives (DTOs), which represent the key <u>science and technology base programs</u> for demonstrating advanced capabilities in the near-term (FY06-07) and mid-term (FY08-FY11). During FY06, DTOs support operational capabilities to Sense, Shape, Shield, and Sustain U.S. forces for passive defense, force protection, and consequence management missions. The science and technology strategy is outlined in chapter 2, and detailed descriptions of the DTOs are provided in the annexes of this report. In addition, the FY06 President's Budget includes an increased investment in research to develop countermeasures against emerging threats that may result from advances in genetic engineering and related scientific disciplines.

Technologies currently in *advanced development* (Budget Activities 4 through 7) provide leading edge tools that will enhance CB defense capabilities for U.S. forces in all CB defense missions in the near-term. As described in the *National Strategy to Combat Weapons of Mass Destruction*, the response to chemical and biological threats requires tailored approaches that recognize the fundamental differences between chemical and biological weapons (and even the different types of these threats). This budget details the comprehensive array of systems under development essential to support principles of contamination avoidance, protection, and decontamination, along with the required T&E capabilities for each area.

Included in advanced development is an increased investement in the Test and Evaluation (T&E) infrastructure. Before 2004, T&E infrastructure needs were identified and submitted as separate needs, and were unfunded. In the FY06 President's Budget Submission, budget needs for the T&E infrastructure are integrated with the research, development, and acquisition (RDA) programs. This budget is based on technology needs and directions, restructured acquisition programs, and integrated the T&E capabilities to execute these programs. The programs are time and funding sequenced to be executable in terms of having the technologies demonstrated and transitioned in synchronization with the T&E capabilities. Thus, the milestones of the acquisition programs are based on the availability of not only the financial resources, but the technology and T&E resources needed to execute the programs. The full effect of this integrated, executable program structure will be realized beginning in FY06. In addition, the CBDP institutional funding of its Major Range and Test Facility Base (MRTFB) will be increased to cover all operating and modernization costs in compliance with Public Law 107-314, Section 232. This will greatly increase the MRTFB stability and availability of critical test facilities to support CBDP test programs in a timely and cost effective manner. Planned capabilities and T&E infrastructure improvements are aligned and planned to support RDA programs in each major commodity (non-medical), including:

- Contamination Avoidance (*Sense* Functional Area)
- Information Systems and Battlespace Management (*Shape* Functional Area)
- Individual and Collective Protection (*Shield* Functional Area)
- Decontamination (*Sustain* Functional Area)

The CBDP has significantly strengthened efforts for improving DoD Installation Force Protection against CBRN threats. DoD has programmed resources to address 200 installations from FY05–FY11. The FY06 program continues to support the consequence management (CM) mission. CM projects fund the development of the Unified Command Suite (UCS) and Analytical Laboratory System (ALS) Block upgrades. CM funding provides for the modernization to address objective operational capabilities for the National Guard WMD Civil Support Teams (CSTs), the Reserve Component (RC) Reconnaissance, and RC Decontamination Teams. It provides full funding for: (1) type-classified protection, detection, and training equipment; (2) development and fielding of upgraded analytical platforms for the detection, identification, and characterization of chemical, biological, and radiological agents used by terrorists in a civilian environment; (3) development and fielding of communication capabilities that are interoperable with other- federal, state, and local agencies; (4) testing and evaluation to ensure that the systems fielded are safe and effective; and, (5) program management funds.

Finally, in FY06, the CBDP will start or continue *procurement* on a variety of CB defense systems intended to provide U.S. forces with the best available equipment to survive, fight, and win in CB contaminated environments. Systems beginning procurement in FY06 include Joint Service Aircrew Mask (JSAM), Multi-Service Radiacs (MSR), and the Joint Service Transportable Decontamination System-Small Scale (JSTDS-SM). In addition, the CBDP will continue procurement and fielding of systems to support all operational capability areas for national security and homeland security support missions.

Overall, the FY06 President's Budget achieves a structured, executable, and integrated medical and non-medical joint CB Defense Program that balances urgent short-term procurement needs that include securing the homeland from terrorist attack, and long-term S&T efforts to mitigate future CB attacks. The two primary areas of increased emphasis in this year's budget are the CB Defense Program's test and evaluation infrastructure and novel biodefense initiatives. The budget improves our biological and chemical research labs infrastructure/ability to address known and emerging threats. It also adds funding for novel biodefense initiatives which take advantage of biotechnology and genetics advances. The focus of these biodefense initiatives is on interrupting the disease cycle before and after exposure, as well as addressing the bioengineered threat.

The program supports our commitment to ensure full dimensional protection for all our fighting men and women operating at home and abroad under the threat of chemical and biological weapons. All of these capabilities are integrated as a family-of-systems essential to avoid contamination and to sustain operational tempo on an asymmetric battlefield, as well as satisfy emerging requirements for force protection and consequence management. In summary, the DoD CBDP remains committed to establishing the optimal balance between the near term requirement to field modernized equipment to the field, and the need to protect and replenish our long term investment in technology.

OVERVIEW OF THE REPORT

Chapter 1 describes the accomplishments, processes, and issues related to program management and oversight.

Chapter 2 provides information on medical and non-medical CB defense requirements and research, development, and acquisition programs. This chapter outlines plans and strategies for the development and acquisition of capabilities in each of the program commodity areas, including contamination avoidance, individual protection, collective protection, modeling and simulation, medical chemical and biological defense, and research, development, and acquisition efforts to address homeland security and provide for force protection.

Chapter 3 provides an analysis of CB defense logistics posture. The analysis reviews the status of quantities, characteristics, and capabilities and limitations of all fielded CB defense equipment, industrial base requirements, procurement schedules, and problems encountered. ***Annex G*** provides detailed logistics data.

Chapter 4 assesses the status of CB defense training, education, doctrine and execercies conducted by the Services—individually and jointly—in order to ensure the readiness of the Armed Forces. Each of the Services' training standards and programs is reviewed. In accordance with Section 1702 of Public Law 103-160 (the FY94 National Defense Authorization

Act), all CB warfare defense training activities of the DoD have been consolidated at the U.S. Army Chemical School.

Chapter 5 provides information on the status of DoD efforts to implement the Chemical Weapons Convention, which was ratified by the United States and enforced as of 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 Chemical Weapons Convention, pursuant to Article X of the Chemical Weapons Convention.

Finally, there are several annexes to this report. ***Annexes A through F*** provide detailed information on Joint- and Service-unique CB defense equipment, including (A) contamination avoidance, (B) information systems, (C) protection, (D) decontamination, (E) medical programs, and (F) homeland security and installation protection programs. ***Annex G*** provides detailed logistics data. This chapter reflects the logistics status at the end of FY04. Assessments were conducted during FY04 to determine the specific warfighter requirements based on the "1-4-2-1" force sizing structure and additional mission requirements for force protection, consequence management, and homeland security. Detailed descriptions are provided for systems and equipment that have been fielded, are in production, or are under development. ***Annex H*** provides a summary of funds appropriated, budgeted, and expended by the DoD CBDP. This information supplements information in Chapter 3. ***Annex I*** provides a statement regarding chemical and biological defense programs involving human subjects as required by 50 U.S. Code Section 1523. As detailed in the annex, no such testing has been conducted in over two decades, and none is planned. ***Annex J*** provides a description and assessment of the test and evaluation infrastructure of the CBDP. This annex provides an overview of the capabilities and limitations of the current infrastructure and proposed investments beginning whth the FY06 budget to improve the infrastructure. ***Annex K*** provides the text of the congressional language requiring this report. ***Annex L*** provides a list of the many acronyms and abbreviations used throughout this report.

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Chapter 1

Department of Defense Chemical and Biological Defense Program Management and Oversight

1.1 INTRODUCTION

In accordance with 50 USC 1522, research, development, and acquisition (RDA) of chemical and biological (CB) defense programs* within the Department of Defense (DoD) are overseen by a single office within the Office of the Secretary of Defense. The Assistant to the Secretary of Defense for Nuclear and Chemical and Biological Defense Programs, ATSD(NCB), serves as this single office. This chapter describes the management and oversight processes and activities related to the effective oversight and management of the Department's CB Defense Program (CBDP). The CBDP mission is to provide CB defense capabilities to effectively execute the *National Strategy for Combating Weapons of Mass Destruction*, and to ensure all capabilities are integrated and coordinated within the interagency community (as described in Section 1.4 of this chapter).

1.2 MANAGEMENT IMPLEMENTATION EFFORTS

The roles and responsibilities of all departmental organizations are detailed in the "Implementation Plan for the Management of the Chemical and Biological Defense Program," which was approved on April 22, 2003. The Department reviewed the plan in 2004 and plans to publish a revised plan in 2005. The current processes, roles, and responsibilities are described in Section 1.3.

1.3 KEY ORGANIZATIONAL RELATIONSHIPS, ROLES, AND RESPONSIBILITIES

Key organizational relationships within the DoD CBDP are portrayed in **Figure 1-1**. The CBDP management structure applies to the processes (1) to provide policy guidance 2) to conduct planning, programming, budgeting, and execution of CBRN defense *research, development and acquisition*, (3) to establish military *requirements* for CBRN defense, (4) to *test and evaluate* CBRN defense programs, (5) to manage chemical and biological defense *science and technology* programs, (6) from program analysis and integration, and (7) for program oversight.

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* While the scope of the public law specifically addresses only chemical and biological defense RDA activities, DoD planning also includes radiological and nuclear defense along with chemical and biological defense in its planning activities. However, radiological and nuclear defense capabilities within the CBDP are limited to certain types of radiation detection equipment, modeling and simulation capabilities, and limited medical research on radioprotectants. Various other radiological and nuclear defense efforts, including such systems for nuclear and radiation hardening, nuclear detection, medical radiological defense, and other selected other programs are outside the scope of the CBDP. These efforts are discussed where they are related to or complement CBDP efforts.

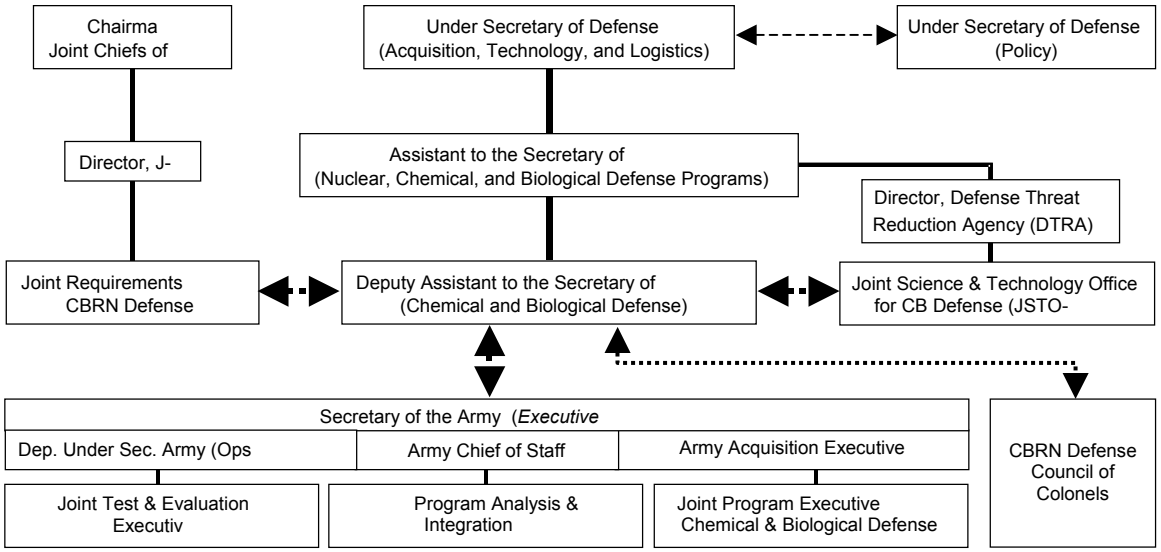

Figure 1-1. CBDP Management & Oversight Structure.

This section summarizes selected roles and responsibilities of key individuals and organizations within the CBDP. The JRO-CBRN Defense was formally established on October 1, 2002. The JRO-CBRN Defense charter was approved on February 4, 2003. The establishment of a JPEO-CBD that reports through the Army Acquisition Executive was directed on September 19, 2002. The specific roles and responsibilities are detailed in the implementation plan for the management of the DoD CBDP, which was approved on April 22, 2003.

1.3.1 Under Secretary of Defense for Policy, USD(Policy)

The USD(Policy) serves as the policy advisor for the DoD CBDP, providing oversight and guidance to ensure that CBDP activities support defense planning guidance and forces policy, Department of Defense relations with foreign countries and the Department's role in U.S. Government interagency policy making.

1.3.2 Under Secretary of Defense for Acquisition, Technology & Logistics, USD(AT&L)

The USD(AT&L) serves as the Defense Acquisition Executive (DAE) for the DoD CBDP. As the DAE, the USD(AT&L) serves as the Milestone Decision Authority (MDA) for the overall program and key selected systems—also referred to as "sentinel" programs.

While total CBDP funding surpasses the funding threshold of a Major Defense Acquisition Programs (MDAP), the CBDP is not categorized as an MDAP since no individual system reaches this funding threshold. USD(AT&L) funding oversight is tailored by creating an "index of systems" to measure performance of CBDP functional areas. These index systems are referred to as "Sentinel" systems. A Sentinel System is a program in advanced development, that represents a balance of *cost*, *complexity*, and *criticality* to justify the USD(AT&L) monitoring the cost, schedule, and performance of the Sentinel system as an indicator of the general programmatic health, not just cost, which is the primary criteria for MDAPs. A summary of Sentinel System performance is provided in the CBDP Performance Plan.

The USD(AT&L) delegates Milestone Decision Authority to the Army Acquisition Executive, who has further delegated MDA responsibility to the Joint Program Executive

Officer for Chemical and Biological Defense (JPEO-CBD). This structure maintains a vertically integrated chain-of-command.

USD(AT&L) responsibilities include (1) approving Overarching CBDP Strategic Plan, (2) establishing a CBDP Overarching Integrated Product Team (OIPT) within the Office of the Secretary of Defense, (3) chairing DAE Oversight Reviews for the CBDP, and (4) approving recommended Program Objectives Memorandum (POM) and submitting to Secretary of Defense.

1.3.3 Assistant to the Secretary of Defense for Nuclear, Chemical, and Biological Defense Programs, ATSD(NCB)

The ATSD(NCB) serves as the single focal point within the Office of the Secretary of Defense (OSD) responsible for overall oversight, coordination and integration of the DoD CBDP in accordance with 50 USC 1522. The ATSD(NCB) serves as the permanent chair of the CBDP Overarching Integrated Process Team (OIPT). The OIPT process supports overall CBDP oversight. The OIPT will oversee the following Working IPTs (WIPTs):

- *Joint Requirements*—Chaired by the JRO-CBRN Defense,
- *Science and Technology*—Chaired by DTRA(CB),
- *Test and Evaluation*—Chaired by the CBDP Test and Evaluation Executive,
- *Advanced Concept Technology Demonstration Oversight Group*—Chaired by Deputy Under Secretary of Defense for Advanced Systems and Concepts.

Additional WIPTs may be formed by the OIPT to address specific issues. WIPTs are advisory bodies and will convene as required to address specific issues that need resolution. WIPTs will not convene as part of the normal coordination process. Unresolved issues will be elevated to the OIPT in a timely manner. Membership in the OIPT and WIPTs includes all appropriate OSD, Service, Joint Staff, and Defense Agency stakeholders. In addition, the ATSD(NCB) has established a Council of Colonels, which serves as a Joint *ad hoc* body to address issues and Service concerns regarding all aspects of the CBDP.

The ATSD(NCB) provides oversight of the CBDP science and technology base (S&T) programs. Science and technology programs are reviewed at the Defense Technology Objective level 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 S&T.

The Deputy Assistant to the Secretary of Defense for Chemical and Biological Defense, DATSD(CBD), is the principal deputy to the ATSD(NCB) for CBDP matters, and the primary staff action office for ATSD(NCB) responsibilities. As the principal deputy, the DATSD(CBD) also supports the USD(AT&L) in carrying out its MDA and oversight responsibilities for the CBDP.

1.3.4 Joint Requirements Office for Chemical, Biological, Radiological, and Nuclear Defense (JRO-CBRN) Defense

The JRO-CBRN Defense began official duties on October 1, 2002. The official charter was approved on February 4, 2003. The JRO-CBRN Defense coordinates with the combatant commands and Services to develop Joint CBRN requirements, and overarching CBRN defense

architecture and a joint capabilities roadmap. The JRO-CBRN Defense defines the required system interoperabilities and operational architectures and validates the development of Joint CBRN defense capabilities through both simulation and technology demonstrations. These efforts will be documented in a Joint CBRN Defense Modernization Plan for validation by the Joint Requirements Oversight Council (JROC).

The JRO-CBRN Defense is a single office within DoD under the Chairman of the Joint Chiefs of Staff responsible for planning, coordination, and approval of joint CBRN defense operational requirements and serving as the focal point for Service, combatant command, and Joint Staff requirements generation. These responsibilities include development of CBRN defense operational requirements, joint operational concepts, and architectures for passive defense, consequence management, force protection, and homeland security. JRO-CBRN Defense leads the development of the DoD CBDP POM with JPEO and Defense Threat Reduction Agency (DTRA) Science and Technology (S&T) support in accordance with Section 6 of the Implementation Plan.

1.3.5 Military Departments

Each of the Military Departments—Army, Air Force, and Navy, including the Marines Corps—plan and execute CBRN defense programs, from basic research through procurement and sustainment. In fulfilling their responsibilities, the Military Departments ensure coordination and integration with other CBRN defense organizations. Following are selected responsibilities of the Military Departments within the CBDP.

- Validate Joint operational concepts and develop Service-sponsored CBRN defense requirements documents using the guidance set forth in the Joint CBRN Defense Modernization Plan. Where new materiel requirements are identified, submit requirement documents to the JRO and recommend for inclusion into the Modernization Plan.
- Include the participation of the JRO as early as possible in the concept development phase for potential CBRN defense requirements.
- Provide acquisition and fielding data for respective CBRN defense requirements to the JRO during development of the DoD CBDP Program Objectives Memorandum (POM).
- Support development of Service annexes to Joint CBRN defense requirement documents.
- Provide representatives to all appropriate CBRN defense meetings and organizations.
- Provide representatives for the CBDP Council of Colonels, which operates under the auspices of the ATSD(NCB) to address issues and Service concerns with all aspects of the CBDP.
- Conduct CBRN defense training, readiness, and sustainment.
- Participate in the review, development and validation of the Modernization Plan, Joint Future Operational Capabilities, and the Joint Priority Lists.
- Perform Service responsibilities to support Joint Programs as assigned by the JPEO-CBD. **Figure 1-2** illustrates current Service responsibilities to support Joint Programs.

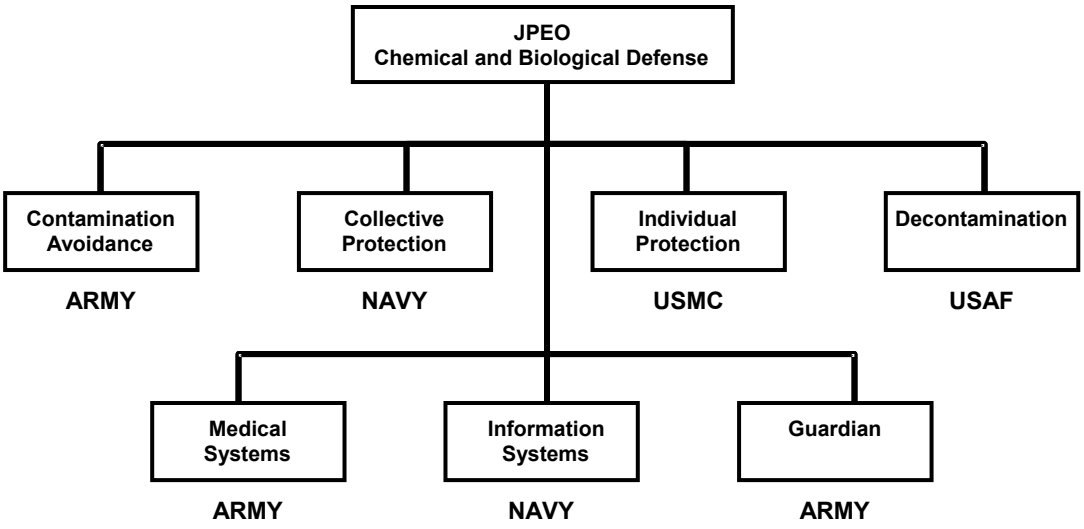

Figure 1-2. Service Responsibilities for Joint Program Management within the JPEO-CBD.

The military departments play a critical role in the execution of all phases of research, development, and acquisition. The military departments provide the essential infrastructure, which includes personnel with unique scientific, technical, and management expertise, and the laboratory and test facilities to meet the demands of developing and fielding CBRN defense equipment. ***Annex J*** of this report provides a detailed description and assessment of the military's chemical and biological defense test and evaluation infrastructure, and the supporting laboratory infrastructure. These include capabilities for handling live chemical and biological agents and conducting a variety of tests. Selected key military facilities, for which more detail is provided in Annex J, include the following:

- U.S. Army Edgewood Chemical and Biological Center (ECBC)
- U.S. Army Medical Research Institute of Infectious Disease (USAMRIID)
- U.S. Army Medical Research Institute of Chemical Defense (USAMRICD)
- U.S. Navy Medical Research Center (NMRC)
- Naval Surface Warfare Center (NSWC), Dahlgren
- U.S. Air Force Operational Test & Evaluation Center (AFOTEC).

1.3.6 Army as Executive Agent

In accordance with 50 USC 1522, the Army serves as the Executive Agent for the CBDP and coordinates and integrates research, development, test and evaluation, and acquisition requirements of the military departments for CBRN defense programs of the DoD. The Secretary of the Army serves as the Executive Agent for the CBDP, and the Assistant Secretary of the Army for Acquisition, Logistics and Technology, ASA(ALT), serves as the Army Acquisition Executive (AAE). Following are selected key responsibilities of Army as the Executive Agent.

- Review all funding for the CBDP.
- Review and recommend approval of the CBDP POM.

- Serve as the Milestone Decision Authority (MDA) for delegated programs, with authority to delegate to the JPEO-CBD. (Note: While the USD(AT&L) is designated as the single MDA for the CBPD, MDA status is delegated by the USD(AT&L) to the AAE. Thus there are two MDAs, though based on a single authority.)
- Serve as Joint Service Materiel Developer to coordinate and integrate acquisition for the CBDP through the JPEO-CBD.
- Provide Program, Analysis and Integration functions for the CBDP.
- Provide the Test and Evaluation Executive for the CBDP.
- Serve as the Joint Combat Developer for the CBDP through the JRO.

1.3.6.1. JPEO-CBD. The JPEO-CBD reports to the AAE and serves as the CBDP Material Developer and oversees Life Cycle Acquisition Management for assigned system acquisition programs within the CBDP. The JPEO-CBD provides centralized program management and Joint Service acquisition program integration for all assigned non-medical and medical chemical and biological defense programs. Following are selected key responsibilities of the JPEO-CBD.

- Serve as the CBDP Milestone Decision Authority for delegated programs.
- Develop and approve program and acquisition strategies.
- Provide the planning guidance, direction, control, and support necessary to ensure systems are developed in accordance with DoD acquisition guidance.
- Integrate interoperability with civilian emergency response agencies in the planning, guidance, direction, and control of newly acquired systems whenever possible.
- Oversee the development, coordination, and commitment to an acquisition program baseline and ensure immediate reporting of all imminent and actual breaches of approved baselines. In addition, ensure development of a recovery plan.
- Prepare required input to POM, Budget Estimate Submission, President's Budget, and other required documentation. Support development of the annual Research, Development and Acquisition (RDA) Plan in coordination with DTRA S&T Manager and the Program Analysis and Integration Office.
- Prepare the Joint Logistics Support Plan for medical and non-medical programs for which JPEO-CBD maintains Life Cycle Management to include sustainment in cooperation with the Services and in coordination with the JRO.
- Establish Technology Readiness Levels (TRLs) and conduct reviews to identify opportunities for transition of chemical and biological S&T programs to acquisition in conjunction with DTRA.
- Ensure interagency cooperation and timely transition of technologies to advanced development programs in order to reduce development cycle times.
- Develop and approve Test and Evaluation Master Plans (TEMP) for assigned programs.
- Provide technical and functional integration across assigned medical and non-medical programs. For medical programs, ensure integration with related DoD material programs required for force health protection.

1.3.6.2. Program Analysis and Integration Office (PAIO). The PAIO supports the CBDP by providing analysis to the OSD oversight office, JRO-CBRN Defense, JPEO-CBD and DTRA. The PAIO provides independent analysis functions to all other elements of the CBDP under

operational direction of the Army Deputy Chief of Staff for Programs (G8) as the Army Executive Agent.

In support of the CBDP OIPT, the PAIO provides independent analysis for decision-makers to enable review and recommendations concerning impacts to the overall integrated CBDP. This analysis includes the CBDP oversight process, published plans, and overall programmatic health of the CBDP. The PAIO will review and analyze fiscal programs, requirements, resource planning, and resource allocation for the program years. The PAIO also maintains the DoD CBDP Future Years Defense Program (FYDP) and provides support to the JRO-CBRN Defense for the POM build. PAIO supports the JPEO and the Program Managers to perform defense acquisition functions necessary to guide assigned programs through each milestone within approved baselines.

1.3.6.3. Joint Test & Evaluation Executive. The Joint CBDP Test and Evaluation Executive chairs the Test and Evaluation (T&E) Executive Working Integrated Process Team (WIPT), which is overseen by the ATSD(NCB). The Deputy Under Secretary of the Army for Operations Research, DUSA(OR), serves as the T&E Executive. Members of the T&E Executive WIPT include the Service T&E executive level representatives, JRO-CBRND, JPEO-CBD, DTRA S&T Executive, Operational Test Activity representatives, and the Director, Operational Test and Evaluation, DOT&E. This WIPT assists the CBDP T&E Executive to resolve major T&E and related issues, which are then documented in TEMPs and Test Plans for DOT&E approval, as appropriate. The T&E Executive also manages T&E infrastructure* to ensure that adequate T&E is conducted for CBDP systems, and is responsible to establish test standards, processes, and procedures.

1.3.6.4. Joint Combat Developer for CBRN Defense (JCD-CBRND). Under the direction of the JRO-CBRND, and supported by the Services and the US Coast Guard (USCG), the JCD-CBRND will coordinate and oversee execution of Joint and multi-Service experiments used to validate the Joint Integrating Concept for CBRN Defense by systematically exploring new and innovative combinations of medical and non-medical Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel, and Facilities (DOTMLPF) capabilities.

Experiments will initially address the full spectrum of CBRN passive defense, force protection, consequence management, and homeland defense. The focus on CBRND limited scale experiments and capabilities differentiates the JCD-CBRND role from that of the much larger Joint Forces Command (JFCOM) role as the DoD Executive Agent for Joint Experimentation.

The JCD-CBRND concept experiments will complement the Science and Technology (S&T) and Advanced Development efforts managed by the Joint Science and Technology Office for Chemical and Biological Defense (JSTO-CBD) and the JPEO-CBD, respectively. Where appropriate, and as directed by the JRO-CBRND, the JCD-CBRND will partner with the JFCOM in the broader DoD joint experimentation process.

Though the U.S. Army Chemical School (USAMCLS) provides a myriad of resources well suited for CBRND experimentation, the JCD-CBRND will take maximum advantage of other personnel, equipment, and facilities available throughout each of the Services, and other

* The T&E infrastructure does not include the laboratory infrastructure, but rather is limited to those facilities that support developmental, operational, and related test and evaluation.

government organizations to reduce costs, shorten timelines, and improve experimental designs. Where possible, the JCD-CBRND should strive to leverage planned exercises and other experiment venues outside of the CBDP.

1.3.7 Defense Threat Reduction Agency (DTRA)

DTRA serves two key roles in support of the DoD CBDP—Funds Manager and Joint Science and Technology Manager. These roles are filled by DTRA's Chemical and Biological Defense Directorate, DTRA(CB), also designated as the Joint Science and Technology Office for Chemical and Biological Defense (JSTO-CBD). The JSTO-CBD provides funds management functions under the oversight of the ATSD(NCB). JSTO-CBD also manages and integrates chemical and biological defense science and technology base (S&T) programs. S&T management responsibilities include the development and integration of S&T program in response to OSD and JRO-CBRN Defense guidance. The JSTO-CBD provides the necessary programming, planning, and budgeting documentation for chemical and biological defense S&T programs. The JSTO-CBD works with the JPEO-CBD to ensure effective transition of S&T efforts to advanced development. The JSTO-CBD also participates in Armed Services Biomedical Research Evaluation and Management (ASBREM) Committee meetings to ensure coordination between medical and non-medical S&T programs. Other JSTO-CBD responsibilities include providing a DoD CB defense S&T liaison with various organizations (to include DARPA, industry, academia, and other government agencies), providing support for DoD CB defense S&T international programs, and providing management and integration of CB defense ACTDs.

1.4 COORDINATION WITH RELATED PROGRAMS AND INITIATIVES

DoD CBDP activities are coordinate with other U.S. government agencies and with other nations to ensure all CB defense capabilities are integrated and coordinated within the interagency community. Management of the development and implementation of national security policies related to CB defense activities by multiple agencies of the U.S. Government are coordinated by the NSC Policy Coordination Committee for Proliferation, Counterproliferation, and Homeland Defense. An overview of key intra- and interagency and international coordination is provided below.

1.4.1 Other U.S. Government Organizations

Several organizations within the U.S. government are developing CBRN defense technologies. Five organizations with which the CBDP currently has formal coordination efforts include: (1) the Defense Advanced Research Projects Agency (DARPA), (2) the Counterproliferation Program Review Committee (CPRC), (3) the Technical Support Working Group (TSWG), (4) the Department of Homeland Security (DHS) Science and Technology Directorate, and (5) National Institute of Allergies and Infectious Diseases (NIAID). An overview of these programs is provided below.

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 CBRN Defense Program by anticipating threats and developing novel defenses against them. The DARPA program is unique in that its focus is on the development of technologies with broad

applicability against classes of threats. DARPA invests primarily in the early technology development phases of programs and the demonstration of prototype systems.

In accordance with 50 USC 1522, the Director of DARPA shall seek to avoid unnecessary duplication of activities under the program with chemical and biological warfare defense activities of the military departments and defense agencies and shall coordinate the activities under the program with those of the military departments and defense agencies. The DARPA BW Defense Program coordinates its efforts with numerous organizations, including the DATSD(CBD) and DTRA(CB) and by participation in the Technology Area Review and Assessment (TARA) process. 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 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. Additionally, the immune building program routinely coordinates activities across government including with the EPA and DHS.

1.4.1.2. **Counterproliferation Program Review Committee (CPRC).** The National Defense Authorization Act for Fiscal Year 1994 (Public Law 103-160, §1605) established the CPRC to optimize funding and ensure development and deployment of technologies and capabilities in support of U.S. counterproliferation policy and efforts, including efforts to stem the proliferation of WMD and to negate paramilitary and terrorist threats involving WMD. The CPRC is an interagency executive committee composed of the Secretary of Defense (Chair), the Secretary of Energy (Vice Chair), the Director of Central Intelligence, Chairman of the Joint Chiefs of Staff, and the ATSD(NCB) as the Executive Secretary. The CPRC Standing Committee, established in 1996, meets regularly to perform the duties and implement the recommendations of the CPRC. The Standing Committee is chaired by the ATSD(NCB). The DATSD(CBD) serves as the Executive Secretary. The Congressional mandate also directs the CPRC to identify and eliminate redundancies and uncoordinated efforts, establish program and funding priorities, encourage and facilitate interagency funding, and ensure DOE programs are integrated with operational needs of other government agencies. The CPRC is also chartered to report annually to congressional defense committees on the activities and programs of the DoD, the DOE, the intelligence community and the Joint Chiefs of Staff related to enhancing U.S. capabilities to counter the proliferation of NBC WMD (including their means of delivery) and NBC terrorism.

1.4.1.3. Technical Support Working Group (TSWG). 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 DoD, specifically the Assistant Secretary of Defense for Special Operations and Low Intensity Conflict, ASD(SO/LIC). The TSWG rapidly develops technology and equipment to meet the high-priority needs of the combating terrorism community, and addresses joint international operational requirements through cooperative R&D with the United Kingdom, Canada, and Israel. The TSWG also has an effective outreach program so that state and local agencies can benefit from new technology developments.

TSWG membership includes representatives from nearly eighty organizations across the Federal Government. These representatives work together by participating in one or more

of TSWG's nine subgroups. One of the subgroups is the Chemical, Biological, Radiological, and Nuclear Countermeasures (CBRNC) subgroup, which is co-chaired by representatives from the Federal Bureau of Investigation and the Intelligence Community. The CBRNC subgroup identifies and prioritizes interagency chemical, biological, radiological, and nuclear combating terrorism requirements, and identifies solutions for detection, protection, decontamination, containment, mitigation, and disposal.

The DoD CBDP and TSWG coordinate requirements and projects to maximize leveraging opportunities. However, equipment requirements for combating terrorism may differ from equipment requirements for the warfighter due to operational, regulatory, legal, and other considerations.

1.4.1.4. Department of Homeland Security Science & Technology Directorate. The Department of Homeland Security (DHS) Science & Technology (S&T) Directorate was established to tap into scientific and technological capabilities in the United States to provide the means to detect and deter attacks using weapons of mass destruction. DHS S&T will guide and organize research efforts to meet emerging and predicted needs and will work closely with universities, the private sector, and national and federal laboratories. The DoD and DHS are currently developing a Memorandum of Agreement to ensure effective cooperation on the science and technology and related initiatives being pursued by both agencies.

1.4.1.5. National Institute of Allergies and Infectious Diseases (NIAID). Prior to the anthrax letter attacks of 2001, the public sector has held relatively little interest in medical biological defense research, because identified biological warfare threats were of minor general medical interest and also because extensive and burdensome statutory safety measures are required in order to work with these agents. By the end of FY02, DoD medical biological defense research efforts included Small Business Innovative Research (SBIR) contracts and contract arrangements with 13 universities and 16 companies in the private sector, four of which are nonprofits. Funded agreements also existed with eight other governmental agencies. The most significant related federal effort resulted from the investment of approximately $1.7 billion in FY03 for a Counterbioterrorism Research Program to be managed by NIAID. However, NIAID has only a modest research investment in this area while the DoD has the infrastructure and expertise necessary to support this effort. Furthermore, NIAID's strategic plan overlaps significantly with DoD efforts. To that end, the NIAID and the U.S. Army Medical Research Institute of Infectious Diseases (USAMRIID), the lead laboratory for medical biological defense research, have entered into an agreement to coordinate portions of their biodefense research and development programs including a shared animal facility, cooperative development of vaccines, drugs, alternate therapies and diagnostics, and development of standardized strain collections.

1.4.1.6 National Science Advisory Board for Biosecurity (NSABB). On March 4, 2004, the Secretary of Health and Human Services chartered the NSABB. The purpose of the NSABB is to provide advice, guidance, and leadership regarding biosecurity oversight of dual-use research, defined as biological research with legitimate scientific purpose that may be misused to pose a biological threat to public health and/or national security. The NSABB will advise the Secretary of the Department of Health and Human Services (HHS), the Director of the National Institutes of Health (NIH), and the heads of all federal departments and agencies that conduct or support life science research. The NSABB will advise on and recommend specific strategies

for the efficient and effective oversight of federally conducted or supported dual-use biological research, taking into consideration both national security concerns and the needs of the research community. NIH shall manage and provide support services for the NSABB. The NSABB is authorized under 42 USC 217a, section 222 of the Public Health Service Act, as amended. The NSABB is governed by the provisions of the Federal Advisory Committee Act, as amended (5 USC Appendix 2), which sets forth standards for the formation and use of advisory committees.

Within DoD, the Army has established a Biological Surety Program. The Vice Chief of Staff of the Army directed the establishment of the Army Biological Surety Program. This is an Army G-3 validated mission to help ensure the safety and security of biologicval agents used in research at DoD laboratories. In 2003, the Army began coordination of the draft Biological Surety Regulation. The final draft of the regulation is in preparation for publication. In 2005, the Army G-3 will lead assistance visits (in coordination with the Department of the Army Inspector General and MACOMs) to assist Army facilities in implementing the regulation. The surety program and regulation were developed in coordination with the emerging DoD biological agent security program, the Department of Human Services "select agent" requirements, and the NSABB.

1.4.1.7. <u>Other Interagency Coordination</u>. The CBDP participates in efforts to coordinate research, development, and other efforts related to CBRN defense with other organizations throughout the federal government. Following are some highlights of these coordination efforts:

- *The InterAgency Board for Equipment Standardization and Interoperability* (known as the IAB), is a partnership with federal, state, and local agencies focused on the capabilities necessary for fire, medical, and law enforcement responses to WMD terrorism.
- Interagency Agreements with departments of Justice's Office Domestic Preparedness to purchase equipment in support of Justice's grant program.
- The White House Office of Science and Technology Policy chaired Weapons of Mass Destruction Program, Research and Development Subgroup.
- The National Security Council.
- Department of Health and Human Services (including the Food and Drug Administration, and the Centers for Disease Control and Prevention)
- U.S. Department of Agriculture.
- Department of Justice.

1.4.2 <u>International Cooperation</u>

The CBDP participates in numerous international cooperative and collaborative efforts to leverage technology development and to achieve commonality, interoperability, and systems integration among U.S. allies and coalition partners. (In addition, there are numerous cooperative efforts in doctrine and training, that is, Standardization Agreements (STANAGS), 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 Research and Development Project Agreements, (6) equipment and material loans, and (7) Research, Development and Acquisition Memoranda of Understanding (MOU).

During FY04, the United States participated in numerous international cooperative research and development efforts. Highlights of these efforts include (1) 50 DEAs with 21 countries, (2) six Technology Development Project Agreements in place or in development, (3) two MOUs, (4) 12 equipment and material loans, and (5) three exchanges under the Engineer and Scientist Exchange Program.

All cooperative agreements yield benefits to all participants in the agreement. In addition, there have been numerous CBRN defense capability gains from FY98 and through FY03 as a result of international cooperation. As a result of testing under the Foreign Comparative Testing (FCT) program, the Canadian Reactive Skin Decontaminating Lotion (RSDL) that was successfully tested under the Foreign Comparative Testing (FCT) program in FY02 has been licensed as a medical device by the Food and Drug Administration (FDA), and has been fielded during FY04. The FCT is the same program that saw successful procurement of the NBC Reconnaissance System (Fox Vehicle), Improved Chemical Agent Monitor (ICAM), the Automatic Chemical Agent Detector and Alarm (ACADA) and components of the Biological Integrated Detection System (BIDS).

With similar intentions, the U.S. has also entered (or are about to enter) into agreements that will permit the cooperative development of selected vaccines considered critical to military operations. Through these cooperative ventures on smallpox and plague vaccines, the U.S. will obtain significant financial assistance, while at the same time mitigating risk in the development process (in the case of the plague vaccine).

Chapter 2

Chemical Biological Defense Requirements and Research, Development, and Acquisition Program Status

2.1 INTRODUCTION

This chapter describes Joint Service chemical and biological (CB) defense requirements and research, development, and acquisition (RDA) programs and the status of these programs—from science and technology base through procurement. This chapter is organized within the framework of the six operationally oriented commodity areas. These commodity areas (and the sections within this chapter) are:

- Contamination Avoidance (2.2)
- Information Systems (2.3)
- Decontamination (2.4)
- Individual Protection (2.5)
- Collective Protection (2.5)
- Medical Systems (2.6)

The six commodity areas above address the traditional warfighting activities outlined in Joint Publication 3-11, *Joint Operations in a NBC Environment*. In addition, Section 2.7 addresses specific activities related to CB defense homeland security and force protection. Activities related to the test and evaluation infrastructure are detailed separately in Annex J.

The Joint Staff Joint Requirements Office for CBRN Defense (JRO-CBRND) completed a baseline capabilities assessment of warfighting operational activities in 2003. This assessment will be expanded in the future to include operational activities in support of homeland security, force protection, and other areas. The 2003 assessment developed a Joint Enabling Concept to align CBRN Defense into the four operational elements—Sense, Shape, Shield, and Sustain. Core capabilities for ***sense*** include reconnaissance, detection and identification; ***shape*** includes information systems; ***shield*** includes individual and collective protection, and medical prophylaxes and pre-treatments, and ***sustain*** includes decontamination, restoration, and post-exposure medical capabilities (i.e., therapeutics and diagnostics). The linkage between these joint enabling concepts and capabilities is illustrated in **Figure 2-1**.

During 2004, the JRO-CBRND led the Combating WMD Enhanced Planning Process (EPP) process that generated options for increased CBDP investment based on the new requirements and accompanying risk. The EPP supplemented the standard planning, programming, budgeting process and was based on guidance from the Secretary of Defense for military forces to be able to protect the homeland, deter forward, swiftly defeat and win decisively. The EPP used an analytical basis for defining requirements for each Service and for the total requirement for the Joint force

Based on the EPP findings, senior leaders agreed to increase the investment for the WMD countermeasures by $2.1 billion from FY06-11. This increase includes $0.8 billion in military construction funding included in the Defense Health Program for a renovation of the facilities at the U.S. Army Medical Institute of Infectious Diseases (USAMRIID). The increase also included $1.3 billion for the Chemical and Biological Defense Program (CBDP)—bringing

the total CBDP investment to $9.1 billion over that period. This investment strategy begins with the $1.549 billion FY06 President's Budget Request. The CBDP increase includes activities to enhance warfighter defense capabilities to include building a new test chamber for non-traditional agents; upgrading test and evaluation facilities; enhancing research and development efforts in areas of agent detection, early warning and battle management, decontamination, collective protection, and medical countermeasures.

When a valid operational need has been identified the Services examine the range of non-materiel solutions first (Doctrine, Organization, Training, Leadership, Personnel, Force Structure) within the Joint CBRN Defense construct in order to provide the most effective force while operating in a CBRN environment. If it is determined that none of the non-materiel options meet the required need, equipment or materiel solutions are pursued through the materiel acquisition process. The research and development modernization process will identify technological approaches that may result in a new operational capability or an upgrade to an existing operational capability.

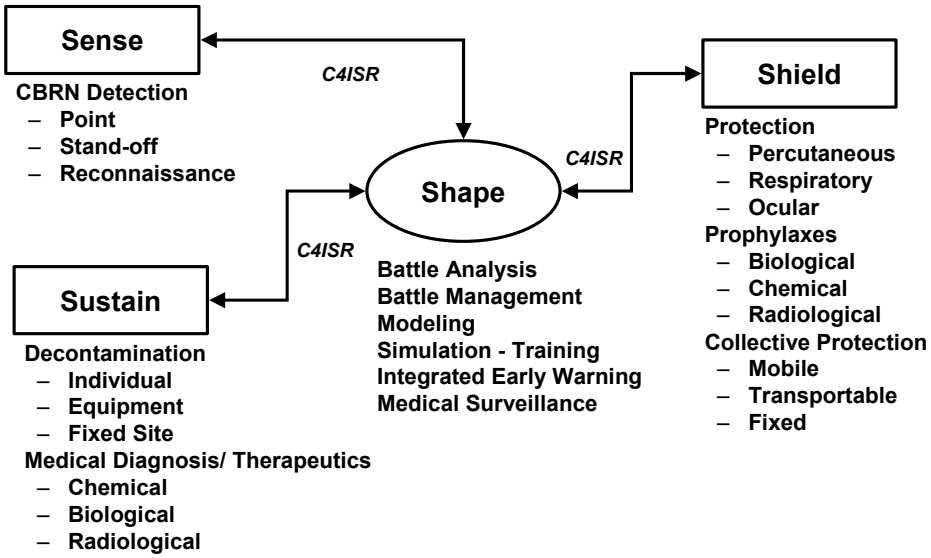

Figure 2-1 Joint CBRN Defense Enabling Concept and Supporting Core Capabilities.

In accordance with the Department of Defense report, *Military Transformation: A Strategic Approach*, November 2003, the CBDP is pursuing a strategy of innovation that includes three components:

- *Continuous small steps* – Incremental capability enhancements generally termed "modernization"
- *Many medium jumps* – Significant capability improvements within the current American Way of War
- *A few big jumps* – New rule sets that leverage new sources of military power, creating a new American Way of War

A key element of modernization includes the need to reduce cycle time in the acquisition of new systems or the integration of emerging technologies into existing systems. The use of open systems and architectures, the emphasis on commercial standards and practices, and adoption of commercial off-the-shelf systems when applicable, allows the Department 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.

"Medium jumps" include a variety of initiatives within the CBDP, including the use of Advanced Concept Technology Demonstrations (ACTDs), such as the Portal Shield ACTD, which resulted in the successful fielding of a networked biological detection system to meet specific installation protection needs. In addition, block upgrades allow for the insertion of new capabilities within existing systems or platforms.

"Big jumps" include approaches to pursuing advanced technologies to significantly improve CBRN defense capabilities for the warfighter in all operational environments. This includes a continuous investment in the science and technology (S&T) base to prevent technological surprise, as well as acquisition strategies, such as the CB Defense Initiative Fund, to solicit advanced technologies and approaches from non-tradition industrial, scientific, and academic sources.

A key programmatic and management tool within the science and technology base for supporting transformation is the use of key projects known as Defense Technology Objectives (DTOs). A DTO is a project (or a collection of closely related projects supporting a specific objective) that clearly states a specific set of objectives, the schedule, costs, specific warfighter payoffs (stated quantitatively against two or more metrics), and the customers for whom the technology is being developed. DTOs represent high priority projects that are consistent with the DoD S&T strategy and with User guidance as expressed in the CBRN Defense Joint Future Operational Capabilities (JFOCs) and the Joint Staff-developed CBRN Defense Baseline Capability Assessment (BCA) capability gaps. In addition to providing the foundation for the S&T program, the DTO construct is also a major source for fulfilling Government Performance and Results Act (GPRA) requirements. DTOs are proposed, reviewed, and updated annually.

Two types of DTOs exist—*applied technology* and *enabling technology*. An applied technology DTO is product oriented and targets specific technology advancements to be developed or demonstrated in support of a needed operational capability. An enabling technology DTO focuses on the development of knowledge to address a specific issue, and is a necessary intermediate step to achieve an operational capability.

Medical CBRN S&T efforts increasingly rely on enabling technology DTOs to evaluate multiple medical countermeasure technologies at the laboratory level, in order to select to one or more lead technologies for further evaluation in a follow-on applied technology DTO and before committing to rigidly controlled pivotal nonclinical studies. In medical programs, the applied technology DTO is intended to bring a mature medical countermeasure candidate forward for transition into advanced development and preparation of an investigational new drug (IND) application, evaluation in human clinical trials, and eventually, FDA licensure of a medical chemical and biological defense product for use by joint service members.

In addition to the use of DTOs, the CBRN defense technology base incorporates basic and applied research, including studies involving CBRN threat agents and toxicology, which supports development across all commodity areas. Understanding established and emerging CBRN threats is a critical factor supporting the overall CBRN defense program. Toxicological and pathological determination of operationally significant exposures to threat agents is fundamental to developing target requirements for materiel solutions across all commodity areas.

Within the science and technology base, the CBDP uses the Small Business Innovative Research (SBIR) program to elicit innovative solutions from the small business community that addresses chemical and biological defense technology gaps confronting DoD and that develop technologies having high commercialization potential in the private sector. (Information on CBD SBIR projects is provided in section 5.2.7 of the DoD CBDP Performance Plan.) SBIR topics are developed in each of the following capability areas to address both chemical and biological threats: detection; protection (individual and collective); decontamination; modeling & simulation; and supporting science (basic research). Additionally, specific program areas include chemical and biological defense medical technologies that address pre-treatments, therapeutics; diagnostics; and emerging threats.

Before 2004, the JSTO, JPEO, and T&E Infrastructure programs were identified and submitted as separate needs. In planning for the FY06 President's Budget Submission, an integrated budget was prepared. This budget was based on technology needs and directions, restructured acquisition programs, and integrated the T&E capabilities to execute these programs into both JSTO and JPEO programs. The programs were time and funding sequenced to be executable in terms of having the technologies demonstrated and transitioned in synchronization with the T&E capabilities. Thus, the milestones of the acquisition programs were based on the availability of not only the financial resources, but the technology and T&E resources needed to execute the programs. The full effect of this integrated, executable program structure will not be realized until 2006.

2.2. CONTAMINATION AVOIDANCE (Reconnaissance, Detection, and Identification)

The CBRN contamination avoidance capability area develops CBRN detectors and identifiers for point, standoff, and early warning applications for use in CBRN reconnaissance, detection and identification. For fixed sites where contamination cannot be avoided or for missions requiring operations in a contaminated environment, reconnaissance, detection, and identification are critical to ensure that forces can assume the optimal protective posture so that they can continue to sustain operations and rapidly identify and decontaminate (if possible or necessary) 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 the areas of chemical and biological standoff detection, early warning detection, miniaturization, and interconnectivity; enhancements in detection sensitivity, interference rejection, logistics supportability, and affordability are also being addressed. The increased lethality and heightened operational tempo of future battlespaces demand responsive detection and warning capabilities in order to reduce force degradation caused by CBRN contamination. These capabilities are critical for force readiness and will continue to be emphasized by the DoD community in the near and far term. Early detection and warning are keys to avoiding CBRN hazards. The following sections detail contamination avoidance science and technology efforts, modernization strategy, and Joint Service programs.

2.2.1 Detection Science and Technology Efforts

2.2.1.1 Goals and Timeframes. The goal of contamination avoidance is to provide a real-time capability to detect, identify, characterize, quantify, locate, and warn against all known or validated CBRN warfare agent hazards, to include non-traditional agents (see **Table 2-1**). 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 CBRN agent detection and remote/early warning CBRN detection. These far-term objective technologies seek to integrate chemical and biological point and remote/early warning detection modules into a single system, the Joint Modular CB Detection System. Research and development efforts seek to optimize and balance system sensitivity, size/weight, cost, power consumption, signature suppression and false alarm rate. Ultimately the goal is direct integration of CBRN detectors as a single system into various platforms linked into command, control, communication, computer, and intelligence (C^4I) networks.

Table 2-1. Detection Science and Technology Strategy.

NEAR (FY06-07)	MID (FY08-11)	FAR (FY12-21)
• Complete Milestone A for Joint Chem/Bio/Rad Agent Water Monitor. • Demonstrate laser enhanced RAMAN technology to detect the presence of chemical agents on surfaces. • Demonstrate enhanced aerogel-based biological agent sample collection capability. • Continue development of the Joint Biological Standoff Detection System (JBSDS) Block I. ▪ Downselect technologies to the best two or three approaches for lightweight integrated CB detection. ▪ Evaluate breadboards in field environments to detect and discriminate (biological vs non-biological) biological and chemical agents at concentration of 1,000 ACPLA at a range of 1 km.	▪ Complete prototype build for an antibody multiplex assay system with reader to reduce consumable cost for JBPDS. ▪ Demonstrate laser enhanced RAMAN technology to detect the presence of chemical agents on surfaces. Support transition of technology into Chemical Unmanned Ground Reconnaissance (CUGR) ACTD. ▪ Conduct analytical feasibility studies on the technical parameters in the detection of CB contamination on surfaces in post decontamination applications. ▪ Continue development of first generation breadboard based on millimeter wave spectroscopy for bio detection.	• Demonstrate integration of chemical and biological agent detection modules into a single sensor suite. • Complete fielding of the Block II JBPDS. • Complete development of CB water monitor. • Tranisition technology to the Joint Modular Chem/Bio Detection System (JMCBDS).

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

<u>New and Ongoing DTOs:</u>
- Stand-off Biological Aerosol Detection
- Chemical Biological Agent Water Monitor
- Lightweight Integrated CB Detection
- Wide Area Aerial Reconnaissance for Chemical Agents
- Chemical Unmanned Ground Reconnaissance (CUGR) ACTD

<u>Completed DTOs</u>:
- Automated Genetic Identification
- Biological Warfare Defense Sensor System (DARPA program)

- Terrorist Chemical/Biological Countermeasures (TSWG program)
- Activity Based Detection and Diagnostics (DARPA program)

2.2.1.2 Potential Payoffs and Transition Opportunities. Future CBRN detection systems will provide the capability to detect, identify in real time, map, quantify, and track all known CBRN contamination in a theater of operations. This will enable commanders to avoid CBRN 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. CBRN detection technologies have dual use potential in Occupational Environmental Health Surveillance for monitoring air pollution, noxious fumes inside enclosed areas, and municipal water supplies.

2.2.1.3 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. Among other technical challenges for detection are the size, weight, and power reduction of detectors, power generation and consumption, development of integrated biological and chemical detection systems, the fusion of sensor data with mapping, imagery, and other data for near real-time display of events, standoff detection on surfaces, and detection and quantification of low level exposures. Challenges for T&E capabilities development include: those of realistically portraying an agent threat environment in a live agent chamber; performing robust, valid agent-simulant correlations; and developing the analytical methodologies and modeling & simulation required to fully characterize the detector system performance under battlefield conditions.

There are two critical challenges facing 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 dependence on reagents and trade-offs among 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.

2.2.1.4. Defense Advanced Research Projects Agency (DARPA) Detection Programs. DARPA has sponsored four related programs that contribute to the development of advanced sensor technology: BW defense environmental sensors, tissue-based biosensors, pathogen genome sequencing, and microfluidic molecular systems.

DARPA BW Defense Environmental Sensors Program. DARPA is developing technologies to enable bioagent detection and identification to include environmental sensors, optically based biosensors, tissue-based biosensors, pathogen genome sequencing, and microfluidic molecular systems.

One approach involves the development of high performance, deep ultraviolet semiconductor laser diodes to be used in compact, reliable, and inexpensive biosensors based on the principles of laser induced fluorescence and ultraviolet resonance-enhanced Raman spectroscopy. The new semiconductor laser diodes will enable the practical use of multiple excitation sources in a single compact sensor, thereby leading to a reduction in false alarms. These sensors will be able to detect viruses, bacteria, and toxins. This program is in its third year of a four-year effort.

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.

A mass spectrometer is being miniaturized for potential use in identifying BW agents and contaminants without the use of liquids, with the goal of establishing end-to-end time faster than one minute. A desktop mass spectrometer using an infrared (IR) laser analysis of the biological sample has been developed by DARPA and commercialized for analysis of biological agents. These systems may be automated for unattended operations.

Another line of research is the integration of several technologies to provide significant improvements in bio-detector capabilities. The DARPA spectral sensing of biological aerosols (SSBA) program is exploring combinations of technologies such as aerodynamic particle focusing, ultrasonic focusing, fluorescence lifetime measurement, mass spectroscopy, and Raman spectroscopy, in conjunction with advanced signal processing to capitalize on potential synergies. Detection technologies that provide information on BW agent pathogenicity, antibiotic resistance and viability are also being developed under the DARPA biological detection program.

DARPA is developing several new technologies for the detection and identification of chemical warfare agents and toxic industrial chemicals in a building environment. Novel approaches to infrared and ion mobility spectroscopy offer the potential for significantly increased sensitivity and reduced false alarms.

DARPA is developing technologies to enable the detection of bioagents in a handheld device through the utilization of advanced isothermal detection methods for DNA, RNA and protein based threats. This technology will enable the realization of a handheld device, operated by military personnel in field environments that will be capable of identifying biological weapon threats across the entire threat spectrum including bacteria, viruses and toxins at the same level of performance currently achieved in the laboratory.

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 Pathogen Genome Sequencing Program. A completed DARPA program has sequenced 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.

DARPA Microfluidic Molecular Systems Program. This program had the goal of developing micro total analysis systems through focused research on microfluidic, chip-scale technologies. This program concluded in FY02. Several demonstrable handheld prototypes, such as a programmable microfluidic system for remote sensors, were tested. 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 was the aim of this program. Microfluidic components/devices that were investigated include chip-scale micropumps/valves, particle separation filters, fluidic interconnects, fluidic manipulation of hybridized microbeads, controlled mixing/dosing, *etc*.

2.2.2. Contamination Avoidance Modernization Strategy

The increased lethality and heightened operational tempo of future battlespaces demand responsive detection and warning capabilities in order to reduce force degradation caused by CBRN contamination. These capabilities—which encompass reconnaissance, detection, identification, and reporting—are critical for force readiness and will continue to be emphasized by the DoD community in the near and far term. **Table 2-2** shows the roadmap of DoD requirements for contamination avoidance, and highlights capabilities being developed and procured in the near term, and developmental programs that are planned to be available in the mid to far-term. Fielded legacy systems maintained by the Services through their operations and maintenance (O&M) accounts are not indicated in this table. While the near-term requirements primarily address service-specific needs, those in the mid to far-terms primarily address Joint Service needs.

Early detection and warning are keys to avoiding CBRN hazards. As a result, DoD is investing in RDA efforts to provide the warfighters real-time capabilities to detect, identify, quantify, and warn against all CBRN warfare hazards. Real time detection of biological agents is currently unavailable and is unlikely in the near to mid-term, though investment efforts are focused on reducing detection times. The near to mid term focus is on developing stand-alone detectors and sensors, system miniaturization, improved sensitivity and specificity, agent characterization, range, decreased false alarm rate, and decreased operation and support costs. This focus will facilitate the integration of chemical detectors into personal warfighter gear (Objective Force Warrior Program (OFW)), CBRN 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 current and planned RDA efforts and Service

involvement. Fielded legacy systems maintained by the Services through their O&M accounts are described in the annex.

Table 2-2. Contamination Avoidance Modernization Strategy.

	Fielded Capabilities	NEAR (FY06-07)	MID (FY08-11)	FAR (FY12-21)
Chemical Point Detection	• Surface off-gas sampling capability (ICAM) • Automatic point detection of nerve and blister agents (ACADA)/(Ship ACADA) • Navy-*Ship based improved automatic point detection of nerve/blister (IPDS)*	• Improved, all-agent programmable automatic point detection; portable monitor; miniature detectors for aircraft interiors; interior ship spaces; wheeled and tracked vehicles; and individual soldiers (JCAD)		• Improved surface contamination monitor • Detection of CB contamination in water (Joint Chemical Biological Radiological Agent Water Monitor, JCBRAWM)
Biological Point Detection	• Navy-*Ship based Interim Biological Agent Detector (IBAD)* • Army-*Biological Integrated Detection System (BIDS)* • Provide critical reagents, assays, and sampling kits necessary to the operation of all DoD biological detection systems. (Critical reagents program) • Joint Portal Shield Network Sensor System	• Automatic long line source and point/mobile biodetection to detect and identify bio-agents; programmable (JBPDS)	• Complete development of JBPDS – increase number of agents detected and identified with increased sensitivity, lower false positive rates; smaller and lighter with increased reliability.	• Automatic point biodetection, to detect and identify; programmable (JBPDS) • Automated, integrated detection of both biological and chemical agents in a single sensor package (Joint Modular Chemical/Biological Detector System, JMCBDS) • JCRBAWM (See above) Program start (FY09) for Joint Modular Chem/Bio Detection System (JMCBDS) – small lightweight biodetector – networked system

	Fielded Capabilities	NEAR (FY06-07)	MID (FY08-11)	FAR (FY12-21)
CBRN Recon-naissance and CB Remote and Stand-off Detection	• Improved CBRN Reconnaissance Vehicle with remote/early warning and data fusion capabilities (M93A1)	• Lightweight passive stand-off detection for chemical agent vapors (JSLSCAD Increment I) • Light reconnaissance vehicle (JSLNBCRS)	• Add biological detection and identification capabilities (JSNBCRS P3I) • Integrated CBRN detection (point/standoff)/identification/ sampling /IAV-NBCRV) • Automated biological remote detection and early warning capabilities (JBSDS Block I) • Lightweight passive stand-off detection for chemical agent vapors (JSLSCAD Increment 2)	• Automated biological remote detection and early warning capabilities (JBSDS Block II) • Artemis (Chemical Agent Stand-off Detection System), detection, ranging, and mapping of chemical rains, vapors and aerosols • Wide area detection • Single, fully-integrated multifunctional NBC Recon platform with NBC Unmanned Ground Vehicle System (UGVS) capability (IAV-NBCRV) • FCS – CBRN Manned Recon and Unattended CBRN Sensors
Radiation Detection	• Army, Marine Corps-AN/PDR-75, AN/VDR-2 RADIAC • Marine Corps- IM-143 • Army-AN/PDR-77 RADIAC • Air Force-ADM-300 • Navy-Multi-function RADIAC	• Army -*Compact, digital whole body radiation measurement (AN/UDR-13)*		• Stand-off radiation detection and measurement • Portable radiation meter

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

* Continuing procurement in near term.

2.2.3. Joint Service Contamination Avoidance Programs

Within the Joint CBRN Defense Program, Service contamination avoidance needs are addressed by ten fully coordinated joint projects. **Table 2-2** highlights Joint programs; Service-unique programs are italicized. The Joint Programs are:

- Automatic Chemical Agent Detection Alarm (ACADA).
- Joint Chemical Agent Detector (JCAD).
- Joint Service Lightweight Standoff Chemical Agent Detector (JSLSCAD).
- Joint Biological Point Detection System (JBPDS).
- Joint Biological Standoff Detection System (JBSDS).
- Joint Service Light NBC Reconnaissance System (JSLNBCRS).
- Joint Chemical Biological Radiological Agent Water Monitor (JCBRAWM).
- Joint Portal Shield.
- Critical Reagents Program.

2.2.4. T&E Infrastructure to Support Contamination Avoidance

Future T&E capabilities to support contamination avoidance will provide the ability to detect and identify agents, as well as build performance correlations between simulated and actual warfare agents. Planned and program-aligned infrastructure and capabilities to support contamination-avoidance programs include:

- Development of a Whole-System Live-Agent Testing (WSLAT) chamber to test biological point detection systems against actual biological agents
- Data-standardization and integration for CB detection systems
- Development of a standoff test capability for CB detectors
- Development of high-speed meteorological and test-environment monitoring capabilities
- Development of agent-to-simulant performance correlations for detection systems
- Testing of CB detection systems with nontraditional agents (NTAs)
- Real-time test-data collection capabilities
- Development and fielding of a synthetic test environment for robust testing of CB detection systems.

2.3. INFORMATION SYSTEMS

The Information Systems area seeks to develop the capability to use automatic collection and fusion of information from all CBRN defense assets throughout the battlespace and integrate that with other relevant battlespace information and C^4I systems. It will integrate threat information, CBRN sensor and reconnaissance data, protective posture data, environmental conditions, medical surveillance, and other data pertaining to the CBRN 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 the CBRN Defense mission, such as 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 CBRN detection and CBRN 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 information and analysis capabilities to enhance hazard forecasting and assessment, and operational decision-making. 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 can assume appropriate protective postures and develop options to continue mission-essential operations.

The Joint Warning and Reporting Network (JWARN) will provide Joint forces with a comprehensive warning and reporting capability to collect, analyze, identify, locate, report, and disseminate CBRN and Toxic Industrial Material hazard information to affected personnel. Providing this information to the warfighter affectively minimizes the effects of hostile CBRN attacks as well as accidents/incidents. JWARN will integrate with Joint/Service C4ISR systems and networks. JWARN will utilize the Joint Effects Model (JEM) and the Joint Operational Effects Federation (JOEF).

The JWARN Block I effort began fielding the first version of software in FY98. The JWARN Block II effort commenced in FY01. The JWARN program achieved a Milestone B (MS B) decision in July 2003. Subsequent to MS B, a contract was awarded and the acquisition strategy was revised. Currently, the acquisition strategy is awaiting approval by the USD(AT&L). The new acquisition strategy eliminates the incremental development of JWARN and combines Block II and Block III into one increment and addresses 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 (FY09), which will detect and identify chemical threats, and which will be cued by early warning systems, such as JSLSCAD and Artemis. The JWARN effort includes a JWARN Component Interface Device (JCID), which provides connectivity to legacy and developmental CBRN sensors and detectors via wire and/or wireless communication. The information from 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.

Information Systems also provides tools for the warfighter to understand a specific challenge and evaluate proposed solutions. These systems provide the warfighter with a full spectrum of capabilities to automatically create warning reports and situational awareness from sensory input, and perform hazard analyses, operational effects analyses, and accurate training. Modeling and simulation capabilities are used to provide situational awareness, to provide hazard warning and prediction, and for planning or modification of operations. In the future, modeling and simulation capabilities will be used to provide operators and decision makers with the ability to analyze courses of action immediately prior to or in concert with response objectives. In addition, modeling and simulation aids in the assessment of Joint and Multi-Service doctrine, training, materiel development, and equipment design (i.e., Simulation Based Acquisition). Modeling and simulation is also used to support warfighter training and the training of battle staffs using larger conflict simulations. In the latter aspect, modeling and

simulation is used to perform and support analyses of CBRN defense operations within the context of larger military operations. Analytic systems such as models are also critical components of larger systems, such as JWARN and command and control systems. These efforts also support simulation-based acquisition in the development of critical CBRN defense capabilities.

The following sections provide a summary of the Modeling and Simulation science and technology efforts, modernization strategy, and Joint Service programs, which support the Information Systems area.

2.3.1 Modeling and Simulation Science and Technology Efforts

The Modeling and Simulation science and technology efforts include four sub-areas to fully meet the CBRN Defense Joint Future Operational Capabilities (JFOCs). A primary JFOC focus is on capabilities to provide improved information systems, characterization of the CBRN environment, information systems, and simulation based acquisition. To provide improved characterization of the CBRN environment, efforts are continuing to provide advanced hazard assessment methodologies, to address specific environmental flow regime issues (such as high altitude and urban transport and diffusion (T&D) methodologies) and to support first principle physics, chemistry, and meteorology efforts. Information Systems technologies are addressing operational effects and processes for fixed site simulations, as well as advances in conflict simulation methodologies and distributed information systems. The technology base efforts also leverage information on weapons effects, medical, and larger DoD Modeling and Simulation communities to address source term and toxicology, interoperability and architectural issues. [Note: Dispersion is the combination of T&D. T&D only refers to the airborne behavior of a contaminant. The DoE uses transport and fate to address additional physical processes. Hazard assessment includes all of these factors, plus the inclusion of source characterization and toxicity.]

2.3.1.1 Goals and Timeframes. The goals of CBRND modeling and simulation science and technology efforts are as follows:

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

Table 2-3 shows specific efforts supporting these goals. Current modeling capabilities are designed to support warfighter efforts to conduct scenario simulations prior to engagements and to train in a realistic manner. Recent advances allow CBD planning to be folded into larger conflict simulation and consequence management tools. SBA tools will be used for detectors in conjunction with other CBD environment models to assess acquisition strategies for several Service/Joint detector and platform acquisition programs. The next generation T&D methodologies will provide a multi-fidelity capability, which will allow the warfighter increased flexibility and more responsiveness to threat and hazard predictions. The far-term capabilities will include a near-real-time operational hazard prediction capability. An ongoing effort in modeling is the incorporation of specific advances in the characteristics of contamination

avoidance, decontamination, medical and protection systems into models so that warfighters are able to evaluate and plan for advances. Integrated conflict simulation capabilities are also envisioned to meet theater and strategic simulation requirements.

Defense Technology Objectives (DTOs) with a modeling & simulation (M&S) or Information System focus include:

- DTO CB.43, Chemical and Biological Warfare Effects on Operations,
- DTO CB.55, Chemical and Biological Hazard Environment Prediction,
- DTO CB.42, Environmental Fate of Agents,
- DTO CB.51, Low-level CW Agent Exposure: Effects and Countermeasures, and
- DTO CB.62, Hazard Prediction with Nowcasting.

Table 2-3. Modeling & Simulation Science and Technology Strategy.

NEAR (FY06-07)	MID (FY08-11)	FAR (FY12-21)
• Demo improved VLSTRACK Version 3.2 for CHEMRATS • Continue efforts with MESO and CBW Computational Fluid Effects (CBW-CFX) technologies • Demonstrate Sea port of debarkation capability: Simulation Training and Analysis For Fixed Sites (STAFFS) • Initiate Joint Effects Model (JEM) acquisition program • Provide an urban dispersion model to JEM • Develop common accreditation standards for models	• Demonstrate and transition MESO and CBW-CFX methodologies to JEM • Demonstrate and transition STAFFS • Demonstrate and transition Joint Medical NBC Decision Support Tool to JOEF • Detection Simulation-Based Acquisition (SBA) application transitioned to Virtual Prototyping Systems (VPS) • Collective Protection SBA application to VPS • Virtual Emergency Response Training System (VERTS) transitioned to Training Simulation Capability (TSC) Block I • Demonstrate emerging advanced information system technologies • Investigate agent fate of non-traditional agents (NTAs)	• Demonstrate advanced system architectures for JEM and JOEF • Demonstrate real-time, course-of-action decision making options technology • Demonstrate micro scale weather forecast hazard prediction capability • Demonstrate mobile forces CBD operational effects capability • Demonstrate emerging advanced info systems technologies • Decontamination SBA applications transitioned to VPS

The objective of DTO CB.43 is to develop a general-purpose model of the operations of large fixed-site facilities [air bases, aerial ports of debarkation (APODs) and seaports of debarkation (SPODs)], with the capability to represent CBRN hazards and their operational impacts. DTO CB.55 will focus on needed methodologies for advanced real-time hazard prediction capabilities. DTO CB.42 will provide required data for accurately predicting the fate of chemical agents on surfaces of military interest. DTO CB.51 will deliver data sets on operationally relevant health effects of exposures to sublethal concentrations of chemical warfare agents. DTO CB.62 will provide the high-resolution meteorological forecasting capabilities that are only required for CBRN operational decision making processes.

2.3.1.2 <u>Potential Payoffs and Transition Opportunities</u>. Future information systems will enhance C4ISR systems with a level of situational awareness with significant improvements including: accurate information, knowledge, and predictions of threats, the environment, operational alternatives and effects in real time, accelerated time, or as required. This will enable commanders to control the battle, analyze the need for CBRN defense actions, verify effective deployment of CBRN defense assets and reconstitution procedures, assume the appropriate protection required to continue operations, and sustain their mission with minimal

performance degradation and casualties. CBRN M&S technologies have dual use potential, *e.g.*, predicting and responding to civil support concerns such as terrorist activities, air pollution alerts, toxic industrial chemical (TIC) releases, both outside and inside enclosed areas, and the safeguard of municipal water supplies. The key payoffs of M&S include: (1) commanders and battle staffs are better trained and able to analyze alternate courses of action with advanced simulations, (2) there is less confusion and more consistent decision making via use of a federation of analytical and real time CBD environment M&S tools, (3) CBRN defense systems and operational concepts match requirements more closely because warfighter feedback is captured earlier in the development cycle under the tenets of SBA, and (4) advanced hazard prediction and human effects modeling has dual use potential in aiding civilian responders or planners to prepare for or respond to terrorist attacks and industrial accidents.

2.3.1.3 Major Technical Challenges. Major technical challenges for M&S include the following: (1) accurate agent fate data, (2) modeling and validating the effects of complex and urban terrain on CBRN hazards, (3) modeling and validating high altitude threat intercept effects, (4) modeling and validating human effects and small unit behaviors in a CBRN environment, (5) modeling and validating effects of low level and long term exposures, (6) effectively quantifying the effects that CBRN hazards have on complex fixed site operations, (7) integrating CBRN effects and operations with C4I systems for training and operations, (8) interjecting CBRN effects into combat and materiel evaluation simulations with adequate fidelity without bringing the simulations to a standstill, and (9) developing engineering level models of CBRN defense equipment that can participate in distributed simulations to support SBA from inception to system retirement.

2.3.2. Information Systems Modernization Strategy

The CBRN Information Systems modernization strategy has been divided into two major pieces: The Warning and Reporting (W&R) Systems and the Modeling and Simulation (M&S) Systems. **Table 2-4** shows the roadmap of DoD requirements for both warning and reporting and modeling and simulation, and highlights capabilities being developed and procured and the near term and developmental programs that are planned to be available in the mid to far-term. Legacy systems that are still maintained by the Services are not indicated here.

W&R systems combine hardware with information systems solely as a result of the need to create the physical means to automatically provide sensor system data to the information system and consequently to provide the resulting information in an effective manner to the human operator. Therefore, W&R systems have evolved from platform based (ANBACIS and MICAD) efforts to the more generic JWARN system hosted on C4ISR systems with the capability of receiving data from or controlling all legacy and future CBRN sensors. Like M&S Systems, W&R systems though capable of stand-alone operation, are typically hosted on other major hardware and software systems.

The CBD M&S program includes efforts from technology base through full-scale system development and demonstration. The Joint Effects Model (JEM) program is based upon the proven technologies of existing agent hazard assessment models and the emerging operational requirements document, which articulates the Joint Service needs. The JEM program achieved Milestone A in May 2001.

The Joint Operational Effects Federation (JOEF) program achieved Milestone A in February 2002. JOEF is the acquisition program that addresses operational effects and planning.

JOEF will use JWARN and JEM to predict or analyze the nature of the hazard area, but will take that information and use a federation of other models and simulations to meet a specific operational commander's or other authority's needs. The combination of JWARN, JEM and JOEF will meet wide spectrum of user needs for analytical M&S systems.

Analysis and training are the keys to being prepared for and responding to a CBRN event. As a result, DoD is concentrating RDA efforts on providing its warfighters and decision makers with analytical systems to predict or forensically analyze events and courses of action for the full spectrum of CBRN threats. In the near term, efforts are focused on taking advantage of technology development in hazard assessment methodologies to provide interim accreditation for a number of analysis regimes. In addition, efforts in operational effects and SBA will be prepared to transition to full scale development programs. In the mid-term, first priority has been given to transitioning the most mature technologies to the new start JEM and JOEF programs. These will provide accredited, common use hazard information systems by the years 2006 and 2008 respectively. Largely due to the maturity of the technologies, requirements and the vision for them, the SBA and Training Systems Capability (TSC) will be addressed behind those for analysis. However, both SBA and TSC are also functionally and structurally dependent upon the analytical systems so a delay in their start is appropriate. Table B-1 in Annex B provides an overview of RDA efforts and Service involvement.

The management challenge involves the coordination and consolidation of numerous previously uncoordinated RDA efforts across the Services and Agencies. This strategy, led by the JPEO through the Joint Project Manager, Information Systems (JPM IS), established in April 2003, has already resulted in the initiation of the above-mentioned Joint Service RDA efforts.

2.3.3. T&E Infrastructure to Support Information Systems

Future T&E capabilities to support battlefield Information Systems will provide the ability to perform automated and integrated stimulation of systems, collection of system performance data, and processing of data to evaluate M&S systems as used within operational test/unit exercises when integrated into an overall battlefield scenario; eventually testing will be virtual simulation with or without a small actual test unit in play. The focus will be on digitizing the environment and performance of systems of systems against which to play the CBDP M&S system, with the ability to run thousands of scenarios quickly to identify major areas of focus and combinations of conditions best suited for actual live testing. Time-sequenced and aligned efforts to support RDA activities in information systems include:

- Development of high-speed ground-truth and test-environment monitoring capabilities
- Development of portable testing capabilities
- Development and implementation of improved data-fusion techniques
- Improvement of test-area data-collection capabilities
- Development of synthetic test capabilities using operational-testing stimulators
- Development and implementation of real-time test-data collection capabilities for field testing.

Table 2-4. Information Systems Modernization Strategy.

	Fielded Capabilities	NEAR (FY06-07)	MID (FY08-11)	FAR (FY12-21)
Warning and Reporting Systems	• Automated, standardized warning and reporting (JWARN Block I) • MICAD Fox vehicle system		• Integrated and automatic warning and reporting (JWARN Block II & III) • JSLNBCRS embedded JWARN system	
Hazards Analysis	• Counterforce hazard prediction (HPAC 4.0) • Passive defense hazard analysis (VLSTRACK 3.1)	• High altitude intercept analysis (PEGEM) • Urban environment analysis (MIDAS-AT) • CONUS facilities analysis (D2PC) • DoD Standard for hazard prediction and effects capability (JEM Block I)	• Increase capability to analyze high altitude intercepts and urban environments (JEM Block 2)	• Multi-fidelity hazard prediction, to move at will from global, to theater, to battle, to building, to individual scale analyses (JEM Block 3) • Micro-scale event analysis (JEM Block 4)
Operational Effects Analysis		• Fixed site analysis (STAFFS) • Medical resources analysis (CREST) • Mobile forces analysis (NCBR Simulator)	• Deliberate and crisis action planning decision support tools (JOEF Block I)	• Additional C41 system integration and incident management (JOEF Block 2)
Simulation Based Acquisition Systems		• Navy-Ship based analysis (CWNavSim) • Point and stand-off detector systems (NCBR Simulator)	• Detection (VPS Block 1) • Biological detection and identification capabilities (VPS Block 2)	• Protection and decontamination (VPS Block 3&4)
Training Simulation Systems		• Virtual Emergency Response Training System (VERTS)	• VERTS Capability becomes Training Simulation Capability (TSC) Blocks 1 and 2 • Individual and crew training systems (TSC Block 2)	• Integrated training systems for battle staffs and commanders (TSC Block 3)

2.4. DECONTAMINATION

When contamination cannot be avoided, personnel and equipment may need to be decontaminated to reduce, eliminate or neutralize hazards after CBRN weapons employment. Decontamination systems provide a force restoration capability for units that become contaminated. Simultaneously, two commercial application systems have been tested and one fielded in response to a second urgent need statement. Technology advances in sorbents, coatings, catalysts, and physical removal will reduce logistics burden, manpower requirements, and lost operational capability associated with decontamination operations. The following sections detail CBRN decontamination science and technology efforts, modernization strategy, and Joint Service programs.

2.4.1. Decontamination Science and Technology Efforts

2.4.1.1 Goals and Timeframes. The goal of decontamination science and technology is to develop technologies to support a key Joint Future Operational Capability (JFOC)—Restore (Decontamination of Equipment/Facilities/Large Areas) JFOC. This capability will eliminate toxic materials or their effects without performance degradation to the contaminated object and will be non-corrosive, environmentally safe, and lightweight (see **Table 2-5**). This area includes decontamination of personnel, individual equipment, tactical combat vehicles, aircraft, ships, facilities, and fixed sites. Decontamination technologies currently being pursued include non-chlorine based oxidants, catalysts that improve reactivity, decontaminants that are effective in both fresh and brackish water, improved reactive sorbents, and nanoparticle technology. Non-ozone depleting fluorocarbons and solvent wash technologies are being investigated for sensitive equipment decontamination, while thermal approaches, solvent wash technologies, and solvent suspensions of reactive nanoparticles are among the candidates being evaluated as a decontaminant for interior spaces of vehicles such as aircraft. In 2003, a Congressionally directed program was initiated to examine vaporous phase hydrogen peroxide as a decontaminant for interior spaces to include military items such as aircraft and the interiors of buildings. New oxidative decontamination formulations that are effective against both chemical and biological agents are being developed through DTO CB.44, Oxidative Formulations. These potential decontaminants will also be nontoxic, non-corrosive, and environmentally safe. CBRN contamination survivability of materiel would also be enhanced.

Table 2-5. Decontamination Science and Technology Strategy.

NEAR (FY06-07)	MID (FY08-11)	FAR (FY12-21)
• Demonstrate oxidative decontaminants for chemical and biological agents	• Demonstrate Sensitive Equipment Decon Systems for interior spaces • Demonstrate concentrated oxidative decontaminants • Demonstrate Family of Applicators • Demonstrate the next generation of reactive sorbent powders	• Demonstrate new self-decontaminating materials • Demonstrate improved thorough decon materials • Demonstrate aircraft and other vehicle interior decontamination • Demonstrate personnel decontaminant

Contamination control involves investigating procedures that minimize the extent of contamination pickup and transfer, and that maximize the ability to eliminate the contamination pickup on the move as well as during decontamination operations. During FY04, increased emphasis was placed on aircraft decontamination, especially analyzing material compatibility

concerns, as part of the Joint Service Sensitive Equipment Decontamination program, the Contamination Avoidance at Seaports of Debarkation (CASPOD) ACTD (DTO JD.23), Restoration of Operation (RestOps) ACTD (DTO. JD.22), which has been completed.

2.4.1.2 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 timely elimination of CBRN hazards 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. Potential uses for environmental remediation, especially those dealing with pesticide and toxic industrial chemical contamination and implications to domestic scenarios, are being exploited.

2.4.1.3. Major Technical Challenges. There are two key technical challenges associated with chemical and biological decontamination. 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 simultaneously reducing the manpower and logistics burden. Challenges to the development of decon T&E capabilities also lie in safety of use of the simulated agent or decontaminant, and in correlating stimulant field performance to that of the corresponding live agent.

2.4.1.4. DARPA Decontamination Programs. The Radiation Decontamination (RD) Program addresses the terrorist threat from the release of a Radiological Dispersal Device (RDD), or so-called dirty bomb, on or upwind of a military installation. This program is developing a system of technologies that will allow for the detection and controlled decontamination of radioactively contaminated buildings and military bases located downwind from an RDD event. The main threat of an RDD event is not that the levels of radiation will be immediately toxic but that a large area will be contaminated and untenable due to the risk of long-term radiation effects. The threshold of contamination that is considered safe corresponds to an absorbed radiation of 1 milliSievert/year at a distance 1 meter from the building surface. To create remediation technologies that will enable fast, low-cost, and efficient decontamination of buildings on military bases following an RDD event, this program requires technologies to detect radioactive material dispersed on building surfaces, as well as new decontamination technologies for cleanup.

2.4.2. Decontamination Modernization Strategy

The goal of the CBRN Decontamination program area is to provide technology to remove and detoxify contaminated material without damaging combat equipment, personnel, or the environment. Decontamination systems provide a force restoration capability for contaminated units. Existing capabilities rely upon the physical application and rinse down of decontaminants on contaminated surfaces. Existing systems are effective against a wide variety of threat agents, yet are slow and labor intensive and present logistical, environmental, material, and safety burdens. Existing systems are also inadequate for electronic equipment decontamination, deficient for large area, port, and airfield decontamination, and rely on water or bleach-based aqueous systems. 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 2-6** shows the roadmap for modernizing decontamination systems in DoD, and highlights capabilities being developed and procured in the near term, and developmental programs that are planned to be available in the mid to far-term. Legacy systems that are still maintained by the Services are not indicated here.

A Decontamination Master Plan provides a roadmap that integrates RDA efforts with non-RDA efforts, including policy, doctrine, standards, and revised tactics, techniques and 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 decontamination approaches, such as sensitive equipment decontamination methods and large-scale decontamination systems attract interest across the Services. Table D-1 in Annex D provides an overview of Joint Service RDA efforts and Service involvement.

2.4.3. 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. An adsorbent that 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 obsolete Decontamination Solution 2 (DS2) and for corrosive High Test Hypochlorite (HTH) and Super Tropical Bleach (STB). New technologies, such as reactive decontaminating systems, oxidative formulations, and enhanced sorbents are being explored and may offer operational, logistical, cost, safety, and environmental advantages over current decontaminants. Present chlorine-based decontaminant solutions pose an unacceptable corrosion risk to 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 under 15 minutes and be effective at a pH below 10.5 in order to minimize corrosion. Potential new solutions-based approaches consist of organic, aqueous and mixed organic-aqueous systems, which use catalytic and oxidative chemistries. Some promising decontaminants under consideration are organized assemblies incorporating monoethanolamine-type moieties, non-chlorine containing oxidants, such as stabilized peroxides, peroxycarboxylic acids and dioxiranes, and liquid slurries or suspensions of nanoparticles in organic solvents.

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

2.4.4. Other Decontamination Programs

The Army is using Commercial-Off-The-Shelf Technology to alleviate M17 shortages until fielding of Joint Service Transportable Decon-Small Scale occurs. The Marine Corps has modified its existing M17 Lightweight Decon System so it can be operated with Military Standard Fuels and would like to replace them with the Multi-Purpose Decontamination System. The Navy has procured and is fielding an M17 Lightweight Decontamination System that can be operated with Military Standard fuels. The M100 Sorbent Decon System began fielding in February 2002. This decontamination system replaces the M11/M13 DAP and associated DS2 used in immediate decon. This system consists of a non-toxic and non-corrosive, powder-based system that provides greater coverage than the M11 at 33% less weight.

2.4.5. T&E Infrastructure to Support Decontamination

Future T&E capabilities for decontamination systems will include the ability to quantitatively assess the operational significance of system degradation caused by decon operations. This is critical for both CB and non-CB systems which require NBC Contamination Survivability (NBCCS). The T&E capabilities will also be focused on providing for quantitative and operationally meaningful characterization of the efficacy of decon systems for hasty, operational, and thorough decon. A future focus is to provide a wider range of simulants for agents and possibly decontaminants for use in field testing/training. There will always be live agent in chambers which are decontaminated to determine efficacy; however, the need also exists to assess operators in decon performance without exposing them to live agent. Time-sequenced and aligned efforts to support RDA activities in decontamination include:

- Development of hazard-assessment models for decontamination
- Expanded simulant-testing capabilities
- Development of capabilities to assess the effects of decontamination on battlefield performance
- Development of capabilities to test decontamination procedures under battlefield-relevant conditions
- Development of decontamination test methodologies for NTAs
- Development of methods to assess degradation performance of decontaminated equipment and systems

Table 2-6. Decontamination Modernization Strategy.

	Fielded Capabilities	NEAR (FY06-07)	MID (FY08-11)	FAR (FY12-21)
Personal Equipment Decontam-inants	• M291 Skin Decontaminating Kit • M295 Individual Equipment Decontaminating Kit	• More reactive, high capacity adsorbent (M291/M295) • Army-*Higher efficiency decon methods (Sorbent Decon)*	• Non-caustic, non-corrosive decontaminant for personnel and equipment	
Bulk Decontam-inants	• High Test Hypochlorite (HTH) • Supertropical Bleach (STB)	• Non-caustic, non-corrosive, easy to store and manufacture multipurpose decontaminants	• Decontaminants for fixed sites • Navy-*Less caustic capability*	• Mission tailored decontaminants • Navy-*Contamination resistant shipboard materials* • Army-*Environmentally acceptable replacement for DS2*
Expedient Delivery Systems	• M100 Sorbent Decontamination System		• Auto-releasing coatings; reduces skin contact hazard & labor requirements • Hand held and man portable decontaminant applicator systems for operational decontamination	• Self-decontaminating, auto-releasing coatings; reduces man-power and logistic requirements eliminates skin contact hazard
Deliberate Delivery Systems	• M17 Lightweight Decontamination System • M12A1 Power Driven Decontamination Apparatus • Army –*Rebuild M12A1 Power Driven Decon Apparatus; Replace M17 Lightweight Decon System*	• High pressure water wash; improved decontaminant dispenser (increased vehicle throughput) • Interim fielding of a commercial off the shelf lightweight decontamination system to replace and supplement the M17 LDS • Interim fielding of a commercially developed unit to perform terrain decontamination	• Rapid large scale decon capability for fixed sites; reduced manpower and logistic burden • Non-aqueous capability for electronics, avionics and other sensitive equipment	• Vehicle interior decon capability • Army-*Waterless decon capability for electronics and avionics* • Air Force-*Sensitive equipment decontamination system for aircraft interiors* • Large scale fixed location decontamination systems for use at fixed site facilities

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

2.5. PROTECTION

Protection provides life sustainment and continued operational capability in the CBRN contaminated environment. The Protection Capability Area provides the capability to shield the force from harm caused by CBRN hazards by preventing or reducing individual and collective exposures and by protecting critical equipment. The protection program is aligned within two thrust areas – individual protection and collective protection.

- ***Individual Protection.*** The primary focus of Individual Protection is to address capability gaps identified in "Respiratory & Ocular Protection," and "Percutaneous Protection." Masks and clothing are the two sub-areas within the individual protection thrust area. Protective masks with reduced respiratory stress, improved protection, compatibility with weapon sighting systems, and reduced weight and cost are being developed. Respiratory protection technology will focus primarily on air purification technologies, materials technologies for mask lens and facepieces. Both advanced vapor separation technologies and advanced aerosol/particulate separation technologies will be investigated to meet future air purification requirements. Technology advances are being pursued to produce mask systems that provide enhanced vision capabilities, laser/ ballistic protection, and further reduction in logistics and physiological burden. Lightweight masks for short-term operations or emergency escape are also being evaluated. Protective clothing and integrated suit ensembles are being developed that will improve protection, reduce the physiological burden, have extended durability, and have less weight and heat stress burden than present systems. Percutaneous protection technology will mainly focus on the development of materials such as: engineered permeable materials that include semipermeable membranes, sorbent loaded semi-permeable membranes, nanobarrier materials, and reactive materials.
- ***Collective Protection*** The collective protection program is driven by capability gaps identified as "Expeditionary Collective Protection". There are two sub-areas in collective protection—Air Purification Systems and Shelter Systems. Air purification technology seeks temporary and permanent air purification solutions for transportable and fixed site applications. Advanced vapor separation technologies, advanced aerosol/ particulate separation technologies, and filter residual life indicators are being investigated to enhance the performance of both single-pass and regenerable air purification systems. Shelter technology will mainly focus on the development of materials such as: engineered permeable materials, impermeable materials, and material treatments. Supporting technologies are being investigated to advance environmental control units, motor blower units, structural components, and test methodology. Current collective protection efforts consist of various types of protective filters, entry/exit portals, and air movement devices that provide purified air to a wide range of applications, including transportable shelter systems. 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 air purification, thermal and environmental control and power generation 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 CBRN hazards. Technologies that

reduce weight, volume, cost, and improve the deployability of shelters and air purification systems are also being pursued.

2.5.1. Protection Science and Technology Efforts.

Table 2-7. Protection Science and Technology Strategy.

NEAR (FY06-07)	MID (FY08-11)	FAR (FY12-21)
• Transition ESLI for Mask Filters into JSGPM • Continue to pursue efforts to reduce size/weight/ power of ColPro systems and components • Continue to expand air purification scope of protection (TIC/TIM & NTA) • Complete clothing aerosol protection efforts for transition into JSLIST • Continue to pursue efforts to reduce physiological loads (thermal and respiratory) • Integrate 6.1 projects (Breathable Butyl Rubber and Polymeric Nanocomposites) into program	• Selectively-permeable membranes will offer lighter weight protective garments and enhanced aerosol protection for the Joint Protective Aircrew Ensemble. • Enhanced protection and performance for the Joint Service General Purpose Mask, Joint Service Chemical Environmental Survivability Mask (JSCESM), and Joint Service Aircrew Mask (JSAM). • Air purification technology efforts will provide enhanced protection and reduced flow resistance for the Army's Future Combat System (FCS), Joint Collective Protection Equipment (JCPE), and Joint Expeditionary Collective Protection (JECP) via either single pass, regenerative filtration or advanced air purification approaches. • CB shelter technology will provide integrated advanced shelter materials and components that enhance the protection provided while reducing the weight, cube, and cost of transportable shelters. These efforts will address requirements of the JCPE and JECP.	• Percutaneous protection efforts will focus on technologies applicable to a CB duty uniform to provide self-decontamination, reduce garment thermal load, and extend the useful life of garments. • Respiratory protection efforts will provide a higher level of protection against a broader spectrum of threats (including high priority TICs), and a mask end-of-service-life indicator for the Next Generation General Purpose Mask and the Next Generation Aircrew Mask. • Air purification technology efforts will provide nontraditional (non-adsorbent based or non-single pass) air purification to meet user requirements for future collective protection systems. • CB shelter technology efforts will provide technologies for universal shelters with CB protection or ability to adapt existing shelters to meet future collective protection systems requirements.

2.5.1.1 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 CBRN warfare agents (see **Table 2-7**). Individual protection equipment must also provide protection against emerging threats, such as non-traditional agents (NTAs) or toxic industrial chemicals (TICs). To achieve these goals, key physiological performance requirements for the design and evaluation of clothing and masks are being established. New barrier and filtration materials and selectively permeable materials are being developed and evaluated to accommodate these performance requirements. Maximizing the protection afforded by mask filters is being addressed by DTO CB.36, Universal End-of-Service-Life Indicator for Mask Filters. The technology is expected to have applications for collective protection and clothing also. Incorporation of agent reactive catalysts and biocides into CB protective materials for increased protec-

tion is being addressed by DTO CB.45, Self-Detoxifying Materials for CB Protective Clothing. DTO CB.61, Advanced Air Purification System Model will develop a model, database, and design concepts for advanced air purification systems that incorporate emerging and mature technologies for the purpose of providing: (1) broader protection against an expanding chemical and biological threat that is more universally adaptable; and (2) reduced logistical burden as compared to current single-pass filter technology.

2.5.1.2. Potential Payoffs and Transition Opportunities. Future T&E capabilities for Protection will provide the ability to relate data to casualty estimation by providing a wider range of threat representation in the testing and system M&S relating component to system to battlefield performance and agent to stimulant.

2.5.1.3. Major Technical Challenges. The major technical challenges for T&E are real time sampling, generation of the evolving threat challenges and threat environments in chamber testing, and to relate test data to toxicological data. Also, new technologies for materials and filters may require new test technologies which can exercise these different mechanisms for protection that are specific to advanced technologies. The measuring systems for testing are required to be increasing sensitive in order to provide precise estimates of system and component performance for using data in dynamic models.

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

DARPA has developed innovative approaches to disinfect and purify water in the field from any source. These approaches include the use of mixed oxidants combined with novel and improved filtration methods. A pen-sized or cap-sized mixed chemical oxidant unit kills or inactivates microbial pathogens, prevents re-growth of microbial contaminants for days after initial treatment, and provides an order of magnitude improvement in disinfection effectiveness against spores compared with chlorine or iodine; a thick film adsorbent removes volatile organics and a direct (forward) osmosis membrane filters undesirable mineral content, pesticides and spore forming bacteria to cover all CBRN requirements. The mixed oxidant

solution can also disinfect equipment, utensils, and possibly wounds inflicted on an individual, though the efficacy and safety of wound disinfection would need to transition to advanced development to be demonstrated in clinical trials and eventual FDA approval. During 2001–2002, the mixed oxidant water disinfection pens were field tested by the Marines in Afghanistan. The mixed oxidant water disinfection pens also may be dispensed as part of a backpack-worn, on-the-move, next generation hydration system compatible with the current fighting load carrier and body armor requirements. A larger scale prototype of the same mixed oxidant technology successfully demonstrated the ability to purify water on board the USS Enterprise. For improved filtration, newly discovered methods to fabricate and treat the surface of carbon are exploited to create far superior performance (lower pressure drops, contact efficiency, improved viral absorption rates) than existing activated carbon granules. Supplementing soldier-centric water purification devices (such as the disinfection pen and a small desalination handpump) designed to provide potable water from conventional sources (puddles, streams, lakes and the sea), recently started programs are dealing with harvesting water from unconventional sources (e.g., water from atmospheric moisture and from combusted hydrocarbons). Highly man-portable devices have been developed to provide at least 3.5 liters of potable water per soldier per day where no surface or subsurface sources of water are available, helping to eliminate 50% of water logistics requirements for the single soldier or small groups of warfighters on demand, at any place and at any time.

Projects in the area of decontamination and neutralization are developing methods for destroying agents in a non-corrosive manner without using extremely high power or harmful chemicals. Current decontamination methods either employ concentrated bleach that can be corrosive to materials, people, and electronics or else methods that use extremely high power lasers, lamps, or discharges. One approach in the DARPA program is the development of BCTP—an emulsion made from water, soybean oil, Triton X 100 detergent, and the solvent trin-butyl phosphate—that is benign to humans, plants, animals, and electronics but quickly kills bacteria, spores, and most viruses. Stable, highly effective biological enzyme/polyurethane foam mixtures are also being explored for their ability to neutralize both biological and chemical threat agents and for the decontamination of exposed personnel and materiel.

In addition, under DTO CB.40, Immune Building Program, DARPA is developing technologies and systems to allow military buildings to actively respond to attacks by agents of chemical or biological warfare so as to (1) protect human occupants from the lethal effects of the agent, (2) restore the building to function quickly after the attack, and (3) preserve forensic evidence about the attack. The program focus is on the challenging problem of protection from covert agent release inside buildings. Enabling buildings to respond actively, in real time, to the presence of threat agents will not only greatly reduce the effectiveness of such attacks, but will also make the buildings less attractive as targets. The program has developed a systems approach to protection of military buildings from attack by aerosolized CWA/BWA. This approach employs sensors to determine the presence of contaminant in the building, active HVAC strategies to minimize the spread of the contaminant, and advanced neutralization and filtration technologies to render it inactive. The program is developing and evaluating systems components and architectures in controlled tests to produce optimized protection architectures. These systems are transitioning to a demonstration in a functioning military building. This will embody the first operational “immune” building. The lessons learned from the program are being incorporated into a software-based toolkit with advanced simulation and design data tools

to permit the transfer of this knowledge and techniques across a wide spectrum of building types and to potential users.

2.5.2. Collective Protection Science and Technology Efforts

2.5.2.1. Collective Protection (CP) Goals. 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 TICs, and (4) improve the deployability of transportable shelter systems (see **Table 2-8**). To achieve these goals, improvements to system components (including transportable shelters) are being investigated along with improvements to the current vapor and particulate filtration media. Regenerative vapor and particulate filtration materials processes are being investigated to eliminate the need for filter change and improve the capability against any battlespace CBRN hazards. The primary effort for investigating adsorbents for both single-pass and regenerative filtration applications is articulated in DTO CB.08 Adsorbents for Protection Applications. Additionally, DTO CB.40, DARPA's Immune Building Program is developing technologies and methods to protect building occupants from both internal and external release of hazardous materials or CBRN threat. Collective Protection strategy will also address transportable shelter systems by investigating improved and self-decontaminating shelter materials, improved seaming processes, and improved closures and airlocks. Also a new DoD-JPEO Readiness Installation Protection Program (GUARDIAN) will incorporate CP technologies.

2.5.2.2. Potential Payoffs and Transition Opportunities. Individual and collective protection investments will result in 1) improved respiratory and percutaneous (skin) protection with reduced physiological and psychological burden to the individual warfighter, 2) improved air purification systems and technologies for collective protection shelter applications, 3) extended operation in a CBRN contaminated environment, 4) improved capability against current and emerging threats, and 5) reduced logistics burden associated with weight, volume, power, and consumables.

2.5.2.3. Major Technical Challenges. The greatest warfighter need is to provide protection against new and emerging threats such as non-traditional agents (NTAs) and TICs/TIMs while allowing warfighters to successfully execute and complete their mission. This challenge applies across the board for Respiratory & Ocular Protection, Percutaneous Protection, and Expeditionary Collective Protection. Gaps exist in protective equipment (masks, suits, and filters) that resists the penetration of liquid, vapor, aerosol, and dusty agents under the range of expected battlefield and system conditions, including duration of wear, use, storage, exposure to battlefield contaminants, climatic environments, and system integrity (maintain mask seal, intact closures and interfaces). Materials are needed that can resist these agents while reducing the physiological burden on the wearer and maintaining vision, mobility, and flame resistance (as required). Technical solutions are needed to extend wear and shelf-life in order to minimize negative impacts on logistics systems (store, ship, transport, maintain, provision, and dispose), including packaged size and volume, number of sizes, storage shelf life, and decontaminability. Technical solutions are also needed to extend the duration of protection in a CB environment and increase the amount of agent that these protective ensembles can endure before failure. Integrating CBRN 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 regard, speech intelligibility and anthropometric sizing against constraints such as cost, size/weight, protection time, and interfacing with other equipment. Residual life/end-of-service life indicators must exhibit sensitivity to a broad range of threats while being environmentally stable and low cost. CBRN protective clothing development requires balancing the physiological and psychological burden imposed upon the warfighter with maximum obtainable CBRN hazard protection. Reactive materials for clothing and shelter applications must be stable, broad spectrum, and fast acting. 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 and shelter systems require tradeoffs with respect to performance, user requirements, size, weight and power constraints, as well as longer life. Threats such as TICs increase the need for additional protection and makes the challenge of improving physiological performance, size, and weight constraints more difficult. Consequently, threat versus design tradeoffs become essential as well as tailoring of equipment to meet the threat. Maintaining toxic free areas for mobile, transportable and fixed sites will require new materials/processes with emphasis on systems development. New sealing processes and closures as well as developing improved airlock designs are critical to collective protection.

2.5.3. Protection Modernization Strategy

Forces cannot always avoid CBRN hazards. Therefore, individuals and 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 CBRN contaminated environments. A summary of protection modernization capabilities is provided in **Table 2-8**, which highlights current and planned developmental programs that will provide new or enhanced capabilities in the near through far-term, as well as capabilities that are being procured or are currently fielded.

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

Protective masks and filters will be improved to reduce breathing resistance, thus enhancing ability to perform mission tasks. Mask systems will require increased CBRN survivability and compatibility with combat or personal equipment. Future respiratory systems, such as the Joint Service Aircrew Mask (JSAM) and Joint Service General Purpose Mask (JSGPM) will require enhanced compatibility with life support equipment and tactical systems, and JSAM with fixed and rotary wing aircraft. They will also require the capability to protect against non-traditional agents (NTAs), TICs as well as traditional CBRN warfare agents. In the future, the focus will be on integrated respiratory protective ensembles, which offer optimal compatibility with personal, tactical, and crew support systems. Key technologies for future mask systems include mask filter service life indicator, advanced materials, improved adsorbents, 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. As an evolutionary program the JSLIST intends to meet these future requirements by introducing evolutionary technologies such as the

chemical glove upgrade into JSLIST chemical protective ensemble solutions as those technologies mature. These technology insertions, which will include enhanced performance, will be accomplished as JSLIST RDT&E Joint Service projects.

Collective protection equipment (CPE) development efforts are focused on CBRN 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 purification (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 mobile and transportable platforms and in fixed facilities 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 Future Combat System, Bradley, Breacher, Heavy Assault Bridge, Future Scout and Cavalry System, the USMC Expeditionary Fighting Vehicle (EFV) (formerly the Advanced Amphibious Assault Vehicle), Assault Breacher Vehicle (ABV), U.S. Navy Littoral Combat Ship and other advanced weapons platforms.

2.5.4. Joint Service Protection Programs

Joint programs are shown in **Table 2-8**; Service-unique programs are italicized. A detailed description of Joint IPE and CPE programs is provided in Annex C.

Individual Protection

Individual Protection is comprised of technologies in the following categories: Surface Protection Ensembles, Aviation Protection Ensembles, Surface Respiratory Protection, Aviation Respiratory Protection, and Universal "Common" Individual Protective Equipment.

Surface Protection Ensembles. Future protective clothing ensembles for Warfighters will require reductions in bulk and weight without any loss of protection or durability. The Joint Chemical Ensemble (JCE) intends to meet these future requirements by inserting revolutionary technologies into chemical protective ensemble solutions as those technologies mature. These technology insertions, which will include enhanced performance, will be accomplished as JCE RDT&E projects. JCE is expected to replace the JSLIST in 2008 as the new RDT&E protective suit effort.

The JSLIST Alternative Source Qualification (JASQ) is a congressionally mandated government-industry partnering effort to seek additional sources for JSLIST materials. JASQ candidates that successfully complete all testing requirements will be considered for inclusion on a Qualified Products List (QPL). In addition, two Industry Initiated Demonstration Products (IIDP) using semi-permeable membranes are being tested in order to determine the research and development potential and for possible consideration in next-generation suit technology.

The Joint Program Manager for Individual Protection (JPM IP) is pursuing an Alternative Footwear Solution (AFS) designed to provide a common CBRN protective footwear that will meet the requirements of the Joint Services. CBRN protective footwear is a system, with legacy footwear, such as the GVO/BVO and fishtails, Multipurpose Overboot (MULO), and an improved shipboard boot are available in sufficient quantities. The AFS program, when fielded, will replace legacy CBRN protective footwear across the Joint Services.

The Integrated Footwear System (IFS), formerly Multipurpose Protective Sock (MPS), is part of the JSLIST ensemble. IFS will fulfill the JSLIST and Joint Service Protective Aircrew Ensemble (JPACE) requirement for a launderable CB protective sock for wear under service footwear. IFS may also be a key component of future JSLIST Alternative Footwear Solutions, to include investigation of a CB resistant combat boot that when worn in combination with a protective sock could provide the required CB footwear protection for the Warfighter. Individuals who cannot complete their missions while wearing protective vinyl overboots will wear IFS in conjunction with their service foot wear.

The JSLIST Block 2 Glove Upgrade (JB2GU) will provide hand protection against liquid, vapor, and aerosol CBRN agents, semi-permeable or selectively permeable to prevent excessive moisture buildup and improve user comfort. It will be flame resistant and its performance will not be degraded by exposure to petroleum, oils, and lubricants (POL) or field contaminants. The JB2GU system will meet all service requirements for NBC protective gloves as stated in both JSLIST and Joint Protective Air Crew Ensemble (JPACE) ORDs. The Block 2 Glove effort will improve upon the Block 1 Glove by incorporating more robust testing and provides a glove solution that satisfies a broader set of user requirements, i.e., JSLIST ORD requirements for ground and shipboard use and JPACE requirements for aviation use. The JB2GU will be designed to achieve a fully integrated interface with the sleeves of JSLIST and JPACE NBC suits and will be compatible with the MOPP exchange/dirty doffing and doctrinal decontamination tactics, techniques, and procedures used for those ensembles.

Aviation Protection Ensembles. The Joint Protective Aircrew Ensemble (JPACE) is a CBRN and fire resistant protective clothing ensemble in development and is intended for use by all USN, USMC, USAF, USA, and USSOCOM aviators and aircrew for all fixed wing and rotary wing requirements. JPACE will provide aviators with a modern capability that replaces the impregnated undergarment and CWU-66/77P, using proven JSLIST technology. The Marine Corps has formally established a requirement for their Combat Vehicle Crewman to use the JPACE. The Army is also establishing a requirement for Combat Vehicle Crewmen to use this garment. JPACE will increase the protection provided over existing garments while reducing heat stress and system weight. JPACE will fully integrate with the Joint Service Aircrew Mask (JSAM), legacy masks, JSLIST Glove Upgrades, MULO, or the CBRN overboot. The JPACE will utilize a block upgrade acquisition approach. Block 1 will provide chemical protection from all liquid, particle, vapor and aerosol CBRN agents, provide CBRN protection over a 16 hours mission and be flame retardant. Block 2 will address the Rotor wash Protection Key Performance Parameter (KPP) requirement.

Surface Respiratory Protection. Currently there is a DTO to develop a low cost End-of-Service-Life Indicator (ESLI) for use in CBRN protective mask filters that will indicate to the user that a mask filter has been contaminated and has a limited if any remaining service life.

The Joint Service General Purpose Mask (JSGPM) will be a lightweight protective mask incorporating state-of-the-art technology to protect ground forces from future threats. Key requirements include: 24 hour CBRN protection, improved fit, vision requirements, lower breathing resistance and reduced weight and bulk. The mask components will be designed to minimize the impact on the wearer's performance and maximize the ability to interface with future Service equipment and protective clothing.

The Block I Joint Service Chemical Environment Survivability Mask (JSCESM) will provide commanders at all levels with greater options for protection, especially in Operations Other Than War (OOTW). It will provide a compact, lightweight, disposable, emergency mask for use in Chemical Warfare Agent (CWA) situations confronting the warfighter while operating in low CWA threat conditions and for medical care providers and patients in instances when using the standard service mask is not practical. It is envisioned that warfighters will use Block II JSCESM in special operations or in non-combat roles and will carry the JSCESM during deployment when a CWA threat is possible, but unlikely. This mask is intended to be a one size fits all and provide limited protection based on agent concentrations for approximately 6 hours.

Aviation Respiratory Protection. The Joint Service Aircrew Mask (JSAM) will provide aircrew members with individual head-eye-respiratory protection against CBRN warfare agents and, for high performance aircraft, will provide aircrew protection under high rates of acceleration and possible GLOC (G-force induced loss of consciousness). JSAM will be compatible with current and planned CBRN ensembles and existing life support equipment, provide flame and thermal protection, and reduce heat stress imposed by existing CBRN protective masks. JSAM will have two variants—one for rotary wing and one for fixed wing applications—and will replace all existing Service aircrew CBRN respirators.

The Army is fielding the M48 protective mask to replace the M43 series masks. The M48 is for Apache pilots. It provides a lightweight motor blower unit, uses a standard battery, and provides increased protective capability.

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

Universal "Common" Individual Protective Equipment. The Joint Service Mask Leakage Tester (JSMLT) is a portable device that will be used to perform preventive maintenance checks and services, and is capable of determining serviceability, proper fit, and identifying defective components of current and future CBRN negative pressure protective masks. This system will provide an expeditionary capability currently not available to the Joint Services that will quantitatively and qualitatively test protective mask for defects and fit by measuring the performance of the mask against known standards. The capability will be provided at the unit or maintenance section level.

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 and vapor agents and allows expansion of protection area and has been fielded. Collectively Protected

Expeditionary Medical Support (CP EMEDS) and Chemically Protected Deployable Medical System (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 CBRN contaminated environment for 72 hours. The M28 Simplified CPE has been integrated into the Army DEPMEDS and the Air Force EMEDS field hospitals.

CP DEPMEDS integrated chemical protection into existing Tent Extendable Modular Personnel (TEMPER)-based medical tents and shelters through the addition of M28 Simplified CPE, chemically protected heaters and air conditioners, and alarms. CP DEPMEDS also includes CBRN protected water distribution and latrine systems. A Milestone C (Type Classification) action was approved 5 September 2003, including Full New Material Release (NMR) approval for CP DEPMEDS.

The CP EMEDS program is an effort to insert environmentally controlled collective protection into currently fielded hospital shelters. The role of CP EMEDS, as part of the Air Force Theater Hospital, is to provide individual bed-down and theater-level medical services for deployed forces or select population groups within the entire spectrum of military operations. CP EMEDS are modular packages, tailored to meet theater requirements, by providing a flexible hospitalization capability. The CP EMEDS +25 has the capability to provide 24-hour sick call, 25 inpatient beds, and emergency medical care to a population at risk of 3,000–5,000. The CP EMEDS provides a contamination free environment where medical treatment can be rendered to personnel without the encumbrance of individual protective equipment.

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 CBRN 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 production to meet an urgent need requirement. Milestone C (Type Classification) was approved 5 September 2003, including Full New Material Release (NMR) approval for the CBPS. Currently, an Urgent Operational Need has been validated and 432 systems have been fielded to support Operation Enduring Freedom; new equipment training and fielding was initiated January 2003.

Other near to mid-term collective protection efforts, such as the Joint Collective Protection Equipment (JCPE) will use the latest technologies in air purification, 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 Expeditionary Collective Protection system (JECP) will be the next generation lightweight, modular, easily transportable, self-supporting collective protection shelter that will provide relief from psychological and physiological stresses during sustained operations in a contaminated environment. Redesign and concept tradeoff assistance regarding advanced filtration technologies, such as Pressure Swing Adsorption (PSA) and Catalytic Oxidation (CatOx) has been provided to the USMC EFV and U.S. Army advanced vehicle efforts. The USAF is currently undergoing a major upgrade to their mobile and fixed site collective protection capabilities.

2.5.5. Other Protection Programs

Programs supporting requirements of a single service are shown in **Table 2-8** as italicized entries. A detailed description of IPE and CPE projects is presented in Annex C.

Surface Protection Ensembles

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

Collective Protection

The Navy includes the Collective Protection System (CPS) on selected spaces on new construction ships. Currently the DDG-51, LHD-1, AOE-6, and LSD-41 ship classes are being built with CPS. The Navy also has the capability to backfit CPS on ships already in Service. The Selected Area Collective Protective System (SACPS) has been installed on selected LHA-1 class ships. The ship CPS Backfit program continues to backfit selected spaces critical to amphibious ships with CPS. These spaces include hospital areas, command and control areas, and rest and relief areas. The Navy Shipboard Collective Protection Equipment (CPE) effort will increase the shipboard particulate filter life (from the current one or two years) to at least a three year service life, through the use of new particulate pre-filter materials and the use of new high efficiency particulate (HEPA) filter media. The Shipboard CPE will thus provide millions of dollars of savings in life cycle costs by reducing shipboard maintenance requirements and providing energy efficient fans. The Shipboard CPE transitioned to the JCPE in FY03.

2.5.6. T&E Infrastructure to Support Collective and Individual Protection

Future T&E capabilities for Protection will provide the ability to relate data to casualty estimation by providing a wider range of threat representation in the testing and system M&S relating component to system to battlefield performance and agent to stimulant. Time-sequenced and aligned efforts to support RDA activities in individual and collective-protection programs include:

- Improved chamber testing capabilities to allow testing with CB agents
- Expanded capability to test advanced protective materials
- Development of hazard-assessment models and situational-analysis methods
- Development of capabilities to test next-generation materials for protection against toxic industrial materials (TICs) which are related to hazard estimates.

Table 2-8. Protection Modernization Strategy.

	Fielded Capabilities	NEAR (FY06-07)	MID (FY08-11)	FAR (FY12-21)
Surface Protection Ensembles	• CB Protective Overgarment Saratoga • Chemical Protective Undergarment (CPU) • Modified CPU (mCPU) • Joint Service Lightweight Integrated Suit Technology (JSLIST)—Overgarment • Battledress Overgarment (BDO) • STEPO • EOD Ensemble • Improved Toxicological Agent Protective (ITAP) • Joint Firefighter Integrated Response Ensemble (JFIRE) • Suit Contamination Avoidance Liquid Protective (SCALP) • 7, 14, and 25 mm Butyl Rubber Gloves • Black and Green Vinyl Overboot • Chemical Protective Footwear Cover SARATOGA	• Advanced protective suit technology; lighter, improved agent protection; reduced heat stress integrated with all respiratory systems. - Improved foot protection - Improved hand protection	• Improved cutaneous protection • Service Life Indicator • Army –*Improved protection for short term use for special purposes (ITAP)* • Textile treatments for improved protection against bio threats	• Integrated multiple threat modular protection (chemical, biological, environmental, and flame) • Self-detoxifying clothing • Indication when protection is no longer required
Aviation Protection	• CWU-66/77P Aircrew Chemical Protective Suit • Aircrew Cape		• Improved protection for aviators (JPACE)	
Surface Respiratory	• M40/M42 Protective Mask • MCU-2A/P • Voice amplification; laser/ballistic eye protection; improved decontaminability, improved comfort (M40A1/M42A2)	• Lightweight CB Masks for low threat environments (JSCESM) • New mask systems for general purpose masks (JSGPM); reduced physiological and psychological burden, improved comfort, enhance optical and communications, improved compatibility		• Advanced Integrated Individual Soldier Protection system (Future Soldier System) • Improved multiple agent protection • Indication when protection is no longer required

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

* Continuing procurement in the near-term

Table 2-8. Protection Modernization Strategy.
(continued)

	Fielded Capabilities	NEAR (FY06-07)	MID (FY08-11)	FAR (FY12-21)
Aviation Respiratory Protection	• MBU-19/P Aircrew Eye/Respiratory Protection (AERP) • M48 Aircraft Mask • CB Respiratory System (A/P22P-14(V)) • M45 Aircrew Protective Mask (ACPM)	• Army-*Aircrew mask compatible with Apache helicopter systems with a significantly lighter motor/blower unit (M48)* • Army-*Improved compatibility with aviation sighting/night vision systems; reduced logistics burden using non-blower systems, selected for Land Warrior (M45)* • New mask systems for general purpose and aviation masks (JSGPM, JSAM)		
Universal "Common	• Protection Assessment Test System (PATS) • Voice Communication Adapter	• Improved mask leakage tester (JSMLT)	• End-of-Service-Life Indicator for Mask Filters • Improved/innovate material and aerosol test procedures/fixtures and models	
Collective Protection	• Transportable Collective Protection Systems (TCPS) • M20A1/M28 Simplified CP Equipment (CPE) • CB Protective Shelter (CBPS) (Medical) • CP DEPMEDS • *Chemically Hardened air Transportable Hospital (CHATH)* • *CP EMEDS* • *Medium General Purpose Tent System* • Collective Protection for Small Shelter System (CP-SSS) • Shipboard Toxic Free Areas (Collective Protection System Backfit)	• Rapid insertion of technology improvements into existing equipment (JCPE) • Marine Corps-*Protection for all Expeditionary Fighting Vehicles* • Army–*CBRN protection for tactical Medical units (CBPS).* *- Collective protection for advanced vehicle concepts.* • Air Force-*Upgrade/install collective protection into existing rest/relief shelters will use CP-SSS.* • Navy-*Backfit ships with contamination free protected zones - (Collective Protection System Backfit)*	• Improved filters to extend filter life, reduce maintenance and reduce logistical burden • Reduced logistics burden, improved protection against current and future threats • Improved current collective protection filters and equipment (JCPE) • Joint Expeditionary Collective Protection initial increment capabilities • Lighter, more mobile, easier setup, more affordable shelters • Improved technologies from DARPA's Immune Building Program	• JECP follow-on increments • Regenerable/advanced protective filtration for vehicles/vans/shelters

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

* Continuing procurement in the near-term

2.6. MEDICAL DEFENSE

2.6.1. Introduction

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

Within the CBDP, medical CB defense research, development, and acquisition (RDA) programs are organized according to capability areas. Within the JSTO-CBD, these capabilities are managed by program officers for pretreatments, therapeutics, diagnostics, and emerging threats. For advanced development and procurement programs, JPEO-CBD manages these capabilities under the Joint Program Manager for CB Medical Systems (JPM-CBMS). The JPM-CBMS is comprised of a headquarters and support element and two Joint Product Management Offices: the Joint Vaccine Acquisition Program (JVAP) and the Medical Identification and Treatment Systems (MITS). (Medical radiological defense research is described in section 2.6.7 below.) **Table 2-9** provides a summary of the programs in the planned modernization strategy through the far term, highlighting capabilities being developed and procured in the near term, as well as developmental programs that are planned to be available in the mid to far-term.

The medical CB defense RDA program 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 CB casualties to enhance survivability, and expedite and maximize return to duty.
(4) Sustain basic research that provides the knowledge upon which innovative diagnostics, prophylaxes, and therapies are developed.

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

Specific initiatives programmed to improve CB defense medical readiness include:

- Development and implementation of a biological defense immunization policy for U.S. forces and other-than-U.S. forces.
- Increased focus of medical technology base research toward the development of antivirals, antibiotics, and toxin therapeutics.

- Continued cooperation and consultation with the U.S. Food and Drug Administration (FDA) for application of the new Animal Rule[1], which allows consideration 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.
- Enhanced medical diagnostic capability for diseases/injuries caused by all agents.
- Studies to elucidate the toxicity and mechanism of action of non-traditional agents, and to determine the effectiveness of current medical countermeasures.
- Studies to evaluate the effects of exposure to low levels of chemical warfare agents (CWAs).
- Exploratory and advanced studies to develop effective preventive, assessment and treatment strategies to mitigate injuries from the spectrum of ionization radiation energies and qualities produced by either nuclear or radiological devices.
- Training of health care professionals for the medical management of chemical, biological, and radiological casualties.
- Effective procedures for the use of the best available medical countermeasures under the new FDA Emergency Use Authorization authority enacted by section 1603 of the National Defense Authorization Act for Fiscal Year 2004. See Table 2.9 for more information.

Since FY01, there has been an ongoing effort to transition medical research efforts from the DARPA program to joint medical biological defense research within the CBDP technology base for exploitation and further development. The overall goal is development of the most promising medical technologies to a level of technology readiness that supports transition out of technology base and into advanced development. Technology base reviews of DARPA-funded programs in Biological Warfare Defense have led to selection of several DARPA research efforts in the Unconventional Pathogen Countermeasures and Tissue-Based Biosensors programs for transition to joint medical biological defense research efforts within the CBDP technology base. The selected programs include:

- Research to develop broad-spectrum vaccines by molecular breeding (gene shuffling) strategies; focused on cross-protection against pathogenic equine encephalitis viruses.
- A novel class of antimicrobial drugs that bind RNA targets involved in the disease process.
- High-level plant-based expression system for vaccine antigens and humanized monoclonal antibodies for biological threat agents.
- Proprietary B-cell sensing technology for rapid and sensitive medical diagnostics for biological threat agents and endemic diseases.
- *In vivo* countermeasures against biological toxin threats of the superantigen family (e.g., staphylococcal enterotoxin B) using a peptide or peptidomimetic antagonist.
- Small-molecule antibiotics that target the cell-cycle regulated methyltransferase (CcrM) DNA methyltransferase enzyme.

[1] 21 CFR Parts 314 and 601, Food and Drug Administration, "New Drug and Biological Drug Products; Evidence Needed to Demonstrate Effectiveness of New Drugs When Human Efficacy Studies Are Not Ethical or Feasible." *Federal Register*: May 31, 2002 (Volume 67, Number 105), Rules and Regulations, Pages 37988-37998.

- Investigation using in silico screening methods of structurally diverse small-molecule inhibitors of the zinc endopeptidase of botulinum neurotoxin serotype A.
- Development of nonspecific immunomodulatory agents using a synthetic lipid A analog (aminoalkyl glucosaminide phosphate).

2.6.2. Reducing Reliance on the Use of Animals as Subjects of Research

Joint medical chemical and biological defense research efforts continue to utilize alternative methods and resources intended to reduce, refine, or replace the use of animals in research. When possible, research programs employ computerized molecular modeling, simulation-based predictions, *in vitro* cell cultures, cell-free reaction systems, and other *in vitro* models to replace the use of animals. Statisticians evaluate all research proposals that use animals to ensure that the minimum number of animals required to obtain scientific validity are used. Animals lower on the phylogenetic scale (or the least sentient species) are used if the selection will permit attainment of the scientific objective. Additionally, a veterinarian with expertise in laboratory animal medicine reviews all procedures that might cause pain or distress in laboratory animals to determine the procedural modifications, analgesics and/or anesthetic regimens that could be incorporated to minimize pain or distress. Detailed protocols are comprehensively reviewed and approved by Institutional Animal Care and Use Committees before experiments are initiated. For medical CB research conducted at U.S. Army Medical Research and Materiel Command (USAMRMC) laboratories, protocols that specify the use of non-human primates undergo further scrutiny by the USAMRMC Animal Use Review Office. The Joint Science & Technology Office for Chemical and Biological Defense (JSTO-CBD) is establishing a review process and organization that will address animal use for activities outside of USAMRMC. Policies and procedures of the Association for the Assessment and Accreditation of Laboratory Animal Care – International are rigorously enforced and followed. DoD policy requires that animal use be conducted in full compliance with the Animal Welfare Act and that animals are to be used in research only when scientifically acceptable alternatives are not available. Accomplishments in research aligned with the objective of reducing reliance on animals in medical CB S&T are reported in Annex E, Section E.2.1.

Table 2-9. Medical Chemical and Biological Defense Programs Modernization Strategy.

	Fielded Capabilities	NEAR (FY06-07)	MID (FY08-11)	FAR (FY12-21)
Pretreatments	• Licensed SERPACWA (Skin Exposure Reduction Paste against Chemical Warfare Agents) • SNAPP (Soman nerve agent pretreatment pyridostigmine)	• Transition Block I bioscavenger to DHHS for advanced development • Anthrax vaccine amendment for new dosing schedule • Transition of improved anthrax vaccine to DHHS/BioShield • Transition of improved smallpox vaccine to DHHS/BioShield	• Development of Block II nerve agent recombinant bioscavenger pretreatment candidate • Vesicant agent prophylaxis candidate • Licensed smallpox (vaccinia virus, cell culture-derived) vaccine	• Licensed nerve agent "bioscavenger" (human butyrylcholinesterase) pretreatment • Development of Block III nerve agent catalytic bioscavenger pretreatment • Licensed improved SERPACWA (aTSP) • Licensed vesicant agent prophylaxis • Licensed vaccines for VEE (virus subtypes IA/B, IE, IIIA), botulinum neurotoxins (A, B), plague, ricin, SEA/B, and anthrax (NGAV) • Licensed vaccines for eastern and western equine encephalitis (EEE and WEE) • Licensed filovirus vaccines (Marburg and Ebola) • Multiagent vaccines against multiple BW threats • Alternative delivery methods for vaccines and immunogens
Therapeutics	• Licensed antibiotic for exposure to anthrax (ciprofloxacin, doxycycline, Penicillin G Procaine) • Licensed Reactive Skin Decon Lotion (RSDL)	• Transition of vaccinia immune globulin for smallpox vaccine complications	• Transition of candidate products to licensed therapeutics for exposure to plague, anthrax and smallpox • Next generation oxime candidate for nerve agent treatment • Therapeutic candidates for vesicant agent exposure • Skin/wound decontamination product candidate (Joint Service Personnel Decon System) • Licensed advanced (improved) anticonvulsant	• Licensed next generation oxime • Licensed therapeutic for vesicant exposure • License skin/wound decontamination product • Licensed broad spectrum antibiotics, antivirals, and toxin therapeutics • Licensed broad spectrum immunomodulator for biodefense against multiple threat agents including anthrax and plague
Diagnostics		• New assays to identify chemical agent exposure • Fielding of JBAIDS (Joint Biological Agent Identification and Diagnostic System) Block I (capability to perform nucleic acid-based analysis on a ruggedized, portable device)	• Biomarkers of exposure for low levels of chemical warfare agents • Improved and new assays to identify chemical agent exposure • JBAIDS (Block II) (adds a toxin detection capability) - continue work to gain FDA approval for use as a diagnostic devices and assays	• License chemical exposure medical diagnostic devices • JBAIDS Block III (integrated hand held device combining sample processing, nucleic acid detection and immunodiagnostics)
Emerging Threats			• Labeling of FDA-approved pretreatments and therapeutics against novel threat agents • Rapid resequencing and other tech-nologies to detect and identify genetically modified and emerging biological agents	• Broad spectrum pretreatments, vaccines, and therapeutics against classes of threat agents

2.6.3. Pretreatments Science and Technology Efforts

2.6.3.1. Goals and Timeframes. The goal of the pretreatments capability area is to conduct basic research in order to develop lead candidate vaccines and chemical pretreatments and protectants that can be administered before exposure to provide both specific and broad-spectrum protection against validated chemical or biological agents. Categories of threat agents addressed in this capability area include nerve agents, viruses, bacteria and toxins. Robust and broadly-effective pretreatments are essential components in the layered, system-of-systems approach to force health protection, conserving warfighter operational flexibility and reducing the logistical burdens of sustaining forces in chemical or biological environments. Emphasis is placed on technologies and approaches leading to the next generation of biodefense vaccines, including multi-agent vaccines, molecular vaccines, new vaccine platforms and adjuvants, and alternate (needle-free) delivery methods. There are four sub-areas within the Pretreatments capability area.

- *Multiagent Vaccine Development*: This sub-area is intended to signal a change in strategic direction, from development of vaccines against single or closely related pathogens, to development of vaccines directed at multiple pathogens. Multiagent vaccines will greatly reduce the logistical burden and cost associated with use of biodefense vaccines
- *Vaccine Research Support*: Studies in this area use systems biology tools (proteomics, genomics, bioinformatics) to provide new insights into pathogen genetics, virulence factors, host-parasite interactions, pathogenic mechanisms, and host immunity. These studies will result in identification of new candidate vaccine targets that will be employed in development of advanced or next-generation molecular and multiagent vaccines. Studies in this area currently focus upon bacterial, viral, and toxin pathogens.
- *Vaccine Technology Development*: The goal of this thrust area is two-fold. The first objective is to explore technologies and validate the effectiveness of candidate vaccine platforms, including engineered viruses, recombinant or fusion proteins, molecular vaccines, and new adjuvants, that will be applicable to development of next-generation multi-agent biodefense vaccines. Developed under the subthrust area heading of Molecular Vaccines, these vaccine platforms should permit insertion of new immunogenic cassettes, facilitating rapid development of vaccines effective against new threat agents (genetically engineered threats or emerging infectious diseases). The second subthrust area is Molecular Immunology. The objective of this subthrust area is to understand, at the molecular level, the events that induce and maintain rapid and effective protective immunity, and to exploit that understanding in the rational design of the next-generation biodefense vaccines.
- *CWA Pretreatments*: This portfolio addresses the requirement for effective pretreatments against chemical warfare agents. One objective is to field a bioscavenger, an advanced pretreatment that is effective against classic and non-traditional agents based on physiological scavengers such as the human butyrylcholinesterase (BuChE) or carboxylesterase (CaE) enzymes. 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. A plasma-derived human butyrylcholinesterase enzyme (pBuChE) has

passed Milestone A, and will be developed for licensure under interagency agreement by the Department of Health and Human Services (DHHS). S&T emphasis in this area is on developing recombinant and catalytic bioscavengers that will protect against both organophosphate nerve agents and novel threat agents.

Current prophylactic measures do not adequately address the full spectrum of chemical and biological weapon (CBW) threats. In the chemical pretreatments subarea, Soman Nerve Agent Pretreatment Pyridostigmine (SNAPP) has recently been approved under the very first demonstration of the Food and Drug Administration (FDA)'s Animal Efficacy Rule, and a barrier skin paste, SERPACWA, has been approved and fielded for protection against percutaneous exposure to chemical warfare agents. In biological pretreatments, two licensed vaccines exist for protection against biological warfare (BW) agents (anthrax and smallpox). In addition, a number of legacy and newly developed univalent vaccines are either in Investigational New Drug (IND) status or ready to transition, pending decision by the acquisition authority." Until approved by FDA, use of pretreatments in IND status (as well as other products in IND status) are limited in accordance with procedures defined in Department of Defense Directive (DoDD) 6200.2, S*ubject: Use of Investigational New Drugs for Force Health Protection*, dated August 1, 2000, which establishes policy and assigns responsibility for compliance with 10 USC 1170, Executive Order 13139, and applicable FDA regulations for the use of INDs for force health protection.

- In the chemical pretreatments capability area, near-term accomplishments include the transition of the nerve agent bioscavenger Block I (plasma-derived human butyrylcholin-esterase) pretreatment to DHHS for advanced development and FDA-licensure. This is a stoichiometric bioscavenger, meaning that one molecule of bioscavenger binds and neutralizes one molecule of nerve agent. Mid-term opportunities include the development of Block II recombinant bioscavenger (rBioscavenger). This removes the potential resource limitations inherent in purifying the bioscavenger from human plasma. Long-term targets include the licensure of rBioscavenger, and an ultimately development of a catalytic bioscavenger pretreatment that enhances efficacy by degrading multiple molecules of nerve agents *in vivo* (see Table 2-10, below).
- Near-term biological pretreatments include transition to advanced development of bacterial (plague and anthrax), viral (Venezuelan equine encephalitis (VEE)), and toxin (Staphylococci enterotoxin-A and B, SEA/B) vaccines. The program will also seek approval of a reduced dosing schedule for the current anthrax vaccine, and a cell culture-derived smallpox vaccine. Mid-term opportunities include advanced development of filovirus (Ebola and Marburg) and ricin toxin vaccines. Long-term targets include licensure of all near-term and mid-term vaccine candidates in advanced development to also include eastern and Western Equine Encephalitis (EEE and WEE) and filoviruses. Additional basic research leading to new vaccine approaches for the intracellular bacterial threats (Tularemia, Brucella, Burkholderia) is needed, potentially focusing on the critical host-pathogen interface within the cell. Furthermore, the program is investigating several alternatives to hypodermic needles for administration of multiagent and recombinant protein vaccines, which will greatly reduce the medical logistics burden and improve user compliance. Another thrust is to identify effective adjuvants to reduce the time and vaccine dose required for development of effective protective immunity (see Table 2-10).

Table 2-10. Pretreatments Science and Technology Strategy.

By 2005	By 2010	By 2017
• Transition Bioscavenger Block I to DHHS for advanced development • Transition plague and anthrax vaccines to advanced development • VEE and SEA/B vaccines transition to advanced development	• Develop Block II recombinant bioscavenger (rBioscavenger) • Advanced development of filovirus and ricin toxin vaccines • Approval of reduced dosing schedule for current anthrax vaccine	• Licensure of rBioscavenger • Development of catalytic bioscavenger • Licensure of near- and mid-term candidate vaccines

2.6.3.2. Potential Payoffs and Transition Opportunities. Investment in pretreatments that provide protection against chemical and biological agents will yield significant gains in force health protection capability while preserving maximal operational flexibility in chemical and biological environments. Effective pretreatments will dramatically reduce medical requirements by reducing the medical resources required to treat CBW casualties among populations that receive these pretreatments, freeing medical assets for other types of battlefield casualties. Further, vaccines and chemical pretreatments currently in the pipeline and under development will provide protection against a wider range of threat agents than is currently possible. Multiagent vaccines will potentially provide protection against multiple agents simultaneously. Effective medical prophylaxes ultimately serve a counterproliferation function by denying an adversary an operational advantage in developing or employing such weapons.

2.6.3.3. Overview of DARPA Programs. Among the vaccine-oriented projects, efforts are underway to identify new anthrax cell and spore surface targets to enhance vaccine efficacy, develop a single-dose oral/nasal anthrax vaccine, and to overcome engineered microorganisms with combinatorial vaccines. Another project is trying to determine what coding sequences that different BW organisms have in common, in order in order to develop a vaccine that will be effective against two or more organisms simultaneously. The focus of this project is plague and anthrax. A synthetic immunostimulant is being tested for ability to enhance the potency of the FDA-approved Anthrax Vaccine Adsorbed (AVA), with the purpose of decreasing the number of immunizations required to achieve protection. Another strategy is genetic manipulation of livestock resulting in host cell resistance to viral pathogens. This strategy employs the rationale that viruses require the cooperation of host cell genes to accomplish many of the steps of infection. These required host genes have been identified by a novel procedure that enables the selection of cells that consequently become resistant to virus-induced lethality. A series of gene products necessary for infection by African Swine Fever Virus and Foot and Mouth Disease have been identified and are now being tested in a transgenic pig production model. For bacterial toxins, cDNA libraries are being screened to produce knock-out mice defective in genes required for toxin effects. Both techniques are being utilized to produce transgenic animals with resistance to toxins, validating the identified genes as targets for prophylactic and/or therapeutic countermeasures to virus or toxin effects.

2.6.3.4. Major Technical Challenges. Major technical challenges in the medical pretreatments capability area include defining appropriate *in vitro* and *in vivo* model systems for investigative purposes, determining mechanisms of action of the threat agents as well as their countermeasures, identifying appropriate immunogenic protective antigens for vaccine targets, delineating pharmacokinetics and pharmacodynamics of pretreatments for chemical agents, stimulating

immune responses to small molecules, developing new and effective adjuvants, selecting vector systems for recombinant protein vaccines, evaluating preliminary safety and efficacy data, determining dose and route of administration, and evaluating process-scale up potential. The development of acceptable surrogate markers of effectiveness is essential to obtain FDA licensure of medical CBD pretreatments, because challenging humans with CBW threat agents to establish vaccine protective efficacy both is unethical and prohibited.

2.6.4. Therapeutics Science and Technology Efforts

2.6.4.1. Goals and Timeframes. The goal of the Therapeutics capability area is to develop lead candidate medical treatments and pharmaceuticals that, when administered after exposure to a chemical or biological agent, mitigate or curtail the effects of that exposure and sustain forces operating in a CBW hazard area. To meet this requirement, medical chemical and biological defense research and development is directly tied to warfighter capability requirements. Categories of threat agents addressed in this capability area include blister, nerve, respiratory and blood agents, toxic industrial chemicals and materials, viruses, bacteria, toxins, novel chemical threat agents, and genetically modified biological agents. Robust and broadly-effective therapeutics are essential components in the layered, system-of-systems approach to force health protection, conserving warfighter operational flexibility and sustaining operational effectiveness of forces operating in a CBW environment. Emphasis is placed on technologies and approaches leading to next-generation biodefense therapeutics, including treatments and pharmaceuticals effective against specific agents and broad spectrum therapeutics effective against entire classes of biological or chemical agents. Additional emphasis is needed on improving the patient-provider interface for administering therapy under BW/CW operational conditions. All subareas within the Therapeutics capability area will depend on the development of validated animal models and surrogate indicators of human efficacy (necessary preconditions for FDA approval). There are four broad subareas within the Therapeutics capability area.

- *Bacterial Therapeutics*: Studies in this thrust area are intended to elucidate the underlying genetics of and molecular basis for bacterial virulence; host-parasite interactions; pathogenic mechanisms; and mechanisms of resistance, recovery and repair. These studies will result in identification of new therapeutic targets to be employed in development of advanced or next-generation treatments for bacterial infection and disease. In addition, drugs and therapeutics that are already FDA-approved for other indications are being evaluated for efficacy against CBW agents.
- *Viral Therapeutics*: Studies in this thrust area are intended to elucidate the underlying genetics of and molecular basis for viral virulence; host-parasite interactions; pathogenic mechanisms; and mechanisms of resistance, recovery and repair. These studies will result in identification of new molecular therapeutic targets that will be employed in development of advanced or next-generation treatments for viral infection and disease. In addition, drugs and therapeutics that are already FDA-approved for other indications are being evaluated for efficacy against CBW agents (bacteria, viruses, toxins, chemical warfare agents).
- *Toxin Therapeutics*: Studies in this thrust area are intended to elucidate the underlying genetics of and molecular basis for virulence; toxin-receptor binding; biochemical activities of toxins and of events cascading from those activities; and mechanisms of resistance, recovery and repair. These studies will result in identification of new

molecular therapeutic targets to be employed in development of advanced or robust next-generation treatments for intoxication by biological toxins.

- *Chemical Agent Therapeutics*: Studies in this thrust area are intended to elucidate the underlying mechanisms of chemical agent-induced injury; toxin, subcellular and molecular target interactions; biochemical activities of toxins and events cascading from those activities; and mechanisms of resistance, recovery and repair. These studies will result in identification of new therapeutic targets that will be employed in development of advanced or next-generation treatments for intoxication by CWA.

Current therapeutic measures do not adequately address the full spectrum of CBW threats. In the chemical therapeutics subarea, an improved oxime is nearing transition to advanced development. In the medical therapeutics subarea, ciprofloxacin and doxycycline have been approved by FDA as treatments for anthrax exposure. In addition, a number of therapeutic candidates are in IND status, pending decision of the acquisition authority. Until approved by FDA, use of therapeutics in IND status (as well as other products in IND status) are limited in accordance with procedures defined in Department of Defense Directive (DoDD) 6200.2, *Use of Investigational New Drugs for Force Health Protection*, dated August 1, 2000, which establishes policy and assigns responsibility for compliance with 10 USC 1170, Executive Order 13139, and applicable FDA regulations for the use of INDs for force health protection.

- Near-term aims for chemical casualty treatment include licensure of an advanced (improved) anticonvulsant for protection from the effects of nerve agent exposure, and advanced development of vesicant agent therapeutics (including ocular therapeutics), skin and wound decontamination products, and next-generation oxime candidates for treating exposure to traditional nerve agents and non-traditional agents (NTA), with licensure projected in the mid-term. Long-term objectives include receptor-targeted therapeutics and protection from CW agent-induced brain trauma and exposure to low-level CW agents, and therapeutics for blister agents (see Table 2-11, below).
- Near-term goals will transition to advanced development the antimicrobial and antiviral compounds currently being developed against validated biological threat agents; this transition will address the need to prevent casualties induced by biological threats. Long-term targets include licensure of broad-spectrum antibacterial, antiviral, and antitoxin therapies. Development of immune modulators for biodefense against multiple threat agents, including plague, anthrax, and smallpox are also far-term targets. For toxin threats, therapeutics target biochemical intervention points in the host's response, such as the recovery of botulinum intoxicated nerve cells, or down-modulation of the toxic shock pathway elicited by the Staphylococcal enterotoxins (see Table 2-11).

Table 2-11. Therapeutics Science and Technology Strategy.

By 2006	By 2010	By 2017
• Licensure of advanced anticonvulsant • Advanced development of vesicant therapeutics	• Licensure of advanced vesicant therapeutics, including next-generation oxime candidates and skin and wound decontamination products • Licensure of a smallpox therapeutic • Licensure of novel therapies using anti-sense or similar strategies • Advanced development of a ricin and botulinum toxin small molecule therapy	• Development of receptor-targeted therapeutics • Advanced therapeutics for blister agents • Licensure of broad-spectrum antibiotics • Development of immune modulators against multiple threat agents

2.6.4.2. Potential Payoffs and Transition Opportunities. The direct payoff from investment in the Therapeutics area is the mitigation of illness or injury following exposure to CBW agents. Coupled with diagnostic capabilities that unambiguously demonstrate exposure to CBW agents at pre-symptomatic time points, effective therapeutics will lead to rapid return to duty, and are critical capabilities for sustaining the force in chemical and biological environments. Additionally, treatment in the pre-symptomatic phase greatly reduces strains on both deployed and receiving medical assets, reducing the logistical support requirements for casualty care. Finally, effective medical treatments serve a counterproliferation function by denying an adversary an operational advantage in developing or employing such weapons. Effective therapy will also depend on a rapid, point of care medical diagnostics capability to augment clinicians' evaluations of etiology.

2.6.4.3. Overview of DARPA Programs. DARPA is pursuing several approaches to develop therapeutics for biological warfare defense. Research is aimed at developing new therapeutics to which resistance cannot be developed, developing new chemical means for immediately and temporarily redirecting the immune system from one target to another, and inducing and/or enhancing natural immunity to infection. A scalable parallel supercomputer and novel docking program for simulating molecular interactions between candidate small molecules and pathogen-specific enzymes and proteins will expedite the search for countermeasures. The effects of bacterial toxins are being addressed, by elucidating the *in vivo* formation of anthrax toxins in order to determine the kinetics of toxin formation, its role in pathogenicity/lethality, and targeting for novel countermeasures. There are also efforts to establish a testing facility and develop animal models of BW agent infection in order to test novel therapeutics and identify "high-risk" vs. "low-risk" subgroups by determining the relative biosignatures of infection. A detailed description of DARPA's biowarfare defense research is included in Annex E.

2.6.4.4. Major Technical Challenges. Major technical challenges in the medical therapeutics capability area include defining appropriate *in vitro* and *in vivo* model systems for investigative purposes, determining mechanisms of action of the threat agents as well as their countermeasures, understanding the pharmacokinetics of therapeutics for chemical agents, expression systems for recombinant products, and detailed modeling of agent-host interactions at the molecular level to facilitate development of small molecule and quick-turn therapeutics. The development of acceptable surrogate markers of effectiveness is essential to obtaining FDA licensure of medical CBW therapeutics and pretreatments, because challenging humans with CBW threat agents to establish efficacy is both unethical and illegal. Challenges to licensure of therapeutics will also include the ability to understand potential adverse effects in subpopulations or the genetics underlying the disease and response to treatment.

2.6.5. Diagnostics Science and Technology Efforts

2.6.5.1. Goals and Timeframes. Early, sensitive, and specific diagnostic testing is an essential component in a layered, system-of-systems approach to force health protection, conserving warfighter operational flexibility and sustaining operational effectiveness for forces operating in a CBW environment. Medical CB diagnostics research is focused on developing assays and evaluating technologies that meet FDA standards for clinical testing. Specifically, the goal is to employ FDA approved systems to (1) identify and confirm individual exposure to BW agents and (2) quickly verify exposure to CW agents or to identify subclinical indicators that may result from low level chemical exposure. Identification and confirmation of exposure to CBW threat agents should be accomplished as soon as possible after exposure and ideally before symptoms

develop in order to allow early initiation of the appropriate countermeasure and rapid return to duty. This capability area evaluates both new and existing technologies in order to discover, identify and monitor biomarkers of infection and exposure. Diagnostics research is tied directly to warfighter requirements and is developed with the end user in mind. Fielded systems should be easy to operate, inexpensive to use and sustain, and highly specific and sensitive. Research in this capability area supports diagnostics used in the military reference laboratories, deployable medical facilities and on the battlefield.

Medical diagnostics deals with diagnosis of infection by or exposure to bacterial, viral, or toxin agents (biological diagnostics) or of exposure to nerve, vesicants, respiratory and blood agents (chemical diagnostics). Collaboration with other government agencies is encouraged. The biological diagnostics portfolio is subdivided into four sub areas and has one ongoing Defense Technology Objective (DTO):

- *Technology Assessment*. This sub thrust area investigates promising new technologies and conducts evaluations to determine their military usefulness. Evaluations are limited to mature technologies. Current areas of interest include DNA microarrays, multiplexed assays, whole genome amplification and mass-spectral/bioinformatics. This sub thrust area directly supports the Joint Biological Agent Identification and Diagnostic System (JBAIDS), Blocks I, II and III.
- *Assay Development*. This sub thrust area develops immunodiagnostic (antibody-based) and nucleic acid-based diagnostic assays for multiple platforms meeting specific technical requirements and for new and existing technologies. Current areas of interest include using recombinant techniques, mass spectrometry and proteomics to design new assays and developing improved sample preparation methods. This sub thrust area directly supports the JBAIDS Blocks I and II.
- *Identification of Novel Agents*. This sub thrust area aims to identify novel agent/host-specific markers that could serve as useful diagnostic targets. Areas of emphasis include *in vitro* and *in vivo* modeling, identification of early, intermediate and late markers of infection/exposure in both the host and the agent, agent biology (molecular epidemiology, genomics, proteomics) and the development of methods supporting the identification of genetically engineered threats.
- *Test and Evaluation (T&E).* This sub thrust area supports the other sub thrust areas by developing animal model systems enabling diagnostic assay validation testing and testing platforms and assays under field conditions. T&E results are used in CONOPS development.
- *DTO CB.56 Methodology to Facilitate Development of Biological Warfare Threat Agent Detection and Medical Diagnostic Systems*. Seeks to develop a standardized testing package for all assays and reagents produced through the biological diagnostics program. The testing package will be prepared for all new and previously transitioned assays. These packages will be used by the Advanced Developer to pursue FDA approval.

The Chemical Diagnostics area seeks to develop screening procedures and definitive analytical methods testing biomedical sample for individual exposure to CWAs (see Table 2-12, below).

Table 2-12. Diagnostics Science and Technology Strategy.

By 2005	By 2010	By 2017
• Develop quantitative fluoride reactivation procedure for blood diagnostics • Continuing support for JBAIDS Blocks I and II • Mine existing data from novel agent identification subtask area to initiate assay development targeting novel markers indicating BW exposure	• Develop cholinesterase diagnostic method for organophosphate detection • Develop assays targeting novel markers indicating BW exposure • Evaluate and recommend technologies suitable for JBAIDS Block III, an integrated hand-held diagnostic device incorporating sample preparation, BWA and toxin detection into one instrument • Development of non-invasive mustard screening for field diagnostics • Develop mustard exposure screening kits	• Using a systems biology research (proteomics, genomics, bioinformatics), identify new and very early (presymptomatic) markers of exposure that will serve as the basis of the next generation of CBW medical diagnostics. (e.g., signature activation of early response genes of the host, as well as unique pathogen or toxin markers)

2.6.5.2. Potential Payoffs and Transition Opportunities. Deployment of these systems is critical to mitigating illness or injury following exposure to CBW agents. Early and definitive diagnosis permits prompt and effective therapy and rapid return to duty, and is a critical component in sustaining forces in a CBW environment. Coupled with effective medical countermeasures, an enhanced diagnostic capability deters the use of CBW by denying adversaries an operational advantage in using such weapons.

2.6.5.3. Overview of DARPA Programs. The DARPA Advanced Medical Diagnostics program developed the capability to rapidly detect the presence of infection by biological threat agents, accurately differentiate them from other pathogens, and correctly identify the pathogen, even in the absence of recognizable signs and symptoms (i.e., when the pathogen numbers are still low). The program leveraged developments in the commercial biotechnology community (e.g., PCR-on-a-chip) as well as identifying new markers of diseases (e.g., exhaled nitric oxide) and developing entirely new classes of diagnostic technologies (e.g., cellular sentries). Many of these projects are in the process of transition activity. Examples of successful transitions include the CDC validation of Time Resolved Fluorescence assay for Anthrax by Perkin Elmer with four additional agents pending validation, Phylos antibody mimics into the JPO/DTRA Critical Reagents Program (CRP), University of Texas chip-based aptamer/ribozyme chip starts new commercial venture with (Alchemix), and the licensure of nanopore sequencing technology to Agilent. Ongoing efforts are aimed at new ways of detecting the biosignatures of infection to permit earlier diagnosis.

2.6.5.4. Major Technical Challenges. Major technical challenges in the Diagnostics capability include developing appropriate sample processing methods for complex biological matrices, and identifying pre-symptomatic host responses (early biomarkers) and translating that information into diagnostic assays to detect CBWA exposure. The program continues to meet the challenges of developing new and more sensitive assays for threat agents and of evaluating/determining the applicability of new technologies to diagnostics in a warfighting environment.

2.6.6. Emerging Threats/Special Projects Science and Technology Efforts

2.6.6.1. Goals and Timeframes. Emerging Threats and Special Projects addresses requirements for medical countermeasures and diagnostic tests directed against genetically modified threat agents, novel chemical threat agents, and acute or chronic exposure to low-level chemical warfare agents. In addition, this capability area seeks to support development and application of systems biology tools (genomics, proteomics, and bioinformatics) that address not only emerging threats, but also the other capability areas in the Medical S&T program. Work conducted in this area will be guided by all applicable agreements, conventions and treaties and is performed to provide defensive capability only.

- *Genetically Engineered Threats*: The goal of this bioinformatics-intensive subarea is to assemble and integrate databases of protein domains responsible for lethality, delivery into human cells, evasion of the immune system, and therapeutic resistance. This information will then be applied to develop effective countermeasures against both novel and genetically modified BW threats
- *Low-Level CWA Exposure-Effects and Countermeasures*: This thrust area, supporting both medical and non-medical S&T areas, is supported by both DTO and non-DTO S&T research. The goals are to explore systemic toxicity of low dose exposure(s) to CWA, with specific emphasis on biochemical, toxicological, and behavioral effects, and to determine the efficacy of extant medical countermeasures on these effects. In addition, basic research efforts aim to identify biomarkers for low level CWA exposure, and to identify novel neurotoxic and immunological effects.
- *Non-Traditional Nerve Agents*: The major goals of this thrust are to make significant gains in our understanding of important NTAs, and to survey existing countermeasures to determine their effectiveness against these agents. The longer term goal is to develop new approaches, based on greater understanding of a wide variety of NTAs, for creating new medical countermeasures to the broad array of novel threat agents (not all of which act via inhibition of acetylcholinesterase). Approaches include establishment of *in vitro* electrophysiological preparations to delineate mechanisms of action of biological regulators and to suggest approaches for pharmacologic intervention; development of 3-D models of NTA-receptor binding as an aid in drug discovery of new anticonvulsants; and development of a toxicogenomic database for the toxic effects of NTAs to aid in characterization of candidate drugs and in preparation of technical packages for FDA submission.

Currently available medical countermeasures and diagnostics do not adequately address all validated threat agents. Even greater capability gaps exist concerning new and emerging threats. With regard to novel chemical threat agents, the investment strategy balances research that promises to bring additional capability to the warfighter in the short term with the basic research necessary to develop revolutionary and broad-spectrum countermeasures in the longer term. Short-term efforts currently involve surveying existing medical countermeasures to determine their effectiveness against these agents. The critical need in the mid-term is to expand our understanding of broader classes of NTAs: what they are, what they do, and how they interact with the host to cause injury and/or death. Once this fundamental knowledge is developed the longer-term work can begin to develop new specific and/or broad-spectrum countermeasures and diagnostics (see **Table 2-13**).

Table 2-13. Emerging Threats Science and Technology Strategy.

By 2005	By 2010	By 2017
• Survey existing medical countermeasures to efficacy against novel agents • Focus on understanding biology of spore germination and on the structure of inhibitors of the process	• Expand understanding of broad classes of NTAs to determine means of activity • Develop rational designs for BWA countermeasures • Discover and characterize genetic elements of pathogenicity and virulence	• Develop new specific and broad-spectrum countermeasures to and diagnostics for NTAs • Transition best candidate pretreatments, diagnostics, and therapeutics to advanced developer

Engineered biological threat agents will also be addressed in stages. Near-term studies will focus on greater understanding of the biology of spore germination and on the structure of inhibitors of that process. Bacterial spores are relatively easily weaponized, so even non-pathogenic spore-forming bacteria are tempting targets for genetic engineering and creation of novel pathogens. These studies will support rational design of BW threat agent countermeasures using X-ray crystallographic techniques, computational chemistry, and the methods of systems biology (proteomics, genomics, and bioinformatics). The Emerging Threats program will also initiate a broad array of studies to discover and characterize the genetic elements of pathogenicity and virulence. Additionally, the program will transition the most promising DARPA-developed candidate pretreatments, therapeutics, and diagnostics into the S&T base and/or to the advanced developer.

In common with the Therapeutic and Pretreatments capability areas, Emerging Threats must invest to develop animal models to assess toxicity of agents and effectiveness of proposed pretreatments or treatments (e.g., percutaneous NTAs and efficacy of barrier creams, decontamination and pharmacological intervention). Appropriate animal models, and valid surrogate markers for clinical efficacy, are required for FDA approval of medical countermeasures against new and emerging threats (see Table 2-13).

2.6.6.2. Potential Payoffs and Transition Opportunities. The direct payoff from the Emerging Threats capability investment is the prevention and/or mitigation of illness or injury following exposure to new, emerging and genetically modified CBW agents. Rapid and accurate detection, identification, and diagnosis serve both clinical and forensic needs, and provide the warfighter with information critical for situational awareness in the CBW environment.

2.6.6.3. Major Technical Challenges. Major technical challenges in the medical therapeutics capability area include defining appropriate *in vitro* and *in vivo* model systems for investigative purposes, determining mechanisms of action of the threat agents as well as their counter-measures, understanding the pharmacokinetics of therapeutics for chemical agents, expression systems for recombinant products, and detailed modeling of agent-host interactions at the molecular level to facilitate development of small molecule and quick-turn therapeutics. The development of acceptable surrogate markers of effectiveness is essential to obtaining FDA licensure of medical CBW therapeutics and pretreatments, because challenging humans with CBW threat agents to establish efficacy is both unethical and illegal. Challenges to licensure of therapeutics will also include the ability to understand potential adverse effects in subpopulations or the underlying genetics.

2.6.7. 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 primary repository of defense radiobiology expertise is the Armed Forces Radiobiology Research Institute (AFRRI). While these efforts may support the requirements of the warfighter as developed by the JRO-CBRND, AFRRI programs are not funded as part of DoD CBDP research programs.

2.6.7.1. Goals. The goals of the MNDRP are as follows:

- Produce effective medical countermeasures against the injuries sustained from exposures to a broad spectrum of ionization radiation qualities, doses and dose rates.
- Through effective medical countermeasures, provide Combatant Commanders with greater flexibility to conduct operations in radiological environments.
- Field a diagnostic biological dosimetry capability to rapidly assess the radiation exposure status of individuals and deployed units under field operating conditions.

2.6.7.2. Objectives. To accomplish the goals, program objectives are focused in the following areas:

- Identify candidate pharmacologic agents for preventing or treating radiological injury through exploratory testing of compounds developed for other or related indications by industry and academia and that demonstrate a rational basis for probable efficacy in mitigating radiological injury.
- Concentrate efforts on developing preventive and treatment measures for the hematopoietic and gastrointestinal systems that are most susceptible to radiation exposures in the low to intermediate radiation dose ranges that represent the most probable threats and where the highest probability is for realizing near-term product solutions.
- Improve the utility of gold standard cytogenetic methods for definitive biodosimetric assessment of radiation doses through advances in sample preparation techniques and automated image analysis that will permit more widespread employment in routine laboratory settings and lead to an enhanced medical management capability for radiation casualties.
- Identify and develop novel molecular biomarkers of and analytical procedures for radiation exposure that can be measured from routine blood sample preparations using common instrumentation platforms that support immunochemical and polymerase chain reaction procedures, that provide a rapid, accurate and precise estimate of radiation dose, and that can be operated under field-deployed conditions.

The primary objective of this research 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; criticality devices that release large prompt doses of neutron radiation and traditional nuclear weapons. Operational requirements include programs in casualty management, medical radioprotectants to diminish radiation injury, medical therapeutic regimens, biodosimetry, and radiation hazards assessment.

2.6.7.3. Threats, Countermeasures, Technical Barriers, and Accomplishments. Section E-3 of Annex E contains a comprehensive listing of countermeasures, technical barriers and accomplishments associated with this program. An overarching discussion of these topics and of the current nuclear/radiological threat environment is presented here as follows:

Threats

Today's environment presents an increasing threat of the use of nuclear or radiological weapons by rogue states or terrorist groups against the citizens of the United States, its armed forces and its allies anywhere in the world. Proliferation of nuclear technology is on the rise in third-world countries by governments with dubious intentions towards the U.S., and terrorist networks have become highly sophisticated and well funded, giving them the opportunity to acquire or develop radiological devices or improvised nuclear weapons such as criticality devices that can release extremely high prompt doses of neutron radiation. Radiological dispersal devices are within reach of anyone who can exploit the readily accessible sources of relatively unsecured radioactive materials, such as those commonly used in industry, medicine and research. Although the reactor vessels of nuclear power plants are hardened against breaches from explosive impacts, storage facilities for the highly radioactive spent fuel rods that they generate and store on site are not, and they are susceptible to sabotage that could spread clouds of radioactive material to populated areas down wind.

If counterproliferation and intelligence efforts fail to deter the use of a nuclear weapon, effective medical countermeasure must be available to treat casualties. Such devices would most likely be utilized against military, economic, or political targets (*e.g.*, an airbase, the seat of government, large population centers, or a commercial port city). In such scenarios, citizens outside the immediate lethal area would be exposed to the prompt high-dose mixed radiation field (neutron-gamma) of the initial explosion as well as to chronic radiation doses resulting from the residual radioactive fallout. The early effects of moderate- to high-dose radiation injury diminish the soldier's ability to fight and survive, while the latent effects of all exposure doses increase an individual's risk of developing late-arising cancers. Effective radiation countermeasures must protect the warfighter from performance decrement and simultaneously diminish lethality and the long-term health effects of radiation injury.

Radiation dispersal events could include the destruction of a nuclear reactor or its storage facility, intentional contamination of a battlefield with nuclear waste, or dispersal of radiological materials in a terrorist bomb blast involving the use of conventional explosives. Most casualties in these scenarios would suffer non-lethal doses of external irradiation and some could become internally contaminated by the ingestion or inhalation of radionuclides. Conventional injuries from the bomb blast would complicate the management of such radiation exposures and further increase the risk of internal contamination. Prophylactic and therapeutic applications of novel pharmacological agents will increase survival and diminish the morbidity of individual soldiers wounded by radiation. A vibrant research program to further increase our understanding of the molecular and cellular damage induced by ionizing radiation is needed to enhance the rational development of effective medical countermeasures against the newly arising radiological threats on the modern battlefield and in the homeland.

Countermeasures

Currently, no FDA licensed medical countermeasures exist to treat the injuries induced by ionizing radiation. Infectious sequelae from exposure to immune system suppressing doses of

radiation or doses that begin to compromise the integrity of the gastrointestinal system are treated with conventional antibiotics. However, choosing the wrong antibiotic, such as one that is strongly effective against the beneficial intestinal anaerobes, actually can increase mortality after irradiation. Damage to the blood-forming system can be treated with the off-label use of hematopoietic cytokines on a case-by-case basis by individual physicians. These treatment modalities may be effective for injuries sustained at low to intermediate doses of prompt radiation but are not ideal. Also, the statutory restrictions that accompany off-label use of drugs make it impractical for widespread application in large patient populations. At higher doses of prompt radiation that cause severe injury to the gastrointestinal, pulmonary, circulatory and central nervous systems, and the total ablation of the bone marrow, few if any treatment options exist. Short of palliative treatment of symptoms to relieve pain and nausea, the only option available to treat high-dose injuries is bone marrow transplantation in an attempt to reconstitute critical blood forming elements. Attempts at bone marrow transplantation are currently heroic at best due to the many complications of managing transplant rejection and graft-versus-host disease, and the life-threatening complications from the other radiation-induced injuries not treated by the transplant.

Similarly, no licensed products exist that can be administered in a prophylactic regimen to prevent or reduce the severity of radiological injury and that are non-toxic. The only currently available option is an amifostine compound licensed for use to prevent or reduce the collateral damage to normal tissues in cancer patients undergoing chemotherapy and radiation therapy. At effective radioprotective doses, amifostine causes nausea and vomiting that would be operationally unacceptable in a fit fighting force, and it is therefore of little value to DoD.

In the area of biological dose assessment (biodosimetry), a cytogenetic procedure that measures a specific kind of radiation-induced chromosome aberration (dicentrics) in circulating lymphocytes is used to estimate the absorbed radiation dose in an individual. Although long recognized as the gold standard in radiobiology for the definitive assessment of radiation dose in a biological sample, the method is technically demanding and resource intensive. The procedure can only be effectively carried out in specialized laboratories by highly skilled individuals using tissue culture techniques, specialized cytogenetic staining methods and sophisticated microscopic image analysis. Analysis time from receipt of sample to final report is two to three days and sample throughput rate is limited. Although the assay is highly specific for radiation-induced aberrations and produces good accuracy and reproducibility in laboratories that have produced robust calibration curves, it depends on the harvesting and culturing of viable lymphocytes from the circulating blood, thus making it ineffective at high radiation doses that render lymphocytes non-viable.

Technical Barriers

The overarching technical barrier to developing effective countermeasures against the medical complications from exposure to ionizing radiation arises from the spectrum of organ system injuries that accumulate as radiation dose increases. At lower doses, radiation causes mild hematopoietic injury that can be managed with standard, symptomatic therapy until recovery to normal levels of the clotting elements of the blood (platelets) and the infectious disease-fighting white blood cells. As radiation dose is increased, damage to the hematopoietic system becomes more severe, requiring intervention at the stem cell level with stimulatory growth factors (cytokines), and the gastrointestinal system becomes involved. The latter eventually leads to translocation of normal intestinal microflora into the circulatory system and life-threatening

systemic infection in a host that is also immunocompromised. As the dose of radiation increases further, the gastrointestinal lining becomes severely compromised, leading to electrolyte and fluid imbalances that must be managed in addition to the translocation of microflora. Also, damage to the bone marrow eventually reaches a point where bone marrow transplant becomes the only option available to affect recovery of that organ system. Pulmonary, circulatory and central nervous system injuries complicate the medical challenge even further at yet higher doses of radiation. The most effective medical countermeasures against this spectrum of injuries will require a combined regimen of synergistic preventive and therapeutic interventions that must be developed and tested in *in vitro* studies and *in vivo* animal experiments. Final efficacy studies of successful drug candidates will have to be carried out under current good laboratory practices in compliance with the FDA's new efficacy rule for drugs that cannot be ethically tested for effectiveness in humans.

In the area of biological dosimetry, the first challenge is to identify new categories of prospective biomarkers for radiation dose that can be accurately measured in hours rather than days using readily available analytical techniques and that can be accomplished by less than highly trained technical personnel under field environments. Ideally, the new biomarkers should be of functional value in situations where the time between radiation exposure and sample collection is unknown and variable, and they should perform equally as well for all qualities of ionizing radiation. Once these criteria are met, the next challenge is to validate the performance of the new markers in human volunteers. Because of ethical considerations, these can only be individuals who are victims of radiation exposure accidents or who are undergoing radiation therapy. In the former case, uncertainty often accompanies the estimate of the actual dose received and the determination of whether the dose was received as a whole or partial body exposure. In the latter case, radiation therapy is administered at highly controlled and focused doses that do not represent the entire spectrum of radiation exposures needed for complete validation. Because of these limitations in data from human volunteers, data must also be obtained from highly controlled animal studies in which the entire spectrum of radiation exposures can be administered, and the results must then be correlated with the data from human subjects to arrive at a valid interpretation.

Accomplishments

Despite the technical challenges facing this area of research, the rate of progress in developing promising prophylactic and therapeutic countermeasures against radiological injury, and in advancing novel analytical technologies for biodosimetric assessment of radiation exposure has increased dramatically. Significant advances in medical science and biotechnology over the past decade are being brought to bear directly or indirectly to create solutions to the medical challenges of preventing and managing radiological injury. It is also important to recognize the nature of radiological injury in assessing the potential for developing effective medical countermeasures. Although medical means cannot shield against the deposition of ionizing radiation energy into living tissues, detailed studies have shown that 70%–80% of radiation-induced injury is the result of secondary biochemical reactions cascading from the initial energy deposition event. More recent studies have elucidated the so-called bystander effect in which soluble factors secreted by an irradiated cell impart a detrimental effect on un-irradiated neighboring cells. As alluded to above, different tissue types have differing susceptibilities to ionizing radiation, offering insight into the pathophysiological mechanisms of injury and the ability to tailor organ-specific medical interventions. This fundamental knowledge

along with what is known about cellular damage surveillance and repair mechanisms, cell cycle regulation and reproductive mechanisms, and other regulatory pathways controlling cellular functions point to unprecedented opportunities for advancement that are limited only by resources.

Table 2-14 below summarizes in general terms the medical countermeasure approaches for addressing nuclear/radiological injuries. **Table 2-15** identifies the modernization strategy for medical radiological countermeasures.

Table 2-14. Medical Nuclear Defense Countermeasures.

PRETREATMENTS
Free radical scavenging agents—-Compounds that neutralize highly reactive oxygen species that are generated in tissues upon the deposition of ionizing radiation and that are a major cause of tissue damage.
Cell cycle regulatory control agents—Small molecular weight synthetic agents that modulate cell cycle regulatory checkpoints by reversibly arresting cell division to allow a cell's natural surveillance and repair mechanisms time to correct DNA damage before lethal mutations become incorporated into daughter cells.
Apoptotic inhibitory agents—Small molecular weight synthetic molecules that inhibit apoptotic pathways that are activated by ionizing radiation and that lead to programmed cell death.
Immune system modulating agents—A variety of naturally occurring biological molecules or synthetic moieties that up-regulate elements of the innate and/or adaptive compartments of the immune system.
THERAPIES
Antibiotics Antimicrobial agents to effectively treat systemic infections caused by enteric microorganisms that translocate across damaged intestinal epithelium without affecting the beneficial anaerobic microorganisms of the intestinal tract.
Hematopoietic cytokines—Recombinant growth factors that stimulate the replication and maturation of hematopoietic progenitor cells to help reverse myelosuppression and to replenish blood platelets.
Epithelial growth factors—Recombinant growth factors that stimulate the regeneration of epithelial cells from basal progenitor cells.
Stem cell replacement—Bone marrow or stem cell transplantation to reconstitute the hematopoietic system incases if complete bone marrow ablation.
DIAGNOSTIC TECHNIQUES
Cytogenetic dose assessment—Cytologic methods to estimate the absorbed dose of radiation based on microscopic imaging of aberrant chromosome morphologies arising from damage to nuclear DNA.
Molecular analyses—Quantitative analytical methods that measure alterations in blood protein levels, cellular messenger RNA levels, or DNA sequences (mutations), the degrees to which correlate with absorbed radiation dose.

Table 2-15. Medical Radiological Defense Programs and Modernization Strategy.

Fielded Capabilities	NEAR (FY05-06)	MID (FY07-12)	FAR (FY13-21)
▪ Antiemetics for palliative treatment of nausea and vomiting. ▪ The Biodosimetry Assessment Tool (BAT) for collection and integration of biodosimetry data to support medical treatment decisions ▪ (Note: No non-toxic licensed products are available for definitive prevention or treatment of radiological injury.)	▪ Pre-clinical cGLP trials of broad-spectrum androstene steroid therapeutic agent ▪ Improved cytogenetic markers, and automated sample processing and image analysis to reduce analysis time and increased throughput rate of biodosimetry system for definitive radiation dose assessment ▪ Antibiotics for post-exposure infectious sequelae. ▪ Licensed cytokine therapy for hematopoietic injury from radiation. ▪ First responder Radiological Assessment Triage (FRAT) providing a handheld device to provide data collection template for analysis of biodosimetric data.	▪ Clinical safety trials in humans for broad-spectrum androstene steroid therapeutic agent ▪ Sustained, slow-release radioprotective drug formulation for extended protection ▪ Preclinical safety and efficacy testing of new-generation drugs and biologics for prophylaxis and therapy of multi-organ radiation injuries ▪ Pre-clinical demonstration of multiplexed molecular biomarker assay for rapid biodosimetric screening of blood samples for radiation exposure, configured into rugged field-portable delivery platform	▪ Licensed products to reduce/prevent the spectrum of short- and long-term (cancer) injuries sustained from exposures to low to intermediate doses of ionizing radiation ▪ Pre-clinical efficacy demonstration of therapies for treating high-dose radiation injuries to the gastrointestinal and respiratory systems ▪ Highly automated and compact cytogenetic-based biodosimetry system for definitive radiation dose assessment in field hospitals ▪ Validation and licensure of molecular biomarker biodosimetry screening assay for forward field operations ▪ Demonstration of enhanced strategy for stem cell replacement therapy

2.6.8. Biological Defense Immunization Programs

Table 2-16 provides information on the current status of immunization given to U.S. forces to protect against exposure to anthrax. **Table 2-17** provides similar information on the Department's smallpox vaccination program.

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

The AVIP web site provides a detailed account on the nature of the threat from anthrax (*Bacillus anthracis*), description of the vaccine, explanation of U.S. DoD policies regarding biological-defense vaccines, U.S. DoD policies regarding the anthrax vaccine, immunization schedule, information on adverse event reporting, and other information related to the AVIP. The AVIP web site may be found on the Internet at http://www.anthrax.mil/.
As of February 28, 2005, 5,218,271 doses of the vaccine have been administered to 1,168,322 persons. Also as of this date, 361,172 service members have received 6 or more doses
In December 1997, the Secretary of Defense announced plans to begin vaccinating Service personnel deployed in High-Threat Areas (HTAs) against the BW agent anthrax. Vaccinations for troops in Southwest Asia began in March 1998. Vaccinations for troops in Korea began in August 1998. The AVIP Agency was established in September 1998 to implement and monitor the DoD policy and Services' plans. Due to an unanticipated delay in release of FDA-approved vaccine, DoD slowed its implementation of the AVIP incrementally between July and November 2000 and June 2001.
BioPort received full approval of all aspects of their Biologics License Application supplement from the FDA on January 31, 2002. On the same date, FDA released three production lots of anthrax vaccine (BioThrax®). BioPort has earned FDA release of additional lots steadily since then.
DoD resumed the AVIP with a priority execution program, continuing with special-mission units, vaccinating forces assigned/deployed to HTAs for more than 15 days and expanding the vaccinations to early-deploying forces designated for this area of operations. On June 28, 2004, with the availability of more vaccine, DoD expanded the AVIP to all of the U.S. Central Command area of responsibility and to the Korean peninsula. On July 28, 2004, DoD resumed the AVIP for personnel previously deferred during the 2000 and 2001 slow downs. An extensive body of literature now documents the safety profile of anthrax vaccine. These data are summarized in the March 2002 report from the National Academy of Science and its Institute of Medicine.

Table 2-17. Smallpox Vaccination Program (SVP).

The SVP web site provides a detailed account on the nature of the threat from smallpox (variola virus), description of the vaccine, explanation of U.S. DoD policies regarding biological defense vaccines, U.S. DoD policies regarding the smallpox vaccine, immunization schedule, information on adverse event reporting, and other information related to the SVP. The SVP website may be found on the Internet at http://www.smallpox.mil/.
As of February 28, 2005, 747,351 DoD personnel were screened and 730,792 personnel were vaccinated against smallpox disease.
On December 13, 2002, the President announced the national smallpox vaccination program, a portion of which involved vaccinating military personnel in mission-critical roles. Vaccinations began three days after the President's announcement. The DoD program vaccinates troops before an attack, to ensure they are personally protected and can continue their missions. The program includes three main groups of people: more than 2,000 members of Smallpox Epidemic Response Teams (SERTs), more than 10,000 members of medical teams for military hospitals and large military clinics, and military personnel who constitute mission-critical forces, principally focused on the U.S. Central Command area of responsibility. On June 28, 2004, DoD expanded the SVP to the Korean peninsula.
In addition to the Smallpox Vaccination Program, DoD issued version 3.1 of the DoD Smallpox Response Plan (www.smallpox.mil/resource/SMAplan/SMAplan.asp) on September 29, 2002. This document consists of a base plan plus 10 detailed annexes. The plan describes DoD's global duties on military installations or during contingency operations, as well as military support to civil authorities. The plan helps DoD prepare for and respond to smallpox outbreak, regardless of magnitude or location. Plan allows for either ring-vaccination or wide-area vaccination as a means of outbreak control.

2.7. CB DEFENSE HOMELAND SECURITY AND FORCE PROTECTION PROGRAMS

This section reflects the incorporation of programs currently managed by JPEO-CBD (specifically by the Joint Program Manager – Guardian) and DTRA to address CBRN Defense Homeland Security and Force Protection. Specifically, this section provides descriptions of efforts and plans related to the following: (1) Joint Service Installation Pilot Project (JSIPP), (2) Installation Protection Program, and (3) National Guard Bureau Weapons of Mass Destruction Civil Support Teams (NGB WMD-CST) and U.S. Army Reserve (USAR) Recon and Decon Units equipment.

The CBRN Defense Homeland Security and Force Protection area seeks to provide urgently needed defensive capabilities to those DoD organizations and forces responsible for responding to CBRN events that affect the missions and people associated with DoD installations. The programs that constitute this thrust differ from the other CBRN defense areas in two ways: 1) They address the need for integrated families of fully developed CBRN systems and 2) they meet the needs of both the military and civilian personnel responsible for responding to CBRN events. From 32 National Guard Bureau Weapons of Mass Destruction Civil Support Teams (NGB WMD-CSTs) and USAR Recon and Decon units to installations as large as the Norfolk Naval complex, comprehensive, integrated approaches to meeting the CBRN threats is imperative. The CBRN Defense Homeland Security and Force Protection area programs in WMD-CST, the JSIPP, and the Installation Protection Program (IPP) will provide both military and civilian first responders and commands with the ability to prepare for, make informed

decisions and manage the consequences of a CBRN event. Of the three efforts, the IPP program is structured using a spiral acquisition strategy to expedite procurement and fielding of emerging capabilities. At this time, all of these efforts are focused on effectively fielding Government and Commercial-Off-the-Shelf technologies and products (GOTS/COTS) to meet the urgent need. However, the spiral nature of these efforts lends itself to upgrading and improving equipment and procedures on a continual basis. The IPP program expects to take advantage of improvements in technology as it happens within the supporting product areas. At the same time, improvements in analytical capabilities will impact the Simulation Based Acquisition tools and processes so that optimized use can be made of available resources.

2.7.1. CBRN Defense Homeland Security and Force Protection Science and Technology Efforts

The CBRN Defense Homeland Security and Force Protection area leverages science and technology efforts of the other product areas. Where unmet requirements are identified and where S&T is required to meet cost objectives, the CBRN Defense Homeland Security and Force Protection area will work with the CBRN S&T community and the associated product area JPM to prioritize investments and integrate requirements. This strategy of supporting sub-system S&T will meet the vast majority of the area requirements.

2.7.1.1. Goals and Timeframes. The goals of CBRN defense homeland security and force protection are to support the WMD-CSTs, and provide CBRN Defensive capabilities to over 200 DoD installations according to the schedule presented in **Table 2-18**.

Table 2-18. Installation Protection Program (IPP) Installation Schedule (new installations per year).

	FY05	FY06	FY07	FY08	FY09	FY10	FY11
IPP	24	25	33	38	41	29	10

2.7.1.2. Major Technical Challenges. Technical challenges are based upon the production nature of the programs. Major technical challenges include the following: 1) Providing biological event identification and warning in time to prevent infection, vice detecting to treat those infected, in a cost effective manner, 2) Low cost, self-configuring communications for sensor networks, 3) Expeditious transition of emerging COTS capabilities, and 4) Comprehensive CBRN Simulation Based Acquisition System. The first two challenges are high on the DoD priority lists and being pursued by many sources. The third challenge may require particular attention from the JPEO and CBRN S&T communities to provide resources to readily evaluate COTS products against the Urgent Capabilities Document requirements. Lastly, Simulation Based Acquisition tools are currently fragmented across the individual system areas and an integrated SBA Analysis Process and tool set will require development. Due to the timeframes to meet the IPP Urgent Capabilities Document requirements, multiple analysis teams will be required to produce analyses and trade-off studies leading to recommended Concept Designs for each of the 200 installations within the IPP. These efforts will require a standardized design analysis process that can provide predictable, consistent, high quality results. The current approach will make use of existing experts and tools to prototype the IPP Design Analysis Process in FY04 leading to more advanced and mature processes on a semi-annual or annual schedule.

2.7.2. CBRN Defense Homeland Security and Force Protection Modernization Strategy

DoD efforts for CBRN Defense Homeland Security and Force Protection rely upon the integration of capabilities provided by the six operationally oriented commodity areas: Contamination Avoidance, Individual Protection, Information Systems, Collective Protection, Decontamination, and Medical Systems. As these commodity areas complete development of emerging capabilities, each product or system will be evaluated for its applicability to meeting the needs of the ongoing CBRN Defense Homeland Security and Force Protection efforts. Some potential contributions from other CBRN RDT&E programs are shown based upon their projected schedules in **Table 2-19**.

Table 2-19. Homeland Security and Force Protection Modernization Strategy.

	NEAR (FY06-07)	MID (FY08-11)	FAR (FY12-21)
Installation Protection	• JSIPP and IPP to over 35 installations • GOTS/COTS: Approved for Service Use CBRN equipment and Systems	• IPP to over 165 additional installations • Use of emerging subsystem advances • Advanced SBA tools	• Use of automated Information Systems • Use of advanced CBRN sub-systems
WMD-CSTs	• Equip CBRNE equipment to the standing up of 12 new NGB WMD-CSTs starting in FY 04 and projected additional 11 new CSTs starting in FY 05 • Equip CBRNE equipment to the standing up of one USAR Decon Company starting in FY04 and complete in FY 05	• The testing and fielding of upgraded Analytical equipment for the Analytical Laboratory System (ALS) as Block I • The testing and fielding of upgraded Communications equipment in the Unified Command Suite (UCS) as Increment I	• Possible Block II for the ALS • Possible Incremental II for the UCS

2.7.3. Joint Service CBRN Defense Homeland Security and Force Protection Programs

2.7.3.1. National Guard Bureau Weapons of Mass Destruction – Civil Support Teams (NGB WMD-CST). Public Law 104-201, 23 September 1996, subject: Defense Against Weapons of Mass Destruction Act of 1996. Defense Reform Initiative Directive (DRID) 25, dated 26 January 1998, approved implementation of the DoD Plan for Integration of the National Guard and Reserve Component into Domestic Weapons of Mass Destruction Terrorism Response. The Weapons of Mass Destruction - Civil Support Team (WMD-CST) mission is to support civil authorities at a domestic CBRNE incident site by identifying CBRNE agents/substances, assessing current and projected consequences, advising on response measures, and assisting with appropriate requests for state support to facilitate additional resources. The WMD-CST is a high-priority response unit supporting civil authorities in responding to a weapon of mass destruction (WMD) situation.

USAR Recon/Decon Units: Public Law 104-201, 23 September 1996, subject: Defense Against Weapons of Mass Destruction Act of 1996. DRID 25 approved implementation of the DoD Plan for Integration of the National Guard and Reserve Component into Domestic WMD Terrorism Response. This plan specified that each Army Reserve Chemical Company will train a platoon-sized element to perform NBC Reconnaissance support to the local incident commander, and that each Chemical Company will train platoon sized elements to provide patient decontamination support to the local incident commander.

Chemical Company (Recon): FORSCOM message dated 241845Z JUN 02: On Order deploy to provide NBC reconnaissance support to the incident commander or Lead Federal Agency to detect and identify CBRN contamination. Provide CBRN reconnaissance support operations to include contamination surveys, agent/material sampling, and assistance with casualty search and extraction.

Chemical Company (Smoke/Decon): FORSCOM message dated 241845Z JUN 02: On Order deploy to conduct NBC personnel and casualty decontamination in support of the incident commander or Lead Federal Agency."

2.7.3.2. Installation Protection Program (IPP). The JPEO-CBD /JPM Guardian IPP constitutes the DoD's first effort to field a full spectrum of NBC installation protection capabilities designed as a family-of-systems to military installations and DoD-owned or leased facilities. The JPM Guardian plans to procure Government and Commercial-Off-The-Shelf (GOTS/COTS) systems designed to meet the operational requirements as identified in the Urgent Requirements Capabilities Document (URC), 14 October 2003.

The IPP is designed to fill a critical gap in an installation's ability to react to a CBRN incident. This program will provide DoD prioritized installations with an integrated CBRN protection and response capability to reduce casualties, maintain critical missions, and effectively restore essential operations. JPM Guardian has an assigned mission to:

- Provide an effective CBRN detection, identification, warning, and protection system for each installation.
- Ensure integration of CBRN networks with existing Command, Control, and Communications, (C3) and augment capabilities to provide effective information management.
- Provide a CBRN capability that will allow for rapid restoration of critical installation operations.
- Protect DoD civilians, contractors, and other persons working or living on U.S. military installations and facilities from a WMD event.

The program is structured using a spiral acquisition strategy to expedite procurement and fielding. Technical risk will be reduced by focusing on mature GOTS/COTS technologies and products. This family of systems package will be fielded as a single, integrated system designed to meet the specific needs of the installation. The design will stress flexibility and the capability for future technology insertion.

2.7.4. Coordination with related CBRN Defense Homeland Security and Force Protection Programs

At the highest levels, these programs are coordinated by participation of the Services, Joint Staff and OSD staff elements in the Overarching Integrated Product Teams (OIPTs). At the operational level, coordination is accomplished by a near-continuous dialog between the Program management and the Services and installations. Joint, Service and Federal Agency IPTs have also been established for key functions within the IPP Program. Coordination has included the following Programs and Initiatives within DoD: Immune Building Program (DARPA); UNWD (DTRA/DOE); BioNet (DoD/DHS); the CBDP S&T Program (DTRA); RestOps and CASPOD ACTDs (DTRA); The Defense of Cities Study (DOE).

2.8. CBRN DEFENSE RDA PROGRAMS REQUIREMENTS ASSESSMENT

ISSUE: **A Judge from the United States District Court for the District of Columbia ruled on October 27, 2004 that the FDA did not complete a 90-day public comment period prior to concluding that AVA was safe and effective against inhalation anthrax disease. Therefore the Judge placed an injunction on the AVIP until FDA completes public comment period and issues a proper Final Rule and Final Order. The DoD immediately paused all anthrax vaccinations until all legal matters are resolved.**

SOLUTION*:* On December 30, 2003, the Food and Drug Administration issued a Final Rule and Final Order Regarding Safety and Efficacy of Certain Licensed Biological Products Including AVA. FDA's final order states that the efficacy analysis in the controlled clinical trial demonstrating the efficacy of the vaccine includes all cases of anthrax disease regardless of the route of exposure or manifestation of disease. This final rule and order make it clear that FDA does not regard the approved anthrax vaccine as "investigational" for protection against inhalation anthrax. However, per the Judge's ruling on October 27, 2004, the FDA must complete a 90-day comment period, followed by evaluation of any additional information provided, prior to issuing its Final Rule and Final Order on AVA. In response to the Judge's action, the FDA issued a Final Rule notice on 29 December 2004 in the Federal Register starting the 90-day comment period.

ISSUE**: The classified GAO Report *Chemical and Biological Defense: Sustained Leadership Attention Needed to Resolve Operational and System Survivability Concerns*, May 30, 2003 (GAO-03-325C), identified several issues related to the ability of key systems to survive after being contaminated by NBC agents and being decontaminated.**

SOLUTION: The Deputy Assistant to the Secretary of Defense for Chemical and Biological Defense (DATSD(CBD)) has been addressing the Chemical and Biological contamination survivability (CBCS) concerns raised in the Government Accountability Office Report GAO-03-325C entitled *Chemical and Biological Defense: Sustained Leadership Attention Needed to Resolve Operational and System Survivability Concerns*. In response to that report, DATSD (CBD) developed a CB Contamination Survivability implementation plan that is responsive to GAO concerns about the CB contamination survivability of major mission critical/ defense critical acquisition systems, and the need for increased management oversight to ensure their survivability. A CB Contamination Survivability focus group was convened that, over the course of six months, developed a CBCS program plan for its implementation. By relying on resident CB expertise among the organizations currently responsible for CBCS policy and implementation, and then encouraging participation of various Service entities, the focus group ensured that the resulting program plan had broad acceptability to acquisition entities. Senior CBRN defense program leadership reviewed the CBCS focus group process and resulting CBCS Program Plan. As a result, two of the five tasks outlined in the roadmap that are essential to implementation of the CBCS Program Plan are currently funded and are in the process of being performed. The plan and follow-on activities are also addressing the requirements of National Defense Authorization Act (NDAA) Section 1053 *Survivability of Critical Systems Exposed to Chemical or Biological Contamination*.

Chapter 3

Chemical and Biological Defense Logistics Status

3.1 INTRODUCTION

The overall logistical readiness status of the Department of Defense's chemical and biological (CB) defense equipment has improved slightly. Several factors have had an adverse effect on the overall DoD readiness and sustainment status—increased demands for by the Services for some CB defense equipment; the increased overall Service requirements in order to support operations in Iraq and Afghanistan; the re-organization of the Army and the approved strength increase of the Army; and equipment modernization efforts in all of the Services.

A number of items continue to pose a moderate to high risk challenge due to low inventories and continued modernization efforts. Automated inventory management and asset visibility initiatives continue to increase the ability to manage what is becoming an increasingly joint collection of CB defense end items and consumables.

The DoD CB Defense Program jointly manages the research, development, and procurement of major end items of CB defense equipment. These items are funded through defense-wide funding accounts. Replenishment of consumable (Class II and VIII) CBRN defense items are managed by the Services and the Defense Logistics Agency (DLA).[1] The existence of defense-wide (rather than Service-specific) research, development, and acquisition funding accounts has ensured the joint integration of CBRN defense programs. However, no defense-wide (that is, joint) operations and sustainment funding mechanism exists for the sustainment of CB defense items, including replenishment and replacement of consumables. Because of this, the *joint* CB defense community is limited to tracking the status of the Services' defense logistics readiness and sustainment programs and making recommendations on funding issues.

The Joint Program Executive Office for CB Defense (JPEO-CBD) coordinates CB defense logistics issues and works to ensure a smooth transition through all phases of equipment life cycles. The JPEO-CBD published the *Joint Service CBRN Defense Logistics Support Plan* (JLSP) in November 2004. A data call conducted by the Program Analysis and Integration Office (PAIO) with input from the data sources for the FY05 JLSP were used to develop the findings in this chapter.

In September 2001, the Quadrennial Defense Review presented a new force sizing construct that supersedes the requirement for supporting two nearly simultaneous Major

[1] Not included in the category of CB defense equipment is equipment maintained by emergency responders typically for HazMat response that may have a CB capability but is not intended for deployment or use in warfare theaters. Most, if not all of this equipment, is considered consumable and is procured either locally (installation level), through higher headquarters, or through special programs. Interoperability with local communities is key to the procurement of these capabilities.

Theater Wars (MTW). Logistics requirements to support the new force sizing construct, termed the "1-4-2-1 construct" are being developed. During the past year, increased focus by all Services and DLA on CB defense logistics has visibly improved the some sectors of the program. Readiness shortfalls have been identified and are being addressed through requirements planning initiatives. In addition, CB defense requirements for homeland defense must be met during the execution of these missions. These requirements have not yet been identified. Additionally, the Services are formulating doctrine, tactics, techniques, and procedures for domestic response to terrorist incidents involving weapons of mass destruction.

The Combating WMD Enhanced Planning Process (EPP) conducted during 2004 was an analytic methodology that linked the Secretary of Defense's (SECDEF) strategic guidance to the Department of Defense (DoD) program development. An EPP is structured to assess required operational capabilities in the context of joint scenarios, concepts and missions resulting in the development of recommended risk-based program alternatives for review and decision by the SECDEF.

Through the FY2004 Strategic Planning Guidance (SPG) the SecDef directed the Chairman, Joint Chiefs of Staff (CJCS); the Director, Program Assessment and Evaluation (D[PA&E]) and the Under Secretary of Defense for Acquisition, Technology and Logistics (USD[AT&L]) to jointly lead an effort to conduct an EPP on the high priority issue of Combating Weapons of Mass Destruction (CbtWMD).

The Joint Requirements Office for Chemical, Biological, Radiological and Nuclear Defense (JRO-CBRND) of the Joint Staff J-8 led the study team effort that conducted the CbtWMD EPP and all relevant DoD stakeholders participated in the analysis process. The two primary objectives of the CbtWMD EPP were to identify funding options for potentially significant increases to the CBRN Defense Program and to identify funding options for recapitalization of the physical and intellectual infrastructure required to address known and evolving WMD threats. In support of these objectives analytical teams were established to (1) develop a force structure based on the SPG directed 1-4-2-1 construct, (2) populate that force structure with relevant programmatic data, (3) identify the key WMD infrastructure needs and (4) conduct a capability-based cost/benefit analysis on alternate programmatic funding options integrating both CBRN Defense program and infrastructure needs. The CbtWMD EPP resulted in several risk-based program options that were vetted through senior-level review panels for validation and accreditation. Final leadership decision on the CbtWMD EPP study results was reflected in the FY06 President's Budget Submission.

As of publication of this report, the Services are also reacting to the demands of the current military actions not modeled by previous studies of consumables requirements such as the Joint Chemical Defense Equipment Consumption Rates (JCHEMRATES) study (published April 1999). To address these shortcomings and to include biological defense, the JRO-CBRN Defense is managing the *Joint Chemical and Biological Defense Expendable Equipment Combat Consumption* (E^2C^2) study. The E^2C^2 study will provide projected consumption rates for consumable equipment in battlefield scenarios consistent with the 1-4-2-1 force planning construct. The Services will then evaluate the results of the study and develop their consumables requirements based on those rates. Service requirements for end items (non-consumables) will be based on Service concepts of the 1-4-2-1 construct. The E^2C^2 study began in FY02 with an identification of user needs and concerns and continued in FY04 with the development of a

campaign combat data base for the study scenario. A Study Advisory Group consisting of representatives from each Service has been convened to establish the consumption rules for the scenario and to examine initial results of the study. The Services are drawing on the lessons learned during these current actions to refine the consumption rules which the E^2C^2 study will use as the basis for its consumption models. The Services are also re-assessing their total needs beyond those of active forces.

The E^2C^2 study is proceeding to ensure that the Services can collectively assess the scenario and achieve consensus on the consumption rules that dictate how equipment is used on the battlefield. At the time of publication of this report, the E^2C^2 study had successfully built the scenario, and had accounted for the CB defense items to be included in the study. The Services are in the process of reviewing the consumption rules in light of initial results.

Until the E^2C^2 study is complete, the Services do not have a current analytical basis for consumables requirements modeling. Previous requirements based on JCHEMRATES results have become outdated and are not consistent with the 1-4-2-1 construct. During this interim period while new requirements are being modeled and validated, the numerical requirements listed in Annex G are draft, thus the risks normally calculated against those requirements are not yet presented. Rather, readiness risks are discussed in terms of general inventory trends, historical patterns, and the health of the industrial base. Once the Services and JRO-CBRN have had adequate opportunity to validate the impact of the 1-4-2-1 construct on their new requirements, the full set of 1-4-2-1 and Total Service requirements will be presented.

The Services have had issues regarding the accountability and management of CB defense item inventories. Limited asset visibility of consumable CB defense items below the wholesale level is being addressed by the implementation of automated tracking systems at that level (for example the Air Force's Mobility Inventory Control and Accounting System and the Marine Corps' NBC Defense Equipment Management Program). The Marine Corps is also resolving these issues through the Strategic Logistics Asset Management (SLAM) project. The SLAM, initiated in 2004, geographically centralizes the Marine Corps' CB equipment in Consolidated Storage Facilities (CSFs) using contract logistics support. The equipment is managed by the NBC Defense Systems Program Manager. The Joint Total Asset Visibility Reporting Warehouse (JTAV-RW) project is also progressing toward integrating these solutions in the long term.

The Services replace and replenish consumable CB defense items through multiple, separate, and distinct funding authorizations, as discussed in Section 3.6 of this chapter. Each Service addresses secondary item procurement policies independently. There continue to be shortfalls of specific CBRN defense items when measured against the interim requirements.

The process by which the Services and DLA fund and store war reserve materiel has been hampered by differing definitions, and deployment strategies, and a lack of validated requirements. The E^2C^2 study is being tailored to address these concerns and thus will create a solid foundation for providing a basis for the common planning of future consumables requirements.

3.2 CBRN DEFENSE LOGISTICS MANAGEMENT

The CBRN defense logistics management structure has become consolidated through implementation of the CBDP Implementation Plan. The JRO-CBRN Defense, in coordination

with the Services and the JPEO-CBD, provides coordination and integration of joint CBRN defense logistics. The JPEO-CBD will identify current readiness and sustainment quantities in the logistics area, with respect to current Joint Planning Guidance. Developmental CBRN defense programs that will be fielded within the FY0611 time period are addressed to identify modernization efforts that are underway. The PAIO initiated a process to collect data and requirements for this report and to ensure consistency across all planning efforts by convening a Joint Service CBRN Defense Logistics Integrated Product Team (LIPT) with JPEO-CBD and JRO-CBRN Defense participation.

As currently envisioned (see **Figure 3-1**) the Services retain "starter stocks" of CBRN defense equipment to support immediate deployments and initial operations. The length of time that these stocks will last each unit depends on the Service's doctrine. Air Force units deploy with 30 days of CBRN defense consumables. Army divisions use a planning figure of 45 days. The Marine Corps Marine Expeditionary Units (MEUs) use a planning figure of 15 days and the Marine Expeditionary Forces (MEFs) use 60 days. Navy shore units use 60 days as the basis for their plans. Navy ships stock 45 days or 90 days of consumable materiel based on the unit's mission. However, Navy ship values are notional in that they are based on peacetime demand and/or projections of wartime demand as contained in pertinent allowance documentation.[2] Once starter stocks are depleted, they would be replaced by swing stocks, then sustained through industrial base production.

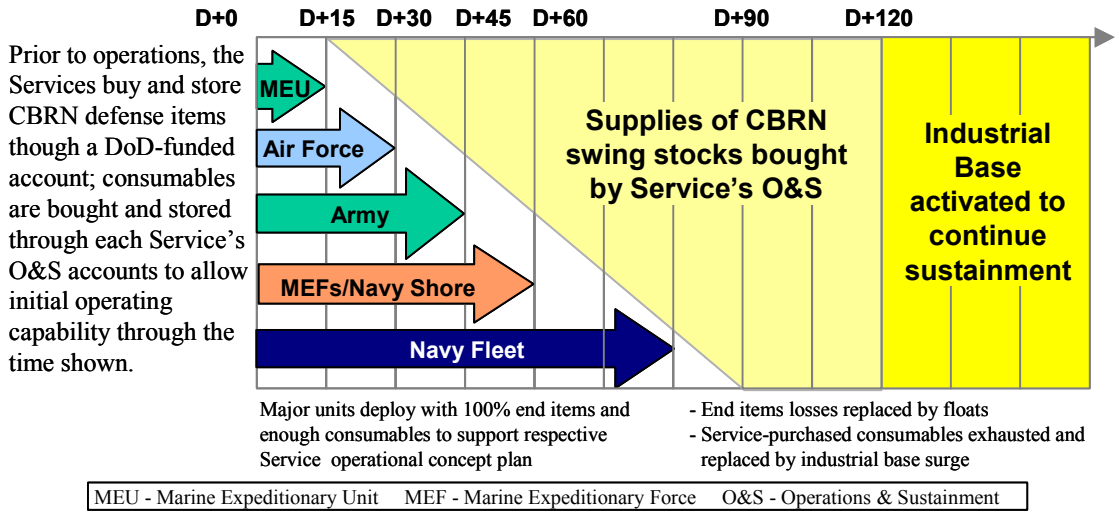

Figure 3-1. War Reserve Requirements and Planning.

For CBRN 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 CBRN defense item managers for "swing stocks," also known as "sustainment stocks." The industrial base is also relied upon to surge production for sustainment. In general this assumption is valid, however, certain items

[2] These concepts will be subject to revision under the 1-4-2-1 construct and with better definition of policies for the funded fielding of specific initial quantities of jointly developed consumable items.

may have long lead-time components, such as fabric for suits, which may delay the industrial base contribution to sustainment.

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

DLA and AMC depots primarily store Army-owned sustainment stocks, although the Air Force, Marine Corps, and Navy may provide funds to store their sustainment stocks. All Services are responsible for individually programming and funding sustainment stocks to provide the required support to their supporting force structure. Because of a lack of visibility of CBRN defense items, unclear wartime requirements, scarce Operations and Sustainment funds, and low priorities given to CBRN defense stocks, the current quantity of DLA and AMC CBRN defense war reserves have been reduced and may not support sustainment requirements for the entire DoD force. These numbers are reflected in the tables of Annex G.

The Army has improved its visibility through an initiative to standardize individual issue of eleven critical CBRN 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 execution plan is managed by HQ AMC and will enable better visibility and rotation of CBRN defense consumable items. The Air Force has a similar program that consolidates stocks of CBRN defense items for deployment in support of contingency operations. These initiatives have also reduced surveillance costs and improved overall management of CBRN defense stocks. The Marine Corps has been leading a Joint IPE Surveillance Technical Working Group, whose initiatives have been increasing cooperative efforts in surveillance and shelf life programs. The Marine Corps' Strategic Logistics Asset Management (SLAM) project geographically centralizes the Marine Corps' CBRN equipment in Consolidated Storage Facilities in which the stored equipment is managed by the NBC Defense Systems Manager who has total asset visibility through a web-based system The Air Force has also deployed the Mobility Inventory Control and Accounting System (MICAS) and is similarly realizing the benefits of its comprehensive shelf life management system. MICAS is also being adopted by the Army. The Navy recently began a reconstitution of all Navy IPE under the Readiness Improvement Program (RIP). RIP is designed to enhance CBR-D asset management and unit readiness at afloat and ashore sites. CBR-D IPE falls under the cognizance of the Damage Control Assistant (DCA) shipboard. An existing system called Damage Control-Operating Space Items Management System (DC-OSIMS) is used to manage all DC equipment. To more effectively manage CBR-D IPE, the CBR module of DC-OSIMS is being upgraded to a web-enhanced browser-based system. Each item is bar-coded and individual kits are provided to each sailor. To enhance CBR-D total asset visibility throughout the Navy, a new web-based system is being developed for tracking of all Navy CBRN assets, called the CBRD Total Asset Visibility Management System, or CBRD TAVMS.

Both DLA and AMC will remain key players in the future CBRN defense logistics management system. The Joint Materiel Prioritization Allocation Board (JMPAB) CB Defense Subgroup, will resolve critical issues related to joint logistical & sustainment issues for the CBDP. DLA and AMC will continue to provide services such as raw data collection, inventory control, and a distribution infrastructure. With the results of the Combating WMD EPP and E^2C^2 studies, the Services and DLA can more accurately assess 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 G-1 through G-5 in Annex G, CBRN Defense Logistics Readiness Data. Tables are included for each of the four Services and the DLA.

3.4 LOGISTICS STATUS

During collection of FY04 data, information on the inventory status of more than 150 CBRN defense equipment items was compiled. The supply needs of deploying troops have caused inventory numbers to fluctuate during the data collection process, so the quantities discussed here and provided in Annex G should be viewed as a snapshot of inventory as of 30 September 2004. Inventory data are also complicated because once certain equipment items are issued, although in possession of a deployed warfighter, they are considered expended and are not counted as on-hand inventory. At the same time, these fluctuations have provided valuable lessons for the sustainment of the industrial base (see Section 3.7).

CBRN 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. However, batteries for critical systems are listed for informational purposes. Inventory tracking for batteries is difficult because of a lack of visibility and because they typically have other applications. Trainers were not included, since they do not reflect wartime service requirements. Characteristics and capabilities of selected fielded CBRN defense items are discussed in detail in Annexes A–F of this report.

Among medical consumables, sodium nitrite and sodium thiosulfate were combined in a single Cyanide Antidote Treatment Kit. The Chemical Agent Patient Treatment Medical Equipment Set and Medical Aerosolized Nerve Agent Antidote (MANAA) Atropine Sulfate Inhalation Aerosol were added.

The risk assessments associated with on-hand inventory of critical items compared with their requirements are normally performed according to the accepted methodology defined in the "RISK ASSESSMENT" box.

RISK ASSESSMENT

Low –	Services have at least 85 percent of wartime requirement on-hand to support requirements
Moderate –	Services have between 70 to 84 percent of wartime requirement on-hand to support requirements
High –	Services have less than 70 percent of wartime requirement on-hand to support requirements

Pending the validation of requirements, some general observations are highlighted as follows:

- The Air Force developed a mitigation plan in concert with procurement of the JSLIST ensembles to minimize risk in individual protection. The Air Force adjusted distribution of remaining suits to compensate for decreased joint funding, while lifting the moratorium on unit expenditure of O&M funds to offset the difference. DLA has assured us that they can fill O&M requisitions without impacting joint funded requisitions.
- The Air Force is relying on the CWU 66/77P to provide a protective aircrew ensemble. It replaces the now obsolete Chemical Protective Undercoverall. Continued planned procurements should mitigate risks in the short term. The Joint Protective Aircrew Ensemble (JPACE), being procured in FY06, will replace the CWU 66/77P.
- 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.
- The stores of DS2 held at Seneca Depot have been declared obsolete so the Services are relying on other bulk decontaminants and applicators, such as Sorbent Decon, while follow-on decontamination solutions are being developed.
- The status of M291 kits remains critical. Present inventory and planned procurements along with improved organic manufacturing capabilities should keep this risk low. Production of M295 kits has improved. Reactive Skin Decon Lotion (RSDL) is scheduled to replace the M291 kit for immediate skin decontamination with a FY07 IOC. Three packets of RSDL will perform the same mission as six packets (one kit) of M291s.
- Medical chemical defense materiel remains generally in low risk. Shortages of 2-PAM autoinjectors can be supplemented with existing supplies of atropine and Nerve Agent Antidote Kits (NAAK), reducing its risk. These items are gradually being replaced by the Antidote Treatment Nerve Agent Autoinjector.
- To meet JVAP requirements, the prime systems contractor (DynPort Vaccine Company) and its subcontractors have retrieved data, files, microbial stocks, and experimental lots of biological defense vaccines produced over the last 10–30 years from government laboratories and contractors in order to conduct an assessment of the suitability of these products for contingency/emergency use. A thorough and ongoing review of this information in the light of current FDA requirements for use under a contingency/ emergency use scenario has been completed. Recommended expanded testing and maintenance requirements are now being evaluated for implementation in order to make these products available for contingency/emergency use to reduce the risk of not meeting wartime requirements. This risk of not meeting wartime requirements is still high but with expanded testing and maintenance over the next year could be reduced to a low to moderate risk.

In general, the Services continue to exhibit shortages in certain critical areas. Shortages exist for CB agent detection systems, collective protection shelters and their respective filters, and biological warfare vaccines. These shortages may have a serious impact on the Joint force's ability to survive and sustain combat operations under CBRN hazard conditions in all of the operational scenarios of the 1-4-2-1 construct. The extent of the operational impact of CBRN defense equipment shortages is under review in several classified studies.

3.5 PEACETIME REQUIREMENTS

In peacetime, quantities of CBRN defense equipment are necessary to train personnel in CBRN defense and to build confidence among our warfighters that CBRN 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 CBRN defense equipment is on-hand to conduct training.

Generally, items used in peacetime for training are drawn from retail 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 are inconsistent in their accountability and tracking of training equipment and in their estimates of on-hand assets. The Joint Equipment Assessment Program (JEAP) has established a Memorandum of Agreement (MOA) with the Defense Reutilization and Marketing Service (DRMS) to segregate CBRN items turned in to Defense Reutilization and Marketing Offices (DRMO) suitable for issue as "Training Only". The JEAP indelibly marks them and fills requests for training items submitted by various authorized DoD agencies. Requirements or applicability for use in homeland security have not been determined or validated. Currently, each of the services has a mixed approach to the use of CBRN defense equipment intended for warfighters during peacetime. Until such time as requirements are defined these types of assets will not be a part of the logistics status report.

3.6 FUNDING

In accordance with statutory requirements (50 USC 1522), funding of RDT&E and procurement is centralized in a DoD defense-wide account. Operations and sustainment (O&S) funding for CB defense materiel is not consolidated at the DoD level. Therefore, for secondary items (*e.g.*, consumables such as decontamination kits, detection kits, and filters), each Service continues to separately fund replenishment and sustainment of CB defense equipment. Depot maintenance and contractor logistics support for some low density major items are also O&S funded. These appropriations are not included in the joint CB defense program.

Funding of CB 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&S funds. For example, replenishment of CB defense items in Army war reserves will require substantial funding through 2006 as some items reach their maximum extended shelf lives and require replacement. The recent plus-up of funds for protective suits is assisting in building an initial stockage and minimum sustainment (war reserve) stock to meet the current 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 CB 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 con-

sumable 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.

3.7 INDUSTRIAL BASE

The CB defense industrial base can be characterized as small niche defense centric sectors embedded in larger commercially dominate industries such as materials, textiles, pharmaceuticals and electronic equipment. This industrial base was robust during the Cold-War era and supported a large number of producers.

With the end of the Cold War, excess inventory of CB defense items coupled with ill-defined threats, and declining budgets led to lower demand for products from the CB Industrial base. The smaller DoD force together with mergers and acquisitions have generally reduced the number of firms participating in current defense production.

Since the late 1990s, and especially since the events of 11 September 2001, demand has grown for CB defense products. The demand increase is a function of ongoing operations such as Operation Enduring Freedom and Operation Iraqi Freedom, DoD's increased emphasis on homeland defense for DoD installations and units, and of the growing threat to homeland security. Another factor driving up demand is the expiration of many stockpiled items from chemical suits, masks, and medicines in inventories built-up during the 1980s. Many of the smaller firms in the sector have merged with or have been acquired by larger, more traditional defense firms. The decreased number of firms has reduced competition in the sector, but the remaining firms appear to have stabilized. While the current sector is stable, vulnerabilities still exist, particularly in collective protection.

The current global political climate coupled with the threat to homeland security is affecting the CB industrial base. Some firms with only commercial experience in producing related products are now attempting to enter the DoD market. Other firms with a long history of producing CB defense items for DoD are now attempting to market products to local and state governments, foreign military, the Department of Homeland Security, as well as to the commercial sector. The potential markets for DoD, foreign military, the Department of Homeland Security, state and local governments and direct sales to concerned citizens have attracted many firms. With the lure of increased demand, some firms without any history or expertise are making inquiries into how they can enter this market. The result is an industrial base in transition.

The industrial base currently ranges from small to large firms set in small subsectors of larger commercial industries but is adjusting to new buyers and increased demand. The sub-sectors of detection and individual protection (IP) should benefit in the long term from a more robust industrial base as new firms enter the market and older firms expand sales to civil agencies. These two sub-sectors are aligned with new demands from the new markets. The challenge to DoD is to work with the testing community to validate commercial product performance so that fielding decisions can be based on high-confidence government test data rather than on manufacturer-provided data. While not yet reflected in the current assessments, the industrial base that supports the detection and IP sub-sectors is expected to improve. The other sub-sectors have not been affected by the new demands of homeland security. Many of

the firms in these other sub-sectors are still dependent on Service demands and sales for their financial survival. Collective protection systems (filters in particular) continue to be the most critical sub-sector in the CB 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.

Strategies in the medical sector work to circumvent these trends. The Chemical Biological Medical Systems (CBMS) Joint Project Management Office (JPMO) acquisition strategy for chemical-biological defense vaccines, therapeutics, and diagnostics is to buy commercially available U.S. Food and Drug Administration (FDA) licensed medical products. The CBMS develops products for the DoD or co-develops medical products with allied nations or other government agencies. Medical chemical-biological development efforts are conducted through contracts with the medical industrial base. The CBMS prime systems contractor for vaccine development has had no difficulty in finding industry partners to achieve CBMS product development goals. Developmental programs for drugs and medical devices have also received multiple responses to requests for information and proposals indicating that sufficient industrial base exists to support the CBMS mission. The major issue in the pharmaceutical industry is concerns of legal liability over possible future side effects of the current generation of vaccines and medicines. Legal issues and limited profitability keep many major pharmaceutical companies from producing for the defense market.

Operation Enduring Freedom and Operation Iraqi Freedom are testing the capacity of the CBRN industrial base. The limitations of the industrial base are due in part to lowered DoD procurements in the ten years leading up to the Global War on Terror (GWOT) and Operation Enduring Freedom. The limited procurements are due to low peacetime demand and budget restrictions. Also contributing to this problem is the inability of DoD agencies to commit to long-term contracts with CBRN defense firms. In recognition of the potential effect on preparedness, an Annual Report to Congress CB Defense Industrial Base Working Group convened to review recent industrial base studies and reports, and to identify ongoing and emerging industrial base issues that will be presented in this and subsequent reports. Examples of some of the industrial base management issues identified and discussed by the Working Group follow.

3.7.1 Single Sources and Diminishing Manufacturing Sources

Diminishing sources and sole sources of manufacturing can adversely impact the supply of CBRN defense items. The Edgewood Chemical Biological Center in Edgewood, Maryland and Rock Island, IL are establishing a Diminishing Manufacturing Sources and Material Shortages (DMSMS) Program for CB Defense programs to address these issues. The general definition of DMSMS in the DoD community is the loss, or impending loss, of manufacturers or suppliers of critical items and raw materials. A manufacturer is lost when that manufacturer discontinues or plans to discontinue production of needed components or raw materials. This discontinuance can be caused by rapid changes in item or material technology, uneconomical production requirements, foreign competition, federal environmental or safety requirements, and limited availability or increasing cost of items and raw materials used in the manufacturing process. DMSMS can occur in any phase of a program's life cycle, from early design phases through post-production support, and has the potential to severely impact the program/end item in terms of schedule and life cycle cost. These problems can affect readiness and operating cost

if left unresolved by increasing repair times and the cost of resolving the materiel shortage. The CBRN defense community is also affected by the implications of sole source, single source, and parts obsolescence issues in the development, production, and sustainment of equipment and systems for the warfighter. This is not solely a problem for the CB defense community but is one common to the DoD when it is the only consumer of a particular item.

Over the past fifteen years the existing DoD DMSMS program primarily focused on micro-electronic components issues. Within the last three years the DoD community has expanded the scope of DMSMS issues resolution to include non-electronic components and end items. The electronics community utilizes the Government Industry Data Exchange Program (GIDEP) tool to provide a database for sharing technical data between the Government and private industry. GIDEP is designated as the Department of Defense centralized database for managing and disseminating DMSMS information. The database contains data for not only parts manufactured in accordance with military or government specification but also commercial parts. To implement an effective DMSMS program in the CB defense community, the private sector and government agencies must be willing to share similar information and data to identify and provide resolution for potential DMSMS issues.

In the past year several initiatives were undertaken toward establishing a CB defense DMSMS program, which is focused on the areas and products managed by the JPEO-CBD:

- The ECBC DMSMS program initiated program status quad charts for CB systems that have DMSMS issues. The charts provide management visibility and status of fielded CB systems for monitoring DMSMS issues until a resolution is obtained. The charts depict the description of the system, national stock number, planned procurements, DMSMS/GIDEP participation, DMSMS case resolution information and status, current suppliers, alternate sources, and government points of contact.
- The data from the DMSMS CB Status Charts are collected and summarized for analysis and to determine trends that assist program managers in making management decisions. The sheets provide pertinent supplier information, number and types of DMSMS issues, and comments.
- Communication is being improved between DLA item managers and the industrial base planners to proactively integrate the DMSMS program elements described above throughout the CB defense community.

The CBRN DMSMS Program gives priority to items identified by Critical Items Lists (CILs). Begun 11 September 2001, the U.S. Army Tank-Automotive and Armaments Command–Integrated Logistics Support Center (TACOM-ILSC) maintains a CIL that tracks on-hand quantities, production, deliveries, demand and requirements for major CB defense items and secondary items. Item managers add remarks and status updates to the list, which is also forwarded to the JPEO-CBD. Managers use the list for asset management and production forecasting, and for facilitating action when JPEO-CBD assistance is needed to resolve issues. The CIL maintained by the JPEO-CBD consists of two lists, both of which are available on the JPEO-CBD web site: one is titled “Major End Item (MEI) Critical Items”; and the other is titled “Critical Spares-Class 2 and Class 9.”

Significant DMSMS issues addressed in the past year include:

Upgrade of M12A1 Diesel Engine Driven (DED) Decontaminating Apparatus: Many of the repair parts were outmoded or obsolete. Cannibalization was the primary means of parts support. This DMSMS effort focuses on insertion of new technology (modernization through spares) at the depot level which makes the unit sustainable for the long term, increases reliability, simplifies operation/maintenance and meets DoD Directive 4140.43 on fuel standardization.

M256A1 Chemical Agent Detector Kit, sole source of filter paper: This effort focuses on finding a permanent solution to the production deficiency of the filter paper used in the kit. In the short term, the manufacturer was convinced to re-start the production line to manufacturer a specific amount (5-yr buy). That filter paper is presently being tested. For the long term, the DMSMS program is actively investigating other sources and/or to transfer technology to the government or to find another contractor to produce the filter paper.

Individual Distribution Breathing Air Hose: The Air Duct Hose is necessary for delivering clean filtered air to the crew breathing space. Systems using this air duct hose are required for the production of several vehicle platforms including the Bradley and Abrams. The present manufacturer is the sole source supplier of these hoses. Recent high demand for this air hose duct has resulted in lead times in excess of one year. Lead times are now long enough to potentially impact the production schedule of new vehicles. A potential second source supplier has been identified, and their manufacturing capabilities to produce the air duct hoses are being investigated.

Reverse engineering of A/E32U-8 and M17 Decon spare parts: Several parts and assemblies are either obsolete or have unreasonably long lead times to procure. This DMSMS effort is to explore alternative options when sources of supply are non-responsive to solicitations and part demand is low. Reverse engineering of these parts and assemblies such that they can be manufactured by alternative sources is proving to be a viable option in resolving DMSMS issues.

Although not a major end-item, another critical chemical defense protective component is the soft shelter material used with the Chemical Biological Protective Shelter (CBPS). A single U.S. supplier manufactures the material at high cost; however, the CBPS system manager is not aware of any concerns to meet material requirements.

To fully implement an effective program, the CBRN defense DMSMS program must have adequate funding for staffing to be able to tie into data sources such as IBHub (AMSAA), Tank and Automotive Research, Development and Engineering Center (TARDEC) Army INFO System, Navy GIDEP, and tools of the other Services, and to identify private industry and organic facilities capable of alleviating sole source issues. Other measures for dealing with a limited or reduced industrial base are described in the following sections.

3.7.2 Maintenance of a Warm Industrial Base

Wartime vs. Peacetime Demands and Surge Capability: Commercial industry, and particularly small businesses, cannot handle the fluctuations in production necessitated by wartime demands when peacetime demand is low or non-existent. Once industry surges production to support a period of high demand, DoD is challenged to maintain the industrial capability after DoD requirements drop to typical low peacetime levels. Small business has difficulty surging production to meet wartime demand for many reasons, among them access to

a skilled/unskilled labor force and/or inadequate production facilities. Generally, items used in peacetime are for intermittent training, requiring units to maintain both training (peacetime) and contingency (wartime) stocks. For consumable items, including CB protective clothing, contingency utility is lost when the item is used (or consumed) for training. In many cases, stockpiling of War Reserve Materiel during peacetime is impractical because of shelf life considerations. However, purchase of certain long lead-time or critical components can facilitate surge capability. For instance, DLA will likely invest Warstopper funds in FY05 in beads and/or fabric that are essential to JSLIST suit production.

Typically, orders for items during peacetime are based on Average Monthly Demand (AMD), which yields a peacetime consumption rate. If AMD is very low, there is a risk of eventual termination of production of an item. In some situations, the use of an item (and hence its attrition due to wear & tear) is not up to the calculated AMD, therefore demand goes down and the quantity being bought decreases. As DoD orders less, surge capacity diminishes because it is uneconomical for the commercial manufacturer to maintain labor staff and capital equipment when sales do not support the infrastructure requirements. The industrial base may then shrink, which often does not present a problem in peacetime. It is a problem should the industrial base atrophy to the point where it may no longer be able to surge to meet a contingency requirement.

Even if minimal peacetime production levels can be maintained, increased production during times of significant demand may not be easily accomplished. Lower demand can significantly impact the maximum production capacity of some critical items. The time to reach maximum production capacity is impacted by the time it takes to hire and train labor, to re-acquire equipment, and/or to recertify production lines. This varies according to how dependent the production is on trained vs. unskilled labor, whether or not the maximum capacity depends on getting more equipment, and whether the manufactured item is covered under a legal certification process, such as the Federal Drug Administration requires for medical products.

Off-Shore Dependence: The CBRN defense program relies on foreign sources of supply for certain items. For example, the JSLIST program has a sole source filter fabric foreign dependency and potential industrial base manufacturing concerns. All fabric manufacturers procure the raw fabric from a German company which is the only source currently approved by the JSLIST Program Manager. The carbon beads or spheres, which are cemented to a fabric layer and combined with another fabric layer, were historically provided by a sole source in Japan. In mid-2004, however, the German fabric manufacturer established a second source of beads in a German manufacturing plant. Additionally, they have committed to building a bead-production plant in the US by the end of 2005. These additional sources will help reduce foreign-dependency concerns.

The Berry Amendment can make it difficult to procure certain critical chemical defense components. A representative case was the M28 NBC shelter liner material, used in joint collective protection shelter systems. The material is constructed from five layers, including a barrier film and a woven scrim. In the past, the material was bought by the Government contractor after being laminated in Canada. The Berry Amendment prohibits the use of DoD funds for procurement of the material since the product is not fully processed and produced in the United States. Producers in the U.S. either do not have the technology or are not interested in setting up a production line for this material due to relatively low quantities of demand. The

Canadian producer is not interested in moving or transferring its production facility to the United States. Some other components to shelter systems are also produced with this material. To alleviate the potential procurement difficulty, a waiver to the Berry Amendment, allowing the manufacture of this material abroad, was signed in mid-2004 and is effective for a period of 12 months. Note that an exemption was already written into the law allowing purchase of protective ensemble material from overseas.

Measures to Preserve Production: An item or capability may be termed unique and essential if it satisfies the following criteria (source: DoD Handbook 5000.60-H, Assessing Industrial Base Capabilities):

- The product or capability exists today only in a single product line, or in a single or very limited set of suppliers
- The capability is so unique that defense needs or missions cannot be met without it
- Its loss causes the development or production of certain existing defense items or defense product areas to be time or cost prohibitive

The DoD has several tools available to preserve a warm industrial base.

Industrial Base Maintenance Contracts (IBMCs): IBMCs preserve an essential manufacturing capability for the future by continuing to fund production of such items even if there is not a current demand for the item. Maintenance Contracts may also fund the sustainment of a manufacturing infrastructure to ensure viability of a production line. An example is the IBMC in place to help a sole source production facility achieve FDA certification and maintain production of nerve agent antidote injectors.

Minimum Sustaining Rates (MSR): Production capabilities can be identified as minimum sustaining rates that the manufacturer is willing to allow to keep a production line warm. This rate can be based on profit, or considerations for future buys and reflected in the contract to keep the base warm and avoid ramp up time, and costly start up charges associated with a cold base.

Contract Bundling: Contract Bundling is the practice of merging several contracts into one with the initial goal of saving administrative costs. Also, the industrial base can be stabilized for products under that contract since even if demand for one product is reduced, a manufacturer has other product lines with which to absorb that particular decrease in production. The practice can be controversial, as critics have contended that bundling may limit opportunities for small businesses in general. Bundling may be more appropriate if manufacturers continue to merge.

Stockpiling: Quantities of critical items may be bought in advance of an anticipated demand to reduce the surge burden on the industrial base and to meet contingency requirements in a more timely fashion while giving the industrial base more time to react. The potential for shelf life expiration, or reduced useful life of stockpiled assets needs to be considered when implementing this option.

The DLA Warstoppers program: This program recognizes that preparedness measures must be taken for certain supply items, and that critical industrial capability must be preserved to support the DoD's readiness and sustainment requirements. The essential production

capability of such supply items must be preserved whenever peacetime demand is inadequate to sustain an industrial base sufficient for readiness and mobilization. The Warstoppers program supports the Services' go-to-war estimated requirements and maintains the sole-source of supply for go-to-war surge.

Warstoppers provides the means to invest in improving industry responsiveness. It includes the funding of several of the Industrial Preparedness Measures (IPMs) described above allowing for the "surge" of battle critical material to increase supply availability of spares and troop support items as directed in Defense planning documents.

Such items for which peacetime demand is inadequate to maintain the industrial base include chemical protective suits and gloves, nerve agent antidote auto-injectors, meals ready-to-eat, and tray pack assemblies.

In addition to the IBMCs that currently preserve critical production capabilities for nerve agent antidotes and chemical protective gloves with a minimal annual investment, DLA initiated several other programs under the Warstopper funding line to protect the industrial base for CBRN defense items:

- Purchased 150,000 BDO at MSR to maintain warm base. (1993)
- IBMC for BDO charcoal slurry line to guarantee capacity until JSLIST went into production. (1993 to approx 1997)
- IBMCs for Butyl Glove facilities (2) as requirements dropped. (approx 1993 to 2000)
- (IBMCs allowed to expire when requirements increased because of shelf life expiration as well as Operation Enduring Freedom/Operation Iraqi Freedom)
- Purchase of JSLIST filter fabric as a hedge against supply disruption. (approx 1998-1999)
- Currently no clothing & textile activities are ongoing. For the future, DLA is looking into the purchase of some beads and/or cloth for future production. At present, the CBRN defense clothing base is running at capacity, constrained only by maintaining steady-state production.

3.7.3 Organic Capabilities

The makeup of the CBRN defense market makes it difficult for private companies to realize acceptable profit margins on many specialty, low demand items. In instances where it is impractical to rely on private sector manufacturing due to the uniqueness of a component or cost, an in-house (organic) capability to manufacture or repair a critical item may be developed.

The primary reason for maintaining viable organic capabilities is for risk mitigation. Manufacturing capability that is concentrated in a few industries presents an increased risk level given the limited ability for the private sector CB defense market to meet the increased demands of actions such as OIF/OEF.

Pine Bluff Arsenal (PBA) presents an example of organic CBRN defense capabilities supporting the areas of individual protection, collective protection, decontamination, and detection; and possesses depot storage capabilities and capacities for all types of CBRN defense assets. Production capabilities for Individual Protection items include the M45 Mask and the Coupling Half Quick Disconnect component. PBA is also capable of repair and/or

retrofit of the M40/M42 series of protective mask. Other capabilities exist for Collective Protection filters (M48A1, M49, M98), and Decontamination kits (M291, M295, M100).

Depot maintenance capabilities for Individual Protection include the M40-series mask, Defensive Chemical Testing Equipment (DCTE) such as the M4, M14, and Q-testers, Collective Protection (Chemical Biological Protective Shelter (CBPS), and the Chemically Protected Deployable Medical System (CPDEPMEDS)), and Decontamination (M12A1 Decon Apparatus). PBA is the Army's National Inventory Control Point (NICP) for all Defensive Chemical Testing Equipment (DCTE) and executes the program for maintenance and rebuild of these assets.

Current capabilities for performing production lot acceptance and shelf life testing for the M291 and M295 Decon Kits, and surveillance testing on the C2 canister and M13 filter. When construction of the Quality Evaluation Facility (QEF) is complete in early FY05, PBA will bring new capabilities on-line for performing all types testing on low-, medium-, and high-flow filters. These capabilities include live agent and surrogate testing, and a partnership with the Battelle Memorial Institute will also provide capabilities for testing on protective suits.

3.7.4 Update of Specific Industrial Base Impacts of Recent Military Actions Including Operations Enduring Freedom and Iraqi Freedom

C2A1 Filter Canisters: The peacetime production rate of C2A1 Filter Canisters by the commercial manufacturer was 30,000 canisters per month. SBCCOM (now TACOM-SBC/ Research Development and Engineering Command (RDECOM)) instituted a material change to the packaging of the canister that saved about one dollar per canister, and allowed the manufacturer to surge production to over 200,000 canisters per month.

Gas Particulate Filters: During wartime the manufacturer of the M48A1 and M18 filters surged production from 500 to 1,200 per month and from 400 to 1,425 per month, respectively. A pilot line has been established at PBA to augment commercial production. 105 M48A1 units have been produced that have passed First Article Testing and been delivered on schedule as of Nov 2004. PBA has also produced prototype filters in support of the Joint Collective Protection Equipment developmental program.

Storage of Bioassay Products: Since the September 11, 2001 attacks and given the current terrorist threat, it has become imperative that the Critical Reagents Program (CRP) be capable of delivering the best products as quickly as possible in order to save lives. As the demand for biological sampling and detection devices skyrocketed, the CRP teamed with TACOM Rock Island to manage the storage and distribution of Biological Sampling Kits. The CRP utilized a 25,000 cubic foot cold storage facility at Pine Bluff Arsenal to store Biological Sampling Kits and distribute them to the warfighter through the US Army Depot Supply System. Currently, Pine Bluff stores and distributes Biological Sampling Kits, Operational and Training Hand Held Assay (HHA) panels, and Portal Shield carriers. A dire need also existed for the improvement and standardization of sampling and detection products to meet the demands of DoD and other federal agencies. The CRP developed a formal Quality Management System (QMS), which focuses on process and product improvements and leverages resources across the nation to deliver the best possible product to the customers. The CRP established a collaborative process that utilizes an Integrated Digital Environment (IDE), which allows the best ideas from DoD scientists, industrial base and academia to be shared and integrated into

one joint solution. Virtual teaming and standardized processes saves time and money by allowing the program to draw support from sites anywhere in the nation.

The Industrial Base Working Group will continue to monitor the industrial base and will address industrial base issues as new demands and new markets affect decisions by the commercial firms within this sector. While the many changes may make the sector more robust, added demands for equipment may induce firms to shift their priorities from military sales to the civilian sector and to the Department of Homeland Security. The JMPAB is one mechanism for helping resolve such conflicts in procurement priority for overlapping DoD and other government agency requirements. Also, the JSNBCDEAP led by the Marine Corps is exercising authority over the release of assets to federal agencies, DoD activities, and the private sector.

3.8 INDIVIDUAL PROTECTION

Recognizing that the risk to individual protection of the warfighter is contingent on the availability of a complete protective ensemble, an alternative risk calculation has been provided in past reports that compared the aggregate quantities of all available fielded items that fulfill a particular protective function with the sum of their requirements. The overall risk is then determined by the component in shortest supply. In the interim until the requirements are updated, **Table 3-1** presents the aggregate inventory totals only.

Table 3-1. Protective Ensemble Inventory Summary.

ARMY			AIR FORCE		
Component	**FY04 On-Hand**	**FY05 (projected)**	**Component**	**FY04 On-Hand**	**FY05 (projected)**
Suits	94,675 *	224,230 *	Suits	905,004	1,458,781
Masks	1,403,244	1,417,857	Masks	267,623	267,630 *
Filters	747,982	1,497,054	Filters	1,966,086	2,242,840
Gloves	270,585 *	286,724 *	Gloves	2,041,558	2,641,415
Boots	215,435 *	225,868 *	Boots	1,440,388	1,581,141
Hoods	2,074,000	3,570,000	Hoods	1,701,679	1,747,952
NAVY			**MARINE CORPS**		
Component	**FY04 On-Hand**	**FY05 (projected)**	**Component**	**FY04 On-Hand**	**FY05 (projected)**
Suits	201,191	242,968	Suits	593,975	645,901
Masks	144,411	145,481	Masks	160,241	160,241 *
Filters	288,250	288,250 *	Filters	313,321	313,321 *
Gloves	177,079	177,079 *	Gloves	309,084	309,084 *
Boots	75,210	75,210 *	Boots	301,670	336,219
Hoods	2,029	2,029 *	Hoods	25,370	25,370 *
COMBINED SERVICES					
Component	**FY04 On-Hand**	**FY05 (projected)**			
Suits	1,794,845 *	2,571,880*			
Masks	1,975,519	1,991,209 *			
Filters	3,315,639	4,361,465 *			
Gloves	2,798,306 *	3,414,302 *			
Boots	2,032,703 *	2,315,111 *			
Hoods	3,803,078	5,345,351 *			

* Partial data at time of publication. Army quantities represent "CDE Go-to-War" assets only.

Historically the risk for individual protection has been higher when the entire protective ensemble (suits, gloves, boots, *etc.*) is assessed on the sum of its individual components within each Service. However, accelerated procurement of all JSLIST components is expected to

rapidly mitigate this risk, and in the course of any military operations, the Services will take appropriate risk-reduction measures.

3.9 CBRN DEFENSE LOGISTICS SUPPORT ASSESSMENT

***ISSUE:* Department of Defense CB Defense Program is identifying readiness shortfalls that may preclude full support of the entire 1-4-2-1 force planning construct. The Services' modernization efforts and common war reserve requirements are lessening 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 (war reserve) stocks. In most cases, accelerated procurement of critical items into war reserves will increase readiness against the potential use of weapons of mass destruction.

During 1998, all four Services participated in the development of the JCHEMRATES IV study, which was finalized in 1999. JCHEMRATES IV provided a more accurate prediction of the initial issue and sustainment quantities required for each Service. A follow-on study, the *Expendable Equipment Combat Consumption* (E^2C^2) Study is being conducted in FY04 and FY05 under the auspices of the JRO-CBRN. 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 has lacked a joint, integrated system to maintain asset visibility of CBRN defense equipment below wholesale level, and lacks a standardized war reserve program for CBRN defense equipment. Resourcing the procurement and sustainment of wartime stocks of consumables such as individual protective equipment, decontamination kits, and detector kits remains the responsibility of the Services.**

***SOLUTION*:** DoD established the requirement for asset visibility and reviewed existing systems and procedures, both for peacetime reporting and wartime reporting. The Services and DLA are addressing the CBRN defense asset visibility deficiency under the auspices of the Joint Total Asset Visibility Reporting Warehouse (JTAVRW) initiative. Additionally, DLA is actively involved in a Business System Modernization (BSM) Program to replace the current legacy inventory management system by FY05. The resulting fully integrated system will interface with the individual Services. The Marine Corps has initiated the Strategic Logistics Asset Management Project (SLAM). The SLAM geographically centralizes the Marine Corps' CBRN equipment in Consolidated Storage Facilities (CSFs) using contract logistics support. The equipment held in the CSFs is managed by the NBC Defense Systems Program Manager who has total asset visibility through a web-based system. The Air Force has implemented the Mobility Inventory Control and Accounting System (MICAS) for inventory management and has demonstrated the system to the other Services. The MICAS has been adopted by the Army. The Navy is pursuing CBRD TAVMS, which is a web-enabled asset management solution. This system is designed to manage CBRD assets from acquisition through disposal, support shelf-life management, and provide total asset visibility resulting in improved readiness. In addition, the recently enacted DoD acquisition policy mandating the use of unique item identifiers (UID) on

critical items and all new acquisitions after January 1, 2004, will facilitate these efforts through better item tracking in these business systems.

ISSUE: **CBRN 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 bases in critical areas. Without the introduction of significant plus ups or the use of innovative business practices (such as the use of performance specifications), many of the small firms that make up this sector may choose to re-focus on the commercial market place.**

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

ISSUE: **Recent world events have focused concern on providing total protection for all deploying warfighters. The Services must have mechanisms in place to ensure that all warfighters are issued complete and functional protective ensembles when deployed.**

SOLUTION: The Services have the following processes in place:

NAVY

a. Issuance. All deployable Navy units have established allowances for IPE. The basic allowance document is the Allowance Equipage List (AEL) crafted for each ship class and deployable unit type. The AEL identifies a numeric allowance for each element of IPE, and if the item, say for example a protective suit or NBC protective mask, is issued in multiple sizes, then the size distribution oriented to the population of the unit in question is provided. The basis of issue for all clothing items is 2.15 per person for amphibious and mine warfare ships and 1.15 per person for the other surface ships; the basis of issue for the expeditionary warfare forces for all clothing items is 2.5 per person and 1.05 for naval installation commands; masks are issued at a rate of 1.05 masks per person. The excess quantities generated cover training needs, size anomalies, and surge assignments that may exist at the unit level. Each ship currently maintains this material centrally under control of the Damage Control Assistant. Those units having completed the Readiness Improvement Program (RIP) have all CBR-D IPE bar-coded and stored in a bag and a bar-coded etched mask sized and fitted and issued to each individual crewmember separately. The material will be returned to ship's custody prior to transfer of the individual. Aviation IPE is issued to the aviator and ground support personnel to the aviator squadron directly prior to overseas movement for Expeditionary Air Squadrons.

b. Inventory Management. Inventory managers issue bulletins regarding imminent expiration and/or extension of shelf life material. Although these are typically issued via naval message, timely distribution of information is occasionally problematic given the number of operating units and the number of local management echelons. Accordingly, the Navy will utilize CBRD TAVMS to automate shelf life data updates

via the Internet throughout the equipment's life cycle. Outdated material is discarded or reserved for training and replacement material ordered using unit operational funds.

c. Preparation for Deployment. On a monthly basis or whenever mission readiness changes, each ship reports its operational readiness through the chain of command via the SORTS reporting system. Any projected deficiencies in readiness that are noted in pre-deployment workups are reported to the Immediate Superior in Command and Type Commander. If material shortfalls, such as a deficiency of IPE, cannot be remedied by requisitioning needed material from the supply system, the Type Commander takes action to fill the shortfall using assets from the NAVSEA Joint Storage Facility to fulfill requirements. It is important to note that the delivery of a fully equipped, mission-capable unit to the operational commander is a Type Commander responsibility.

ARMY

a. Issuance. Army policy varies regarding authorization of contingency stocks to various units:

Force Package 1 (FP1) and supporting units - Army authorizes these early deployer units to maintain two complete sets on hand per individual authorized on the unit Modified Table of Organization & Equipment (MTO&E), plus a small overage to accommodate sizing. These units conduct periodic command inspections to ensure that proper maintenance of contingency IPE, and Army training requirements include an annual evaluation of each soldier to ensure proper fit and employment of the protective ensemble components.

FP2 and above and supporting units - Army authorizes follow-on deployer units to draw IPE requirements from contingency stocks maintained at Blue Grass Army Depot (BGAD) through the automated Army Electronic Product Support (AEPS) network. Units determine requirements, to include sizing tariff, and submit them via secure email to the AEPS website. Submitted requirements are validated and approved by the parent MACOM, item manager, and ADC G-4, and then release by BGAD to the requesting unit.

Sustainment stocks for all units are maintained in pre-positioned accounts at various theater-specific support locations.

b. Inventory Management. Protective masks are unit property and receive PMCS inspection as prescribed by the appropriate item technical manual.

The Army's Natick Test Activity routinely tests, by lot number, each of the expendable ensemble components to validate shelf life. Deficient lots are identified to the appropriate item manager and the Army ADC G-4 for publication to Army units via appropriate notification message.

Army regulation and periodic technical bulletins direct owning units to survey on-hand stocks annually, unless sooner notified, of potential shelf life problems by the Army ADC G-4. Upon identification of expiring shelf life for specific commodity lots, deficient stocks are issued as training items and replacement stocks appropriately requisitioned.

c. Preparation for Deployment. At in processing at the unit, each soldier is evaluated by the unit CBRN defense staff for proper size and fit of each protective ensemble item.

The unit CBRN staff records the information for each individual and maintains in unit battle book.

When in receipt of deployment orders, each soldier is inspected by unit supervisors for possession of all required IPE. All shortages (FP2+ units) are immediately requisitioned from BGAD via AEPS for issue upon receipt prior to deployment from home station or at the port of embarkation.

d. Medical Nuclear Biological Chemical Defense Materiel (MNBCDM). The U.S. Army OTSG sustains the initial issue inventory of consumable MNBCDM for deploying and forward deployed forces. MNBCDM is used for pre-treatment and treatment of NBC injury to the individual soldier. OTSG centrally manages MNBCDM in Deployable Forces Packages, stored in strategic locations throughout the world, and approves all releases of centrally managed MNBCDM to deploying units. Each unit currently draws the following items per individual soldier: 3 Nerve Agent Antidote Kits (Mark I), one Convulsant Antidote Nerve Agent (CANA) autoinjector, 15 days of supply (30 tabs) of an antibiotic (Ciprofloxacin or Doxycycline), and an Individual's Guide to MBCDM. OTSG also procures the following: the Antidote Treatment Nerve Agent Autoinjector (ATNAA) as a one-for-one replacement for the Mark I; Pyridostigmine Bromide (PB) for pre-treatment against nerve agent (Soman) exposure; Skin Exposure Reduction Paste Against Chemical Warfare Agents (SERPACWA), which, in conjunction with mission-oriented protective posture (MOPP), enhances soldier protection from chemical warfare agents; and 6 potency and dated items for the unit Medical Equipment Set (MES), Chemical Agent Patient Treatment. OTSG began centralized management of MNBCDM in 1994.

   MNBCDM provides the individual soldier with the capability to give self-aid or buddy aid to treat injuries resulting from NBC warfare agents. Each MES, Chemical Agent Patient Treatment, provides medical personnel with the capability to treat 30 chemical casualties. In support of Operation Iraqi Freedom 1, OTSG issued individual MNBCDM to almost 300,000 deploying soldiers and potency and dated items for 400 Chemical Agent Patient Treatment Sets to deploying medical units.

   OTSG is changing the way it calculates MNBCDM sustainment requirements to support the 1-4-2-1 Force Planning Construct. Currently MNBCDM requirements are calculated by Force Packages.

AIR FORCE

a. Issuance. Air Force Instruction (AFI) 10-2501, *Full Spectrum Threat Response Planning and Operations* establishes standard basis of issue (BOI) Air Force member stationed in or deployable to nuclear, biological, chemical and conventional (NBCC) medium and high threat areas. The current BOI consists of four operational suits (to provide 96 hours of protection) and one training suit per individual.

b. Threat Areas

   Low Threat Areas (LTA). Within LTAs, only military or emergency-essential personnel filling mobility positions are authorized individual protective equipment. C-1 (one half of the BOI) authorizations will be stored at the host installation. Sustainment assets for CONUS units are stored at the Consolidated Mobility Bag Control Center(s)

according to AFI 23-226. For OCONUS units, sustainment assets will be stored using MAJCOM guidance.

Medium Threat Areas (MTA). Within MTAs, all military and emergency-essential civilian personnel are authorized a C-1 bag. Only personnel assigned to mobility positions are authorized sustainment equipment. Both C-1 and sustainment equipment are stored and deployed using MAJCOM guidance.

High Threat Areas (HTA). Within HTAs, all military and emergency-essential civilians are authorized the full issue of both C-1 and sustainment assets. Storage, issue and deployment of these assets will be according to MAJCOM guidance.

c. Inventory Management. Some individual units maintain a portion of their IPE (normally Security Forces), i.e. protective masks (minus operational filters), protective vests, etc.) and are responsible for maintenance and inspection in accordance with tech manuals. Most IPE is centrally stored at Base Logistics Readiness and all required inspections and inventories take place there. Management of assets is accomplished through the Mobility Inventory Control and Accountability System (MICAS). HQ Air Force Civil Engineer Support Agency (AFCESA) and HQ Air Force Installations & Logistics monitor IPE issues such as shelf life expiration or extension and lot testing. Upon any changes in regard to stocked items, they send equipment advisories to each MAJCOM for distribution to their respective units.

d. Preparation for Deployment. Squadron or Group commanders identify deployable Air Force members and emergency-essential civilians at unit-level. Once identified, personnel are sized and information is maintained at the base Logistics Readiness function. Upon receipt of deployment orders, each individual is issued IPE and given a quantitative fit test in their protective mask. The test is conducted to ensure each mask will provide its wearer optimum respiratory protection. IPE shortages are reported in Status of Resources and Training System-Chemical (SORTS-C) and worked through MAJCOM to overcome.

MARINE CORPS

a. Issuance. Each command has a designated table of equipment that lays out the asset requirements for that unit. The Commands' equipment is stored, maintained, and issued by Consolidated Storage Facilities (CSFs). When the on hand inventory does not support issuing to a commands' full table of equipment, the Marine Expeditionary Force (MEF) Commander will determine which units are given priority and the quantities to be issued. Redistribution of CBRND equipment between CSFs may be required to support the 1-4-2-1 construct. Redistribution between CSFs is coordinated between the MEFs, the NBC Defense Systems Program Manager, the Proponent for Readiness (Deputy Commandant for Plans Policies and Readiness), and approved by the Proponent for NBC defense (Deputy Commandant for Combat Development).

b. Inventory Management. The Marine Corps has initiated the Strategic Logistics Asset Management Project (SLAM). The SLAM geographically centralizes the Marine Corps' CBRN equipment in CSFs using contract logistics support. The equipment held in the CSFs is managed by the NBC Defense Systems Program Manager (PM) who has total asset visibility through a web-based system. The Deputy Commandant for Combat Development is responsible for determining the capabilities required and establishing

the Tables of Equipment. The PM is responsible for the replenishment of equipment held in the CSFs. Unit commanders are not responsible for providing O&M funds to sustain their equipment.

c. Preparation for Deployment. Units preparing for deployment will notify their MEF Headquarters and the CSF of their intent to draw CBRN equipment. Commands are required to inspect the equipment held in the CSF to ensure it is ready for deployment. All SORTS Reporting commands are required to include CBD Equipment readiness in their SORTS Report.

***ISSUE*: Increasing demands for CBRN equipment dictate that an integrated program of supply and maintenance activities to include shelf life surveillance be conducted to optimize utilization of CBRN assets below the wholesale level.**

***SOLUTION*:** The Marine Corps Logistics Command, Albany, Georgia, leads the Joint Equipment Assessment Program (JEAP) for Nuclear, Biological and Chemical Defense (NBCD). It has expanded its capabilities in shelf life management in support of the Defense Logistics Agency (DLA), Defense Supply Center Philadelphia (DSCP), Defense Reutilization and Marketing Service (DRMS), Navy, Air Force, and Army. Specifically, the JEAP functions now include:

- Chair, Joint Service Individual Protective Equipment Technical Working Group (JSIPETWG).
- Manage and execute toxic agent shelf life extension testing of CBRN Defense Assets.
- Maintain and manage set-asides for shelf life extension testing, as well as samples for each lot produced during acquisition or follow on contractual buys, and pull samples from each wholesale DLA Defense Distribution Center (DDC) warehouse, worldwide.
- Maintain a Joint Services CBRN defense clothing and textiles web page containing shelf life data, item descriptions, stock numbers, and lab reports for first article testing for the Joint Services.
- Conduct random cyclic evaluations of CBRN defense assets at selected DLA depots annually.
- Support operational requirements for the Navy's CBRN defense assets Readiness Improvement Program (RIP).
- Co-chair for CBRN defense assets for DoD shelf life committee.
- Manage accountability of CBRN clothing assets turned in to DRMS Worldwide.
- Management support for the Joint Equipment Assessment Units (JEAUs).
- Consolidate and analyze assessment data and provide semi-annual report to Joint Project Manager, Individual Protection (JPM IP).

The JEAP has responsibility for shelf life management, assessment/surveillance and notification of all items identified as clothing used for the protection from nuclear, biological and chemical warfare agents within DoD. The JEAP Web Site at http://shelflife.pmnbc.com/ currently posts all IPE shelf life extension information and can be accessed by an individual with a user name and password. Samples of each manufactured lot are received and those assets are stored for future follow on surveillance testing. The clothing and textile web site has streamlined the dissemination of information on a DoD level, assuring all chemical protective items that have been tested for shelf life

extension are listed and available to all users. As a joint venture, the JEAP will continue to request funding support for the surveillance program. The services as well as DLA will continue to POM and provide funding for the testing of assets for which they are responsible to the JEAP program office. The JEAP will in turn provide a ROM for those assets to be tested. In FY03DLA and the Services along with Congressional Plus-Up provided available funding to support this effort, however, the funding, was insufficient to accomplish the entire testing requirement. This centrally managed program that commenced in November 2002 has extended DoD CBRN defense assets' shelf life, avoiding the requirement of procurement prior to whole life expiration. This action has identified a significant cost avoidance for DoD. Additionally, by all service agencies consolidating the management of shelf life testing, the JEAP has eliminated excess or duplicative test efforts and provided a single historical base providing a more efficient process within DoD. Within the JEAP are mobile Equipment Assessment Units (EAU) for Individual Protection (IP) readiness assurance, which are led by the Marine Corps. This organization has Headquarters at Marine Corps Logistics Base (MCLB), Albany, GA and mobile units located at Camp Lejeune, NC, Camp Pendleton, CA, Camp Foster, Okinawa Japan, Kaneohe, HI and Fort Worth, TX. The mission of the EAUs is to ensure the operational and combat readiness of NBC Defense IP equipment within all Military Services and other Federal agencies as may be directed. These missions are accomplished using a systematic methodology of assessment, inspection, non-destructive testing, maintenance and training that culminates into a higher readiness posture. This provides and organization's command element a product improvement tool that assists in serviceability and maintainability of NBC Defense assets.

The JPM IP, has established a Joint Service Individual Protective Equipment Technical Working Group (JSIPETWG). The JSIPETWG serves as a committee of experts to provide technical expertise and recommendations on fielded CBRN-D individual protective equipment (IPE) issues. Among the areas to be addressed by the JSIPETWG are issues/concerns and policies related to total lifecycle management of CBRN protective systems, components, accessories, and associated IPE and support equipment that are the responsibility of the JPM IP. A charter outlining the membership, scope, and operating procedure for the JSIPETWG was signed in May 2004.

The JEAP has also continued to conduct random, non-destructive, cyclic assessments utilizing specified Army, Navy, Air Force checks and services. The result of this effort is published separately in a Joint Service Mask Assessment Report, published semi-annually.

The JEAP has also established a Memorandum of Agreement (MOA) with the Defense Reutilization and Marketing Service (DRMS) to provide expert technical assistance with the sorting, assessment and proper disposal instructions for excess CBRN clothing and textiles turned in to Defense Reutilization and Marketing Offices (DRMO) throughout the world. Additionally, the JEAP is segregating CBRN items suitable for issue as "Training Only", from these turn-ins, marking them accordingly and filling requests submitted by various authorized DoD agencies. This MOA was established in March 2003 and establishes the JEAP as the only authorized recipient of excess CBRN clothing and textiles turned in to DRMO. An added bonus to this process has been the recovery of condition code "A" items turned in to various DRMOs. These items have either been returned to the service that turned them in or placed back in stock for reissue.

Note: The negative impact of asset expiration on operational readiness and force protection continues to result in Congressional interest (*i.e.*, Congressional Hearings, GAO audits, DODIG Investigations). Without testing and extension of these type II, NBCD clothing and textiles assets they will be placed in a non-issueable status. This could result in the unnecessary disposal of hundreds of millions of dollars in assets and the requirement to fund for replacements. Cost avoidance, as displayed below in ***Figure 3-2***, saves millions of dollars for all end-users of type II, NBCD clothing and textiles. Surveillance testing conducted by JEAP can continue to be a great asset for the DoD community, but greater funding for this program can enable proactive scheduling of testing instead of reactive testing when items are identified expired and commands are under short timelines to get serviceable gear, which usually means they have replace the item.

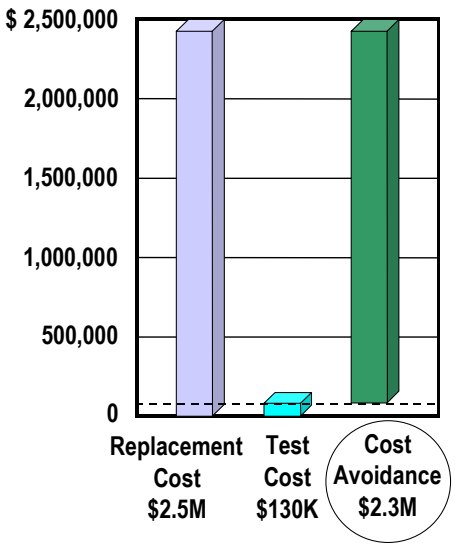

Figure 3.2. An Example of FY03 BVO/GVO Shelf Life Testing (On Going).

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Chapter 4

Chemical, Biological, Radiological and Nuclear (CBRN) Defense Education, Training and Doctrine

4.1 INTRODUCTION

The DoD Chemical and Biological Defense Program (CBDP) builds on the success of each Service into effective joint CBRN defense capabilities by leveraging efforts and applying joint requirements documents, joint doctrine and Tactics, Techniques, and Procedures (TTPs), joint modeling, simulation, and wargaming; Professional Military Education and joint professional training to Service CBRN defense programs. In response to a number of assessments and reports, the Joint Requirements Office (JRO) for CBRN Defense continued implementation of a multi-year strategy to enhance the CBRN Defense-related awareness across the Joint Service community. This strategy includes providing CBRN Defense training, education and awareness at Service and Joint Professional Military Education institutions and colleges and at Combatant Commander staffs. The JRO initiative also supports the review of joint doctrine, ensuring that the foundation, upon which education, training and operations is established, properly reflects CBRN conditions and issues.

4.2 CBRN DEFENSE IN PROFESSIONAL MILITARY EDUCATION

Within the Professional Military Education (PME) system, most colleges currently provide limited CBRN defense considerations and do not adequately address CBRN threat or U.S. response capability in their curricula, and associated wargames and workshops. It is essential that personnel of all Services assigned to joint staffs understand the CBRN threat, are familiar with U.S. capabilities to detect and mitigate the threat, and comprehend their staff roles and responsibilities in dealing with CBRN issues.

A JRO initiative provides support to the Service and Joint PME system. This was accomplished by providing: review of curriculum and wargame scenarios to ensure CBRN is properly addressed; subject matter expert (SME) support to wargames; guest speakers who are experts in the CBRN arena; awareness training for faculty; workshops to stimulate CBRN synergy among the institutions; and by developing course curricula and other related support. During FY04, the JRO provided the following support:

- Coordinated and facilitated the JRO-CBRN Defense SME Guest Speaker Program at Joint and Service PME institutions. This support involved 25 SME lectures at Joint Forces Staff College (JFSC), Army Command and General Staff College and the Air War College for a total of 406 officers.
- Assisted with the development of wargaming at Joint and Service PME institutions. The JRO provided assistance to the Army War College's Strategic Crisis Exercise, Air War College's Solo Challenge, and the Joint, Land, Air and Sea Simulation conducted by the Air Force Wargaming Institute for all senior-level colleges. This support affected over

400 officers and ensured that the appropriate levels and types of CBRN events were inserted into these wargames.

- Coordinated and provided CBRN Defense SME technical assistance at Joint and Service PME institutions in the review and improvement of existing core and/or elective curriculum. For example, the JRO reviewed and provided improvements to the CBRN Annex to the Operational Plan used by the JFSC in its Asymmetric Warfare Exercise (Purple Rogue). These products are used by all students attending the JFSC and these enhancements will help ensure that proper consideration is afforded to CBRN defense planning and mitigation efforts.
- Conducted the CBRN Faculty Curriculum Developers Course in the National Capitol Region. This is a four hour workshop designed to provide CBRN subject matter expertise to curriculum developers and educators who are interested in integrating CBRN issues into their curricula. Attendees included faculty from National Defense University (NDU) and JFSC.

The USAF Counterproliferation Center sponsors a three hour core presentation for all students who attend Air War College at Air University, Maxwell AFB, Montgomery, Alabama, entitled DFW 6530, *Emerging CONOPS for Counter-Chemical, Biological and Radiological Warfare*, that is offered by the Warfighting Department. The Center also teaches three elective courses containing homeland security, chemical and biological warfare, and nation state adversarial issues. Additionally, the Center conducts three workshops each year on counter-proliferation and WMD topics and hosts an annual USAF Counterproliferation Conference.

4.3 CBRN DEFENSE TRAINING

All Services conduct CBRN defense specialist professional training at the same location in accordance with Congressional statute (P.L. 103-160, Section 1702). Currently, all Service training, except for medical CBRN courses, is co-located at the United States Army Chemical School (USACMLS), Fort Leonard Wood, Missouri. Each Service conducts their training with their own Service instructors. Each service establishes standards of proficiency and currency for CBRN defense training. The following sections describe each Service's activities for CBRN defense training.

4.3.1 Army

The USACMLS led the analytical efforts to support the Army First Responder Program, a major component of the Chemical, Biological, Radiological, Nuclear, and High-Yield Explosive (CBRNE) Installation Preparedness Program. In May 2004, the Army obtained approval of a Functional Needs Analysis (FNA) that identified the gaps in capabilities for doctrine, organizations, training, materiel, leadership and education, personnel, and facility (DOTMLPF) requirements for CBRNE Installation Preparedness. In March 2004, using the draft FNA, a CBRNE Installation Preparedness Program Functional Solutions Analysis (FSA) was completed, identifying the solutions to fill the gaps in capabilities identified in the FNA. Standardization of equipment, to include equipment for both Continental United States (CONUS) and Outside CONUS (OCONUS) installations, and the corresponding foundational training in accordance with 29 CFR 1910.120, *Hazardous waste operations and emergency response*, new equipment training, and new organization training were central themes of the

review process, which included the Army Staff, U.S. Army Training and Doctrine Command (TRADOC), Office of the Surgeon General (OTSG), U.S. Army Medical Command, the U.S. Army Medical Department Center and School (AMEDDC&S), the Installation Management Agency, other TRADOC centers and schools, and the Joint Program Manager - Guardian.

4.3.1.1 Individual Training. Various government training is available that instruct the operation and employment of this equipment, but the need to train soldiers for CBRNE installation protection OCONUS as well as for similar missions while deployed had a significant impact on gap analysis. In 2004, the USACMLS performed a training requirements determination and began developing a proposal to establish an internationally recognized standard for CBRNE Responder personnel.

4.3.1.2 Medical Training. The Army and the Defense Health Program funds medical CBRN training in support of patient care, leader development and medical force health protection. Patient care training provides medical professionals with the clinical skills necessary to diagnose and treat individuals exposed to CBRN agents. Leader development prepares Army medical leaders to plan for and manage CBRN casualties on the battlefield or in the United States. Leader Development training includes: 1) Officer Basic Course, 2) Officer Advanced Course, 3) Basic NCO Course, 4) Advanced NCO Course, 5) Principles of Military Preventive Medicine Course, and 6) Preventive Medicine Specialist Course.

Medical force health protection training provides preventive medicine personnel with the skills necessary to support Force Health Protection programs across the full spectrum of military operations. Training is conducted at the 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 U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM). Training modalities include in residence training, training conducted at the requesting unit's site (On Site training), and through Distance Learning programs. Each training modality offers unique advantages. In residence 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, without direct student-instructor interactions. A summary of Army-sponsored medical CBRN training is provided in **Tables 4-1** and **4-2**.

Table 4-1. Summary of Army Medical CBRN Training in FY04 [as of 30 Sep 04].

Type of Training	Total Number Trained	Army Trained
AMEDDC&S		
Leader Development (NBC)	3713	3702
CBRNE	20119	20119
AFRRI		
Medical Effects of Ionizing Radiation (MEIR)	625	287
USAMRICD		
Medical Management of Chemical and Biological Casualties Course (MCBC) in residence	407	242
FCBC in residence	479	445
On-site to active military	744	508
On-site training – Non military	121	
MCBC Video	62	57
MCBC Computer based Training	549	86
Medical Response to Chemical Warfare and Terrorism 2000 Satellite Broadcast/Video Course	8	3
Biological and Chemical Warfare and Terrorism: Medical Issues and Response 2001 Satellite Broadcast/Video Course	19	9
Satellite: Biological & Chemical Warfare and Terrorism: Advanced Topics on Medical Defense Against Biological and Chemical Agents	2999	450

Table 4-2. Summary of hours awarded to physicians and nurses for MCBC during FY04.

Type of Training	Physician Hours	Nurse Hours
USAMRIID/USAMRICD		
MCBC in residence	7924	3527.4
MCBC Offsite course	1712.25	3893.3

4.3.1.3 Army CBRN Defense Specialists Training. U.S. Army CBRN Defense Professional Training presently takes place at Fort Leonard Wood, Missouri. Training consists of three enlisted/non-commissioned officer courses two officer courses, and two Re-Classification Classes. At initial entry level (See **Table 4-3**), enlisted soldiers and officers receive training in chemical, biological, and radiological agents, plus HAZMAT characteristics, smoke and decontamination operations, chemical and radiological survey procedures, HAZMAT awareness operations, 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.

Table 4-3. U.S. Army Professional and Initial Entry Training (FY04).

Training Command	Type of Training	Training Method	Number of Graduates*
USACMLS	Chemical Officer Basic	Initial Entry - Resident	220
USACMLS	Chemical Captain's Career Course	Initial Entry - Resident	59
USACMLS	Chemical Officer Advanced -RC	Resident	53
USACMLS	Chemical Operations Specialist One Station Unit Training (OSUT/OSUT2/AIT)	Initial Entry - Resident	1685
USACMLS	Chemical BNCOC	Resident	160
USACMLS	Chemical BNCOC (RECLASS)	Resident	57
USACMLS	Chemical ANCOC	Resident	158

* Graduates included from all services and foreign military. (Data source ATRRS for period FY04)

Specialized functional training is conducted in standalone courses attended by DoD, Allied, and international students, as shown in **Table 4-4**. All courses use a resident training method and are conducted at USACMLS.

Table 4-4. U.S. Army Specialized Professional Training (FY04).

Type of Training	Training Duration	Number of Graduates*
Nuclear, Biological, Chemical Reconnaissance	6 weeks	111
Master Fox Scout	3 weeks	0
Biological Integrated Detection SYS (BIDS) SP	4-weeks, 3 days	375
Decontamination Procedures (Non-US)	1 week	150
Radiological Safety (Installation Level)	3 weeks	52
Operational Radiation Safety	1 week	126
WMD Installation Emergency Responder	1 week	0
WMD-CBRN Installation Planner's Course	1 week	0
Civil Support Skills Course	8 weeks	99
Chemical Pre-Command & Div/Corps	1 week	22
US Coast Guard Strike Force	1 week	0

4.3.1.4 Army Medical Initiatives.

AMEDDC&S Initiatives.

NBC Sciences Branch Joint Civilian CBRNE Training Initiative. The AMEDDC&S gave support to a partnership with the Associated Medical Schools of NY (AMSNY), NY State Academic Dental Centers (NYSADC) and the University of Southern California (USC) Dental School for the purpose of developing a well-trained civilian reserve medical corps to meet surges in healthcare demands resulting from catastrophic events. This partnership will:

- Train future civilian medical and dental leaders in WMD and CBRNE response and crisis management;
- Adapt military CBRNE education and training materials to civilian needs, with emphasis on curriculum for physicians, dentists and other health professionals;
- Create a civilian-military academic fellowship program for WMD training and policy formation.

This was demonstrated by the two projects AMEDDC&S, NYSADC, and AMSNY co-sponsored with the US Army Recruiting Command in 2004.

- 35 New York medical/dental students and advisors traveled to Fort Sam Houston, Texas and received 40 hrs of CBRNE lectures and hands on training in a field environment.
- Developed and delivered a 2-day CBRNE First Responders course to over 200 NYC fire fighters, police, Department of Corrections officers, nurses, physicians, and other clinical care personnel. At the conclusion of this activity, participants should be capable of understanding the medical aspects of CBRNE terrorism and managing CBRNE casualties.

Memorandum of Agreement between the United States Army Medical Department Center and School and the Department of State. Under the authority of the Foreign Assistance Act of 1961, the Department of State, Bureau of Diplomatic Security (DS), is responsible to provide a safe, secure environment for the conduct of United States diplomacy and promotion of United States interests worldwide. The DS Antiterrorism Assistance (DS/ATA) program is a technical assistance and cooperation program that enhances the capabilities of selected foreign governments to combat terrorism, through police and security training and training-related activities. The Weapons of Mass Destruction First Responder Awareness Seminar is a DS/ATA course that is delivered in country to the host nations emergency services personnel. AMEDDCS will be requested to provide professional expertise and instructional service support in the areas of Radiation Health Physics and Chemical and Biological Agents to the ATA Weapons of Mass Destruction First Responder Awareness Seminar. This year's efforts reached 7 countries and over 600 first responders.

Fort Sam Houston Anti-Terrorism Plan CBRNE Section Development. The AMEDDC&S, NBC Sciences Branch chaired the CBRNE working group IAW 525-13 and DODI 2000.18. The NBC Sciences branch has the lead in developing the CBRNE emergency response for the installation's anti-terrorism plan.

NBC Sciences Branch Oversight Training Initiative. The Army Medical Command's advanced training in management of chemical and biological threat agent incidents is conducted through two subordinate commands of the Medical Research and Materiel Command. Together, USAMRICD and USAMRIID conduct the Medical Management of Chemical and Biological Casualties (MCBC) and the Field Management of Chemical and Biological Casualties (FCBC) courses. These courses train all members of the health care team, including emergency responders and public health officers, in the medical preparation for, and treatment of, chemical and biological warfare agents. Although they have a military focus, these courses have become increasingly important in the national and international anti-terrorism effort.

USAMRIID and USAMRICD additionally cooperated this past year to produce a six part satellite program on advanced topics in the medical management of biological and chemical warfare agents. These were explicitly constructed to meet both deployed military and urban and homeland defense needs. The data (**Table 4-2**) clearly demonstrate the utility of the programming and also demonstrate the outreach capability of this educational medium.

USAMRICD and USAMRIID successfully met their mission to train every Army medical unit deploying into Theatre in support of both Operations Enduring Freedom (OEF)

and Operation Iraqi Freedom (OIF).

USAMRICD is actively engaged in support to homeland defense. In addition to the areas discussed above, the Institute stood up a course to prepare international partners to respond effectively to incidents involving WMD, and the Public Health Service included the MCBC as required training for its EMATs (Emergency Management Teams).

In short, the USAMRICD is actively engaged with both the military and the civilian medical and first responder communities in order that they be fully equipped and confident in their ability to medically manage chemical agent incidents. The data clearly reflect this dual emphasis and on the success with which it is meeting.

Support to U.S. Army Medical Command (MEDCOM) Homeland Security Initiatives. The AMEDDC&S provides subject matter expertise in support of the Joint Services CBRNE Training Program. This program is evolving in collaboration with the Defense Medical Readiness Training Institute (DMRTI) and the Services. It is a two-phase program consisting of distance learning and on site evaluations. Phase I consists of seven long distance modules, which will be distributed through the Army Distance Learning System. The first module aired June 2004 and the rest in September 2004. Phase two has yet to be implemented but consists of on site evaluations for Army Medical Treatment Facilities to evaluate the sustainment of CBRNE response.

4.3.1.5 Reserve Component Initiative Training. As part of the on-going US Army Reserve Domestic Response Decontamination and Reconnaissance initiative (begun in 1999), US Army Reserve soldiers have been trained through the US Army Technical Escort Course (J5), the Pennsylvania State Fire Academy and at the US Army Reserve's Joint Interagency Civil Support Training Center. To date, 348 US Army Reserve Chemical Soldiers have received HAZMAT training through the Pennsylvania State Fire Academy in Lewistown, PA. Of this number, 50 were trained there in 2004. At the Fort Dix Joint Interagency Civil Support Training Center, 234 soldiers received Mass Casualty Decontamination training in 2004, adding to the hundreds previously trained in other locations. The US Army Reserve added 64 Technical Escort trained soldiers to its ranks in 2005.

4.3.2 Air Force

Air Force policy is to provide initial Nuclear, Biological, Chemical, and Conventional (NBCC) defense training to military personnel and emergency essential civilians in or deployable to NBCC medium and high threat areas (**Table 4-5**) and refresher training every 15 months. NBCC Defense training instructors at base level receive their professional training through Air Force Apprentice, Craftsman and Advanced courses at the Air Force Civil Engineer Readiness School, Fort Leonard Wood, Missouri. Selected command, control, and response personnel receive additional home station and/or in-residence to meet requirements for hazardous material emergency response, WMD emergency response, exercise evaluation team duty. The designation of NBCC threat areas is used for both deliberate and execution level planning. Airbases within these geographical locations are categorized as NBCC high, medium, or low threat areas. Assessments use open source publications, MAJCOM and theater guidance, and unclassified intelligence information and are updated annually, or as needed.

Table 4-5. NBCC Threat Areas.

NBCC Threat	Geographical Location
High Threat Area[1]	Bahrain, Balkans Region, Diego Garcia, Egypt, Greece, India, Iraq, Israel, Jordan, Kingdom of Saudi Arabia, Kuwait, Pakistan, Qatar, Republic of China (Taiwan), Republic of Korea, Somalia, Singapore, Sudan, Thailand, Turkey, United Arab Emirates
Medium Threat Area[2]	Germany, Italy, Japan, and Yemen
Low Threat Area[3]	All locations not listed as a high or medium threat area

4.3.2.1 Individual and Team (Collective) Training. At the individual level, the Air Force uses a multi-level approach to CBRNE related training. All new enlisted inductees receive 14 hours of CBRNE Defense related training during basic training at Lackland AFB, TX. Depending on the recruiting quotas, approximately 45,000 new Airmen are trained annually. Instruction includes basic individual defense measures to include wear of protective equipment (to include protective mask); alarm signals; mission oriented protective postures; CBRNE characteristics, identification, detection, reporting, decontamination; and a mask confidence exercise. The training combines with other combat skills at the end of full week of training and exercises into a full scale Ability to Survive and Operate Exercise. The Education, Training, and Exercise Working Group is formulating strategy to ensure all new officer inductions receive similar indoctrination in the future. (See below.)

Air Force medical personnel receive CBRN defense training initially at Commissioned Officer's Training or at their technical schools during Basic Expeditionary Medical Readiness Training or Expeditionary Medical Readiness Course. All other personnel (emergency essential civilians and/or contractor personnel) in theater or deployable (who have not completed training during their inception into the Air Force) will receive initial CBRN defense training at their respective installation.

To keep their skills up-to-date and to introduce new or changed procedures and equipment, all initially trained personnel are required to attend refresher training every 15 months. For both initial and refresher training, the Air Force is transitioning to a blended learning concept to train all Airmen to prepare for and respond to the full spectrum of threats.

[1] *NBCC High Threat Area (HTA).* Forces in these areas are at risk from attack with NBCC weapons and subject to terrorist use of weapons of mass destruction (WMD). Potential adversaries within the region either possess or are likely to possess a substantial stockpile of NBCC weapons and weapons systems and may have special operations forces capable of conducting sustained attacks on airbases. Actual or potential terrorist threats exist during peacetime or wartime. Air Force personnel and units in or deployed to these locations will be organized, trained, and equipped to survive NBCC attacks and conduct sustained combat operations in NBC environments.

[2] *NBCC Medium Threat Area (MTA).* Forces in these areas are at risk to attack with NBCC weapons and subject to terrorist use of WMD. Potential adversaries within the region either possess or are likely to possess NBCC weapons and have weapons systems and may also have special operations forces capable of conducting limited attacks on airbases. Actual or potential terrorist threats exist during peacetime or wartime. Air Force personnel and units in or deployed to these locations will be organized, trained, and equipped to survive NBCC attacks and conduct combat operations in NBC environments.

[3] *NBCC Low Threat Area (LTA).* Forces in these areas are not considered at risk from attack with NBCC weapons, but are subject to attack by terrorists using WMD. Actual or potential terrorist threats exist during peacetime or wartime. Air Force personnel and weapons systems in or deployed to these locations will be organized, trained, and equipped to survive attacks by terrorists using WMD and restore primary mission capability. CONUS installations will comply with applicable Continuity of Operations Plans and nuclear fallout shelter requirements in AFI 10-2501 and AFMAN 32-4005, *Personal Protection and Attack Actions*.

Distance learning technologies will be used to deliver standardized knowledge-based materials, which will allow for academic self-paced learning and provide the student the ability to access the materials 24 hours a day/7 days a week. Upon successful completion of knowledge-based training objectives, Air Force Civil Engineer Readiness Flight instructors will help students accomplish demo-performance objectives in a classroom environment focusing on key tactics, techniques, and procedures. The instructors from the Civil Engineer Readiness Flights are the Air Force's CBRNE defense training instructors. These instructors receive their professional training through Air Force Apprentice, Craftsman and Advanced courses at the Air Force Civil Engineer Readiness School, Fort Leonard Wood, Missouri.

The next tier of training is accomplished through Task Qualification Training by performing individual wartime duties as they would in a CBRN environment. In addition, aircrews are required to conduct Task Qualification Training Flights while wearing chemical defensive equipment.

Finally, each individual's education and training are further refined during various exercises (**Table 4-6**) conducted to hone the individual's skills and identify shortfalls in the overall unit's capability while operating in a CBRNE scenario.

Table 4-6. Major Accident and WMD In-Residence Training Requirements.

Target Audience	Rank (or Civilian Equivalent)	Assigned To:	Number Personnel Trained	In-Residence Training (In Addition to Local Training)
On-Scene Commander	0-7 through 0-10	Response Task Force	2	Commander and Staff Radiological Accident Response Course Response Workshop (DNWS)
			0	Air Force On-Scene Commander Course (AU)
On-Scene Command and Alternates	0-5 through 0-6	Initial Response Base or Disaster Control Group	8	Radiological Accident Command, Control and Coordination Course (DNWS)
			0	Air Force On-Scene Commander Course (AU)
Officer or Civilian		Response Task Force	5	Radiological Accident Command, Control and Coordination Course (DNWS)
			0	Air Force On-Scene Commander Course (AU)
Officer/Enlisted or Civilian	E-7 through 0-5	Response Task Force or Disaster Control Group	108	Radiological Accident Command, Control and Coordination Course (DNWS) or Radiological Emergency Teams Operations Course (DNWS)
Disaster Response Force	Any Rank	Contingency Support Staff, Contamination Control Team, or EOD	182	Radiological Emergency Team Operations Course (DNWS)
Exercise Evaluation Team Chief or Inspector General Evaluator		Response evaluation duties	0	Air Force On-Scene Commander Course (AU)

DNWS - Defense Nuclear Weapons School, Kirtland AFB, NM
AU – Air University, Maxwell AFB, AL

Beyond the standard CBRNE defense related training, selected command, control, and response personnel (**Table 4-6**) receive additional home station and/or in-residence training and participate in exercises to respond to hazardous material emergencies (to include terrorist use of weapons of mass destruction). Specialized team members and personnel in senior or key leadership positions also receive additional information that will help them make appropriate risk management decisions and to better lead their personnel while ensuring air base survivability.

4.3.2.2 Air Force CBRN Defense Specialist Training. The 366th Training Squadron, Detachment 7, Civil Engineer Readiness School at Fort Leonard Wood, Missouri offers seven in-residence courses designed to enhance the CBRN proficiency of primary-duty Air Force Civil Engineer Readiness Flight personnel (**Table 4-7**). These courses fulfill the differing needs of the total force, including Active Duty, Air National Guard, and Air Force Reserve.

Table 4-7. Air Force Professional Training.

Course Name	Training Duration	Number of 2004 Graduates
Civil Engineer (CE) Readiness Apprentice course	53 days	309
CE Craftsman Course	10 days	69
CE Advanced Readiness Course	5 days	77
CE Readiness Flight Officer Course	20 days	0*
CBRN Cell (Resident) Course	5 days	74
CBRN Cell (Mobile Training Team)	5 days	14
Full Spectrum Threat Response Course	5 days	11

* New Course—Begins in FY05

4.3.2.3 Air Force CBRN Defense Training Initiatives. Because CBRN defense is an urgent need, Air Force efforts have focused on expanding and improving readiness through the C-CBRNE CONOPS as describe below.

The C-CW Element of the C-CBRNE CONOPS. The Air Force has traditionally shaped its chemical warfare passive defense capability by adapting approaches and capabilities developed by the Army chemical defense community (as the accepted DoD-wide lead for most chemical defense programs). However, after six years of analysis and testing, the Air Force has a much better understanding of the chemical effects on airbase operations. With this understanding, the Air Force implemented the C-CW element of the C-CBRNE CONOPS. Analysis indicates that adopting these procedures will help reduce expected CW sortie degradation from roughly 40 to less than 10 percent.

In addition, the Air Force is tailoring procedures at some installations through the Operational Effectiveness Assistance (OEA) process. The OEA is an installation-level analysis to assist unit-level integration and implementation of critical C-CW tactics, techniques, and procedures. OEAs comprise evaluation of each installation's threat, mission and infrastructure, and model each installation's processes to identify high-leverage actions for improving mission capability in a contaminated environment. The OEA provides quantifiable recommendations and tools to tailor the C-CW element to the installation's unique requirements through a hands-on, unit-level approach.

The C-BW Element of the C-CBRNE CONOPS. In 2004, the Air Force began to focus its C-BW CONOPS development effort on three activities. The first was a series of exercises

designed to develop C-BW policy and guidance for fixed-site operations in an OCONUS wartime operations environment. The Air Force engaged a cross-functional team to conduct four visits to Kunsan AB to develop C-BW Tactics, Techniques, and Procedures (TTPs) that will form the basis of a C-BW CONOPS for Air Force-wide implementation. Kunsan AB is viewed as an ideal setting given their robust exercise regime and wartime footing. Referred to as the Kunsan Focused Effort (KFE), it is the first analytic effort that will quantitatively link BW to operational capability. The initiative specifically examines the BW impact on mission recovery and sustainment of operation in a wartime setting. KFE includes a well-defined methodology supported by modeling and analytic tools.

The second activity was to improve bio-defense guidance in CONUS/peacetime environments through the Weapons of Mass Destruction Installation Training and Exercise Program and the Joint Service Installation Pilot Project.

The third activity is the ongoing research initiated by the BDTF into the operational impacts of biological warfare. The BDTF transitioned its responsibilities to the USAF C-CBRNE Council in 2003. The Council is the single coordinating body for C-CBRNE activities within the Air Staff.

The Counter-Radiological Warfare (C-RW), Counter-Nuclear Warfare (C-NW), and Counter-High-Yield Explosive (C-EW) Elements of the C-CBRNE CONOPS. The other elements of the CONOPS are still under development. Work on the C-RW element began in 2003, with a C-RW study completed in early 2004. The C-RW study is an operationally focused, science-based report the Air Force can use to develop guidance for Commanders to deter, prevent, and respond to radiological attacks and to recover operational capability in an RW environment while limiting risks to personnel and resources. The requirements for C-NW and C-EW elements are being scoped.

The USAF C-CBRNE Master Plan. The Chief of Staff of the USAF published a C-CBRNE Master Plan with four implementation roadmaps. This plan coordinates USAF efforts over a five-year period to establish, maintain, improve, and evaluate its readiness to accomplish the full suite of C-CBRNE missions and to operate in a CBRNE environment. The Master Plan outlines the operational capabilities the Air Force needs to counter the CBRNE threat, outlines a methodology and approach for developing and enhancing those capabilities, and organizes these efforts into four sub-plans or "roadmaps." Three of these roadmaps parallel the service's Title X responsibilities to organize, train, and equip, with the fourth covering fundamental research and definition of the problem and potential solutions.

USAF/XO C-CBRNE Education, Training, and Exercise (ETE) Initiative. In 2004, the USAF Director of Operations (XO) initiated a comprehensive C-CBRNE ETE initiative designed to institutionalize and operationalize C-CBRNE. The XO outlined the following operational objectives:

- Define C-CBRNE knowledge (learning objectives) and training skill sets that drive Air Force Education, Training, and Exercise institutions.
- Develop life-cycle education curricula critical to teaching C-CBRNE principles, risk management, and decision-making tools.
- Analyze/create life-cycle individual, functional, senior leader, and specialized training to fill gaps and ensure consistency with C-CBRNE guidance, TTPs, and innovative

solutions.

- Reinforce realistic C-CBRNE operations through exercises/wargames that properly capture CBRNE impact on airbase-operating environments.

4.3.2.4 Air Force Medical Training Initiatives. The completion rate for the Medical Management of Biological Casualties Course is 84% (5,689 trained/6779 total providers).

In 2004, the Air Force Medical Service conducted training for over 50% of its Medical Treatment Facilities (MTFs) with a CW/BW Tabletop Exercise named CODE SILVER. CODE SILVER began with three pilot bases (Hill AFB, UT; Fairchild AFB, WA; Travis AFB, CA). During January through October 2004, CODE SILVER was conducted at 37 AF MTFs (CONUS and OCONUS) and four ANG medical units. CODE SILVER is presented as a tabletop exercise consisting of two scenarios, a contagious biological agent event and a toxic industrial chemical incident perpetrated as terrorist events. Each scenario is played for 4 hours in a free thinking format with all information available to all the players. This allows all players (medical and installation personnel, as well as local community emergency responders) to see what is going on and be actively engaged throughout the whole response.

CODE SILVER will continue in FY05 to train the rest of the AF MTFs. In addition, the exercise has been expanded to include a command and control situation dealing with a terrorist incident that the installation and community leadership work through. Also, four new scenarios have been added in FY05 (Chemical/Radiological Dispersal Device, Venezuelan Equine Encephalitis Virus, Phosgene, and Tularemia).

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-D Personnel Qualification Standard (PQS) training. Navy personnel also conduct periodic unit CBR-D training and pre-deployment unit training exercises. The Naval Aviation Maintenance Program, OPNAV 4790.2 has been modified to reflect CBRD requirements for personnel protection and for equipment cleaning. This doctrinal change institutionalizes CBRD in Naval Aviation.

4.3.3.1 Individual Training. The Navy provides initial entry-level CBR-D 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 an exercise designed to increase individual confidence in the protective equipment. Officers receive two hours of class time focused on personal protection equipment and survival skills.

Officer and Enlisted Personnel assigned to ship and shore billets requiring CBR-D expertise receive additional CBR-D related instruction. This includes 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, Rhode Island. Officer and Enlisted personnel assigned to Ashore Expeditionary Forces (including Naval Construction

Forces) also receive follow-on CBR-D instruction. This training includes the SEABEE Personal Protection and Decontamination and Command Center Staff CBR-D Operations courses of instruction at Naval Construction Training Center Gulfport, MS and Port Hueneme, CA. Information on selected individual CBR-D training standards is provided in **Table 4-8**.

Table 4-8. Navy Basic CBR-D Standards Complete CBR-D Fundamentals Personnel Qualification Standard.

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

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

After reporting to designated units, Navy personnel are required to complete basic and advanced CBR-D PQS training. PQS is a compilation of the minimum knowledge and skills that an individual must demonstrate to qualify to stand watch or perform other specific duties necessary for the safety, security, or proper operation of a ship, aircraft or support system.

4.3.3.3 Medical Training. Information on the status Navy CBRN defense medical training as of the end of FY04 is provided in **Table 4-9**.

Table 4-9. Navy Medical CBRN Defense Training Status.

	Clinicians			Non-clinicians		
	Trained	**Total**	**% Trained**	**Trained**	**Total**	**% Trained**
Officers	2192	4382	50%	1006	4022	25%
Enlisted	59	2386	2%	257	33,903	1%
Total	2251	6768	33%	1263	37,925	3%

Clinicians by Corps	Trained	Total Inventory	% Trained
Medical Corps	1621	2833	57%
Dental Corps	475	1051	45%
Nurse Practioner	29	263	11%
Physicians Assistant	67	235	29%
Hospital Corpsman (HM)	59	2386	2%
Total	2251	6768	33%

Navy Medicine has defined training that will meet training requirements. The updated

training includes standardized, formal courses, and the new tri-service CBRNE electronic training program located on Navy E-learning that became available in OCT 04. Acceptable training courses include:

- Medical Management of Chemical and Biological Casualties Course (MCBC) – USAMRICID
- Field Management of Chemical and Biological Casualties Course (FCBC) – USAMRICID
- Medical Effects of Ionizing Radiation Field Course – AFRRI
- Biological Warfare Detection Course (BWDC) – Biological Detection Research Department (BDRD) – This course is for Advanced Lab Technicians (NEC 8506) and Preventive Medicine Technicians (NEC 8432).
- CBRNE Emergency Medical Preparedness and Response Courses hosted on Navy E-Learning:
    - Clinician's Course – All Physicians (MC), Dentists (DC), Nurse Practitioners (NP), Physician Assistants (PA) and Independent Duty Corpsmen (IDC)
    - First Responder/Operator Course – Corpsmen (HM), Dental Techs (DT), Nurses (NC), Medical Service Corps Officers(MSC)
    - Executive/Commander's Course – Senior Leadership
    - Basic Awareness Course – All other non-medical DON personnel, civilian, and contactor

Navy Medicine is transitioning CBRN training to a standardized and auditable reporting system. Training numbers in this report for FY04 indicate training reported in certifiable databases. It also provides data on clinician training by Corps. Non-medical, non-security medical department personnel will be required to participate in the CBRN Basic Awareness Course hosted on Navy e-Learning beginning in FY05 with full implementation by FY07.

Presently, Navy clinicians attend the Management of Chemical, Biological and Radiological Casualties Course at USAMRICD, USAMRIID, AFRRI. Two Medical Service Corps Officers are selected annually to complete a one-year fellowship at the US Army Research Development and Engineering Command, Aberdeen Proving Ground MD. Advanced training in the entire medical defense spectrum against chemical, biological and radiological agents, including environmental contaminates encountered during deployment, is provided. Specific focus on the planning and execution of military response and support to CBRN related events, both domestically and during conflict, is also emphasized. Additionally, Advanced Lab Technicians and Preventive Medicine Technicians may receive Biological Warfare detection training provided by the Navy Medical Research Center (NMRC).

4.3.3.4 Navy CBR-D Specialist Training. The Navy Construction Training Center Detachment at USACMLS, Fort Leonard Wood, Missouri, offers two courses of instruction for Navy CBR-D specialists. The courses are open to Navy, Coast Guard, Military Sealift Command, and select foreign military personnel, E-5 and above. Courses are designed to provide both afloat and ashore commands with individuals who can successfully perform their requisite duties in a CBR contaminated environment. In addition, the training enables CBR-D specialists to act as the primary CBR-D trainers for their respective commands. For fiscal year 2004, 219 students graduated from the Navy courses conducted at Fort Leonard Wood, MO.

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. (See **Table 4-10**).

Table 4-10. U.S. Navy CBR-D Courses.

Course Name	Course Location
Shipboard CBR-D Specialist Course	Fort Leonard Wood, MO
Disaster Preparedness Officer Course	
Recruit Training CBR-D	Naval Training Center Great Lakes, IL
Basic Engineering Core Course (BECC)	
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
Preventive Medicine Technician "C" School	Naval School of Health Sciences, San Diego, CA
Confirmatory Lab Operator	Naval Medical Research Center, Silver Spring, MD
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 and Naval Construction Training Center Port Hueneme, CA
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
Division Officer	Surface Warfare Officers School Newport, RI
Damage Control Assistant	
Department Head	
Executive Officer	
Commanding Officer	

4.3.4 Marine Corps

The Marine Corps trains its personnel to accomplish their wartime mission in any battlespace condition and in every environment. Anytime Nuclear, Biological, and Chemical Defense (NBCD) is separated from other training events, it is conditioning Marines to regard NBCD operations as a separate form of warfare. Complete integration of NBC Defense training will ensure that all Marines possess a thorough understanding of NBCD operations and

procedures. All personnel must be trained to recognize NBC attacks, don the field protective mask and protective clothing quickly, perform assigned missions wearing protective clothing, and survive and continue to operate for extended periods in an NBC environment. All Marine Corps organizations must continually integrate NBCD training to develop unit integrity, cohesion, and NBCD operational expertise.

4.3.4.1 Individual Training. Annually, on a calendar year basis, Individual Survival Standards (ISS) training is conducted for all Marines using the standards of proficiency outlined in MCO 3400.3F. In conjunction with ISS training, all Marines complete an Individual Protective Equipment (IPE) Confidence Exercise, once per calendar year.

4.3.4.2 Unit Training. Units must be able to perform to the Basic Operating Standards of Proficiency and NBC Team Operations when conducting missions under NBC conditions. These standards are outlined in MCO 3400.3F**.**

4.3.4.3 CBRN Defense Specialist Training. Completion of the required initial basic instruction and sustainment of proficiency are paramount to the ability of the unit NBC Defense Officer and NBC Defense specialist in accomplishing the mission of NBC Defense in their respective units. The minimum training requirements for initial instruction and sustainment of proficiency are located in MCO 3500.70 (NBC Defense Training and Readiness Manual). **Table 4-11** provides a complete list of schools available for NBC Officers/Specialists.

4.3.4.4 Marine Corps CBRN Defense Initiatives. Marine Corps CBRN Defense Initiatives are broken down into two areas—Operating Force Initiatives and Supporting Establishment Initiatives.

Operating Force Initiatives. The Marine Corps' focal point for all CBRN defense issues resides under the Deputy Commandant for Combat Development (DC CD). The DC CD chartered an Operational Advisory Group (OAG) that has completed a 3-year effort where they have evaluated the Marine Air Ground Task Force's (MAGTF) ability to conduct the CBRN defense operations necessary to support the Marine Corps' Expeditionary Maneuver Warfare Concept. The evaluation assessed the Doctrine, Organization, Training, Materiel, Leadership, Personnel, and Facilities (DOTMLPF) necessary to support a MAGTF operating in a CBRN environment. The results of this evaluation have been incorporated into a MAGTF NBC Defense Operating Concept, which will serve as the basis for a rewrite of the Marine Corps Warfighting Publication 3-37, MAGTF NBC Defense Operations. The Concept was approved by the Assistant Commandant of the Marine Corps in February 2005 and will begin a coordinated time phased effort to transition the operating force to the new Concept, and resolve numerous DOTMLPF deficiencies identified by the OAG. Operating Force Training is shown in **Table 4-11**.

Supporting Establishment Initiatives. The Deputy Commandant for Plans, Policies and Operations has continued to improve the Marine Corps' installation first responder capability with equipment upgrades and training. Enhanced WMD exercises for installations include local communities which further cement our initial response capabilities. The completion of Joint Service Installation Pilot Project (JSIPP), continuation of Unconventional Nuclear Warfare Defense (UNWD) coupled with our First Responder Program has provided a valuable tool for the preparedness of our installations. Camp Pendleton, CA will be the first of nine Marine

Corps installations inducted into the Guardian project during FY05 and further enhance the Marine Corps' Installation Protection Program.

The Marine Corps continued CBRNE Tier III equipment upgrades for its installations improving responder capabilities in line with local communities and other DoD programs. It also completed Tier III training for 16 Marine Corps Installations and two Marine Corps Reserve centers. The sustainment training identified in **Table 4-12** was provided to Camp Lejeune first responders and certified hazmat technician course provided to Camp Fuji.

Table 4-11. USMC CBRN Defense Operating Force Training.

Training Command	Type of Training	Training Duration
USMC NBCD School	NBC Defense Specialist Basic Course	12 weeks
USMC NBCD School	NBC Defense Officer Basic Course	7 weeks
USACMLS	Chemical Captains Career Course	26 weeks
SACMLS	Nuclear, Biological, Chemical Reconnaissance	6 weeks
USACMLS	Master Fox Scout	3 weeks
USACMLS	Radiological Safety (Installation Level)	3 weeks
USACMLS	Operational Radiation Safety	1 week
USA Red Stone	Technical Escort	3 weeks, 3 days
DNWS	Radiological Emergency Team Operations Course	9 days

Table 4-12. USMC CBRN Defense Supporting Establishment Training.

Course Name	Course Location/Duration
CBRN Awareness	MTT/4 hrs
CBRN Operations	MTT/4hrs
Incident Command	MTT/8 hrs
Hazmat Technician	MTT/16 hrs
CBRN EMT Technician	MTT/8 hrs
Healthcare CBRNE Provider	MTT/8 hrs
Command and Staff	MTT/2-4 hrs

4.3.5 Joint CBRN Defense Training

A JRO initiative assists the combatant commands to reduce CBRN-related training gaps, by working within the Joint Training System (JTS). This is accomplished by providing: CBRN familiarization training to staffs, SME support to the planning, execution and assessment of exercises, and other related support. Part of the JRO initiative is the Joint Senior Leaders Course (JSLC). JSLC is sponsored by the JRO and conducted at the USACMLS in Ft Leonard Wood MO three times per year. See **Table 4-13**.

Table 4-13 Joint Senior Leaders Course (JSLC) attendees for CY04.

Component	Number Attended
Army	3
Army Reserve	14
Army National Guard	23
Marine Corps	1
Marine Corps Reserve	1
Navy	2
Navy Reserve	5

Coast Guard	1
Air Force	5
Air National Guard	9
Foreign Military	4
Civilian/Other Agency	27
TOTAL	**95**

This course is designed to offer critical elements of CBRN subject matter expertise, with an operational to strategic-level focus, to senior leaders who wish to augment their understanding of current CBRN issues. The JSLC provides an understanding of how commanders, staffs, and organizations can integrate CBRN planning and operational considerations into the mission analysis and decision making process. It also provides a forum for senior leaders to exchange ideas and gain a familiarization with the most current CBRN defense issues.

Other JRO activities included the following:

- Coordinated/conducted Mobile Training Team (MTT) sessions of the Joint CBRN Familiarization Course (JCBRNFC) at U.S. Northern Command, Alaska Command (including Alaska National Guard Units) and Joint Task Force-Consequence Management with total audience of 144 students. The JCBRNFC is designed to familiarize Joint Staff Officers with the threat of CBRN weapons, joint force NBC defense, and joint staff officer NBC roles and responsibilities. This one-day, 8 hour curriculum reinforced participants' awareness of the CBRN proliferation threat, and of their potential roles in countering this threat while serving in the billets to which they are assigned.
- Planned, coordinated and conducted a Biological Senior Level Seminar (SLS) at U.S. Forces Korea (USFK). The primary objective of the Seminar was to educate and inform seminar participants about the North Korea Biological Threat, its potential impact and associated battlefield planning and actions. The seminar was also presented to help the USFK staff in their preparation for exercise Ulchi Focus Lens 04 and future revisions of Operational Plans and Contingency Plans. Participants included 80 Republic of Korea and United States senior military leaders (O6 and above) from the Combined Forces Command and USFK staffs and component commands including General Laporte (Commander, CFC) and General Kim (Deputy Commander, CFC). The two major portions of the seminar included lectures on the Biological Threat and Biological Agent Impacts and Mitigating Actions.
- During 2004, the Joint CBRN Defense Capabilities Improvement Initiative Team (JCBRN CIIT) continued to integrate new JCBRN processes and developments into the Joint National Training Capability and Joint Training System in order to provide and improve CBRN Defense capability to the warfighter in the shortest time possible. This organization codified a formal working relationship between the JRO and Joint Forces Command (JFCOM) to improve current and emerging Joint Force Warfighting and supporting capability in a CBRN environment. Under the JRO lead, the JCBRN CIIT assisted Combatant Commanders (COCOM) with CBRN-related tasks/missions in each of the four phases of the JTS-Requirements, Plans, Execution and Assessment. The JCBRN CIIT provided support to three COCOMs-U.S. Pacific Command, U.S. Northern Command, and U.S. European Command in 2004. (See Section 4.4.1. for details.)

- The JRO completed a review of the current Universal Joint Task List (UJTL) version 4.2. During the review, the UJTL's were cross checked against the latest definitions of SENSE, SHAPE, SHIELD, SUSTAIN, and format was made consistent with the JFCOM guidelines of how to write UJTL tasks. Based on this review, the JRO proposed changes to the Joint Mission Essential Tasks (JMETs) to correlate them with the National Response Plan (NRP) and associated Department of Homeland Security JMET equivalents. The NRP changes the focus of response from any single threat or disaster to an all-hazards approach of incident management based on prevention, preparedness, response, and recovery pillars. This focus allows the DoD to begin to consolidate doctrine and operations involving CONUS and OCONUS support to DHS and DoS into an incident management strategic national (SN) JMET with supporting lower level JMETs for WMD/CBRNE terrorism, disaster relief, humanitarian assistance, and wartime operations under both immediate response and request for assistance missions.

4.4 EXERCISES

4.4.1 JRO provided support to the following exercises during 2004:

Pacific Command (PACOM) Exercise Support. During 2004, the JRO participated in both of United States Forces Korea's (USFK) major exercises: Reception, Staging, Onward Movement and Integration (RSOI 04) and Ulchi Focus Lens (UFL 04). Both exercises dealt specifically with developing and testing a new operational concept fielded by both PACOM and USFK—the Biological Operational Planning Team (Bio-OPT). The Bio-OPT is a cell formed within the commander's staff to advise and develop planning responses to CBRN events in theater. The initial use of this cell proved a success in developing USFK responses to CBRN events, as well as educating and informing other staff members and components on the dangers of CBRN events to plans and execution.

European Command (EUCOM) Exercise Support. The JRO supported EUCOM by providing subject matter experts and CBRN analysts to Agile Response 04. These personnel assisted EUCOM in developing and executing a proactive consequence management mission.

Northern Command (NORTHCOM) Exercise Support. Support to NORTHCOM constituted the bulk of analytical and subject matter expert support during 2004. Application of JRO assets to NORTHCOM's major exercise, Determined Promise, resulted in a comprehensive analysis across strategic, operational, and tactical facets of NORTHCOM's mission.

4.4.2 Joint, Combined, and Service CBRN Exercises

4.4.2.1 United States Special Operations Command (USSOCOM). USSOCOM participates in recurring CBRN-related readiness exercises. These exercises are directed under various classified programs.

4.4.2.2 NORAD USNORTHCOM CBRN Defense Training. During FY04, NORAD and USNORTHCOM developed or supported the following events that provided CBRN defense training:

- NORAD and USNORTHCOM conducted two major exercises: VIGILANT OVERVIEW 04-2/UNIFIED DEFENSE 04 in Feb 04, and AMALGAM VIRGO/DETERMINED PROMISE 04 (AV/DP 04) in Aug 04. These exercises included scenarios designed to train and assess the ability of the Commands and their assigned units to execute DoD domestic

CBRN contingency and consequence management plans. Academic training was conducted in conjunction with these exercises to familiarize staff and senior leadership participants with general and exercise-specific CBRN background information. Each exercise provided the opportunity for all levels of response, from first responders to senior decision-makers, to practice CBRN event detection, warning, and management as appropriate. In addition, AV/DP 04 included events allowing NORAD personnel to exercise the *NORAD Nuclear, Biological, and Chemical Warning and Reporting System.*

- In cooperation with the Department of Homeland Security, NORAD USNORTHCOM supported the Senior Officials Exercise #4 on 19 Aug 04. This exercise used multiple CBRN scenarios to identify and evaluate the unintended consequences on different levels of government of transition to Homeland Security Alert System threat condition Red. The event served to identify and gather Department/Agency protective measures along with State, local, and private sector measures.
- On 14 May 04 NORAD USNORTHCOM conducted the National Guard/Reserve Component Senior Leadership Table Top. Using two CBRN scenarios, this tabletop fostered discussion on the integration of National Guard and Reserve Component forces in homeland defense and CBRN consequence management operations. This training directly prepared the attendees to support final planning and operations assisting the U.S. Secret Service during the G8 Economic Summit in Jun 04. The seven Service Reserve leads, OSD Reserve Affairs, and JS Reserve Affairs participated in this tabletop.

4.4.2.3 <u>Air Force CBRNE Related Exercises</u>. All AF installations must develop scenarios and conduct exercises based on the installation's Full Spectrum Threat Response (FSTR) Plan 10-2 and other emergency plans. **Table 4-14** is a summary of all Air Force CBRN Defense Exercise requirements based on threat location. **Table 4-15** below is a summary of the types and frequencies of exercise that installations must conduct.

Table 4-14. Air Force CBRNE Defense Exercise Requirements.

CBRNE Threat Area [4]	Minimum Exercise Requirements
Low	**Annually** - Conduct attack response exercise implementing the base FSTR Plan 10-2 and other contingency plans (*i.e.*, CBRN, terrorist, or conventional attack). - Conduct an attack response exercise for units' mobility commitments based upon the threat at deployment locations.
Medium	**Semiannually** - Conduct attack response exercise implementing the base FSTR Plan 10-2, BSP, and other contingency plans (*i.e.*, CBRN, terrorist, or conventional attack). One exercise may be satisfied by a tabletop exercise. - Conduct attack response exercise for unit mobility commitments based on the threat at deployment locations. One exercise can be satisfied by a tabletop exercise.
High	**Semiannually** - Conduct attack response exercises implementing the base FSTR Plan 10-2, BSP, and other contingency plans.

[4] Air Force installations within these geographical locations are categorized as CBRNE high, medium or low threat areas based on threats posed by enemy ranges of theater ballistic missiles (TBMs). However, bases also face threats other than missile-delivered weapons, to include infiltrators, witting or unwitting human vectors infected with contagious BW agent, off-base dispensing of agent from ground sources, and aerial dispersal from aircraft that remain outside the base perimeter.

Table 4-15. Installation Full Spectrum Threat Exercise Requirements.

Type of Exercise	Category	Frequency [c]	Remarks
Major Accidents	Munitions	Annually	Applies only to the munitions at the installation.
	Radioactive material	Annually	Applies only if the installation is an Air Force fixed nuclear facility.
	Nuclear weapons	Annually [a]	
	Off-base response	Annually	
	Mass casualties	Annually	
	Air Show Response	As applicable [b]	
	HAZMAT Team	Annually	
Terrorist Use of WMD	Chemical, radiological, nuclear or high-yield explosive incident	Biannually	Execute cross-functionally according to the local WMD threat; incorporate all local response elements. Alternate annually between the two categories of Terrorist Use of WMD exercises.
	Biological Attack incident	Biannually	
Enemy Attack	CBRNE Low Threat Area	Not to Exceed 15 Months	Implement FSTR Plan 10-2 and other contingency plans.
		Not to Exceed 15 Months	Exercise unit's mobility commitments.
	CBRNE Medium Threat Area	Not to Exceed 7.5 Months	Implement FSTR Plan 10-2, BSP and other contingency plans. Integrate exercise requirements for units with mobility commitments.
	CBRNE High Threat Area	Quarterly	Implement FSTR Plan 10-2, BSP and other contingency plans.

Notes:

a. CONUS MAJCOM RTF and the OSC exercise at least every other year. The theater commander determines RTF exercise frequency in OCONUS areas.
b. Exercise prior to installation's Air Show.
c. Exercise frequency requirements are minimum, and may be increased by the EET Chief as approved by the installation RWG.
d. Vary to include CBRNE weapons or material.
e. Include all requirements as stated in AFI 10-229.

4.4.2.4 Marine Corps.

- Exercise Terminal Fury (December 2003). This exercise consisted of multi-service participation and involved activation of the NBC Warning and Reporting System using the Joint Warning and Reporting Network (JWARN) software suite, coupled with the Command and Control Personal Computer (C2PC) software program.
- Exercise Tayoreau Partner (December 2003). The 9th Engineer Support Battalion, 3d FSSG annual exercise hones the units engineer construction skills and affords additional training. This exercise serves as the culmination of NBC defense training, while utilizing the materiel systems to construct decontamination sites, emplace warning and signal devices, and evaluate lessons learned.
- Exercise Ryukyu Express (December 2003). The Command Element headquarters, supported by a Combat Service Support Detachment, comprised of Headquarters and Service Battalion, 3d FSSG, conducts this annual exercise serving as an additional opportunity to deploy the Commanding General's staff in a simulated field environment.
- During the period of February to October 2004, I MEF personnel conducted 34 real world

Sensitive Site Exploitation (SSE) operations in Iraq.

- Exercise RSO&I (March 2004). MARFORPAC participated in this annual exercise conducting NBCD planning and execution, while exercising the NBC Warning and Reporting System.
- Marine Expeditionary Force Exercise (MEFEX)/Marine Air-Ground Task Force (MAGTF) Staff Training Program (MSTP) (June 2004). III MEF exercised the Joint Warning and Reporting Network (JWARN) coupled with the continuation of NBC defense training.
- Exercise Ulchi Focus Lens (August 2004). MARFORPAC units participated in this exercise including exercising the NBC Warning and Reporting Network (via JWARN). Within the construct of the exercise, U. S. Marine Corps units actively engaged in NBC scenario development and execution with Joint forces.
- I MEF personnel conducted a one week Combat Operations Center (COC) exercise in preparation for the OIF II-1 deployment February 9 - 13, 2004, and August 16 - 20, 2004. MEF and MSCs (1st MarDiv, 1st FSSG, and 3d MAW) participated in conducting NBC Center Operations and refining/reaffirming standing operating procedures (SOPS) when conducting Sensitive Site Exploitation (SSE) Operations.

4.4.2.5 Army.

AMEDD CBRN Defense Exercise Program Initiatives.

In FY03, OTSG and USAMEDCOM combined their exercise initiatives. OTSG and USAMEDCOM sponsor three to five CBRNE exercises each year. USAMEDCOM complies with JCAHO recommended external emergency/mass casualty exercises twice a year at all MTFs. Thirty-six USAMEDCOM MTFs supplied with decontamination equipment train in patient DECON monthly. In FY04, OTSG sponsored I Corps' Pacific Guard, AC/RC Medical CBRNE Conference and Exercise in Portland, OR; SHORESH 04, a U.S./Israeli Chem-Bio Table Top Exercise, Leesburg VA; and Fort Bragg's and XVIII Airborne Corps Orbit Comet Force Protection one day Table Top Exercise, Fort Bragg, NC and exercise support to the Health Physics track, at the Force Health Protection Conference, Albuquerque, NM. Additionally, OTSG participated in Southeast Regional Medical Command's National Special Security Event exercise, Augusta, GA. Concurrent with the above exercises OTSG conducted a series of 10 command post exercises designed to examine specific aspects of CBRNE response.

The purpose of these exercises remains to support the testing and refinement of medical CBRN defense operational concepts, capabilities, and command and control (C2) relationships through a series of unit/installation/medical treatment facility exercises. These exercises will be utilized to evaluate and enhance concepts and processes developed as part of the U.S. Army Medical Department CBRN Defense Program. Future exercises include continued support to I Corps' Pacific Guard series, and the Force Health Protection Conference; a functional command post exercise for Keller Army Community Hospital, West Point, NY; and support for a NATO sponsored Chem-Bio exercise later in 05.

USACMLS' Weapons of Mass Destruction – Civil Support Team (WMD-CST) Program. The USACMLS' WMD-CST program has been productive in FY04. The Army activated all 12 of the Phase IV WMD-CST teams, graduating 277 CST members through attendance at 8 iterations of the Civil Support Skills Course (CSSC). The CSSC classes are comprised of officer and enlisted members from the Army and Air National Guard. USACMLS worked in

FY04 to complete an analysis of CST training requirements and use this information to adjust the Program of Instruction (POI) and lesson plans for the CSSC that will be implemented in FY05. USACMLS also assisted the Program Manager to complete an initial operational test & evaluation (IOT&E) of the Analytical Laboratory System (ALS) and prepared a special text for the ALS in support of new equipment training (NET), Doctrine and Tactics Training (DTT), and sustainment training in units. This effort was instrumental in the fielding of 32 ALS to the 32 existing certified WMD-CST teams. USACMLS completed needs and solutions analysis, and are preparing requirements documents for materiel solutions for the WMD-CST program and are also involved in the planning and coordination of the Initial Collective Lanes Training that will be executed by first and fifth Armies. This training is to facilitate the certification process of the 12 WMD-CST in phase IV that were authorized and funded in FY04.

4.5 CBRN DEFENSE DOCTRINE

CBRN Defense doctrine exists at the Joint, Multi-service and Service levels. Initiatives have continued through 2004 that have supported efforts to make CBRN defense doctrine more integrated, relevant and current. Each Service (to include the National Guard Bureau and Reserve Component) has CBRN defense doctrine that supports or is integrated into the multi-Service doctrine/TTP manuals developed by the four Services. The core Joint and Multi-Service, and Service unique CBRN Defense doctrine publications are listed in **Table 4-16.**

Table 4-16. Core CBRN Defense Doctrine.

Publication	Status/Comment	Army	Air Force	Navy	Marine Corps
Joint Publication 3-11, *Joint Operations in a Nuclear, Biological, and Chemical Environment*, 11 July 2000	Joint Doctrine	●	●	●	●
Joint Publication 3-26, Joint Doctrine for Homeland Security	Joint Doctrine (Under development)	●	●	●	●
Joint Publication 4-02, *Doctrine for Health Service in Joint Operations*, July 2001	Joint Doctrine (Under revision)	●	●	●	●
Joint Publication 3-40, *Joint Doctrine for Combating Weapons of Mass Destruction*	Joint Doctrine	●	●	●	●
Joint Publication 3-41, *Joint Tactics, Techniques and Procedures for CBRN Consequence Management*	Joint Doctrine (Under development)	●	●	●	●
Multi-Service Tactics, Techniques, and Procedures (MTTP) for NBC Defense of Theater Fixed Sites, Ports and Airfields	Multi-Service Doctrine	FM 3-11.34	AFTTP (I)3-2.33	NTTP 3-11.23	MCWP 3-37.5
CBRN Contamination Avoidance	Multi-Service Doctrine	FM 3-11.3	AFTTP (I)3-2.43	NTTP 3-11.25	MCRP 3-37.2A
Nuclear Contamination Avoidance	Multi-Service Doctrine	Part of 3-11.3	Part of 3-11.3	Part of 3-11.25	MCRP 3-37.2B
MTTP for NBC Aspects of Consequence Management	Multi-Service Doctrine	FM 3-11.21	AFTTP (I)3-2.37	NTTP 3-11.24	MCRP 3-37.2C
MTTP for NBC Defense Operations	Multi-Service Doctrine	FM 3-11	AFTTYP(I) 3-2.42	NWP 3-11	MCWP 3-37.1
CBRN Decontamination	Multi-Service Doctrine	FM 3-11.5		NWP 3-11.26	MCWP 3-37.3
MTTP for NBC Protection	Multi-Service Doctrine	FM 3-11.4	AFTTP (I) 3-2.46	NTTP 3-11.27	MCWP 3-37.2

Publication	Status/Comment	Army	Air Force	Navy	Marine Corps
Field Behavior of NBC Agents	Multi-Service Doctrine	FM 3-6	ATTP 105-7	NTRP 3-11.32	MCRP 3-37.B
NBC Field Handbook	Army Doctrine	FM 3-7			
Potential Military Chemical/Biological Agents and Compounds	Multi-Service Doctrine	FM 3-11.9	AFTTP(I) 3-22.55	NTRP 3-11.32	MCRP 3-37.1B
MTTP for NBC Vulnerability Assessment	Multi-Service Doctrine	FM 3-11.14	AFTTP (I) 3-2.54	NTTP 3-11.28	MCRP 3-37.1A
MTTP for NBC Defense of Theater Fixed Sites, Ports, and Airfields	Multi-Service Doctrine	FM 3-11.34	AFTTP (I) 3-2.33	NTTP 3-11.23	MCWP 3-37.5
MTTP for NBC Reconnaissance and Surveillance	Multi-Service Doctrine	FM 3-11.19	AFTTP (I) 3-2.44	NTTP 3-11.29	MCWP 3-37.4
CBRN Response in Support of Incident Management	Army Doctrine	FM 3-11.22			
Digital Corps and Divisions	Army Doctrine	FM 3-11.85			
Chemical Staffs and Units	Army Doctrine	FM 3-11.100			
MTTP for Biological Surveillance	Multi-Service Doctrine	FM 3-11.86	AFTTP(I) 3-2.52	NTTP 3-11.31	MCRP 3-37.1C
CBRN Handbook: SSE and Environmental Recon Operations	Army Doctrine	FM 3-11.24			
CBRN Responder Operations Handbook	Army Doctrine	FM 3-11. 23			
Health Service Support in a Nuclear, Biological, and Chemical Environment	Multi-Service Doctrine (under revision)	FM 4-02.7 (FM 8-10-7)	AFTTP 3-42.3 AFTTP 3-47.3	NTTP 4-02.7 Draft	MCRP 4-02.1E
Treatment of Nuclear and Radiological Casualties	Multi-Service Doctrine	FM 4-02.283	AFMAN 44-161 (I)	NTRP 4-02.21	MCRP 4-11.1B
Treatment of Biological Warfare Agent Casualties	Multi-Service Doctrine	FM 8-284	AFMAN (I) 44-156	NTRP 4-02.23	MCRP 4-11.1C
Treatment of Chemical Agent Casualties and Conventional Military Chemical Injuries	Multi-Service Doctrine (under revision)	FM 8-285	AFJMAN 44-149	NAVMED P-5041	FMFM 11-11
NATO Handbook on the Medical Aspects of NBC Defensive Operations (AMedP-6[B])	Multi-Service Doctrine	FM 8-9	AFJMAN 44-151	NAVMED P-5059	
MTTPs for Recovery Operations in a Chemical Biological, Radiological, Nuclear Environment	Navy/Marine Corps Dual Designated Doctrine			NTTP 3-02.1.1	MCWP 3-37.6
Chemical and Biological Defense NATOPS (Naval Air Training and Operating Procedures Standardization)	Navy and Marine Corps Doctrine			NAVAIR 00-80T-121	
Surface Ship Survivability	Navy Doctrine			NTTP 3-20.31	
Chapter 470 Shipboard BW/CW Defense and Countermeasures	Navy Doctrine (Under revision)			NTRP 3-20.31.470	
Guide to Biological Warfare Defense and Bioterrorism – Afloat and Ashore	Navy Doctrine			TM 3-11.1.02	
Marine Air Ground Task Force (MAGTF) NBC Defense Operations	Marine Corps Doctrine				MCWP 3-37
Counter-Chemical, Biological, Radiological, Nuclear, and High Yield Explosive Operations	Air Force Doctrine		AFDD 2-1.8		

Publication	Status/Comment	Army	Air Force	Navy	Marine Corps
Full-Spectrum Threat Response	Air Force Doctrine		AFPD 10-25		
Full Spectrum Threat Response Planning and Operations	Air Force Doctrine		AFI 10-2501		
Nuclear, Biological, and Chemical Defense Operations and Standards	Air Force Doctrine		AF Manual 10-2602		
Airman's Manual	Air Force Doctrine		AF Manual 10-100		

4.5.1 Joint/Coalition Medical Doctrine Initiatives

The Army's Office of The Surgeon General, Directorate of Health Care Operations (DASG-HCZ) is the Lead Agent for DoD on medical international issues, to include CBRN medical operational issues. The Force Management Division (DASG-HCF) is responsible for coordinating and developing U.S. positions within the medical NBC functional area in accordance with the policies and directives established by ASD (HA) and ASD (P). The medical NBC staff officer serves as the US Head of Delegation to the NATO Medical NBC Working Group (MED/NBC WG) and its subcommittee the Biological Medical Advisory Committee.

During FY04, the U.S. achieved significant milestones with NATO MED/NBC WG Standardization Agreements (STANAGS) under U.S. custodianship.

- STANAG 2242, Policy for the Chemoprophylaxis and Immunotherapy of NATO Personnel Against Biological Warfare Agents. This STANAG is intended to develop a unified approach in NATO doctrine and policy in the use of chemoprophylaxis by NATO personnel against biological warfare agents with the potential to cause infectious disease. The U.S. released Ratification Draft 2 of STANAG 2242 to the nations in June 2004
- STANAG 2873 (AMed P7), Concept of Operations for Medical Support in NBC Environments. The U.S. released Study Draft 2 of AMed P7 to all NATO nations for review and comment during Fall 2004. AMed P7 establishes concepts of operations (CONOPS) and a planning methodology for Allied forces that promote effective conduct of medical operations in NBC environments. It defines a capability-based approach to the development and evaluation of medical courses of action designed to minimize or eliminate the impact of NBC incidents through deliberate interventions
- STANAG 2476 (AMed P8) Planning Guide for the Estimation of NBC Battle Casualties (Biological). The U.S. released Study Draft 1 of the AMed P8 Biological Addendum to all NATO nations for review and comment during Fall 2004. The Addendum provides casualty estimates for smallpox, brucellosis and glanders for all tactical scenarios, delivery systems and attack intensities considered in the STANAG; provides estimates of casualties from secondary infection for the contagious agents plague and smallpox; and considers human sources of exposure as a delivery mechanism for these agents. The Addendum also provides a set of casualty estimates for influenza, considered as a contagious disease of operational significance spread from human to human.

The U.S. recommended ratification for five NATO MED/NBC WG STANAGS since

January 2004. Documents recommended for ratification by the U.S. include:

- STANAG 2242, Policy for the Chemoprophylaxis and Immunotherapy of NATO Personnel Against Biological Warfare Agents.
- STANAG 2461, (AMed P6) NATO Handbook on the Medical Aspects of Defensive Operations (Nuclear).
- STANAG 2462, (AMed P6) NATO Handbook on the Medical Aspects of Defensive Operations (Biological).
- STANAG 2478, Medical Support Policies for NBC Environments
- STANAG 2954, Training of Medical Personnel for NBC Operations

During FY04, the U.S. also reviewed and commented on several NATO NBC/MED WG STANAG Study Drafts. STANAGs reviewed include:

- STANAG 2278, Medical Advice on Restriction of Movement.
- STANAG 2358, First Aid and Hygiene Training in an NBC or ROTA Environment.
- STANAG 2463, (AMed P6) NATO Handbook on the Medical Aspects of Defensive Operations (Chemical).
- STANAG 2474, Determination and Recording of Ionizing Radiation Exposure for Medical Purposes.
- STANAG 2491, Policy for the Immunization of NATO Personnel Against Biological Warfare Agents.

The DASG-HCZ also oversees doctrine development to support CBRNE hazards in domestic applications for the support of the Federal Response Plan and the National Response Plan. The Army Medical Department Center and School (AMEDDC&S) leads in doctrine and development for military medical support for Defense/Military Support to Civilian Authorities (DSCA/MSCA). The AMEDD focus is on medical support of Homeland Defense and Homeland Security consequence management in a CBRNE environment

4.5.2 Navy and Marine Corps Doctrine

During FY04, the Navy and Marine Corps have fully participated in all multi-Service doctrine working groups to produce and update the joint and multi-Service CBRN Defense doctrinal publications listed in **Table 4-15**. Navy and Marine Corps representatives have also continued to play actives roles during FY04 in all meetings and reviews associated with the ongoing development of improved NATO standardization agreements (STANAGS) and Allied publications such as the Allied Joint Publication 3.8 (Allied Joint Doctrine of NBC) series.

During FY04, these two Services have continued their work in tandem to update existing and produce new doctrine focused on the unique maritime-related requirements of Navy and Marine Corps warfighters. The Marine Corps Capstone Doctrinal Publication for Marine Air Ground Task Force (MAGTF) NBC Defense Operations is being rewritten to address Marine Corps Expeditionary Maneuver Warfare (EMW) concepts. Marine Corps Warfighting Publication (MCWP) 3-37 will be completed during FY05.

During FY04, updated procedures for recovering potentially contaminated military forces and civilian personnel, equipment, and supplies were refined and documented into a new dual designated doctrinal publication entitled Recovery Operations in a CBRN Environment. With the emerging/evolving concepts of SEA BASING, Ship to Objective Maneuver (STOM),

Operational Maneuver From the Sea (OMFTS), and Maritime Prepositioning Forces (MPF) 2010, the effectiveness of these maritime-unique CBRN-defense and consequence management procedures are becoming more and more critical.

In June 2003, the Marine Corps (MCCDC) and Air Force (AFXON) signed a memorandum of agreement (MOA) establishing a joint working group (JWG) designed to enhance both services' efforts in the area of counter CBRN warfare concepts of operation (CONOPS). This will continue to be an ongoing forum for the exchange of information and products in an attempt to leverage both services expertise in the area of CBRN defense against real world situations and challenges.

A new publication, Chemical and Biological Defense NATOPS (Naval Air Training and Operating Procedures Standardization), NAVAIR-00-80T-121, provides USN/USMC aviation commands and personnel with tactics, techniques, and procedures to enable units to survive, operate in and recover from exposure to CB warfare agents. It was promulgated in October 2004 after an extensive review and validation period. Also in October 2004, the Navy promulgated NTTP 3-20.31, Surface Ship Survivability, with updated general guidance on damage control, firefighting, hazardous materials safeguards, and CBRN defense. The Navy is now in the final stages of developing NTRP 3-20.31.470, Shipboard BW/CW Defense and Countermeasures (formerly referenced as NSTM 470), with updated detailed guidance on defending a ship against chemical or biological agent attack.

4.6 CBRN DEFENSE TRAINING, EXERCISES, AND DOCTRINE ISSUES

4.6.1 Army

ISSUE: **Technical Escort Proponent for Training.**

SOLUTION: On 10 October 2004 the USACMLS will assume doctrine and training proponency for the Technical Escort (TE) mission. The USACMLS Training Development Directorate prepared for this new mission by conducting coordination with the TE School and conducting an analysis of the TE Course and training materials. In FY05 a complete analysis of the existing training being conducted at Redstone Arsenal will be completed to ensure it meets the requirements of the Technical Escort Units and is relevant based on regulatory requirements and lessons learned.

4.6.2 USTRANSCOM

ISSUE: **Contamination Avoidance at Seaports of Debarkation (CASPOD) Advanced Concept Technology Demonstration (ACTD).**

SOLUTION: To mitigate the effects of an asymmetrical attack at SPOD, technical and TTP aspects of the FY03 RestOps ACTD were reflected in operations at a SPOD. Many technical aspects were successfully transplanted and a final report prepared in December 2004.

ISSUE: **Large Frame Aircraft Decontamination Demonstration (LFADD) field test.**

***SOLUTION*:** In an effort to validate methodologies for decontamination of aircraft, the LFADD field test was conducted at Eglin AFB with several options of decontamination being tested. The final test report will outline numerous decontamination issues,

strategies, and TTPs, and is due in February 2005.

ISSUE: **Exchange Zone (EZ) Field Test.**

***SOLUTION*:** Limited transportation assets may necessitate limited use of previously contaminated vessels by transloading at an intermediate staging base through an exchange zone. Use of this exchange zone is designed to mitigate cross contamination between vessels, but will increase the required personnel, material handling equipment, and time. Testing to date has proven this methodology a viable option with a final test to occur April 2005.

ISSUE: **Mobility Capability Study (MCS).**

SOLUTION: The OSD and JCS, in coordination with USTRANSCOM, have sponsored the MCS and is designed to model the throughput needed to support a warfighter in a forward location. Part of the Anti-Access to SPODs and APODs is the asymmetrical use of chemical agents to interrupt the Time-Phase Force Deployment Data and to examine what alternative actions need to be considered.

ISSUE: **Air Mobility Command (AMC) Counter-Chemical, Biological, Radiological, Nuclear, and High Yield Explosives (C-CBRNE) Education, Training, and Exercise (ETE) Initiatives.**

SOLUTION: AMC is incorporating C-CBRNE education and training into courses of instruction throughout the command. AMC has identified 27 courses for the inclusion of C-CBRNE instruction that addresses employment of airlift and aerial refueling assets in a CBRNE-contaminated environment. Each block of instruction is tailored to the specific audience and is designed to foster a better understanding of the effects of CBRNE attack on air mobility operations.

4.6.3 Joint/Tri-Service

ISSUE: **CBRN Defense Readiness and Training Assessment**

SOLUTION: In response to the General Accounting Office (GAO) Report 02-38, Chemical and Biological Defense, "DoD Needs to Clarify Expectations for Medical Readiness," the Defense Medical Readiness Training Institute (DMRTI) was tasked by Deputy Assistant Secretary of Defense (Force Health Protection and Readiness) (DASD/FHP&R) to review the Services current CBRNE medical training and develop a standardized Tri-Service CBRNE Training Program. Assistant Secretary of Defense for Health Affairs memorandum dated 9 January 2004, directed the services to implement the Tri-Service CBRNE Training Program over a three year period. The Tri-Service CBRNE Training Program requires all medical personnel (Active, Reserve, Civil Service and Contract) throughout the Department of Defense to receive initial and sustainment training. Training shall meet the Standards of Proficiencies cited in the program.

The program includes a multilevel, multidisciplinary medical CBRNE Training Continuum Matrix that has a consistent, core content based on the blended adult learning methodology capable of being executed at multiple sites. At present, each Service and multiple agencies within each Service are providing a spectrum of Medical

CBRNE training products. DMRTI specified: what standards of proficiency were necessary to support Medical CBRNE readiness; that needed training, when, how much, one time and recurring training; recommended Tri-Service curriculum (with alternative existing courses); metrics to measure compliance; and reporting requirements. Standards of Proficiency were developed to meet the requirements of the majority of medical personnel but may not apply equally to all medical personnel. Standards of proficiency apply to specific personnel based on duty assignment/job description. Training Levels of the Standards of Proficiency have a specific purpose and audience in mind and are organized into three categories. The three training levels are initial, sustainment, and advanced. (1) Initial: Addresses training requirements for military medicine personnel, including military, DoD civilian, and contract personnel. The initial training level should be completed in accordance with DODI 1322.24, requiring service-specific requirements and training be completed by medical personnel during the first 12 months of assignment. (2) Sustainment: This is a level of subject and task knowledge applicable to military medicine personnel. They will be able to identify why the task must be done and why each step is needed. The sustainment standards of proficiency should be part of the mandatory medical readiness training. Training should be completed once every three years. (3) Advanced: Advanced level is specific training designed for a determined target audience that requires specialized training. Personnel will be able to resolve problems relating to the task and evaluate conditions and make proper decisions about the subject. Training will be required one time or as defined by assignment.

Each of the training levels have distinct Standards of Proficiency based on the specific actions that personnel should be able to perform after training to meet real-world requirements. The Standards of Proficiencies for initial and sustainment levels are provided in **Table 4-176**. The advanced training level will be developed during CY05.

Table 4-17. Tri-Service CBRNE Standards of Proficiency.

Initial Training Level	**Sustainment Training Level**
• Recognition	• Event Recognition
• Detection	• Triage Management
• Force Protection	• Diagnosis & Treatment
• Decontamination	• Force Protection & First Aid
• Incident Response	• Decontamination

The services directed personnel assigned to the Military Health System (MHS) to complete the *Emergency Medical Preparedness/Response Web-based Course (EMPRC)* in order to meet the CBRNE training requirements. The services launched the program on service-specific distributed learning sites in third and fourth quarters of 2004. This course was developed as a collaborative effort with the services and meets the Tri-Service Standards of Proficiency for initial and sustainment medical CBRNE training.

CBRNE Standards of Proficiency Reports will be submitted by the Services to DMRTI on a quarterly basis beginning 1st quarter CY 05. DMRTI will consolidate and

forward the reports to Force Health Protection Council (FHPC). FHPC will monitor the Services compliance with medical training metrics and provide DASD/FHP&R annual status reports.

***ISSUE:* Only a Small Percentage of Service Members Passing Through the CTCs Encounter NBC Defense Training Tasks Because an Army or Marine Corps Regulation or Order Requiring It is Lacking**

SOLUTION: The General Accounting Office (GAO) Draft Report 05-08, Chemical and Biological Defense, "Army and Marine Corps Need to Establish Minimum Tasks and Improve Reporting for Combat Training Centers," dated October 22, 2004, recommends the Secretary of Defense direct the Secretary of the Army to establish the minimum NBC tasks for units attending training exercises at CTCs.

***ISSUE:* Service Regulations or Orders Do Not Now State That NBC Training at the CTCs Must Be Captured in a Standardized Format**

SOLUTION: The General Accounting Office (GAO) Draft Report 05-08, Chemical and Biological Defense, "Army and Marine Corps Need to Establish Minimum Tasks and Improve Reporting for Combat Training Centers," dated October 22, 2004, recommends the Secretary of Defense direct the Secretary of the Army to standardize reporting formats to capture NBC training that occurs at the CTCs.

***ISSUE:* The Marine Corps Does Not Provide Any Clearly Articulated NBC Defense Training Tasks or Requirements That Must Be Accomplished in Conjunction with the Combined Arms Exercises**

SOLUTION: The General Accounting Office (GAO) Draft Report 05-08, Chemical and Biological Defense, "Army and Marine Corps Need to Establish Minimum Tasks and Improve Reporting for Combat Training Centers," dated October 22, 2004, recommends the Secretary of Defense direct the Secretary of the Navy to direct the Commandant of the Marine Corps to establish the minimum NBC tasks for units attending the combined arms exercise at Twentynine Palms.

***ISSUE:* The Marine Corps Does Not Employ a Standard Method of Reporting NBC Training at Twentynine Palms or Provide the Marine Corps' Trend and Lessons Learned Reporting Systems with NBC Training Information**

SOLUTION: The General Accounting Office (GAO) Draft Report 05-08, Chemical and Biological Defense, "Army and Marine Corps Need to Establish Minimum Tasks and Improve Reporting for Combat Training Centers," dated October 22, 2004, recommends the Secretary of Defense direct the Secretary of the Navy to direct the Commandant of the Marine Corps to standardize reporting formats to capture NBC training that occurs during a combined arms exercise at Twenty Nine Palms.

Chapter 5

Status of DoD Efforts to Implement the Chemical Weapons Convention

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 January 1, 2005 there are 167 States Parties to the CWC, including the United States. In 2004, 9 countries ratified or acceded to the CWC. The ninth session of the Conference of the States Parties, the highest policy making organ of the organization for the Organization for the Prohibition of Chemical Weapons (OPCW) comprising 167 member States, convened in The Hague from 29 November to 2 December 2004. Over 600 delegates from 108 member states were in attendance. A number of important decisions were made by this conference to ensure the continued, effective implementation of the CWC. The conference approved Libya's request to convert chemical weapons production facilities into a pharmaceuticals plant to produce low cost vaccine to be distributed to the African market. These vaccines are urgently required in the treatment of AIDS/HIV, malaria and tuberculosis.

5.2 DEPARTMENT OF DEFENSE IMPLEMENTATION OF THE CWC

In 2004, DoD hosted 90 inspections and visits at chemical weapons (CW) storage, former production, and destruction facilities. The Army (the Service most directly affected by CWC implementation activities) and DoD's Defense Threat Reduction Agency (DTRA) continue to host and escort inspectors from the Organisation for the Prohibition of Chemical Weapons (OPCW) Technical Secretariat (TS). The OPCW is charged with overseeing world-wide implementation of the CWC. TS inspectors conduct both continuous and non-continuous monitoring at DoD CW destruction facilities and systematic inspections at DoD CW storage, former production and Schedule 1 facilities. DTRA provides CWC Orientation Training and associated Mission-Support Training—Treaty Escort Training, Hazardous Materials (HAZMAT), and Hazardous Waste Operations and Emergency Response (HAZWOPER)—to United States Government (USG) National Escorts and other treaty compliance personnel. In 2004, 120 USG personnel completed orientation training. DTRA insures all escorts are trained and ready to receive OPCW TS Inspection Teams.

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. The OPCW conducted nine chemical industry inspections in 2004. In addition, DTRA supported and participated in five DOC tabletop challenge inspection exercises and a DOC-sponsored field training challenge inspection exercise at a U. S. commercial chemical facility.

DoD conducts a Chemical Weapons Agreements Implementation Working Group (CWIWG), chaired by the Office of the Secretary of Defense (OSD) Treaty Manager—the Deputy Assistant to the Secretary of Defense (Chemical Demilitarization and Threat Reduction), to implement the CWC. Through regularly recurring meetings, representatives of 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 quarterly and small group meetings are held as needed to address specific requirements in support of the CWIWG. A Compliance Review Group (CRG), also charged by the Treaty Manager, has been established within DoD to address, as needed, CWC compliance concerns. OSD, the Joint Staff, the Military Services, and DTRA provide technical experts to support activity at the U.S. Delegation to the OPCW in The Hague, The Netherlands.

The Army is the executive agent for the Chemical Demilitarization Program which has the mission to destroy all U.S. chemical warfare material while ensuring maximum protection of the public, personnel involved in the destruction effort, and the environment. The Army works through OSD to ensure this program is compliant with CWC provisions.

5.3 SAFETY ORIENTATION FOR INSPECTORS

All OPCW inspectors who conduct continuous monitoring at U.S. chemical weapons demilitarization facilities are required to attend a 32-hour safety orientation, which is broken down into two sections and is presented by the Army. One section is a 24-hour health and safety orientation (HSO) course, which is a USG requirement of all personnel who must be present on a more than short-term basis at U.S. chemical demilitarization facilities. The second section is an 8-hour Ammunition Safety Course. A 48-hour demilitarization protective ensemble (DPE) procedures course is required only for those inspectors designated by the OPCW TS, whose responsibilities would include the use of such protective equipment. Approximately 178 currently assigned OPCW TS inspectors have attended HSO training; eight inspectors have taken the 48-hour DPE class. The orientation is conducted at the Chemical Demilitarization Training Facility in Edgewood, Maryland or at The Hague. Annual 8-hour HSO refresher courses are also required and are being accomplished by the Army in The Hague. DTRA provides USG national escorts for OPCW inspectors while attending required training at U.S. facilities. DTRA ensures that all inspectors 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 OSD and 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 declarable, have been visited by Military Service representatives

and DTRA technical experts. DTRA will continue to support site assistance visits and Army treaty implementation and compliance meetings.

All of the Military Services have held exercises to test their preparedness for short-notice CWC challenge inspections. Such exercises involve the active participation of Service, OSD, 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 a comprehensive Lessons Learned report to ensure DoD readiness for possible challenge inspections. The Services have initiated efforts to ensure that in the case of a challenge inspection, affected commands take timely and appropriate measures, based on lessons learned, to demonstrate compliance while protecting security concerns.

In coordination with the Navy, DoD sponsored a mock challenge inspection exercise in 2004, using the Naval Air Warfare Station, China Lake, California as the challenged site. DoD's overall objective was to practice using existing CWC compliance guidance and improve the processes by which the DoD would demonstrate compliance with the Chemical Weapons Convention.

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 govern-ment contractors. In 2004, DTIRP distributed over 27,000 arms control and security educa-tional products (electronic and print media). DTIRP supported all nine OPCW industry inspections by providing a Security Countermeasures Officer to assist DOC with protecting proprietary information and hosting inspections. The program also provided the Army's Chemical Material Agency with tailored training to six of its chemical depots and trained over 400 site personnel. The Chemical Technology Security Course, the only 5-day course within the USG that specifically discusses security concerns and site preparations for facilities subject to CWC inspections, was presented twice. The DTIRP has provided, and will continue to provide, arms control vulnerability assessment teams in support of any requirement to assess risks to critical national security assets, United States industry and research institutions. The DTIRP took part in one DOC site assistance visit in 2004. In addition, DTIRP supported and participated in five DOC tabletop challenge inspection exercises and a DOC-sponsored field training challenge inspection exercise at a U.S. commercial chemical facility. Program personnel also participated and presented at twelve arms control and security conferences.

5.6 TECHNICAL EQUIPMENT INSPECTION PROGRAM

The Technical Equipment Inspection (TEI) Program ensures OPCW TS verification equipment meets U.S safety, environmental and security requirements through a familiarization process authorized by OPCW Conference of States Parties. Familiarization results are docu-mented in the U.S. "Certification Report of Chemical Weapons Convention Organisation for the Prohibition of Chemical Weapons Technical Secretariat Equipment." In addition, TEI verifies and confirms OPCW equipment entering and exiting the United States and performs chemical agent monitoring of inbound OPCW equipment for all OPCW inspection teams at the

Point of Entry. The chemical agent monitoring is conducted to protect both U.S. and OPCW personnel and to prevent inaccurate findings as a result of pre-existing contaminants on the OPCW verification equipment.

5.7 ARTICLE X ASSISTANCE AND OTHER ASSISTANCE

Under Article X of the CWC, a State Party to the treaty may make an appeal for assistance through the Director-General of the TS. In accordance with a condition established in the U.S. Senate's resolution of ratification for the CWC, the United States, with respect to any State Party not eligible for certain specified assistance under the Foreign Assistance Act of 1961, would provide "no assistance…other than medical antidotes and treatment," should any such State Party request assistance under Article X of the CWC.

Under the CWC, DoD has not provided any chemical weapons detection equipment or assistance in the safe transportation, storage, and destruction of chemical weapons to other States Parties. Such assistance, however, is being provided to Russia under DoD's Cooperative Threat Reduction (CTR) program.

Annex A

Contamination Avoidance Programs

Table A-1. Contamination Avoidance Research, Development, & Acquisition (RDA) Efforts.

Category		Nomenclature	Status	USA	USAF	USMC	USN
Automatic Detectors and Monitors	Chemical	- M22 Automatic Chem Agent Detector Alarm (ACADA)	Production	Joint	Joint	Joint	Rqmt
		- MK27 Shipboard ACADA	Production				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	- Interim Biological Agent Detector (IBAD)	Fielded				*Rqmt*
		- Biological Integrated Detection System (BIDS NDI)	Fielded	*Rqmt*			
		- BIDS P3I	Fielded	*Rqmt*			
		- DoD Biological Sampling Kit	Fielded	Joint	Joint	Joint	Joint
		- Detection System, Biological Agent: Joint Portal Shield	Production	Joint	Joint		Joint
		- Joint Bio Point Detection System (JBPDS) -- Block I	Production	Joint	Joint	Joint	Joint
		- Dry Filter Unit (DFU)	Production	Rqmt			Rqmt
		- Hand Held Assays (HHA)	Production	Rqmt			Rqmt
		- Critical Reagents Program (CRP)	RDTE	Joint	Joint	Joint	
		- CB.37 Chemical/Biological Agent Water Monitor	DTO				
		- CB.50 Lightweight Integrated CB Detection	DTO				
Stand-Off Detection and Remote/ Early Warning		- Joint Service Lightweight Stand-off Chemical Agent Detector (JSLSCAD)	RDTE	Joint	Joint	Joint	Joint
		- Joint Bio Stand-off Detection System (JBSDS)	RDTE	Joint	Joint		Joint
		- CB.35 Standoff Biological Aerosol Detection	DTO				
NBC Reconnaissance		- Joint Service NBC Reconnaissance System (JSNBCRS)	RDTE				
		--NBCRS/CB Mass spectrometer	*	*Rqmt*		*Rqmt*	
		--Joint Service Light NBC Reconnaissance System (JSLNBCRS)	*	Rqmt	Rqmt	Joint	*Interest*
		- NBC Recon Vehicle (NBCRV)	RDTE	Rqmt			
		- CB.53 Wide-Area Aerial Reconnaissance for Chemical Agents	DTO				
		- JA.40 Chemical Unmanned Ground Reconnaissance (CUGR) ACTD	DTO				
Radiation Detection		- AN/UDR-13 Pocket Radiac	Fielded	Rqmt	Interest		
		- AN/PDR-56 Radiac	Fielded			Rqmt	
		- AN/PDR-75 Radiac	Fielded	Rqmt		Rqmt	
		- AN/PDR-77 Radiac	Fielded	Rqmt			
		- AN/VDR-2 Radiac	Fielded	Rqmt		Rqmt	
		- IM-143 Pocket Dosimeter	Fielded			Rqmt	
		- Multi-Function Radiac	Fielded	Rqmt	Rqmt		
		- ADM-300A	Fielded	Rqmt			

Joint = Joint Service requirement
Rqmt = Service requirement
Rqmt Interest = requirement or interest in sub-product
LRIP = Low Rate Initial Production
Fielded = Fielded Capability (Sustained by Services)
Joint* = Draft Joint Service requirement
Interest = Service interest, no imminent requirement
* = Sub-product(s) of a Joint project
DTO = Defense Technology Objective (Science & Technology Base Program)
RDTE = Research, Development, Test & Evaluation (Advanced Development program)

AUTOMATIC DETECTORS AND MONITORS

FIELDED AND PRODUCTION ITEMS

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

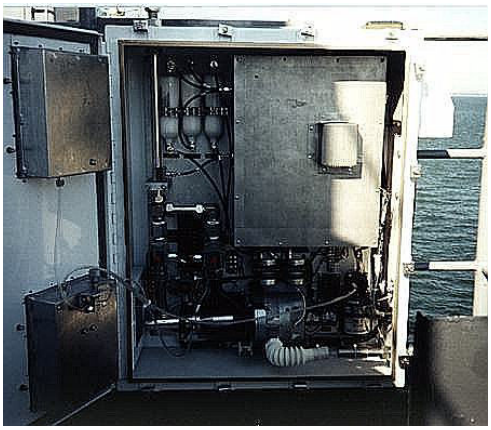
The CAM is a hand held instrument capable of detecting, identifying, and providing relative vapor hazard readouts for G and V type nerve agents and H type blister agents. The CAM uses ion mobility spectrometry (IMS) to detect and identify agents within one minute of agent exposure. A weak radioactive source ionizes air drawn into the system, and the CAM then measures the speed of the ions' movement. Agent identification is based on characteristic ion mobility and relative concentrations based on the number of ions detected. The ICAM has the same chemical agent detection capability as the CAM; improvements are that it is 300% more reliable, starts up 10 times faster, and the modular design is much less expensive to repair. The ICAM has the additional features of an RS-232 data communications interface, and the ability to be programmed for new/different threat agents. The four pound, 15" long ICAM can be powered either by an internal battery or by an external source through the ICAM's combination power/fault diagnosis/RS-232 plug. The ICAM may be used for a variety of missions, to include area reconnaissance and area surveillance, monitoring of decontamination operations, and medical triage operations. The ICAM significantly reduces the level and frequency of maintenance *vs*. CAM without affecting performance. The ICAM sieve pack has double the capacity of the two CAM sieve packs, which results in twice the operational life of the ICAM over the CAM. The ICAM will significantly reduce operating and sustainment costs associated with the CAM.

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 is a collectively-protected, HMMWV-mounted S788 shelter and is modular to allow component replacement and exploitation of "leap ahead" technologies. The NDI variant (M31) (*shown*) is capable of detecting and presumptively identifying four BW agents simultaneously in less than 45 minutes. The P3I BIDS is capable of detecting and presumptively identifying eight BW agents simultaneously in 30 minutes. The suite is semi-automated and contains several technologies, including the Ultraviolet Aerosol Particle Sizer (UVAPS), Chemical Biological Mass Spectrom-

eter (CBMS), Mini-Flow Cytometer, and the Biological Detector (BD). Thirty-eight BIDS NDIs 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. Fielding of 38 systems to the 7th Chemical Company was completed in October 1999. In 4QFY03, the third BIDS Company, 13th Chemical (P3I), began fielding at Ft. Hood, Texas and was completed in 3QFY04. As full-rate production becomes complete, program emphasis will continue on planned upgrades and sustainment. BIDS fielded in FY04 and beyond will utilize the upgrade capability of the Joint Biological Detection System (JBPDS) Block I.

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 deployed among ship platforms as dictated by fleet priorities.

Joint Portal Shield (Biological Agent Detection System)

Joint Portal Shield (JPS) is an interim Joint Service biological detection system used to protect high value fixed assets. The system uses an innovative network of sensors to increase probability of detecting a biological warfare attack while decreasing false alarms and consumables. The JPS system consists of a variable number of biological sensors forming a network under the command and control of a centralized command post computer (CPC). The CPC communicates with and monitors the operation of each sensor. The sensor is modular in design and can detect and presumptively identify up to eight BW agents simultaneously in less than 25 minutes. In addition the system has a chemical sensor interface (M22, M21, M90), which provides an integrated chemical and biological sensor network capability. The system successfully attained MSIII and systems were provided to support a Joint Staff "Directed Buy". The JPS has been deployed to a total of nine sites in Northeast Asia and 12 sites in the Middle East.

In June FY03 CENTAF consolidated efforts and shutdown operations at four sites resulting in a total 17 JPS sites. Contractor Logistics Support personnel are on-site at fielded locations in the CENTCOM and PACOM theaters of operation to maintain and sustain equipment. In FY03/04 JPS was provided to four Joint Service Installation Protection Program (JSIPP) sites. In FY03 the JPS System was upgraded with the JBPDS collector, BAWS, and a new identifier. Independent Developmental and operational testing has been completed. The fleet was upgraded worldwide in FY04. JPEO-CBD provides lifecycle management of the system. System consumables were transitioned to Rock Island Arsenal in FY03, while maintenance is lifecycle Contractor Logistic Support. Upgrades enable JPS to have similar performance to JBPDS characteristics.

Joint Biological Point Detection System (JBPDS)

JBPDS provides point biological detection capabilities for all four services throughout the battlespace. The system, which at end state will replace all "current force" detection systems (*i.e.*, JPS, BIDS, IBADS), is more affordable and effective. The sensor's highly maintainable and modular design detects and presumptively identifies ten BW agents simultaneously in less than 20 minutes. This program has developed a standard biological detection suite that will be integrated on Service designated platforms. Its detection suite is common across multiple configurations (*i.e.*, the XM96 Portable, the XM97 Shelter, the XM98 Shipboard, and the XM102 Trailer Mounted for airbase, vehicle, surface combatant, Stryker and JSLNBCRS, and marine expeditionary applications). The system may be operated locally or remotely, and fully automates the functions of: *collection* (capturing samples of the suspect aerosol for systems and confirmatory analysis), *detection* (interrogating and broadly categorizing the contents of the aerosol), *identification* (providing presumptive identification of the suspect BW agent), and *warning* (providing visual and audible alert to local and remote control units). The acquisition strategy allows for significant economies throughout the RDA process, eliminating duplicative efforts among the Services, and greater logistic supportability in joint operations. The modular design strategy also offers the fastest possible fielding of these urgently required systems, as well as the flexibility needed to continuously improve the system with the latest advances in the biological detection/identification, information processing and engineering sciences.

Fielding of JBPDS began in FY03. In response to the national emergency, a network of eight JBPDS systems was deployed in the National Capital Region. These systems, referred to as the Homeland Defense Trailer (HDTR), were deployed November 28, 2001 and were fully operational on December 3, 2001. These HDTR systems are deployed in a commercial trailer configuration that was jointly developed and produced. The system was also deployed to a critical site during Operation Iraqi Freedom.

Fielding of 35 M31E2 JBPDS Biological Integrated Detection Systems to the 375th Chemical Company began in June 2003 and was completed in November 2003. In support of the Joint Service Installation Pilot Program, five JBPDS were also deployed at a CONUS site, which was completed in November 2003. Army fieldings planned in FY04-05 include additional BIDS Companies.

Dry Filter Unit (DFU)

The Dry Filter Unit is a stand-alone collector that can be used to collect internal and external ambient sample for subsequent analysis using Hand Held Assays (HHA) and Polymerase Chain Reaction (PCR) assays. It is simple, has an exceptional concentration factor, is inexpensive, and extremely flexible. When mated with a detection technology, these characteristics allow the detection of low concentrations of biological agents. The DFU can be used for both internal monitoring, and external monitoring. It is complementary to and does not replace the role or need for more robust detection systems such as JBPDS, JPS and BIDS. The system was developed in response to critical

needs identified after the conventional and anthrax terrorist attacks in 2001. System development was originally funded with DERF. In FY 2003 it was further procured and fielded based on an Umbrella Urgent Need Statement by the Joint Requirement Office to support Combatant Commander's urgent needs in support of OIF and other initiatives. To date over 1700 DFUs have been fielded to units, sites (including six JSIPP sites), ships, and select U.S. cities to provide for BW attack monitoring.

Hand Held Immunochromatographic Assay (HHA)

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

DoD Biological Sampling Kit

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

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" x $2^1/_2$" booklets. Each booklet contains 25 sheets of detector paper that are capable of detecting G series nerve agents (GA, GB, GD, 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-feet long rolls on a 1.25-inch diameter core. M9 paper can detect G and V nerve agents, H agents, and L agents but it cannot distinguish the identity of agents. It turns pink or a shade of red when in contact with liquid chemical nerve and blister agents. M9 paper is typically placed on the BDO, equipment, and vehicle exteriors to warn personnel of the presence of a liquid chemical agent.

M18A3 Chemical Agent Detector Kit

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

M272 Water Test Kit

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

M8A1 Automatic Chemical Agent Alarm (ACAA)

The M8A1 ACAA is a system that continuously samples the air to detect the presence of dangerous concentrations of G and V type nerve agent vapors. This system is currently being replaced by the ACADA in many Army units. Displaced M8A1 systems are being cascaded to lower priority units throughout the Army. The M8A1 ACAA may be employed in a number of configurations, but all configurations are built around the M43A1 detector unit and the M42 alarm unit. The configurations differ primarily in their mountings and power supplies: ground mounted and battery operated, or mounted on a vehicle and powered by the vehicle's electrical system. The M43A1 detector unit measures $7^1/_2$" x $5^1/_2$" x 11". Using the battery in ground mounted operations adds

another $7^3/_4$" to the height. The M43A1 detector unit uses a radioisotope 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 Mustard 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.

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

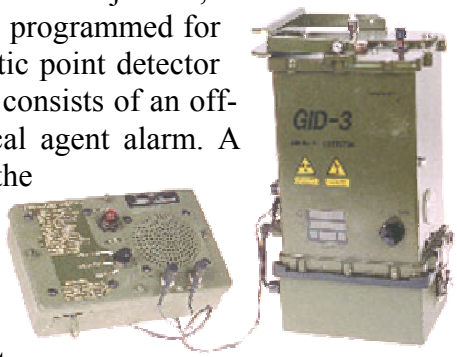
CAPDS is a fixed system capable of detecting nerve agents in vapor form, using a simple baffle tube ionization spectrometer. Installed in a ship's upper superstructure level, CAPDS obtains a sample of external air, ionizes airborne vapor molecules, and collects them on a charged plate after eliminating 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 CAPDS system is being replaced by the MK 26 Mod 0 Improved (Chemical Agent) Point Detection System

Improved (Chemical Agent) Point Detection System (IPDS)

The IPDS is a new shipboard point detector and alarm that replaces the existing shipboard CAPDS. IPDS uses special elongated ion mobility cells to achieve the resolution necessary to counter false alarms caused by interfering 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 has been fielded 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. In FY04, enhancements were made to the ACADA to decrease maintenance and increase life expectancy of systems that are operating 24 hours a day, 7 days a week. The ACADA 24/7 version has been fielded within the Joint Service Installation



Pilot Program in FY03 and early FY04. Additional improvements will be the addition of the ACADA 24/7 to detect and identify Toxic Industrial Chemicals that pose a threat to DoD Installations. This variant of the ACADA was fielded in FY04 in support of JPM Guardian programs.

AUTOMATIC 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 that 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 (materiel development lead), Air Force (requirements lead), and Marine Corps requirement. Navy interest.

Key Requirements:

- Detect, identify, and quantify 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 detect CBR agents at or below harmful levels in water and not false alarm to common interferents. The system will be compact, man-portable and easy to use, and be decontaminated to a negligible risk level.

Defense Technology Objective (DTO) CB. 37 Chemical/Biological Agent Water Monitor

Objectives. This effort will develop system concepts and technologies to meet the service requirement for a Joint Chemical/Biological Agent Water Monitor (JCBAWM). 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 source (pretreatment, ponds, lakes, rivers, etc.,) and product waters (post treatment verification and distribution quality assurance). 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. This DTO address Joint Future Operational Capability of Contamination Avoidance: Medical and Environmental Surveillance. 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. In FY01, development of standardized test evaluation protocols was completed and the

Defense Technology Objective (DTO) CB. 37 Chemical/Biological Agent Water Monitor
testing of technologies was initiated. Transition criteria were established based on JCBAWM Operational Requirements Document (ORD). A first-generation design for a water monitor system was completed and the breadboard build was initiated. In FY02, the breadboard was completed and surety testing was initiated. In FY03, receiver operator curves (ROC) were established on the breadboard to predict technology performance. In FY04, Milestone A was completed for the biological detection portion of the program. **Challenges.** The challenges for the system will include a requirement 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 challenge in terms of both agent sensitivity and specificity. The system will also be required to operate in near real time. Research conducted in FY03 based on ROC curve analysis predicts chemical agents will be more difficult than previously assumed. Sensitivity requirements also pose a significant challenge. The requirement is in the parts-per-trillion to parts-per-billion range for chemical agents. Chemical agents undergo chemical changes in water much more quickly than in air. Factor such as hydrolysis will be significant. Biological agents could undergo changes as well, making the detection problem somewhat dynamic. **Milestones/Metrics.** **FY2005:** Complete prototype build and assessment methodology. **FY2006**: Complete Milestone A for chemical detection portion of program. Conduct utility assessment.

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.

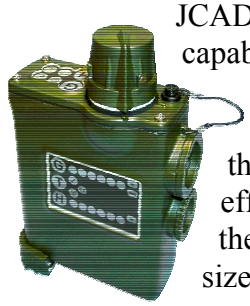
Rationale:

- 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
- Capable of being modified to detect future agents

Description:



JCAD (*Gate II candidate shown*) 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. 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.

Critical Reagents Program (CRP)

Rationale:

- Supports requirements of all Services, as well as biological detection programs of DoD first responders, other Federal Agency's, and NATO countries'.

Key Requirements:

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

Description:

The CRP ensures the quality, availability, and security of BW reagents, ECLAs, PCRAs, HHAs, and DoD Biological Sampling Kits, which are critical to the successful development, test, and operation of DoD biological warfare detection systems and medical biological products. The program maintains an R&D effort to ensure the best possible reagents are available for use against both current and emerging threats and to include analysis of commercially available reagents and technologies. The CRP consolidates all DoD antibody, antigen, gene probe/primer, ECLA, PCRA, HHA, and DoD Biological Sampling Kit developments and requirements. The CRP has reagents and HHAs to detect 10 BW threat agents from the ITF-6A threat list. The CRP provides required reagents and HHAs to support fielded DoD BW detection systems (BIDS NDI and P3I, XM-99 Joint Portal Shield, IBAD, and DoD Biological Sampling Kits) and developmental systems (JBPDS), as well as other Federal Agencies and NATO allies. The near future requires the development of environmental and diagnostic molecular reagents for the JBAIDS. Outlying years will focus on the development of reagents to identify new and emerging threats and the procurement of improved reagents to replace older stocks.

Joint Biological Tactical Detection System (JBTDS)

Rationale:

- Approved Joint Operational Requirements Document.

Key Requirements:

- Lightweight biological detection system
- Capable of being integrated into warning and reporting network
- Be field upgradeable to detect new and/or additional biological threat agents

Description:

The JBTDS will be developed to provide warfighters a lightweight sensor with biological agent detection, warning and sample isolation capabilities. The detector will be networked to provide a cooperative detection capability to increase the probability of warning personnel and reduce the probability of false alarm. Each JBTDS will be capable of acting in two modes: a biological agent detector mode and/or a command module. The command module will be capable of receiving data from the arrayed detectors (three or more) while being able to control the detectors and track information generated within the network. Control capability will consist of remotely resetting, enabling and disabling the detectors on the network and tracking information generated within the network. The capabilities of the network will include both hardwire and wireless interfaces to provide maximum flexibility in fixed site and remote application. The required throughput of the system will be consistent with the alert data exchange and archiving requirements. The sample isolation feature will collect and preserve a sample for evacuation and analysis. JBTDS will have the flexibility to warn automatically or to permit for manual intervention in the detection-to-alarm process. JBTDS will be employed remotely or in an unattended configuration, on platforms to include vehicles, aircraft, and by foot-mobile forces.

Joint Modular Chemical and Biological Detection System (JMCBDS)

Rationale:

- USSOCOM approved Joint Operational Requirement Document.

Key Requirements:

- Provide lightweight and handheld, point, stationary and on-the-move CB detection capability
- Capable of being integrated into warning and reporting network
- Act as a link in the chain of overall battlefield contamination avoidance for joint, allied, and coalition forces.

Description:

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

DTO CB. 50 Lightweight Integrated CB Detection
Objectives. This DTO will develop technology to meet the requirements of the Joint Modular CB Detection (JMCBD) System. The critical path is to demonstrate an overall size of two cu ft and weight of 35 lb with biological sensitivity of 15 agent containing particles per liter of air (ACPLA) and chemical identification equal to that of the Joint Chemical Agent Detector. This will demonstrate the potential to meet the JMCBD operational requirements.
Payoffs. This effort addresses the Joint Future Operational Capabilities for Contamination Avoidance in Biological Early warning Detection/Discrimination, Chemical Early Warning Identification, and Chemical Detection and Identification. This effort will provide the next generation of smaller, lighter CB detection capabilities and will be the first to provide an integrated system for CB capabilities. This DTO addresses the overarching need to reduce the total number of systems out in the battlefield for better logistics.
Challenges. The major technological challenges are in the biological detection and discrimination to reduce the overall size, weight, and power requirements, integration of chemical and biological capabilities, and integration of the next generation of aerosol collection/sampling technology. The primary focus will be a cost to benefit analysis on the level of discriminate for biological detection and the size and weight of the overall system. Current philosophy is that the higher level of biological discrimination will require a bigger and heavier system. Integration of chemical and biological capabilities will be a challenge due to the fundamental differences in the nature of the materials. Integration of aerosol collection/sampling will be dependent on the availability of technology.
Milestones/Metrics.
FY2005: Downselect technologies to the best two or three approaches. Prepare preliminary design concepts based on these approaches.
FY2006: Assess ability of technology to meet JMCBDS requirements. Design brassboard. Initiate fabrication of brassboards. Transition for technology insertion into Joint Biological Point Detection System and reconnaissance systems as enhancements/replacement for the biological trigger systems to detect/identify chemical aerosols.
FY2007: Complete fabrication of brassboards. Test and evaluate.

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. The M21 is no longer in production.

STAND-OFF DETECTION AND REMOTE/EARLY WARNING

RDTE ITEMS

Joint Service Lightweight Standoff Chemical Agent Detector (JSLSCAD)

Rationale:

- Joint requirement.

Key Requirements:

- Automatically detect nerve, blister, and blood agents at standoff distances up to 500 m
- 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 500 m. The system will be light, compact and operate from a stationary position or on-the-move. The JSLSCAD Michelson interferometer employs a passive infrared system that will detect presence of chemical agents by completing a spectral analysis of target vapor agent chemical clouds. JSLSCAD is envisioned for employment on various platforms and in various roles, including fixed site defense, unmanned aerial vehicles, tanks and other vehicles, and on board ships. Among the vehicle platforms will be the STRYKER NBCRV and JSLNBCRS (both HMMWV and LAV variants). During FY04, DoD continued development and test and evaluation of the JSLSCAD.

Biological Remote/Early Warning

The Joint Biological Remote Standoff Detection System (JBSDS) program is intended to give the warfighting commander a significantly shortened decision

cycle regarding biological attacks; that is, the commander will see and be able to react to a biological attack much faster, thereby allowing many more personnel to take protective measures before they become exposed to the biological warfare agents. This means that fewer people will become casualties, and fewer people will have to take post-attack medical treatments.

Joint Biological Standoff Detection System (JBSDS)

Rationale:

- Joint Requirement

Key Requirements:

- Detect and track aerosol clouds out to 5km
- Discriminate biological clouds from non-biological clouds out to 3km
- Operationally eye and skin safe

Description:

The JBSDS uses an IR and UV laser to detect (5km) and discriminate (1km) aerosol clouds at operationally significant concentrations. The increment 1 JBSDS is being developed in response to an urgent demand identified in a Joint Staff Statement of Urgency and will be fielded to the U.S. Army and the U.S. Air Force. The increment 1 JBSDS provides 120 degree scanning while operating from fixed sites or mobile platforms in a stationary mode. The next generation system will provide 360 degree scanning while operating on-the-move and will be fielded to all four Services. The increment 1 JBSDS underwent a combined Production Qualification Test during FY03 and a Milestone B FY03. A Milestone C is scheduled for FY05, an IOT&E FY06 and FUE FY07. A MS B for the next generation system is planned for FY08.

DTO CB. 35 Standoff Biological Aerosol Detection
Objectives. This DTO will develop and demonstrate technology for an advanced, standoff biological detection capability to both detect and discriminate biological aerosol clouds at operationally significant concentrations.
Payoffs. This DTO addresses Joint Future Operational Capability Contamination Avoidance: Biological Early Warning Detection/Discrimination and Identification. 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. In FY02, system performance parameters were established through coordination with users, and downselection of candidate technologies based on weighted criteria including performance, logistics, platform, operational concerns, maturity, and cost was conducted. Experimental data were generated to support downselect. Downselected technologies include long-wave and mid-wave infrared (LWIR and MWIR),

DTO CB. 35 Standoff Biological Aerosol Detection
Differential Scattering/ Differential Absorption Lidar (DISC/DIAL), and Passive LWIR Spectroscopy. **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, possibly leading to cost-effective hybrid technology concepts (use of two or more technologies) for the final system design. **Milestones/Metrics.** **FY2005:** Complete data collection in field environments. Initiate analysis and modeling studies to evaluate the capability to detect and discriminate (bio vs. nonbio) agents at a concentration of 1,000 ACPLA at a range of 1 km with a false alarm rate of one per week in both daytime and nighttime operations. Identify the performance tradeoffs for each technology and optimize final system performance to meet user requirements. **FY2006:** Demonstrate the optimized system performance to detect and discriminate biological agents. Evaluate the feasibility of the demonstrated technology to meet chemical standoff detection requirements.

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 Spectrom-

eter, CAM/ICAM, AN/VDR-2, and M22 ACADA. The NBC sensor suite has been digitally linked 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

Stryker NBC Reconnaissance Vehicle (NBCRV)

Rationale:

- U.S. Army Requirement

Description:

The Stryker NBCRV will incorporate enhanced chemical and biological detectors that will allow on-the-move standoff chemical agent vapor detection (*i.e.*, JSLSCAD). The NBCRV integrates a biological agent detector with detection, identification and sampling capabilities equivalent to or greater than the JBPDS. CB agent detection capability is added through the Chemical Biological Mass Spectrometer (CBMS), which improves the detection and identification of liquid agents. Integration of common NBC technical architecture will facilitate low-cost expansion/upgrading of on-board computers. Stryker NBCRVs Program with enhanced CB Sensor Suites will be used to equip the Army's future Brigade Combat Teams.

Joint Service Light NBC Reconnaissance System (JSLNBCRS)

Rationale:

- Joint U.S. Army, U.S. Air Force, and Marine Corps Requirements

Key Requirements:

- Stand-off and point detection from vehicle mounted or dismounted operations
- Chemical standoff detection
- Detection while on-the-move capability from speeds of 0–45 kph
- Biological point detection and identification
- A dismountable, handheld, self-contained chemical point detection capability
- Radiological detection capability (vehicle mounted or dismounted operations)

- Collective protection
- Environmental Conditioning Unit capable of providing climate conditioning for the crew and equipment
- Overpressure protection from all known agents

Description:

The JSLNBCRS will provide a premiere vehicle for accurate, rapid NBC combat hazard information by verifying the absence of, finding, mapping, and marking radiological, biological, and chemical hazards. The JSLNBCRS will be an integration of advanced NBC detection and analysis equipment suited for Marine Air-Ground Task Forces (MAGTFs), U.S. Air Force tactical forces, and U.S. Army Light Contingency Forces. Two variants, the HMMWV and the Light Armored Vehicle (LAV) are planned and will house the same equipment.

DTO CB.53 Wide-Area Aerial Reconnaissance for Chemical Agents

Objectives. This DTO will: (1) develop and demonstrate a lightweight, wide-area passive standoff imaging detection system for airborne reconnaissance of chemical warfare (CW) agents for the purpose of contamination avoidance and facilities evaluation; (2) utilize existing hyperspectral imaging sensors to perform phenomenology studies to determine the optimal tradeoffs between spatial and spectral resolution for mapping of CW threats; and (3) design and demonstrate a passive CW imaging detection system based on commercial off-the-shelf (COTS) focal plane array (FPA) and digital signal processing (DSP) technology. This DTO will have a strong focus on measurement and analysis of airborne detection phenomenology, real-time signal processing requirements, and algorithm development.

Payoffs. This DTO addresses Joint Future Operational Capability of Contamination Avoidance: Chemical Early Warning. The Wide Area Aerial Reconnaissance System (WAARS) 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 WAARS will be capable of operating at fields of view 8 to 100 times greater than current systems. In addition, scan speeds must be increased significantly to allow for high-speed applications and more sophisticated signal processing techniques. The potential deployments include fixed sites, ground vehicles, unmanned aerial vehicles, helicopters, and high and low aircraft.

Challenges. Airborne deployment of a passive standoff system requires a detailed understanding of the measurement phenomenology. Wide-area detection using imaging focal plane array (FPA) technology demands higher speed operation and more sophisticated signal processing techniques than current systems. A significant effort is required to perform the necessary measurements and determine the tradeoffs between wide-area spatial resolution and the spectral resolution required to detect and map a CW threat. Knowledge of these tradeoffs will enable the design of practical detection algorithms that can be implemented using existing digital signal processing technology. The most significant current challenge is posed by the high frame rate required to perform imaging interferometry. Novel solutions must be developed to efficiently acquire and process this high-speed data and implement algorithms that can execute in real time.

Milestones/Metrics.

DTO CB.53 Wide-Area Aerial Reconnaissance for Chemical Agents
FY2005: Develop a 3-Hz, 128x128 tunable hyperspectral imager. Perform sensor characterization tests. Develop off-line algorithms and signal processing techniques. **FY2006:** Conduct demonstration of enhanced FTIR and tunable IR systems with real-time data processing. Determine optimum spectrometer performance specifications in terms of scan speed, spatial resolution, and spectral resolution.

DTO JA.40 CBRN Unmanned Ground Reconnaissance (CUGR) ACTD
Objectives. The CUGR ACTD will exploit Next Generation Sensor (NGS) technology to demonstrate an improved CBRN contamination detection capability in the current manned reconnaissance capabilities and demonstrate the military utility of CBRN unmanned ground reconnaissance systems. These capabilities will improve the speed of traditional zone, area, and route reconnaissance, as well as provide unmanned and restricted terrain reconnaissance. CUGR will permit future NBC Reconnaissance assets to keep pace with maneuver forces on the battlefield, extend protection for both the mounted and dismounted forces and permit rapid maneuver to exploit our superior technology. The ACTD will develop supporting Concept of Operations (CONOPS) and Tactics, Techniques and Procedures (TTPs) for employment of the technology applications (Manned and Unmanned Ground Reconnaissance). The CUGR addresses the JRO-CBRND Joint Future Operational Capabilities (JFOCS) of NBC Reconnaissance, Chemical/Biological Standoff Detection and Point Detection. **Payoffs.** The end-state of the CUGR ACTD is to provide an advanced sensor suite for near rear-time CBRN detection, sampling, and identification for manned and unmanned platforms. These new CBRN reconnaissance systems will increase the pace of operations and maneuver. In addition, the ACTD will introduce Raman technology with the Joint Contaminated Surface Detector (JCSD) in the manned reconnaissance vehicles. The JCSD can detect Chemical Warfare Agents (CWAs), Toxic Industrial Chemicals/Toxic Industrial Material (TICs/TIMs) and Non-Traditional Agents (NTAs). This system will not degrade existing CBRN sensors on the JSLNBCRS. CUGR will provide detection capability to investigate urban terrain and integrate NBC detection while keeping crews/systems out of the contamination and minimizing the exposure to hostile direct fire weapons. **Challenges.** Significant progress has been made in both the biological and chemical standoff detection arenas. Despite this, significant challenges remain in terms of developing a cost-effective approach for accurate surface contamination detection and identification, and real-time detection algorithms. The CUGV challenge includes the aforementioned plus integration of select CBRN/TIM sensors onto small robotic platforms. **Milestones/Metrics.** **FY2005:** Complete JCSD data collection of three surfaces - develop algorithms/Prioritize CUGV capabilities. **FY2006:** JCSD Demonstration on CBRN Recon Platforms/CUGV prototype integration. **FY2007:** Field JCSD-equipped CBRN Recon platforms/CUGV Demonstration.

RADIATION DETECTION (RADIACS)

FIELDED AND PRODUCTION ITEMS

AN/VDR-2

The AN/VDR-2 measures gamma dose rates from 0.01 µGy/hr (micro-Grays per hour) to 100 Gy/hr and beta dose rates from 0.01 µGy/hr to 5 cGy/hr. The unit functions simultaneously as a dose rate meter and dose meter with independent adjustable alarms that can be set at any level over the entire range. Dosage data is independently stored in non-destructive memory for display on command and may be retained when the unit is turned off. The unit is powered by three 9 volt batteries.

AN/PDR-75 Radiac Set

The AN/PDR-75 measures dose from 0 to 999 cGy (centi-Gray). The Radiac Set consists of a dosimeter and a reader. It provides the capability to monitor and record the exposure of individual personnel to gamma and neutron radiation. Each individual will be issued a DT-236/PDR-75 dosimeter. This device, worn on the wrist, contains a neutron diode and a phosphate glass gamma detector. When a determination of exposure is required, the dosimeter is inserted into a CP-696/PDR-75 reader, which then displays the cumulative neutron and gamma dose. The reader is issued at the company level and the dosimeters are issued to all combat, combat support, and combat service support personnel. The reader can be powered by a BA-5590 lithium battery, vehicle battery, or external power supply via adapter cables provided.

AN/PDR-77 Radiac Set

The AN/PDR-77 Radiac Set is a set of portable radiation detection equipment for detecting alpha, beta, gamma, and x-ray radiation. The set consists of a radiacmeter to which one of three radiation probes can be attached for measuring particular types of radiation. The probes are part of the set. The set includes accessories and basic test and repair parts for unit maintenance including a carrying pouch with shoulder straps capable of holding the radiacmeter, alpha probe, and beta/gamma probe for field use. The entire set is contained in a carrying case (large briefcase) for easy portability and storage.

AN/UDR-13 Pocket RADIAC

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

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. The MFR provides an improved capability to support both wartime and peacetime nuclear accident response operations. The MFR alone detects gamma radiation but in combination with the OA-9449/PDQ probe it can measure gamma and detect beta radiation. 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, multi-function 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.

Annex B

Information Systems Programs

Table B-1. Information Systems RDA Efforts.

Category	Nomenclature	Status	USA	USAF	USMC	USN
Warning and Reporting	- Joint Warning and Reporting Network (JWARN)	RDTE/Prod	Joint	Joint	Joint	Joint
	- Multipurpose Integrated Chemical Agent Detector (MICAD)	Fielded*	*Rqmt*		*Rqmt*	*Rqmt*
Hazards Analysis	- Vapor, Liquid and Solid Tracking (VLSTRACK)	RDTE/Fielded	Joint*	Joint*	Joint*	Joint*
	- Chemical Warfare Naval Simulation (CWNAVSIM)	RDTE				Rqmt
	- MESO	RDTE	Joint*	Joint*	Joint*	Joint*
	- CB Warfare Computational Fluid Effects (CBW-CFX)	RDTE	Joint*	Joint*	Joint*	Joint*
	- Hazard Prediction and Analysis Capability (HPAC)	Fielded	Joint*	Joint*	Joint*	Joint*
	- Joint Effects Model (JEM)	RDTE	Joint*	Joint*	Joint*	Joint*
	- CB.42 Environmental Fate of Agents	DTO				
	- CB.62 Hazard Prediction with Nowcasting	DTO				
	- CB.55 Chemical and Biological Hazard Environment Prediction	DTO				
	- CB.51 Low-level CW Agent Exposure: Effects and Countermeasures	DTO				
Operational Effects Analysis	- Simulation Training and Analysis For Fixed Sites (STAFFS)	RDTE	Joint*	*Rqmt*	Joint*	Joint*
	- Joint Operational Effects Federation (JOEF)	RDTE	Joint*	Joint*	Joint*	Joint*
	- Joint Medical NBC Decision Support Tool (JMNBCDST)	RDTE	Joint*	Joint*	Joint*	Joint*
	- CB.43 Chemical and Biological Warfare Effects on Operations	DTO				
	- JA.28 WMD Combat Assessment	DTO				
Training Simulation	- Virtual Emergency Response Training System (VERTS)	RDTE	Joint*	Joint*	Joint*	Joint*
	- Training Simulation Capability (TSC)	RDTE	Joint*	Joint*	Joint*	Joint*

Joint= Joint Service requirement
Rqmt= Service requirement
* = Sub-product(s) of a Joint project
Fielded = Fielded Capability (Sustained by Services)
Joint*=Draft Joint Service requirement
Rqmt = sub-product requirement or interest
Rqmt Interest = requirement or interest in sub-product
RDTE = Research, Development, Test & Evaluation (Advanced Development program)
DTO=Defense Technology Objective (Science & Technology Base Program)

WARNING AND REPORTING

FIELDED AND PRODUCTION ITEMS

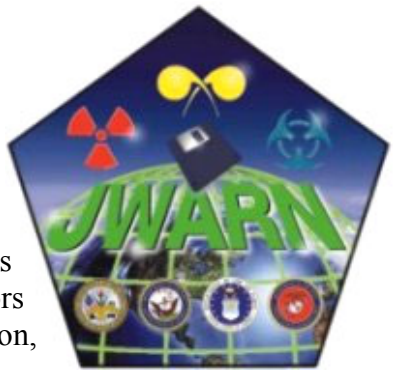
Joint Service Warning and Reporting Network (JWARN) Block I (FUE FY 99)

Rationale:

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

Key Requirements:

- Capable of generating NBC reports
- Capable of automatic transmission of NBC alarm and data



Description:

JWARN Block I is an automated Nuclear, Biological, and Chemical (NBC) Information System. JWARN Block I is essential for integrating the data from NBC detectors and sensors into the Joint Service Command, Control, Communication,

Computers, Information and Intelligence (C^4I^2) systems and networks in the digitized battlefield. JWARN Block 1 provides the Joint Force an analysis and response capability to predict the hazards of hostile NBC attacks or accidents/incidents. JWARN Block I 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 Block I is 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 allows operators to provide commanders with analyzed data for decisions for disseminating warnings to the lowest echelons on the battlefield. It provides additional data processing, production of plans and reports, and access to specific NBC information to improve the efficiency of NBC personnel assets. Block II is planned to integrate this capability into Command and Control centers so that it will be a segment on existing and future C4ISR systems, and to integrate the sensor outputs directly and automatically with the NBC warning and reporting tools so that sensor data automatically feeds the information system.

Multipurpose Integrated Chemical Agent Detector (MICAD) Embedded Common Technical Architecture (ECTA) Pre-Planned Product Improvement (P3I)

Rationale:

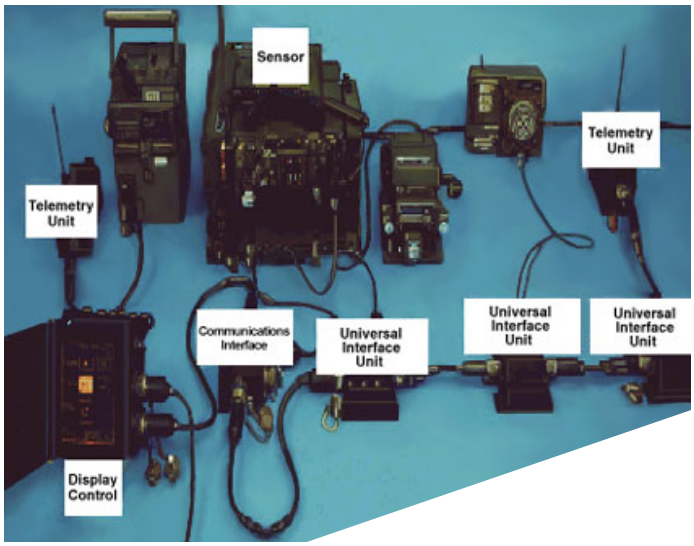
- Army, Navy, and Air Force requirement

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 (Fox, M93A1) operation

Description:

ECTA completely meets the JWARN ORD requirements for a fully automated CBRN Information System for vehicles, shelters and ships where data is taken directly from the CBRN sensors to generate warning and reporting information directly to and on the host C4ISR system. ECTA provides the Joint Force a legacy analysis and response capability to predict the hazards associated with any CBRN event. ECTA is a P3I to the MICAD system deployed on the Army's Fox vehicles. As such, the ECTA will take MICAD functions such as control of NBC sensors which



is performed through direct, hard wire connections, operator initiated analysis using legacy tools such as the Vapor Liquid Solid Tracking (VLSTRACK) and Hazard Prediction and Analysis Capability (HPAC), and automatic generation of NATO Standard warning reports using JWARN Block 1 software, and imbed the control functionality within the host C4ISR system. Initial target C4ISR systems are the Maneuver Control System (MCS) used by the Army for Fox vehicles, the GCCS-M system used on Navy ships, and the Theater Battle Management Core Systems (TBMCS) used by the Air Force.

WARNING AND REPORTING

RDT&E ITEMS

Joint Service Warning and Reporting Network (JWARN) Block II (FUE FY 06)

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

Description:

JWARN Block II completely meet the JWARN ORD requirements for a fully automated CBRN Information System for stationary, vehicular, mobile and dispersed sensor applications that takes data directly from the CBRN sensors and generates warning and reporting information directly to the host C4ISR system. JWARN Block II will provide the Joint Force a comprehensive analysis capability with the use of the Joint Effects Model (JEM), which is currently under development to replace legacy analysis tools. JWARN will also provide the Joint Forces with the operational capability to employ evolving 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 and hosted as a segment on C4ISR systems at the appropriate level defined in Service-specific annexes and employed by NBC defense specialists and other designated personnel. The JWARN system will transfer data automatically via hard wire or other means from and to the actual detector/sensor/ network nodes 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 NBC reports, and access to specific NBC information to improve the efficiency of NBC personnel assets.

HAZARDS ANALYSIS

FIELDED AND PRODUCTION

Vapor, Liquid and Solid Tracking (VLSTRACK)

VLSTRACK is a chemical and biological agent hazard assessment model that predicts the behavior of agents and the resulting hazards from a chemical or biological weapons attack. This model has been verified and validated against data concerning passive defense against biological and chemical weapons and is the only model accredited by the Department of Defense for this purpose. It supports operational decisions, operational contingency planning, hazard assessment doctrine, acquisition program studies, and requirements generation. VLSTRACK Version 3.1 is available and fielded but is no longer supported as an active acquisition program. This technology is being transitioned to the Joint Effects Model (JEM) Acquisition Program.

Hazard Prediction and Assessment Capability (HPAC)

HPAC provides the means to predict the effects of hazardous material releases into the atmosphere and its impact on civilian and military populations. It models incidents involving nuclear, biological, chemical and radiological (NBCR) weapons, nuclear reactor accidents, Toxic Industrial Chemicals, Toxic Industrial Materials and high explosive collateral effects resulting from conventional weapon strikes against enemy weapons of mass destruction (WMD) production and storage facilities. HPAC has been verified and validated against data for active offense, active defense and passive defense against WMD weapons, production facilities and storage structures. It has well documented independent verification and validation including peer-reviewed journal publication. HPAC is accredited by DoD for active defense against NBCR facilities, approved as the SHAPE NBCR Modeling Capability and NATO Allied Technical Publication 45 (ATP) Standard, and accredited by USSTRATCOM for its NBCR planning. HPAC supports operational decisions, operational contingency planning, hazard assessment doctrine, acquisition program studies, and requirements generation. HPAC Version 4.04 is currently available and fielded directly from the Technology development program conducted by the Defense Threat Reduction Agency (DTRA). Training is also available from the developer, US Army Chemical School, DTRA's Nuclear Weapons School, and the NATO/SHAPE School at Oberamergau. This technology is being transitioned to the Joint Effects Model (JEM) Acquisition Program.

HAZARDS ANALYSIS

RDTE ITEMS

CWNAVSIM (Chemical Warfare Naval Simulation)

Rationale:

- Navy requirement

Key Requirements:

- Predict ship system degradation resulting from a chemical attack
- Predict Mission Oriented Protective Posture (MOPP) resulting from a chemical attack
- Predict shipboard chemical agent detection system effectiveness

Description:

CWNAVSIM was developed to address specific Naval acquisition program decisions regarding chemical weapons defensive systems, specifically the Tactics, Techniques and Procedures (TTP) needed to defend the ship and the placement of detection devices. The CWNAVSIM model is comprised of three modules: Deposition and Weathering of

a Chemical Attack on a Naval Vessel (DAWN), Ship Chemical Warfare Ventilation Model (VENM) and the Naval Unit Resiliency Analysis (NURA). DAWN simulates Gaussian puff vapor and liquid clouds (primary cloud) interacting with the ship surfaces using potential flow equations. The DAWN module allows deposition and off gassing (secondary cloud) of the contaminant from the ship's external surfaces. The primary and secondary clouds are then entrained into the ship and transported throughout by the ship's HVAC system. VENM traces the vapor movement internally keeping track of concentrations and dosages in each compartment using a zonal model. VENM can simulate attack scenarios without input from the DAWN module. NURA provides casualty assessments and ship's mission degradation. NURA was developed primarily from the Army's AURA code. Currently the DAWN module is being replaced with CBW-CFX Computational Fluid Dynamic (CFD) code.

MESO (3D mesoscale meteorological model)

Rationale:

- Joint requirement

Key Requirements:

- Advance the state-of-the-art in use of Lagrangian particle transport and diffusion (T&D)
- Advance the state-of-the-art in characterization of the planetary boundary layer
- Address physical processes and hazard assessment capabilities of current standard models for CBD

Description:

MESO is developed to provide a T&D capability that is more accurate and more theoretically sound than Gaussian puff methodology but does not require the time and computer resources of a full Navier-Stokes Computational Fluid Dynamics (CFD) code. The development effort for the Department of Defense is also intended to provide advances in modeling important physical processes relevant to hazard assessment. MESO is currently not in distribution.

Chemical and Biological Warfare Computational Fluid Effects (CBW-CFX)

Rationale:

- Joint requirement

Key Requirements:

- Track threat from vapor, liquid, and solid CB agents around or within complex structures, *e.g.*, ships and buildings

Description:

CBW-CFX uses CFD code to model the transport, diffusion, deposition, and surface evaporation of chemical and biological agents in and around 3-D structures. CFX is a commercial code, which allows licensed users to develop subroutines that can be used within the code. CBW-CFX adds methodology for physical processes unique to chemical and biological agents. CBW-CFX is intended for use by researchers. To extend its utility it has been interfaced with other models, *e.g.*, VLSTRACK and the Ventilation Model (VENM).

Defense Technology Objective (DTO) CB. 42 Environmental Fate of Agents
Objectives. This DTO will measure and understand the physicochemical processes of chemical agents on surfaces in order to predict their persistence and residual agent concentration in operational scenarios via an agent fate model. Such data will be incorporated with CB environment models to enhance description of the CB Battlespace environment and its evolution in time.
Payoffs. This DTO addresses the Joint Future Operational Capability of Battle Management: Battlespace Analysis and Planning. This DTO establishes challenge levels and protection factors necessary for multi-service operating environments based on validated datasets and consistent analytical methodology, and develops a science-based understanding of the chemistry and physics of chemical warfare agents on surfaces. A surface evaporation module will be produced - validated against laboratory studies, wind tunnel tests, and field trials to reduce uncertainty for predicting chemical threat agent fate and persistence. Such a module, when addressing physical processes relevant to environment fate of agents on surfaces, serves as a key component for addressing persistence analysis for future novel chemical and biological threat agents. Data developed by this effort, when incorporated with CB environment models, will decrease risk to operational commanders when faced with critical decisions in the CB battlespace. Such decisions have impact not only on the survivability of the warfighter, but also on the integrity of the mission in the face of disruptions due to chemical agent hazards. Results of this program will directly support numerous decision tools such as the Joint Effects Model (JEM) and Joint Operational Effects Federation (JOEF). During FY04, lab scale wind tunnels for measuring the surface evaporation of chemical agents were developed and validated. The evaporation of HD on glass and the dissemination of thickened agents were accomplished. The Chemical Hazard Estimation Method & Risk Assessment Tool (CHEMRAT) and the surface evaporation module of VLSTRACK were updated with the most recent agent fate data.
Challenges. Dispersing and measuring the surface evaporation of thickened agents on complex matrices such as concrete and asphalt. Scaling agent evaporation measurements from lab-size wind tunnels to outdoor conditions in an agent persistence and contact model.
Milestones/Metrics. **FY2005:** Perform and document surface evaporation testing of HD, GD and VX on a non-porous substrate; start concrete surface investigation and begin testing on soil and asphalt. Perform and document GD and VX fate on soil components (sand and clay). Validate test methodology for agents on live grass. Complete agent/inert substrate prediction model from lab-scaled wind tunnel data. Complete and document methodology development.. **FY2006:** Complete surface evaporation testing of HD, GD, and VX on concrete, asphalt, soil, and grass in both lab and outdoor environments. Complete agent (HD, GD, VX) secondary evaporation model for concrete, asphalt, soil and grass and make predictions of outdoor field test experiments; conduct validation experiments. Complete and document residual contact measurements.

Agent Fate, Model Validation, and Source Characterization Databases

Rationale:

- Joint requirement

Key Requirements:

- Provide the Joint Service with field trial data assembled within databases in spreadsheet format
- The spreadsheets will contain information needed to develop or validate any open terrain contaminant transport and fate model
- Evaluate the validity of source characterization parameters
- The databases will initially directly support the Joint Effects Model (JEM) program
- The databases will be used to validate M&S tools developed under the M&S CA and the Information Systems Technology Business Area (BA)

Description:

Agent Fate Database: Currently CB Modeling and Simulation capabilities do not adequately address the fate of chemical agents deposited onto various surfaces and the resulting vapor and liquid hazards. The ability to assess these risks is key to post attack recovery planning, developing new equipment performance specifications, and the general planning for operational performance degradation expected due to the presence of persistent chemical agents. The goal of the Agent Fate Database is to translate detailed laboratory and field acquired data to improve the behavior characterization of chemical agent liquid deposited onto materials sufficiently well that computer models can be developed to simulate the behavior and accurately predict the resulting contact and vapor hazards. Results from modeling studies and analyses can then be used to develop decontamination and restoration of operations doctrine and training and influence the acquisition of materiel needed to meet associated requirements.

Model Validation Database: Each of the three DoD standard models (VLSTRACK, HPAC, and D2PC) has been validated against field trial data. The source terms, meteorological conditions, and contamination levels will be collected from the field trial reports and the files used for model validation. All relevant information will be put into an Oracle database. Additional literature search of DTIC and Technical Libraries will be performed for field trial reports contain data for contaminant releases in open areas that can be used for model validation. The data will be extracted from these reports and added to the validation database in the same fashion as the original set of reports. Further literature searches will be done to locate reports containing data on the flow of contaminants around buildings and to collect data characterizing the behavior of chemical or biological agents under conditions representative of high altitudes. This additional data will be added to the validation database for use in validating the complex flow and missile intercept capabilities of JEM Blocks 2 and 3.

Source Characterization Database: The overall objective is to develop a source characterization database of CB agent delivery systems as part of M&S tools available to the operational CB community and in direct support to the HPAC program. A tool called CARREM has been developed to estimate a delivery system's initial source, in parameters needed by transport and diffusion models. Subject matter experts will

evaluate the validity of these estimated parameters. When there is no consensus in the validity of the parameters or the experimental methods used to obtain them, a community accepted value would be determined. In cases where there is a significant disagreement in a value and there is no clear indicator which is the more valid, the parameters will be identified as an estimate used pending further experimentation or investigation.

DTO CB.62 Hazard Prediction with Nowcasting
Objectives. The overall objective is to develop a high–resolution local, regional, and global atmospheric prediction system that describes and forecasts/nowcasts battlespace environment (BSE) parameters to support prediction of the fate of chemical and biological agents, smoke, toxic industrial materials, and other agents in the environment for all DoD applications; and incorporate these BSE parameters into improved chemical/biological (CB) dispersion models to more accurately describe dispersion under a wider range of atmospheric conditions (night time, stable, in complex terrain, at high altitudes, etc.), than current capabilities. This DTO matures emerging basic research (6.1) for direct applications to the Service (6.4) users. The work necessary to integrate the Joint Effects Model with mesoscale nowcasts constitutes the technical effort that will be done under this DTO. **Payoffs.** CB dispersion models will be improved by investigating methodologies that more accurately represent turbulent fluctuations, and will be coupled to atmospheric models in a physically realistic (thermally and dynamically) manner. **Challenges.** As time-critical decisions are necessitated, the forecast capability to support dispersion modeling should be tied to real-time observational nowcast and battlefield management systems such as JWARN (currently in development) for executing and managing prudent operations in the battlespace. Improved modeling of high-altitude and near-surface atmospheric physics and agent behavior, especially in environments containing interferents such as smoke, fog, and dust, will require significant effort to validate. Considerable effort is required for the operational test and evaluation of the capability, exercise support, and development of concepts of operations, tactics, techniques, and procedures. **Milestones/Metrics.** **FY2005:** Incorporate improved from environmental model into the Joint Effects Model, the next-generation CB hazard model. **FY2006:** Enhance near-surface environmental characterization and demonstrate improvements using the Joint Effects Model. **FY2007:** Develop data assimilation techniques to improve forecasts of near-surface characteristics important for hazard prediction. **FY2008:** Demonstrate transitionable telescoping environmental prediction capability using a combination of global and mesoscale data assimilation systems couple with real-time nowcast update in support of the Joint Effects Model.

DTO CB.55 Chemical and Biological Hazard Environment Prediction
Objectives. The objective of this effort is to develop an improved capability to predict the behavior of chemical and biological agents in the environment. It will address the physical and biological processes that effect chemical and biological agents after they have been released into the environment. These processes include transport, diffusion, deposition, evaporation, biological decay, and reaerosolization and will incorporate new methodology developed under DTO CB.42 (Environmental Fate of Agents) that describes agent fate and persistence. This DTO directly supports the Joint Effects Model (JEM) ORD.
Payoffs. This capability will allow the warfighter to assess potential hazards from the use of chemical or biological weapons on the battlefield. This information is an important consideration when evaluating possible courses of action and their associated risks. Since the Joint Operational Effects Federation (JOEF) makes use of the chemical and biological hazard environment predictions, improvements in the capabilities to make those predictions will likewise improve the results of the operational analyses performed by JOEF.
Challenges. The primary challenge to developing this capability is the scale of the problem domain (meters to many kilometers). There are a wide range of interacting processes involved and a variety of operational environments that must be addressed. Each of the modeled processes of transport, diffusion, deposition, surface adsorption, surface desorption, evaporation, and biological decay is addressed through mathematical calculations that are valid over a specific range of conditions but may be unsuitable outside that range. For example a fast-running Gaussian model (designed for flat terrain) might be applied to transport and diffusion in an urban environment for rapid analysis, but the results will be very inaccurate compared to a full computational fluid dynamics analysis that requires greater computing resources. Computer code implementation also represents a continuing challenge. The need for faster codes that execute on available and affordable computer platforms will be an ongoing issue for the foreseeable future. New methodology on agent persistence, surface evaporation, reaerosolization (produced under DTO CB.42) will need to be integrated into this broader modeling framework of hazard prediction tools.
Milestones/Metrics.
FY2005: Further enhance the complex terrain and flow around structures modeling capability to address variable surface characterization and solar effects on agent evaporation (shading of areas as a function of time of day). Perform code optimization and validation of the complex terrain and flow around structures tools. Improve integration of hazard environment prediction tools to allow automated data transfer between various models. Incorporate methodologies for agent fate and persistence developed under DTO CB.42.
FY2006: Transition the complex terrain and flow around structures modeling capabilities to JEM Block III program.

Joint Effects Model (JEM) (FUE FY 06)

Rationale:

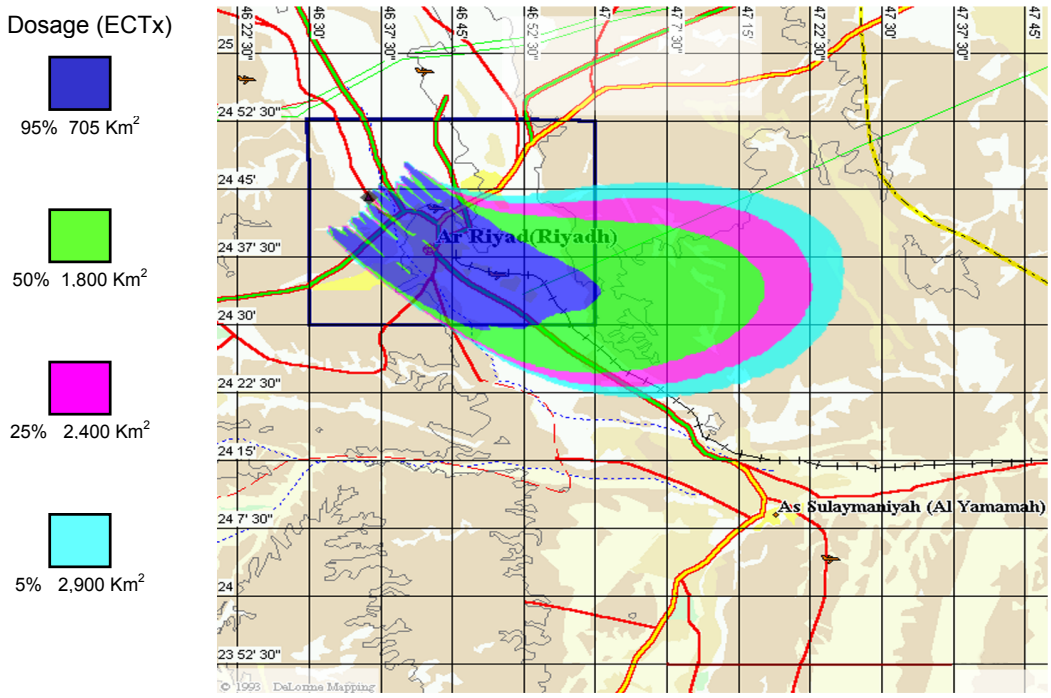
- Joint Army, Navy, Air Force, and Marine Corps requirement

Key Requirements:

- Predict hazard areas and contamination effects from nuclear, chemical or biological attack
- Predict hazard areas and contamination effects from nuclear, chemical or biological agent releases and releases of toxic industrial materials

Description:

JEM is the acquisition program that will transition the science and technology capabilities of VLSTRACK, HPAC, and D2PC. Once fielded, JEM will be the standard DoD NBC hazard prediction model. JEM will be capable of modeling hazards in a variety of scenarios including: counterforce, passive defense, accident or incidents, high altitude releases, urban NBC environments, building interiors, and human performance degradation; some of these capabilities will be included following release of Block 1. JEM will support defense against NBC and Toxic Industrial Material (TIM) weapons, devices, and incidents. JEM will be verified, validated, and accredited (VV&A) in accordance with the applicable DoD VV&A directives. When used operationally, JEM will reside on and interface with command, control, communications, computers, and intelligence (C4I) systems. Warning systems on those C4I systems will use JEM to predict hazard areas and provide warning to U.S. forces within those areas. When used analytically, JEM will assist DoD components to train jointly, develop doctrine and tactics, and assess warfighting, technology, and materiel development proposals, and force structuring. JEM (unclassified version) may also support homeland defense through use by Civil Authorities and Allies.



Research thrust: *Low-Level CW Agent Exposure*

- Identified biomarker(s) to indicate low level chemical exposure.
- Continued studies of neurotoxic effects of low dose chemical agent exposure.
- Examined the potential for immunological deficits following nerve agent exposures.
- Identified potential medical countermeasures for low level chemical warfare nerve agent and HD exposure.
- Assessed short-term behavioral, physiological, and neuropathological effects of VX nerve agent in rodents following low-dose exposures for varying durations and their potential impact on human operational readiness.
- Initiated studies on the effects of current prophylactic and therapeutic treatments on the maximum tolerated dose for repeated chemical warfare agent exposures and on other indices of chemical agent toxicity.
- Evaluated the efficacy of the FDA-approved oxime treatment, pralidoxime chloride (2-PAM), against biochemical and behavioral effects induced by repeated low level exposure to chemical warfare nerve agents in guinea pigs.

The following DTO is a key effort in addressing the issues of Low-Level CW Agent Exposures. This research is being conducted with coordination between the medical and non-medical research communities.

DTO CB. 51 Low-Level CW Agent Exposure: Effects and Countermeasures
Objectives. This DTO will deliver data sets on operationally relevant health effects of exposures to sub-lethal concentrations of Chemical Warfare Agents (CWAs). These data sets will, in turn, support development and refinement of risk assessment tools. Specific objectives are to extrapolate relevant experimental effects to determine post-exposure health problems that may impact subsequent operational readiness; and design and execute studies to generate scientifically valid data to serve as a basis for reducing the error in health risk assessment predictions useful for military Operational Risk Management (ORM) decisions. **Payoffs.** This DTO addresses deficiencies in the current understanding of the consequences of CWA exposure that may be encountered by military personnel across a range of deployment settings. For even as clear a toxicological endpoint as lethality, historical assumptions used to extend the prediction of exposures out in time have been shown to be overly conservative for the best studied agent, GB. The major goal of this effort is to understand the dose-response relationship for traditional CWAs (G-series, V-series and HD) with an object to identify the most appropriate endpoint to use for determining response actions. For example, a quantitative description of nerve agent-induced pupil effects (miosis) could serve as such a 'first noticeable effect', but less obvious changes in mental function could more significantly degrade operational performance at low-levels of exposures. Consistent and defendable data generated by this program will significantly reduce the error currently embedded in various estimates of toxicity and will provide a consistent and uniform basis for extrapolating information on health effects and potential short- or long-term performance decrements from exposure times and concentrations relevant to military operations. In addition, these data will be essential in creating requirements criteria for detector design, personal protective gear, and decontamination activities. Finally, the characteristics and magnitude of adverse health effects in these less-than-lethal exposure settings may suggest a need for novel medical protection or prophylaxis strategies.

DTO CB. 51 Low-Level CW Agent Exposure: Effects and Countermeasures
Challenges. Significant technical hurdles must be addressed to create and maintain stable exposure conditions for some agents. Cross-validation of inhalation, parenteral and dermal routes of exposure conditions must be addressed in a series of integration studies. Selection of appropriate animal model systems must be carefully designed to reduce the difficulty of extending such data to human exposures and to permit optimal detection of performance-degrading health effects. Collation of all results into a unified Operational Risk Management (ORM) framework will require novel approaches to traditional treatments of scientific data. **Milestones/Metrics.** **FY2005:** Complete cross-validation studies for exposure route comparison that refine operational human health risk assessments. Complete inhalation data set to define the extended range of operational effects for GF in swine and VX in rodents. Complete and deliver assessments of the short-term effects of VX on higher order behavioral tasks in nonhuman primates following a range of low-dose exposures for varying durations to improve estimates of impact on human operational readiness. **FY2006:** Deliver inhalation dataset to define longer time, lower level operational effects for VX in swine and GD in rodents that refine operational human health risk assessments. Complete and deliver assessments of the long-term and delayed effects of CWA nerve agents on behavior and physiology following a range of low-dose exposures for varying durations, and assess potential impacts on human operational readiness in subsequent deployments. **FY2007:** Deliver inhalation data set to define longer time, lower level operational effects for HD in swine.

OPERATIONAL EFFECTS ANALYSIS

RDTE ITEMS

Simulation Training and Analysis For Fixed Sites (STAFFS)

Rationale:

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

Key Requirements:

- Determines operational effects of CB warfare environment on military fixed site operations
- Interfaces with key NBC models, simulations, and data bases

Description:

STAFFS is a general-purpose simulation model which represents the operations of large fixed-site facilities such as air bases, aerial ports of debarkation (APODs) and seaports of debarkation (SPODs), with the capability to represent chemical and biological warfare (CBW) attacks and their effects on operations. No other capability currently exists within DoD to assess the operational impact of CBW attacks on critical fixed-site targets. Due to their fixed location and essential combat support roles to forces in the theater of operation, these rear-area facilities can be expected to be high priority targets to aggressor forces and thus one of the most likely targets to encounter CB weapons and

their effects. These sites may be particularly susceptible to repeated CBW attacks, which could significantly degrade logistical throughput and hamper combat operations. STAFFS is currently in use and being further developed in two major functional areas: 1) support of wargaming and operational exercises including distributed interactive environments, and 2) support of operational and requirements analysis. Wargame applications run interactively with STAFFS accepting input and providing output to other model applications running as a system. Man-in-the-loop games and simulations may be performed. Analysis applications typically involve the examination of many different simulation/analysis cases (a case matrix) often involving parametric representation of unknown system data. Different user interfaces are provided specific to the application. STAFFS wargaming applications utilize an interactive graphic user/system interface while analysis applications typically utilize file base batch processing.

STAFFS utilizes spatial and temporal CB challenge data calculated by other standard CB hazard assessment models including VLSTRACK and HPAC. CB equipment and agent effects represented in high resolution include detectors, protective gear, decontamination, toxic and infective agent effects, collective protection, medical treatment, equipment induced thermal effects, equipment induced encumbrance, and doctrinal procedures such as work-rest cycles. These effects are represented by engineering level sub-models, which can be easily changed to represent different equipment capabilities and levels of availability. Basic operational tasks are modeled using a task-network approach that is adaptable to any desired level of resolution. STAFFS is developed by AFRL. Limited training is currently available.

Joint Operational Effects Federation (JOEF) (FUE FY 06)

Rationale:

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

Key Requirements:

- Analyzes operational issues and doctrine through the interrelation and effects of various elements within the overall system.
- Evaluates the performance of particular equipment based on material characteristics.
- Assesses individual Warfighter ability to perform mission essential tasks.
- Aggregates individual performance parameters into unit effectiveness.
- Integrates existing transport/diffusion models for CB agent hazards.

Description:

The JOEF will provide the operational community with the federated models and simulations specific to their operational environment required to predict or immediately respond to the need for operational effects information relative to any nuclear, radiological, chemical, or biological event. JOEF will include both fixed site and mobile forces simulation capabilities that, when married to specific data bases, will simulate all nuclear, radiological, chemical and biological defense processes, forces, and battlespace environments. In addition, the Federation will address both personnel degradation and medical processes and resources. JOEF will be used by both the operational commander and operational analyst to make rapid course of action analysis effects- based

operational decisions, logistics decisions, CBD asset location decisions, and develop TTPs for CBD operations. The JOEF will be utilized by: 1) operational planners and decision makers in support of course of action assessment and plan evaluation; 2) the analysis community in support of high level concept assessments and system effectiveness studies and 3) Joint exercises and experiments in support of planning, execution, and analysis. The JOEF vision is of a set of validated low-to-medium resolution warfare entity models, certified data, appropriate simulation services, and related user support tools in a framework suitable for modeling multi-warfare scenarios.

Joint Medical NBC Decision Support Tool

Rationale:

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

Key Requirements:

- Provide the capability to support deliberate planning, crisis action planning, exercises/training, and execution of medical support for operational missions, both on the battlefield and in urban environments.
- Interface with current and co-developmental medical planning tools such as the Medical Analysis Tool (MAT), Command and Control systems, medical informatics including the Defense Medical Surveillance System (DMSS) database, and Joint Warning and Reporting Network (JWARN) for discretionary transmission of data.

Description:

The Joint Medical NBC Decision Support Tool will enable the Service/medical planner/operator to model and analyze the NBC battlefield both to identify Service/Joint Force agent exposures on military and civilian populations and to estimate NBC casualties. It will also relate treatment protocols (time, task, treater files) to these casualties to determine: medical materiel requirements, medical personnel requirements, medical evacuation requirements and for hospital bed requirements at Levels 3-5. As such, it supports operational decisions, operational contingency planning, threat assessment doctrine, acquisition program studies, and requirements generation.

DTO CB. 43 Chemical and Biological Warfare Effects on Operations
Objectives. This DTO will develop a general-purpose model of the operations of large fixed-site facilities (air bases, aerial ports of debarkation (APODS), and seaports of debarkation (SPODS)), with the capability to represent chemical and biological warfare (CBW) attacks and their operational impacts (i.e., sortie generation rate, cargo throughput).
Payoffs. This DTO addresses Joint Future Operational Capability of Battle Management Analysis, with secondary modeling and simulation support to Contamination Avoidance. The model will assess the operational impact of CBW attacks on fixed-site targets, which are particularly susceptible to CBW attacks, significantly degrading their output, and hampering combat operations. It is intended as both an interactive and distributed tool, filling an important gap in the DoD modeling and simulation toolset. In wargaming simulations, the model will receive tasking inputs from its operators or the other simulations, and will generate corresponding degrades after an attack. It will alert the theater wargame model of the mission results and determine the disposition of assets on the mission, track surviving

DTO CB. 43 Chemical and Biological Warfare Effects on Operations

assets, and model asset turnaround for other missions. The model will provide wargaming support for APODs, SPODs, depots, and other fixed-site facilities. In studies, it can be used to assess the feasibility of base operations in a given CBW scenario, responding to the postulated threat and the defensive capabilities of a selected fixed-site facility. Operational planners can determine best trade-offs for base assets, work degradation, and relocation options. Newly fielded hardware/defensive capabilities (equipment procurement, detector deployment or modified CONOPS) can be assessed in terms of increased sortie rate, cargo throughput, or reduced casualties. The model will help determine the best mix of CBW defense capabilities and the most effective acquisition strategy.

Challenges. Obtaining datasets that are complete, accurate, and representative for each contemplated use of the model is the most significant challenge. Validating model results with real-world results of CBW operational exercises is difficult because data are extremely limited. Data collection is time consuming and costly. Support of controlling organizations is frequently necessary, not only in making the data available, but also in its reduction, interpretation, and conversion to usable formats. In some cases the data will have to be obtained through experimentation, such as the effect of wearing next-generation CBW protective equipment and performing typical tasks. Other challenges include developing methodology for APODs/SPODS and increasing model execution speed sufficiently for wargaming environments.

Milestones/Metrics.

FY2005: Test and finalize toward JOEF transition Block 2. Perform internal V&V.

DTO JA.28 WMD Combat Assessment*

*This DTO is funded by DTRA (under PE 0603160BR) in coordination with the CBDP

Objectives. This DTO will develop and demonstrate the capability to perform combat assessment of counterforce strikes conducted on enemy chemical, biological, and nuclear-related targets. Systems that perform weapons of mass destruction (WMD) combat assessment are intended to provide the Combatant Commander with timely indication of the magnitude and severity of adverse consequences (e.g., assessment of atmospheric release of chemicals, biological agents, or radiological materials) resulting from U.S./coalition combat action against WMD targets. Combat assessment may be conducted by sensors mounted on deployable systems such as unmanned vehicles or with expendable sensors that are emplaced either pre- or post-strike. Sensors may consist of material collectors and collector-identifiers, with real-time or near-real-time reporting capability. Technological solutions may also include development and weaponization of materials to tag effluent plumes released from targets as a result of combat action to provide cueing for remote detection systems (and advanced warning of potential downwind WMD contamination). Sensor systems/host vehicles may also egress a target area to facilitate recovery and forensic analysis of collected material.

Payoffs. This effort will provide the warfighter with the capability to rapidly assess the results of planned strikes on enemy WMD targets, providing indication of hazards to friendly forces, population centers, etc., as well as the capability for real-time bomb impact assessment/bomb damage assessment for the WMD target set.

Challenges. Challenges include standoff detection of WMD agents and tracking of post-strike plumes/clouds from chemical, biological, and radiological agent-related targets; developing sensors for point collection and real-time identification of chemical, biological, and radiological agents in plumes containing post-strike interferents such as sand, dust, explosive by-products, and corrosive materials; miniaturizing and packaging sensor systems for militarily deployable systems; integrating technology

DTO JA.28 WMD Combat Assessment*
into existing U.S./Coalition C4ISR architectures; and developing taggant material compatible with U.S./Coalition weapons and tactical/strategic sensors. **Milestones/Metrics.** **FY2005:** Develop prototype potential Biological Combat Assessment systems and taggants. **FY2006**: Demonstrate Biological Combat Assessment Collection System and taggants. **FY2007**: Demonstrate Biological Combat Assessment Identification System. **FY2008**: Develop prototype potential Radiological Combat Assessment systems. **FY2009**: Develop prototype potential Chemical/Biological/Radiological combined systems.

TRAINING SIMULATION SYSTEMS

RDTE ITEMS

Virtual Emergency Response Training System (VERTS)

Rationale:

- Army requirement.

Key Requirements:

- Visually immersive training environment for specialized missions of the US Army National Guard Weapons of Mass Destruction Civil Support Teams—WMD CST.
- Must represent not only the deploying military units' personnel and equipment, but also the civil first responders and their equipment with which the CSTs will work.
- Detailed visual and structural databases required for each city/site.

Description:

The VERTS is being developed to enhance the training of WMD CSTs. WMD response requires significant training demands for individual and collective tasks. Soldiers and airmen must be proficient on a wide array of government and commercial equipment for NBC protection, detection and medical response. The WMD CSTs, in particular, are required to master a variety of equipment and procedures. The VERTS is required to support both individual and collective training. VERTS supports training in all tasks for the CST. It allows training on procedures for response to dangerous NBC agents, procedures that are difficult if not impossible to recreate in a live training environment. VERTS also allows mission rehearsals in actual and realistic urban settings. Training in the virtual cities of VERTS allows these teams to learn to navigate in actual cities, in actual buildings and to do so without the threat of being observed by adversaries, criminals and terrorists. VERTS, by being distributable over a network, allows teams to train together without having to travel long distances. Once validated for CSTs, VERTS offers the promise to train other DoD response elements and first responders as well.

The simulation system will consist of a network of PC-based modules that will serve as Survey Team Stations (Desk-Top), a Chief Trainer/Battlemaster Station, Immersive Station, Medical Station, Network Server Station, AAR Station, and Data Logger Station.

Training Simulation Capability (TSC)

Rationale:

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

Key Requirements:

- Provide an integrated and consistent training tool for warfighters to prepare for operations in a NBC environment
- Integration with and have access to current and planned individual service C^4I^2RS systems
- Provide ability to gather and store lessons learned and identified failure/error incidents in order to provide after action review
- Provide capability to use NBC effects models and mission data to perform mission rehearsals using a simulation federation.

Description:

The TSC will provide the ability to simulate NBC attacks using NBC defense assets and Command, Control, Communications, Computers, Intelligence, Information, Reconnaissance, and Surveillance (C^4I^2RS) systems for training and exercises. It will allow for exercise planning, execution, and capturing lessons learned for after action review (AAR). It will provide the capability to use or simulate the use of NBC sensors, Tactical Engagement Simulation (TES) gear, and simulators for training and exercises. The TSC will provide the capability to simulate NBC environments and effects under live, virtual, and constructive simulations. It will provide the capability to use training and simulations in both Command Post Exercise (CPX) and Field Training Exercise (FTX) environments. It will operate in conjunction with the Joint Warning and Reporting Network (JWARN), future Joint NBC Information Systems, and the other Modeling and Simulation capabilities developed to support NBC defense requirements.

The TSC will be used at all levels of NBC defense decision-making to train for and simulate NBC attacks against friendly forces. It will provide for the training and use of simulation capability by all NBC defense personnel and commanders related to NBC threats and scenarios. When fully fielded, the TSC will provide capabilities from individual and team trainers up through large unit battle staff training capabilities.

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Annex C

Non-Medical Protection Programs

Table C-1. Protection RDA Efforts.

	Category	Nomenclature	Status	USA	USAF	USMC	USN
INDIVIDUAL PROTECTION	Aviation/ Surface Respiratory Protection	- MBU-19/P Aircrew Eye/Respiratory Protection (AERP)	Production	Interest	Rqmt	Interest	
		- M48 Aircraft Mask	Production	Rqmt			
		- CB Respiratory System (A/P22P-14(V))	Production			Rqmt	Rqmt
		- M45 Aircrew Protective Mask (ACPM)	Production	Rqmt		Interest	
		- M45 Land Warrior Mask	Production	Rqmt	Rqmt		
		- M40A1/M42A2	Fielded	Rqmt		Rqmt	Rqmt
		- MCU-2A/P	Fielded		Rqmt		Rqmt
		- Joint Service Aircrew Mask (JSAM)	RDTE	Rqmt	Rqmt	Rqmt	Rqmt
		- Joint Service General Purpose Mask (JSGPM)	RDTE	Rqmt	Rqmt	Rqmt	Rqmt
		- Joint Service Chemical Environment Survivability Mask	RDTE	Rqmt	Rqmt	Interest	Rqmt
	Universal Common Individual Protective Equipment	- Protection Assessment Test System (PATS)	Production	Rqmt	Rqmt	Rqmt	Interest
		- Voice Communication Adapter	Fielded	Rqmt	Rqmt	Rqmt	Rqmt
		- Joint Service Mask Leakage Tester	RDTE	Interest	Rqmt	Rqmt	Rqmt
		- CB.36 End-of-Service-Life Indicator for NBC Mask Filters	DTO				
	Aviation/ Surface Protection Ensembles	- CB Protective Overgarment Saratoga	Fielded	Interest		Rqmt	Interest
		- Chemical Protective Undergarment (CPU)	Fielded	Interest		Int-NIR	Interest
		- Modified CPU (mCPU)	Production	Rqmt			
		- CMU-34P and CMU-35P (USN modified CPU)	RDTE	Rqmt		Rqmt	Rqmt
		- Joint Service Lightweight Integrated Suit Technology -- Overgarment -- Boots (MULO)	 Prod.* Prod.*	 Rqmt Interest	 Rqmt Rqmt	 Rqmt Rqmt	Rqmt
		-Battledress Overgarment (BDO)	Fielded	Rqmt	Rqmt	Rqmt	Rqmt
		Joint Protective Aircrew Ensemble (JPACE)	RDTE	Rqmt	Rqmt	Rqmt	Rqmt
		- CB.45 Self-Detoxifying Materials for Chemical/Biological Protective Clothing	DTO				
	Specialty Suits	- STEPO	Fielding	Rqmt			
		- EOD Ensemble	Production		Rqmt		
		- Improved Toxicological Agent Protective (ITAP)	Production	Rqmt			
		- Joint Firefighter Integrated Response Ensemble (JFIRE)	Fielded	Rqmt	Rqmt		
		- Suit Contamination Avoidance Liquid Protective (SCALP)	Fielded	Rqmt			
COLLECTIVE PROTECTION	Tentage and Shelter Systems	- M20A1 Simplified CP Equipment (SPE)	Fielded	Rqmt	Rqmt		Rqmt
		- M28 CP Equipment (CPE)	Fielded	Rqmt	Rqmt		Rqmt
		- CB Protective Shelter (CBPS) (Medical)	Production	Rqmt	Interest	Interest	
		- CP Deployable Medical System–Chemically/ Biologically Hardened Air Transportable Hospital (DEPMEDS/CHATH)	Production	Rqmt	Rqmt	Interest	
		- CP Expeditionary Medical Shelter System (CP EMEDS)	Production	Interest	Rqmt	Interest	Interest
	Collective Protection (CP) Systems	- Shipboard Collective Protection System (CPS)	Production	Interest	Interest		Rqmt
		- Modular Collective Protection System (MCPE)	Fielded	Rqmt	Interest		Interest
		- M8A3 Gas-Particulate Filter Unit (GPFU)	Fielded	Rqmt			
		- M13A1 GPFU	Fielded	Rqmt	Rqmt		Rqmt
		- Joint Collective Protection Equipment (JCPE)	RDTE	Rqmt	Rqmt	Rqmt	Rqmt
		- CB.40 Immune Building Program (DARPA)	DTO				
		- CB.61 Advanced Air Purification System Model	DTO				
	Generic Filters	- M48/M48A1 (100 cfm) Gas-Particulate Filter	Fielded	Rqmt		Rqmt	Rqmt
		- M98 (200 cfm) Gas-Particulate Filter Set	Fielded	Rqmt	Rqmt	Interest	Rqmt
		- Fixed Installation Filters	Fielded	Rqmt	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
DTO = Defense Technology Objective (Science & Technology Base Program)

INDIVIDUAL PROTECTION EQUIPMENT

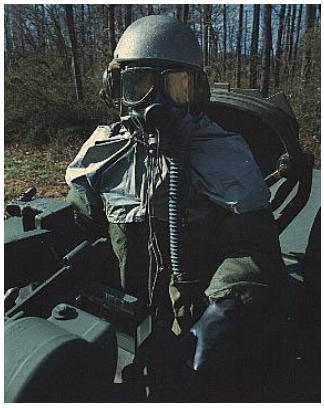
SURFACE RESPIRATORY PROTECTION FIELDED AND PRODUCTION ITEMS

MCU-2A/P Protective Mask

The MCU-2A/P provides eye and respiratory protection from all chemical and biological (CB) 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. The MCU-2A/P designed to meet needs of the Air Force ground crews and the Navy Shipboard and shore-based support units.

M40/42 Series Protective Mask

The M40/42 series protective masks provide eye-respiratory face protection from CB warfare agents, toxins and radioactive fallout particles. Each mask consists of a silicone rubber face piece with an in-turned peripheral face seal and binocular rigid lens system. The facepiece is covered with a chlorobutyl/EPDM second skin to provide optimum liquid agent protection for the masks. It accommodates NATO standard canisters, which can be worn on either cheek of the mask. The M40 series (*left*) is designed for the individual dismounted ground warrior, while the M42 series (*right*) is designed for combat vehicle crewmen. Recent improvements include a universal second skin, making the mask compatible with JSLIST and Saratoga overgarments, and ballistic/laser protective eye lens outserts. The mask facepiece has been made a spare part, which has resulted in a significant operation and support cost savings. Use of modular parts permits the M40 series facepiece to be used in both the M40 and M42 configuration. This has resulted in significant operational and support cost savings.



Voice Communication Adapter

The Voice Communication Adapter (VCA) is a low risk program providing additional capability to the M40/42 mask. The VCA provides effective voice communication between masked personnel enhancing Command and Control on the Nuclear, Biological, Chemical (NBC) contaminated battlefield. The VCA is a joint program between the USMC and U.S. 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. The Air Force is fielding a second skin for the MCU 2A/P.

SURFACE RESPIRATORY PROTECTION R&D ITEMS

Joint Service General Purpose Mask (JSGPM)

Rationale:

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

Key Requirements:

- Provide the wearer above-the-neck protection from CB agents, radioactive fallout particles, and Toxic Industrial Materials (TIMs)
- 24-hour CB protection
- Lower breathing resistance and reduced weight and bulk than currently fielded protective masks

Description:

The JSGPM (*prototype shown*) 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 anticipated threats. The mask components will be designed to minimize the impact on the wearer's performance and to maximize the ability to interface with current and co-developmental Service equipment and protective clothing.

Joint Service Chemical Environment Survivability Mask (JSCESM)

Rationale:

- Joint Army, Special Operations Command (SOCOM), Navy, and Air Force requirement

Key Requirements:

- One size fits all
- For low threat area usage
- Limited protection
  (2 hours, limited agent concentrations)
- Small, lightweight

Description:

The JSCESM will be a lightweight complement to the JSGPM. It will provide commanders at all levels with greater options for protection, especially in Operations Other Than War. The JSCESM will provide a disposable, emergency mask for use in NBC situations confronting the Services operating in low NBC threat conditions and

military medical care providers and patients in certain instances when using the standard service mask is not practical. Warfighters in special operations or other combat/non-combat roles will carry JSCESM (in the uniform cargo pocket) or while in civilian clothing (concealable) during deployment when an NBC threat is possible, but unlikely. Additionally, other missions exist for the JSCESM such as use in collective protection shelters if the shelter filtration system fails or emergency evacuation of a shelter is required when contamination is present.

AVIATION RESPIRATORY PROTECTION FIELDED AND PRODUCTION ITEMS

M45 Aircrew Protective Mask (ACPM)

The M45 Air Crew Protective Mask is specially designed to meet the requirements of Army helicopter pilots and crews (except for the Apache helicopter). It does not require power or forced air to provide CB protection; it provides compatibility with helicopter optical systems, aircraft displays and night vision devices; and has reduced weight, cost and logistical burden when compared to the M43 series of mask. The ACPM has close fitting eyelenses mounted in a silicone rubber facepiece with an in-turned peripheral seal, a detachable hood system, and utilizes the standard NATO canister. The M45 will replace the M43 (Type II) and the M24 aviator's mask. The M45 fits a higher percentage of the extra-small and -large population, and is used as a mask for personnel who do not get an adequate face seal in the M40 or MCU-2A/P masks. It will be used to phase out the extra-small M17 masks currently being used for some hard-to-fit personnel. The M45 is also used for specific ground force applications where close eye compatibility is required for unique equipment such as for the Land Warrior system.

M48 Protective Mask

The M48 is the third generation M43 series masks. The M48 mask replaced the M43 Type I mask and is the only mask for the Apache aviator until the Joint Service Aircrew Mask – Apache Variant is produced. The M48 mask consists of a lightweight motor blower, a new hose assembly, a web belt, the mask carrier, facepiece carrier, eyelens cushions, and facepiece. The motor blower is aircraft mounted with a quick disconnect bracket on the pilot's seat during flight operations.

Aircrew Eye/Respiratory Protection (AERP)

The AERP, MBU-19/P (replaces the MBU-13/P system for aircrews) is a protective mask that 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 Assemblies (A/P22P-14(V) 1, 2, 3, & 4) NDI

The CB Respiratory Assembly is a self-contained protective ensemble designed for all forward deployed rotary-wing and fixed-wing aircrew members. Respirator assemblies are provided in the following configurations: A/P22P-14(V)1 Helo (self contained), A/P22P-14(V)2 LOX, A/P22P-14(V)3 OBOGS, and A/P22P-14(V)4 Panel Mounted Regulator. 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.

AVIATION RESPIRATORY PROTECTION R&D ITEMS

Joint Service Aircrew Mask (JSAM)

Rationale:

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

Key Requirements:

- Continuous CB protection for aircrew members
- Improved anti-G protection
- Be compatible with existing personal clothing and aircrew life support equipment/systems

Description:

JSAM will be a lightweight CB protective mask that can be worn as CB protection for all aircrew. With the addition of anti-G features, it can be worn as combined CB and anti-G protection for aircrews in high performance aircraft. It will be compatible with existing CB ensembles, provide flame and thermal protection, provide hypoxia protection to 60,000 feet, and the CB portion will be capable of being donned in flight. JSAM will also be compatible with existing aircrew life support equipment.

UNIVERSAL COMMON INDIVIDUAL PROTECTIVE EQUIPMENT

FIELDED AND PRODUCTION ITEMS

M41 Protection Assessment Test System

During the issuing process for Protective Masks it is absolutely essential that the mask be properly fitted to the individual to ensure the highest protective value. The M41 Protection Assessment Test System (PATS) validates proper fit of a mask to the face of the individual. It tests all current military and several commercial masks. The system provides a visual display of the fit achieved by the mask when worn by the individual and requires calibration every 18 to 24 months. The M41 PATS has been acquired by the Air Force, and Marines.

MQ1A Mask Tester

The MQ1A mask tester also validates proper fit of a mask to the face of the individual. It tests currently fielded AF MBU-5/P and MBU-12/P aviator masks and the MBU-13/P and MBU-19/P aviator NBC protective masks. The system provides a visual display of the fit achieved by the mask when worn by the individual. The MQA1 Mask Tester is currently in use by the Air Force at units supporting the MBU-5/P, MBU-12/P, MBU-13/P and MBU-19/P.

UNIVERSAL COMMON INDIVIDUAL PROTECTIVE EQUIPMENT

RDTE ITEMS

Joint Service Mask Leakage Tester

The Joint Service Mask Leakage Tester (JSMLT) will be a portable test system capable of testing the serviceability of a protective mask in the field. It will have expanded capability compared to the M41 PATS by allowing component level testing of the mask as well as system level testing with added components. It will provide a capability for an overall mask serviceability and fit factor validation of protective masks in the field.

Defense Technology Objective (DTO) CB.36 End-of-Service-Life Indicator for NBC Mask Filters

Objectives. A low-cost, qualitative, end-of-service-life indicator (ESLI) will be developed 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 ESLI filter prototypes with target challenge agents.

Payoffs. This effort addresses the Respiratory Individual Protection/Unlimited Respiratory Protection (OC/EC) JFOC by alerting the user that his/her mask filter has been exposed to chemical agents or battlespace contaminants and has a limited remaining service life. Presently there are no means to determine the residual life of fielded filters. Development of a chemical agent ESLI will greatly enhance serviceman safety by alerting the user to replace the filter before its gas life capacity has expired. Other

Defense Technology Objective (DTO) CB.36 End-of-Service-Life Indicator for NBC Mask Filters

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 ESLI technology developed in this effort will have direct application to commercial Chemical, Biological, Radiological, Nuclear (CBRN) respirators used by first responder personnel responding to CBRN terrorist events, as well as other dual-use applications such as residual life indicators for collective protection filters and chemical protective clothing.

Challenges. Development of an ESLI to detect such a wide range of chemical warfare agents is considered moderate risk. Although state-of-the-art passive (non-powered) technologies such as colorimetric indicators exist for detecting specific contaminants, most rely on specific reaction chemistry and, thus, are not suitable as broad-spectrum vapor/gas indicators. Realistically no single indicator is expected to achieve such nonspecificity; however, it is feasible that a combination of different indicator technologies could be used to target key organic vapor and acid gas agents. This DTO will focus on low-cost passive indicator technologies capable of detecting major chemical warfare agents of concern.

Milestones/Metrics.

FY2004: Continued fabrication and demonstration testing of ESLI filter concept models to verify ESLI is a reliable indicator of gas life depletion for key target agents (i.e., GB, HD, CK, AC and CG). Continued efforts to determine the effects of common environmental factors (i.e., heat and humidity) that may impact ESLI performance and evaluated the effects of long term storage. This DTO supported several protective equipment (mask) programs which addressed Baseline Capability for Respiratory and Ocular Protection - Limited TIC protection; priority number 19.

FY2005: Assess the effects of common battlespace interferents on ESLI performance. Optimize ESLI design and complete demonstration testing on ESLI filter prototype(s). Investigate new indicators (or optimize existing indicators as required) to detect sorbent-depleting battlefield contaminants. This DTO will transition to the Joint Service General Purpose Mask (JSGPM) program and addresses the Baseline Capability for Respiratory and Ocular Protection – Limited TIC protection; priority number 19.

SURFACE PROTECTIVE ENSEMBLE FIELDED AND PRODUCTION ITEMS

Battle Dress Overgarment (BDO)

The BDO is a camouflage patterned (desert or woodland), two-piece, air permeable overgarment typically worn over the duty uniform. The overgarment material consists of an outer layer of nylon cotton, and an inner layer of activated charcoal impregnated polyurethane foam. The BDO provides protection against chemical agent vapors and liquid droplets, biological agents (to include toxins), and radioactive alpha and beta particles. The BDO is issued in a sealed vapor-barrier bag that protects the garment from rain, moisture and sunlight. The BDO provides 24 hours of chemical agent protection once contaminated and has a field durability of 22 days (extendable).

Joint Service Lightweight Integrated Suit Technology (JSLIST) Overgarment

The JSLIST Overgarment will provide 24-hour protection with up to 45 days of wear and 6 launderings. The 24-hour protection and 45 days of wear applies for a period of up to 120 days after the garment is removed from its vacuum packaging. 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 (CP) Suit, Saratoga (USMC)

Like the JSLIST, the SARATOGA CP Suit is an air permeable, camouflage patterned overgarment. The 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 45 days of wear.

SURFACE PROTECTIVE ENSEMBLE RDTE ITEMS

CWU-66/P Aircrew Ensemble

The CWU-66/P, a one-piece flightsuit configuration, provides 16-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 combat vehicle crewman coverall, battle dress uniform, or aviation battle dress uniform, the CPU provides 12 hours of both vapor and liquid protection and is durable for 15 days.

SURFACE PROTECTIVE ENSEMBLES RDTE ITEMS

Joint Service Lightweight Integrated Suit Technology (JSLIST)

The JSLIST program is a fully cooperative Joint Service RDTE and procurement effort chartered to develop and field 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. There are six JSLIST clothing item components: 1) overgarment, 2) lightweight garment, 3) undergarment, 4) socks, 5) boots and 6) gloves. Each of the Services' requirements are incorporated by these six JSLIST components.

In April 1997, the JSLIST program type classified and began fielding the JSLIST Overgarment and Multi-purpose Overboot (MULO). Current JSLIST RDT&E includes programs intended to field a chemical protective glove to meet U.S. SOCOM requirements (JSLIST Block 1 Glove Upgrade), a follow-on chemical protective glove program (JSLIST Block 2 Glove Upgrade) intended to field a chemical protective glove to meet Joint Service requirements found in both the JSLIST and Joint Protective Air Crew Ensemble Operational Requirements Documents (ORD) and Alternative Footwear Solution (AFS), Integrated Footwear System (IFS) Multipurpose Protective Sock program, which will field a sock to meet the requirements found in the JSLIST ORD.

The JSLIST Additional Source Qualification (JASQ) was initiated to qualify additional sources of JSLIST materials and to conduct field wear tests and laboratory chemical tests on commercial JSLIST suit candidates. The JASQ candidates that perform as well as, or better than the current JSLIST garment will be considered for placement on a JSLIST qualified products list and may be authorized as additional JSLIST material sources.

Joint Protective Aircrew Ensemble (JPACE)

Rationale:

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

Key Requirements:

- Provides below-the-neck protection for rotary and fixed wing aircrew
- 30 day wear time with 16 hours of protection within a contaminated environment
- Launderable
- Compatible with aircrew mounted aviation life support systems
- Ejection safe and water survivable

Description:

JPACE (*concept shown*) will be a CB protective ensemble for all services' aviation communities. It will be a replacement for the Navy and Marine Corps MK-1 undergarment, Army Aviation Battledress Uniform (ABDU)-BDO and/or CPU system and AF CWU-66/P overgarment. JPACE will provide aviators with improvements in protection, reduced heat stress in CB environments, extended wear, and service life. In addition, it will be compatible with legacy aviation mask systems and co-developmental masks, such as the Joint Service Aircrew Mask (JSAM). This ensemble will be jointly tested with JSAM and will be used as a technical insertion to the Army

Air Warrior program. JPACE will provide the fixed and rotary wing aviator with below-the-neck protection against CB threats.

Modified Chemical Protective Undergarment (mCPU)

A modified CPU (mCPU) is being developed to include a pass-through for microclimate cooling unit tubing. The mCPU worn with the ABDU will be used as interim chemical protection for Army aviators until the development and fielding of JPACE.

DTO CB.45 Self-Detoxifying Materials for Chemical/Biological Protective Clothing
Objectives. Agent reactive catalysts and biocides will be directly incorporated into CB protective clothing and their capability to self-detoxify agents in a cost effective clothing system will be demonstrated.
Payoffs. This DTO addresses the Joint Future Operational Capability of Individual Protection (Respiratory and Percutaneous) by reducing the probability of skin, eye, or respiratory contact with NBC agent hazards. This effort will simplify personal decontamination and provide an increased level of protection to CB protective clothing through the added capability of self-detoxification. The most efficient and cost-effective agent reactive catalysts and biocides that neutralize chemical/biological warfare (CW/BW) agents will be incorporated into fibers, coatings, and membranes, resulting in increased protection and a substantially reduced hazard when donning and doffing as well as disposing of contaminated clothing. Reactive nanoparticles in fibers have been shown to break down nerve gas VX simulant and mustard. Hyperbranched compounds that float to surfaces have been synthesized to increase the effectiveness of reactive compounds by concentrating reactive nanoparticles and other decontaminating catalysts near protective fabric surfaces. Surface enrichment of hyperbranched materials has been demonstrated in coatings. Undergarments have been treated with chloramines to kill biological warfare agents, and N-halamine chemistry has been applied to nylon/cotton fabrics, polyesters, and polyurethane coatings. Aerosol “catch and kill” mechanisms have been shown to work for antimicrobially treated electrospun fibers.
Challenges. The addition of agent reactive catalysts and biocides to advanced CB clothing systems must strike a balance between the new self-detoxifying capability and the extra weight of additives to the garments. Since CB clothing is burdensome to wear, any extra weight must result in additional benefit to the warfighter. In this case, the additional benefit is increased protection. Agent reactive catalysts are specific in their behavior. Catalysts have been developed that are effective against mustard, for example, while other catalysts have been shown to be effective against nerve agents. It is not practical at this time to expect universal agent neutralization. In general, biocides are more universal in their activity.
Milestones/Metrics.
FY2004: Demonstrated ability to produce materials employing self detoxification chemistries for G-nerve agents, VX, and HD blister by commercial electrospinning. Demonstrated improved reaction rates for hyperbranched surface migrating compounds. Demonstrated agent deactivation chemistry of fiber bound catalysts through solution and vapor challenge testing for a target reactivity level of 1 mg agent/cm2/day. Demonstrated effectiveness of scaled up N-halamine treated materials against significant biological challenges. Demonstrated nanoparticle reaction rates in excess of 2 mg agent/cm2/day in both fiber and coating form. Downselected most reactive, cost effective nanoparticle compositions and optimize those materials for reactivity rates and range of materials they detoxify. This DTO supported Joint Expeditionary Collective Protection (JECP) program which addressed Baseline Capability Assessment (BCA) Expeditionary COLPRO - Size, power, and weight limitations; priority number 11 and Expeditionary COLPRO - Correct quantity shortfalls; priority number 25. The DTO also

DTO CB.45 Self-Detoxifying Materials for Chemical/Biological Protective Clothing
supported the current Joint Service Lightweight Integrated Suit Technology (JSLIST) program. **FY2005:** Demonstrate scaled-up electrospun self-detoxifying membranes. Optimize materials and processing conditions for reactive fibers/films/membranes. Select materials from DTO and related projects. Measure chemical/aerosol breakthrough of candidate fabrics. Measure durability of candidate fabrics from all sources. Conduct toxicology and live agent testing of manufactured fabrics. Select fabric design from agent anddurability testing. Manufacture prototypes. Conduct field-testing. Collect user assessments. Select overall garment design from field-testing and report findings. This DTO supports the Joint Expeditionary Collective Protection (JECP) program which addresses Baseline Capability Assessment for Expeditionary COLPRO - Size, power, and weight limitations; priority number 11 and Expeditionary COLPRO - Correct quantity shortfalls; priority number 25. This DTO also supports the current Joint Service Lightweight Integrated Suit Technology program. **FY2006:** Fabricate prototype garments. Demonstrate activity of treated fabric systems. Measure chemical/aerosol breakthrough of garments. Conduct field-testing of chemically self-detoxifying fabric systems. Collect user assessments. Field test biocidal treated ensemble for durability and persistence of reactivity. Conduct Chemical Weapon Agent (CWA) simulant and live CWA testing on worn garments to assess durability. Develop transition plan. **FY2007:** Optimize garment designs and manufacture optimized prototype garments. Demonstrate durability and overall cost-effectiveness of scaled-up electrospun self-detoxifying membranes, N-halamine-treated textiles, and materials containing reactive nanoparticles. Measure chemical/aerosol breakthrough of optimized garments. Conduct field testing and assessments. Downselect candidates. Transition to JSLIST upgrade.

PROTECTIVE ACCESSORIES
FIELDED AND PRODUCTION ITEMS

Chemical Protective Footwear Covers (CPFC)

The CPFC are unsupported, impermeable, butyl rubber overshoes that can be stored flat. They are a loose fitting butyl rubber upper vulcanized to a non-slip molded butyl rubber sole with five holes to allow lacing around the foot. They are worn over the combat boot. They have the ability to resist acid, jet fuel, oil and fire. They were manufactured in two sizes, small and large, but are no longer being procured.

Chemical Protective Sock

This sock is the first generation Air Crew Chemical Defense Equipment. It is plastic and disposable. The sock comes in one size as 500 ea per roll, 21 inch long, 4 mils thick and 8 in wide flat extruded tubing with 1/8 in wide heat-seal closure. This sock is to be worn over regular sock.

Disposable Footwear Cover

Plastic over-boots are worn over the flyer's boot. They protect the user from chemical contamination en-route from the shelter and the aircraft. They come in one size and are removed before entering the aircraft or shelter.

Green Vinyl Overboots /Black Vinyl Overboots (GVO/BVO)

The GVO/BVO are fitted vinyl overshoes that are worn over the combat boots to provide chemical agent protection and/or moisture vapor protection during wet weather. The impermeable GVO/BVO provide protection against chemical agents for 24 hours and are durable for up to 60 days.

Multipurpose Overboot (MULO) *(JSLIST Boots)*

The MULO is a joint service program under the auspices of the JSLIST program. It is made of an elastomer blend and is 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 from chemical agents with a wear life of up to 60 days. The MULO provides more durability, improved traction, resistance to POLs, flame protection, decontaminability, and has better donning and doffing characteristics over standard footwear.

Chemical Protective (CP) Gloves

The CP butyl 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, and aircrews. The 14 mil glove is used by personnel such as aviators and mechanics, in cases when good tactility is necessary and stress to the glove is not too harsh. The 25 mil glove is used by personnel who require a durable glove to perform close combat tasks and heavy labor. The 14 and 25 mil glove sets provide protection for at least 24 hours. The 7 mil glove set should be replaced within 6 hours of exposure to a chemical agent.

Glove Inserts

These gauntlet cotton inserts are worn under the chemical protective (CP) butyl rubber gloves. They provide perspiration absorption. They can be worn in either hand and are available in three sizes (small, medium and large).

Chemical Protective Helmet Cover

The Chemical Protective Helmet Cover is intended to provide any standard helmet with protection from chemical and biological contamination. It is a one-piece configuration made of butyl coated nylon cloth and gathered at the opening by elastic webbing enclosed in the hem. The covers come in one size and are of olive green color.

Aircrewman Cape

This disposable cape is a one size fits all plastic bag (74 in x 23 in) worn over the entire body to provide additional protection against liquid contamination. The cape should be worn if

aircrews have to walk around liquid contaminated areas and if aircraft are not sheltered. If worn, the cape is removed before entering the aircraft.

SPECIALTY SUITS

FIELDED AND PRODUCTION ITEMS

Joint Firefighter Integrated Response Ensemble (JFIRE)

JFIRE is a joint effort between the Air Force (lead agency) and the Army. The JFIRE Program has developed an ensemble that will protect military firefighters in accordance with National Fire Protection Association (NFPA) standards and provide CB protection during firefighting operations in a CB environment. JFIRE leverages the JSLIST overgarment for chemical protection, to be worn under aluminized proximity firefighting outergear and with a switchable filtered/supplied air mask with chemical warfare kit. A commercial off-the-shelf glove that can be used for both fire and CB protection has replaced the need for CB gloves to be worn under standard proximity gloves. JFIRE meets several key requirements, including (1) providing 24 hours of CB agent protection against 10 g/m^2 liquid agent, (2) providing firefighters CB protection in both structural and crash fire fighting/rescue operation, (3) allowing firefighters to use mission essential tools and equipment in a CB environment, (4) providing resistance to water and all standard fire fighting chemicals (foam, CO_2, aircraft POL), and (5) is capable of being donned in 8 minutes.

Suit Contamination Avoidance Liquid Protection (SCALP)

The SCALP can be worn over standard chemical protective garments to provide one hour of protection from gross liquid contamination. The SCALP, which consists of a jacket with hood, trouser and booties, is made from a polyethylene-coated Tyvek™ impermeable material.

Self-Contained Toxic Environment Protective Outfit (STEPO)

STEPO (*shown left*) provides OSHA level A protection for Army Chemical Activity/Depot (CA/D), Explosive Ordnance Disposal (EOD) and Technical Escort Unit (TEU) personnel. The STEPO is currently being fielded to CA/D, TEU and EOD. The STEPO is a totally encapsulating protective ensemble for protection against CB agents, missile/rocket fuels, POL, and industrial chemicals for periods up to four hours. The ensemble incorporates two types of NIOSH approved self-contained breathing systems (one hour and four hour configurations) and a tether/emergency breathing apparatus option, a battery powered Personal Ice Cooling System (PICS), a hands-free communications system, and standard M3 Toxicological Agent Protective (TAP) boots and gloves. The suit is capable of being decontaminated for reuse up to 5 times after chemical vapor exposures. STEPO shares common, modular components with the ITAP and JFIRE ensembles simplifying logistics and reducing costs.

EOD M3 Toxicological Agent Protective (TAP) Ensemble

One-piece coverall for the protection of personnel engaged in extreme hazardous decontamination work or other special operations involving danger from spillage or splashing of chemical agents including toxic industrial material. The coverall is constructed from butyl rubber coated plain weave nylon cloth and comes in four sizes (small, medium, large and extra large). The design consists of snap-type button front and protective flap. This is a special purpose Life Support Clothing and Equipment item.

Improved Toxicological Agent Protective (ITAP)

ITAP replaces the M3 TAP ensemble. ITAP enhances existing capabilities by increasing personal protection and reducing the thermal burden on the wearer. ITAP also provides skin and respiratory protection both during peacetime and wartime for short term operations in Immediately Dangerous to Life and Health (IDLH) toxic chemical environments (up to 1 hour), emergency life saving response, routine Chemical Activity operations and initial entry and monitoring. ITAP shares common, modular components with the STEPO and JFIRE ensembles, simplifying logistics and reducing costs.

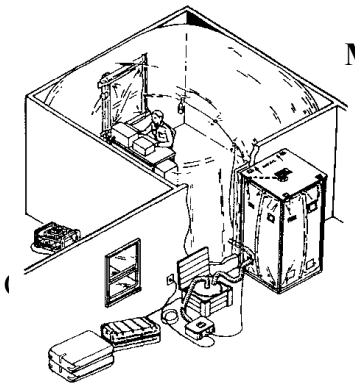
ITAP provides splash and vapor protection against potential exposure to liquid agent when worn as a system—requirements: 10g/m^2 HD, VX, GB, L agent challenge for 1 hour. It provides an optional Personal Ice Cooling System (PICS), and is functional as a system where temperatures range from 0° to 100°F when used with the cooling system. The ITAP suit and overhood are capable of being decontaminated for a minimum of 5 reuses, 2 hours per use (1 hour at IDLH), after vapor and particulate contamination. After liquid contamination ITAP suit will be decontaminated and held for disposal.

The ITAP fabric is self-extinguishing meeting NFPA 1991. The fabric is also static dissipative and does not hold a charge sufficient to set off munitions and explosives in accordance with current Explosive Safety Board requirements. The fabric is light in color to reduce operator solar heat load, and is capable of being stored within the temperature range of 0° to 120°F. ITAP has a minimum shelf life of 5 years.

COLLECTIVE PROTECTION EQUIPMENT

TENTAGE AND SHELTERS

FIELDED AND PRODUCTION ITEMS

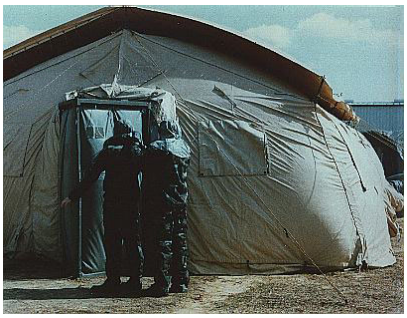


M20/M20A1 Simplified Collective Protection Equipment (SCPE)

The M20/M20A1 SCPE is used to convert an interior room of an existing structure into a positive overpressure, NBC collective protection shelter where individuals can perform assigned

missions without wearing the protective mask and overgarment. The M20 SCPE system consists of a liner, protective entrance, filter canister, and support kit. The SCPE is a low cost method of transforming a room in an existing structure into an NBC collective protection shelter for command, control and communication (C^3), medical treatment, and soldier relief functions. M20A1 is a room liner for existing shelters. The M20A1 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 CPE (SCPE)



The M28 CPE is a low cost method of transforming existing tentage into an NBC collective protection shelter for command, control and communication (C^3), medical treatment, and soldier relief functions. M28 is a liner for the TEMPER tent. M28 CPE components include a CB vapor resistant polyethylene liner that provides a protected area in an existing structure; a collapsible, protective entrance that allows entry to/exit from the protected area; a hermetically sealed filter canister, which provides filtered air to both the liner and the protective entrance; and a support kit, which contains ducting, lighting, sealing and repair material and an electronically powered blower. A pre-planned product improvement (P^3I) program building upon the M20 SCPE design, resulted in the improved M20A1 SCPE and the M28 CPE models which, in addition to a vapor agent resistance capability, they also provide a liquid agent resistance capability, protective liners for tents, interconnections, and an interface with environmental control units. These improved models also remove the restriction imposed on the M20 SCPE with respect to exit/entry procedures therefore, meeting the mission requirement as outlined in the M20 SCPE Letter Requirement by allowing 150 or more people to enter and exit the shelter over a 24 hour period.

Chemically Protected Deployable Medical System (CP DEPMEDS)

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 operations 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.

Collective Protection for Expeditionary Medical Support (CP EMEDS)

The Air Force's CP EMEDS program is an effort to insert environmentally controlled collective protection into currently fielded hospital shelters. The role of CP EMEDS, as part of the Air Force Theater Hospital (AFTH), is to provide individual bed-down and theater-level medical services for deployed forces or select population groups within the entire spectrum of military operations. CP EMEDS Small Portable Expeditionary Aeromedical Rapid Response (SPEARR), +10, and +25 configurations are modular packages, tailored to meet theater requirements, by providing a flexible hospitalization capability. The CP EMEDS +25 has the capability to provide 24-hour sick call, 25 inpatient beds, & emergency medical care to a population at risk of 3,000–5,000. The following capabilities are also available: medical command and control, preventive medicine, trauma resuscitation and stabilization, general and orthopedic surgery, critical, urgent, & primary care, aeromedical evacuation coordination, aerospace medicine, dental, and limited ancillary services. The CP EMEDS is used in a CB threat area and permits operation in CB active environments while minimizing impact to the AFTH mission. The CP EMEDS provides a contamination free environment where medical treatment can be rendered to personnel without the encumbrance of individual protective equipment.

Chemically/Biologically Hardened Air Transportable Hospital (CHATH) – Fielded

The Air Force's CHATH program is a Joint effort with the Army to enable medical personnel to deploy and setup in CB threat areas and operate in CB 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 developed a Chemically/biologically Hardened Air Management Plant (CHAMP). The CHAMP filters CB contaminated air, and recirculates and filters interior air to maintain a clean hospital standard, provides heating, cooling, and over-pressurization to the hospital. The CHAMP can be operated from standard electrical sources or from its own internal generator. The CHAMP comes equipped with an Automatic Transfer Switch (ATS) to maintain power after Base power

is shut off. The ATS starts the Diesel generator after three seconds of power interruption. The CHAMP allows the CHATH to be staged near warfighters in the field in a bare base environment. The CHATH can be deployed in increments of 10, 25, and 50 beds. This flexibility of the CHATH system helps ensure the best medical care is as near to the crisis area as possible.

CB Protected Shelter (CBPS)

CBPS is a highly mobile, rapidly deployable shelter system designed to be used for Level I and II forward area medical treatment facilities and forward surgical teams. CBPS also replaces the M51. The system is self-contained and self-sustaining. The CBPS consists of a dedicated M1113 Expanded Capacity Vehicle (ECV), a Lightweight Multipurpose Shelter (LMS) mounted onto the vehicle, a 300 square foot airbeam supported CB protected shelter, and a High Mobility Trailer with a towed 10kw tactical Quiet Generator Set. The ECV and LMS transports a crew of four and their gear. All medical equipment required for the shelter is transported in the LMS or on the trailer. The CB shelter is rolled and carried on the rear of the LMS during transport. The CBPS is operational within 20 minutes with a crew of four. All power required to support operations is provided by the ECV engine or with the 10kw generator for limited power. The system is environmentally conditioned by a hydraulically powered environmental support system, which provides filtered air, heating, air conditioning, and electrical power. This system is presently in full rate production. Pre-planned product improvements are underway to improve operational suitability and reliability of the current version for forward deployed light divisions. A Self-Powered Electrical Support System (SP-ESS) is being developed to eliminate the need for using the HMMWV engine for primary power.

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 gauge. CPS is modular and is based on the 200 cfm M98 Gas-Particulate Filter Set. CPS includes filters, filter housings, high pressure fans, airlocks, pressure control valves, low pressure alarm system, and personnel decontamination stations. These systems are being installed through both new ship construction and the CPS Backfit program.

COLLECTIVE PROTECTION SYSTEMS

RDTE ITEMS

Shipboard Collective Protection Equipment (CPE)

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 CPE provides a contamination-free environment within specified zone boundaries such that mission essential operations and life sustaining functions can be performed during or after a CB attack. The objective of this program is to provide Pre-Planned Product Improvements (P3I) to the current Shipboard CPS to decrease logistic costs by extending particulate filter life, reducing shipboard maintenance requirements, and providing energy-efficient fans. The program develops improvements to existing shipboard HEPA and gas adsorber filters, supports long term shipboard testing of filter improvements to develop filter life database, and provides plans for backfitting existing non-CPS ships. Shipboard CPE is being installed on selected new construction ships. The Shipboard CPE program transitioned to the JCPE program in FY03.

Joint Collective Protection Equipment (JCPE)

Rationale:

- Draft Joint Service requirement

Key Requirements:

- Rapid insertion of technology improvements to existing equipment
- Increased number of shelters for command/control, medical, and rest/relief areas
- Improved shipboard systems
- Standardization of equipment

Description:

JCPE provides needed improvements and cost saving standardization to currently fielded collective protection systems by using the latest technologies in filtration, shelter materials, and environmental controls to provide affordable, lightweight, easy to operate and maintain equipment. Inserting improved technology into currently fielded systems will result in improved perform-

ance with reduced operating costs. Standardization of individual system components across Joint Service mission areas will reduce logistics burden while maintaining the industrial base. Taken both individually and collectively, these tasks will improve NBC defense readiness for Joint Services by providing state-of-the-art, off-the-shelf solutions for currently fielded equipment deficiencies.

DTO CB. 40 Immune Building Program (DARPA Program)

Objectives. This DTO will 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 protect the human occupants from the lethal effects of the agent, restore the building to function quickly after the attack, and preserve forensic evidence about the attack.

Payoffs. Enabling buildings to respond actively and 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. In FY04, this DTO designed and optimized the system for demonstration at a military installation.

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 such as 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.

FY2005: Conduct full-scale demonstration at military installation.

GENERIC NBC FILTERS AND COLLECTIVE PROTECTION FILTRATION SYSTEMS

FIELDED AND PRODUCTION ITEMS

Generic, high volume air flow NBC filters, and CP filtration systems exist that are currently installed on a wide variety of applications. These CP systems are modular and have been applied to numerous vehicles, vans, mobile shelters, and fixed sites.

GENERIC NBC FILTERS

NBC filters are used to remove Nuclear and Biological particulates and Chemical aerosols and vapors from the air supplied to collective protection systems.

M48/M48A1 Gas-Particulate Filter

The 100 cubic foot per minute (cfm) filter is used in the M1A1/A2 Abrams tank, M93 Gas Particulate Filter Unit (GPFU), CB Protected Shelter, and Paladin Self Propelled Howitzer.

M98 Gas-Particulate Filter Set

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 airflow rates.

600 cfm and 1200 cfm Stainless Steel Fixed Installation Gas Filters

These filters are used in fixed site applications where high volumes of airflow are required. They can be stacked to provide higher NBC filtered airflow rates. Particulate filter would be procured separately.

GENERIC NBC CP FILTRATION SYSTEMS

The following are 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, Stryker vehicles, 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 M48A1 Gas-Particulate Filter in the 100 cfm system and the M98 Gas-Particulate Filter Set in the others.

DTO CB. 61 Advanced Air Purification System Model
Objectives. The effort will develop a model, database, and design concepts for Advanced Air Purification systems that incorporate emerging and mature technologies for the purpose of providing: 1) broader protection against an expanding chemical and biological threat that is more universally adaptable and 2) reduced logistical burden as compared to current single pass filter technology. This will be accomplished by developing a model for Advanced Air Purification systems that can address wide application requirements by providing the optimal mix of technologies. Enhanced protection capabilities will result as well as improvements in weight, cube, logistics and cost. **Payoffs.** This DTO addresses three Joint Future Operational Capabilities for Transportable, Mobile, and Fixed Site Collective Protection. Advanced Air Purification systems for improved protection against

DTO CB. 61 Advanced Air Purification System Model
chemical, biological, radiological, and nuclear (CBRN) agents and toxic industrial materials (TIM) will provide smaller, lighter weight systems with reduced power and logistical requirements. The Advanced Air Purification Systems Model will be employed as a tool by the platform development community to configure an optimized air purification system (air conditioning, aerosol/particulate, and chemical removal processes) for the application. The model will permit the rapid, confident, tradeoff of competing characteristics (weight, volume, power, consumables, threat, performance, unit cost, life cycle cost, etc.) to ensure the best possible system configuration to meet user requirements. The Advanced Air Purification Systems Model will also be useful to the procurement community to assess proposed systems and for identification of technological gaps by the S&T community to focus R&D. Applications include Deployable Medical System (CP DEPMEDS), and Chemical Biologically Protected Shelter (CBPS), mobile systems [e.g., Advanced Amphibious Assault Vehicle (AAAV), C-17 transport, Future Combat Systems (FCS), and Ship Collective Protection Equipment (SCPE) Program], and for fixed sites. Benefit to the warfighter is an air purification system optimized to meet user need (threat protection, size, weight, power requirements, etc.). **Challenges.** Currently, there is no known system of technologies that offers near universal protection against all threats. The goal of this effort is to identify the air purification technology or combination of technologies (hybrid) that most optimally meets the needs of the application. Many of these technologies when considered as stand alone systems are capable of removing CBRN agents and TIMs. However, each technology may have limitations that need to be overcome. For example, single-pass filters cannot effectively remove some of the TIC vapors, regenerative filtration systems produce toxic levels of agent in the purge gas for extended periods of time and catalytic systems require consumable acid-gas scrubbers. The objective of this effort is to utilize the advantages of each of these approaches to develop a system that maximizes chemical/biological protection while minimizing size, weight, energy, and logistics burden. A considerable challenge will be development of appropriate standard test and evaluation methodology. Incorporating all of the parameters into a single, validated model will also be a significant challenge. **Milestones/Metrics.** **FY2005:** Identify high priority model applications, compile user and operational requirements and initiate population of databases using data in literature, existing system performance and module models. Configure lab scale system to measure required design data. This DTO supports the Joint Expeditionary Collective Protection (JECP) program and addresses Baseline Capability Assessment for Expeditionary COLPRO - Size, power, and weight limitations; priority number 11 and Expeditionary COLPRO - Correct quantity shortfalls; priority number 25. **FY2006:** Continue identification of high priority model applications, compile user and operational requirements and initiate population of databases using data in literature, existing system performance and module models. Configure lab scale system to measure required design data. This DTO supports the Joint Expeditionary Collective Protection (JECP) program and addresses Baseline Capability Assessment for Expeditionary COLPRO - Size, power, and weight limitations; priority number 11 and Expeditionary COLPRO - Correct quantity shortfalls; priority number 25. **FY2007:** Complete high priority model applications and population of databases using data in literature, existing system performance and module models. Complete configuration of lab scale system to measure required design data. This DTO supports the Joint Expeditionary Collective Protection (JECP) program and addresses Baseline Capability Assessment for Expeditionary COLPRO - Size, power, and weight limitations; priority number 11 and Expeditionary COLPRO - Correct quantity shortfalls; priority number 25. **FY2008:** Complete test and validation of Advanced Air Purification System Model. Modify Advanced Air Purification System Model as dictated by test and validation results. Complete final version Advanced Hybrid Air Purification System Model and transition.

Annex D

Decontamination Programs

Table D-1. Decontamination RDA Efforts.

Category	Nomenclature	Status	USA	USAF	USMC	USN
Personnel	- M291 Skin Decontaminating Kit	Production	Rqmt	Rqmt	Rqmt	Rqmt
	- M295 Individual Equipment Decon Kit	Production	Rqmt	Rqmt	Interest	Rqmt
	- M100 Sorbent Decontamination System and Solution Decontaminants	Production	Rqmt	Interest	Rqmt	Interest
	- Joint Service Personnel/Skin Decontamination System (JSPDS)	RDTE	Rqmt	Rqmt	Rqmt	Rqmt
	- CB.44 Oxidative Formulation	DTO				
Combat Equipment, Vehicles, and Aircraft	- M17A2/A3 Lightweight Decontamination System	Production	Rqmt	Rqmt	Rqmt	Rqmt
	- M17 MCHF Lightweight Decontamination System	Production		Int-NIR	Rqmt	Rqmt
	- Joint Service Sensitive Equipment Decon (JSSED)					
	Joint Sensitive Equipment Decon System	RDTE	Rqmt	Rqmt	Rqmt	Rqmt
	Joint Platform Interior Decon System (JPID)	RDTE	Rqmt	Rqmt	Rqmt	Rqmt
	- Joint Service Family of Decontamination Systems (JSFDS)					
	Joint Portable Decon System (JPDS)	RDTE	Rqmt	Rqmt	Rqmt	Rqmt
	Joint Service Transportable Decon System	RDTE	Rqmt	Rqmt	Rqmt	Rqmt
	Joint Service Stationary Decon System	RDTE	Rqmt	Rqmt	Rqmt	Rqmt
	- CB.66 Radiation Decon Program (DARPA)	DTO				

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
Defense Technology Objective (Science & Technology Base Program)
** This ACTD support more than the decontamination functional area, but is placed in only one annex to prevent redundancy.

PERSONNEL

FIELDED AND PRODUCTION ITEMS

M291 Skin Decontamination Kit

The M291 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 war-fighters to remove, neutralize, and destroy chemical and biological warfare agents on contaminated skin. The kit is carried in a pocket of the battlefield protective suits.

M295 Equipment Decontamination Kit

The M295 kit consists of four individual wipedown mitts, each enclosed in a soft, protective packet. The packet assembly is designed to fit comfortably within the pocket of a BDO. Each wipedown mitt in the kit is comprised of a decontaminating sorbent powder contained within a non-woven polyester material and a polyethylene film backing. In use, sorbent powder from the mitt is allowed to flow freely through the non-woven polyester pad material. Decontamination is accomplished through sorption of contamination by both the non-woven polyester pad and by the decontaminating sorbent powder. The M295 enables the warfighter to perform basic decontamination to remove, neutralize, or destroy CB warfare agents and toxins on contaminated personal and load bearing equipment.

M100 Sorbent Decontamination System

The reactive sorbent decontamination system provides a simple, rapid, and efficient system to decontaminate small and individual issue items of equipment. It is effective in all environments, is less corrosive, and presents a lowered logistics burden through improved shelf life and reduced special handling and storage needs. The M100 system uses a catalytic component that reacts with the chemical agents being adsorbed; this eliminates the potential hazard created by the off-gassing of agents from used adsorbents.

PERSONNEL

RDT&E ITEMS

Joint Service Personnel/Skin Decontamination System (JSPDS)

Rationale:

- Joint Service requirement

Key Requirements:

- Provide Food and Drug Administration (FDA) approved decontaminant for use on skin
- Decontaminate better than the M291 Skin Decontaminating Kit

Description:

The JSFDS program is a joint effort. The JSPDS is a member of the JSFDS and will provide the warfighter with the ability to decontaminate skin and limited individual

equipment. JSPDS will use the latest in technology to reduce or eliminate hazards in a safe and effective manner. The system will be approved by the FDA.

DTO CB.44 Oxidative Formulation
Objectives. This DTO will develop a noncorrosive, material-compatible, nontoxic, environmentally friendly oxidative chemical/biological decontaminant to replace current inventory decontaminants DS2 and STB/HTH. Candidate oxidative formulations will meet threshold and objective levels as specified in the Joint Service Family of Decontaminants Operational Requirements Document for potential insertion as planned product improvement.
Payoffs. Products developed in this effort support the Joint Future Operational Capability of Restoration, Equipment/Facilities/Area Decontamination. This capability provides a means of decontaminating CWAs and BWAs that yield desirable reaction products. This approach will allow for formulation of the solution into a liquid or dry concentrate and allows decon to occur in an acceptable pH range. Dual-use concentrates will eliminate the need for multiple decontaminants and will minimize storage and transportation requirements, reducing the overall cost associated with supporting decon operations. The material friendly nature of the oxidative formulations will greatly reduce the damage to materials that is the case with currently fielded decontaminants, thus reducing the requirement for the costly replacement of decontaminated pieces of equipment. During FY02, optimization of a peroxycarbonate-based decontaminant that shows outstanding efficacy on chemical and biological agents, including at high and low temperature has been completed. Demonstration of efficacy of several non-optimized candidate peracid-based formulations on chemical and biological agents has also been completed.
Challenges. Reactivity, pot life, and long-term storage requirements are significant challenges. In addition, compatibility of formulation components may be an issue. In order to reduce the logistical burden, appropriate packaging must be well thought out. Leveraging off of industry expertise will greatly reduce potential risk in these areas and potentially reduce developmental and production costs.
Milestones/Metrics. **FY2005:** Complete safety, health, and environmental testing. Complete robust live agent chamber testing and determine which candidates meet efficacy requirements. Demonstrate limited operational utility of down selected decontaminants and associated applicators using simulant field trials in relevant environments and determine which candidates meet efficacy and operational requirements. Prepare IPR packages.

COMBAT EQUIPMENT, VEHICLES, AND AIRCRAFT

FIELDED AND PRODUCTION ITEMS

M12A1 Power Driven Decontamination Apparatus (PDDA); Skid-Mounted

The M12A1 consists of three main components: a pump unit, a 500 gallon tank unit, and a 600 gallon per hour liquid fuel water heater. The M12A1 is a flexible system that can be used for purposes such as de-icing, fire fighting with water or foam, water pumping and transport, and personnel showering in addition to equipment and area decontamination. The M12A1 can pump 50 gallons of decontaminating solution per minute through both of

its hoses. The integral shower assembly provides 25 shower heads. The M12A1 is typically mounted on a 5 ton truck for tactical mobility, but can be dismounted to facilitate air transport. The USMC has replaced the M12A1 PDDA with the M17 MCHF Lightweight Decontamination Apparatus.

M17 Series Lightweight Decontamination System (LDS)

The M17 series Lightweight Decontamination System (LDS) is a portable, lightweight, compact engine driven pump and water heating system. The system is used during decontamination operations. The LDS is capable of drawing water from any source and delivering it at moderate pressure and controlled temperatures. The system has an accessory kit with hoses, spray wands, and personnel shower hardware. It also includes a collapsible water bladder.

M17 MCHF Lightweight Decontamination System

The M17 Marine Corps Heavy Fuel (MCHF) LDS is a portable, lightweight, compact, engine-driven pump and multifuel-fired water heating system. The system is capable of performing the same hasty and deliberate decontamination procedures as required of the M17 series LDS. All components can be moved by a four-man crew, and can be operated using Military Standard Fuels (diesel fuel, JP-8, *etc*.) It can decontaminate both sides of a vehicle or aircraft simultaneously, and can decontaminate personnel, equipment, and other materiel without an external power source and in coordination with a water tank or natural water resource.

COMBAT EQUIPMENT, VEHICLES, AND AIRCRAFT

RDTE ITEMS

Joint Service Sensitive Equipment Decontamination (JSSED)
Joint Sensitive Equipment Decontamination; Joint Platform Interior Decontamination System

Rationale:

- Joint Service requirement

Key Requirements:

- Non-aqueous based decontamination systems for sensitive equipment and vehicle interiors
- Provide decontamination systems for platform (vehicle/aircraft/ship) interiors
- Capable of being used in both mobile and fixed-sites
- Decontaminated equipment will retain tactical mission capability following decontamination

Description:

Provide a first ever capability to decontaminate chemical and biological warfare agents and toxins from sensitive electronic, avionics, electro-optic equipment, and vehicle interiors. Its use must be compatible with and not degrade sensitive materials or equipment. It must be operator safe and offer protection from off-gassing and direct liquid exposure during decontamination.

Joint Portable Decontamination System (JPDS),
Joint Service Transportable Decontamination System (JSTDS) and Joint Service Stationary Decontamination System (JSSDS)

Rationale:

- Joint Service requirement

Key Requirements:

- Provide restoration capability at fixed site locations
- Provide improved/state-of-the-art CBRN decontamination equipment
- Provide non-hazardous and environmentally safe CBRN decontaminants

Description:

These three programs and the JSPDS are part of the Joint Service Family of Decontamination Systems (JSFDS). The program will provide the warfighter with a family of decontaminants and applicator systems to decontaminate equipment, facility equipment and terrain. The JSFDS will include JPDS and JSTDS and JSSDS systems to provide the range of required combat equipment, vehicle and aircraft decontamination capabilities, excluding sensitive equipment. Decontaminants will be less corrosive and hazardous than existing decontaminants. Application systems will reduce the manpower intensive decontamination processes.

DTO CB.66 Radiation Decontamination Program (DARPA Program)
Objectives. The Radiation Decontamination (RD) program is developing a system of technologies that will allow for the detection, decontamination, and controlled clean-up of radioactively contaminated buildings and military bases located downwind from a radiological dispersal device (RDD) event. The main threat of an RDD event is not that the levels of radiation will be immediately toxic but that a large area will be contaminated and untenable due to the risk of long-term radiation effects. The threshold of contamination that is considered safe corresponds to an absorbed radiation of 1 milliSievert/year at a distance 1 meter from the building surface. To accomplish this goal, this DTO requires technologies to detect radioactive material dispersed on building surfaces, as well as new decontamination technologies for cleanup.
Payoffs. Create remediation technologies that will enable fast, low-cost, and efficient decontamination of buildings on military bases following an RDD event.
Challenges. The objectives of this DTO will be achieved through the successful completion of three phases. Phase I involves the development of Wide-Area Radionuclide Detection (WARD) technologies to rapidly identify buildings contaminated with radioactive material and Radionuclide Capture Decontamination (RCD) technologies to rapidly remove radioactive contamination from building surfaces. The capabilities of these technologies will be tested on prepared, standardized coupons of various representative building materials. In Phase II, bench tests with scaled up RCD and WARD

DTO CB.66 Radiation Decontamination Program (DARPA Program)
materials will be performed and small batch equivalent performance will be demonstrated. Lastly, Phase III will be a full-scale demonstration of selected technologies at a DOE site. **Milestones/Metrics.** **FY2005:** Demonstrate decontamination of Cs-137 and Co-60 from concrete, granite, and marble so that the remaining radiation levels are not higher than 1 mSv/year above background. Demonstrate detection of 1 mSv/year of Cs-137 and Co-60 on concrete, granite, and marble above background. **FY2006:** Perform bench tests with scaled up RCD materials and demonstrate small batch equivalent performance. Perform bench tests with scaled up WARD materials and demonstrate small batch equivalent performance. **FY2007:** Demonstration at a DOE site**.**

Annex E

Joint Medical Chemical, Biological, Radiological and Nuclear Defense Research, Development and Acquisition Programs

Joint medical chemical, biological, radiological and nuclear (CBRN) defense research, development and acquisition (RDA) programs are addressed in three sections of this annex:

- Section E.1 medical chemical defense,
- Section E.2 medical biological defense,
- Section E.3 medical radiological defense.

The organization of this annex is intended to correspond to the organization of budget documents, as this report is intended to supplement the President's Budget Submission in accordance with 50 USC 1523. The organization of this information does not correspond directly to the management structure of organizations within the Chemical and Biological Defense Program (CBDP). Notably, the Joint Science and Technology Office for Chemical and Biological Defense (JSTO-CBD) address medical research in four capability areas: pre-treatments, therapeutics, diagnostics, and emerging threats. Within sections E.1 and E.2, chemical and biological countermeasures are addressed within these four capability areas. Advanced development and acquisition efforts managed by the Joint Program Executive Office for Chemical and Biological Defense (JPEO-CBD), Joint Program Manager for Chemical and Biological Medical System (JPM-CBMS) are also described in these sections.

The primary repository of medical radiological defense expertise is the Armed Forces Radiobiology Research Institute (AFRRI). These efforts are described in Section E.3. While these efforts may support the requirements of the warfighter as developed by the JRO-CBRND, AFRRI programs are funded separately from the DoD CBDP.

Table E-1. Medical Chemical, Biological, Radiological Defense RDA Efforts.

Category	Nomenclature	Status	USA	USAF	USMC	USN
Medical Chemical Defense	- Antidote Treatment – Nerve Agent Autoinjector	Fielded	Joint	Joint	Joint	Joint
	- Convulsant Antidote for Nerve Agents	Fielded	Joint	Joint	Joint	Joint
	- Advanced Anticonvulsant System	RDTE	Joint	Joint	Joint	Joint
	- Medical Aerosolized Nerve Agent Antidote	Fielded	Joint	Joint	Joint	Joint
	- Soman Nerve Agent Pretreatment Pyridostigmine	Fielded	Joint	Joint	Joint	Joint
	- Skin Exposure Reduction Paste Against Chemical Warfare Agents (SERPACWA)	Fielded	Rqmt			
	- Chemical Agent Prophylaxes (Bioscavenger)	RDTE	Joint*	Joint*	Joint*	Joint*
	- Improved Nerve Agent Treatment System (INATS)	RDTE	Joint*	Joint*	Joint*	Joint*
	- CB.48 Improved Oxime	DTO				
	- CB.57 Non-Traditional Nerve Agent Medical Countermeasures	DTO				
Medical Biological Defense	- Anthrax Vaccine Adsorbed (BioThrax™)	Fielded	Joint	Joint	Joint	Joint
	- Smallpox vaccine (Dryvax vaccine (1:1)	Fielded				
	- Clostridium Botulinum Toxins Medical Defense System	RDTE	Joint*	Joint*	Joint*	Joint*
	- Improved Plague Vaccine	RDTE	Joint*	Joint*	Joint*	Joint*
	- Ricin Vaccine	RDTE	Joint	Joint	Joint	Joint
	- Tularemia Live Vaccine	RDTE	Joint	Joint	Joint	Joint
	- Venezuelan Equine Encephalitis Vaccine	RDTE	Joint*	Joint*	Joint*	Joint*
	- Joint Biological Agent Identification and Diagnostic System	RDTE	Joint	Joint	Joint	Joint
	- CB.32 Alternative Delivery Methods for Recombinant Protein Vaccines	DTO				
	- CB.46 Recombinant Ricin Vaccine	DTO				
	- CB.47 Improved Immunodiagnostic Platform	DTO				
	- CB.54 Therapy for Smallpox and other Pathogenic Orthopoxviruses	DTO				
	- CB.27 Therapeutics Based on Common Mechanisms of Pathogenesis (DARPA Program)	DTO				
	- CB.56 Methodology to Facilitate Development of Biological Warfare Threat Agent Detection and Medical Diagnostic Systems	DTO				
	- CB.58 Western and Eastern Equine Encephalitis (WEE/ EEE) Vaccine Constructs for a Combined Equine Encephalitis Vaccine	DTO				
	- CB.59 Therapeutic Strategies for Botulinum Neurotoxin	DTO				
	- CB.60 Vaccine Technologies for Protection Against Filovirus (Marburg and Ebola viruses) Exposure	DTO				
	- CB.63 Therapeutic Strategies for Treating Filovirus (Marburg and Ebola Viruses) Infection	DTO				
	- CB.64 Rapid Detection, Threat Assessment and Attribution of Genetically Engineered Biothreat Organisms Using Microarray-Based Resequencing Technologies	DTO				
	-CB.65 Multi-agent (molecular) vaccines for bio-warfare and genetically engineered agents	DTO				
Medical Radio-logical Defense	- Radioprotective Drug Development	RDTE				
	- Therapeutic Strategies for Radiation Injury	RDTE				
	- Automation of the Definitive Cytogenetic Assay for Radiation Dose Assessment	RDTE				
	- Molecular Biomarkers for Radiation Dose Assessment	RDTE				
	- MD.20 Cytogenetic-Based Diagnostic Biodosimetry System	DTO				
	- MD.29 Medical Countermeasures Against Bacterial Sepsis After Irradiation	DTO				
	- MD.37 Prevention of Ionizing Radiation Injury by Isoflavones	DTO				

Joint= Joint Service requirement
Rqmt= Requirement
Joint*=Draft Joint Service requirement
DTO = Defense Technology Objective (a Science and Technology Base Program)

E.1 MEDICAL CHEMICAL DEFENSE RESEARCH

E.1.1 Fielded Products

Advances in medical research and development (R&D) significantly improve the war-fighting mission by sustaining unit effectiveness through conserving the fighting strength of our forces and supporting the nation's global military strategy, which requires the ability to effectively deploy and operate. Medical R&D products (materiel and non-materiel solutions) provide the foundation that ensures the fielding of a flexible, sustainable, modernized force across the spectrum of conflict and in the full breadth and depth of the battlefield. Overcoming medical threats and extending human performance have provided a significant increase in military effectiveness in the past and present the potential for future enhancement of military operational effectiveness. Following are fielded medical chemical defense items, including pharmaceuticals, materiel, and technical information and guidance (with initial fielding date shown.)

Pharmaceuticals:

- Nerve Agent Antidote Kit (Mark I), 1983
- Skin Decontamination Kit (M291), 1990
- Convulsant Antidote for Nerve Agent (CANA), 1991
- Medical Aerosolized Nerve Agent Antidote (MANAA), 1994
- Soman Nerve Agent Pretreatment Pyridostigmine, 2003
- Antidote Treatment Nerve Agent Autoinjector (ATNAA), 2003
- Skin Exposure Reduction Paste Against Chemical Warfare Agents (SERPACWA), 2003

Materiel:

- Test Mate® ChE (Cholinesterase) Kit, 1997.
- Resuscitation Device, Individual, Chemical, 1990.
- Decontaminable Patient Litter (NSN 6530-01-380-7309), 1991.
- Chemical Warfare (CW) Protective Patient Wrap (NSN 6530-01-383-6260), 1991.
- Computer-Based Performance Assessment Battery, 1993.

Technical Information and Guidance:

- Medical Planning Guide of NBC Battle Casualties Chemical, AMedP-8(A), Vol. III, Ratification Draft.
- Field Manual (FM) 8-285, *Treatment of Chemical Agent Casualties and Conventional Military Chemical Injuries*, 1995.
- *Field Management of Chemical Casualties Handbook*, Second Edition, July 2000
- Technical Bulletin (TB) Medical (MED) 296, 1996: *Assay Techniques for Detection of Exposure to Sulfur Mustard, Cholinesterase Inhibitors, Sarin, Soman, GF, and Cyanide*.
- Compact Disk - Read-Only Memory (CD-ROM) on "Management of Chemical Warfare Injuries," 1996.
- *Medical Management of Chemical Casualties Handbook*, Third Edition, July 2000.

E.1.2 Medical Chemical Defense R&D Accomplishments

The medical chemical defense R&D technical barriers and accomplishments during FY04 are grouped by the major medical chemical defense strategy areas, which are:

- *Nerve Agent Defense.*
- *Vesicant Agent Defense.*
- *Chemical Warfare Agent Defense.*

Today's chemical threat is not restricted to commonly accepted classical agents, such as vesicants [sulfur mustard (HD)], nerve agents (soman, sarin, tabun, and VX), respiratory agents (phosgene), or blood agents (cyanide). Potential adversaries may develop novel threat agents. Additionally, the potential for transient or sustained systemic toxicity from low dose exposure(s) to chemical warfare agents must be thoroughly investigated to determine the potential effect on Service members. The ability to provide timely and effective medical countermeasures to new threats depends upon maintaining a high level of technological capability. Sustaining and enhancing this technological capability is dependent upon the continued support of a robust program investigating basic pathophysiological mechanisms which, in turn, contributes to the knowledge and database upon which new, innovative, and improved diagnostics, pretreatments, and therapies are based.

Countermeasure strategies to the classical and novel threats include pharmaceuticals, medical equipment, specialized materiel or medical procedures, and concepts for training, doctrine, and organization. Medical countermeasures are designed not only to prevent lethality but also to preserve and sustain combat effectiveness in the face of combined threats from chemical and conventional munitions on the integrated battlefield by:

- Rapid diagnosis of chemical agent exposure.
- Prevention of the effects of chemical agents (*e.g.*, prophylaxes or pretreatment).
- Far-forward treatment upon exposure to chemical warfare threats (*e.g.*, antidotes).
- Chemical casualty care (*e.g.*, therapy and management).

Medical chemical defense research was managed by the JSTO-CBD in FY04. Following are FY04 technical accomplishments by the DoD laboratories conducting research in the CBDP S&T medical program in FY04. Medical Research and Materiel Command (USAMRMC) laboratories consist of the U.S. Army Medical Research Institute for Infectious Diseases (USAMRIID), U.S. Army Medical Research Institute of Chemical Defense (USAMRICD), and the Walter Reed Institute of Research (WRAIR). These laboratories were the principle science and technology base performer for the JSTO-CBD). Contributing Navy laboratories were the Naval Research Laboratory (NRL) and the Naval Medical Research Center (NMRC)and the contributing laboratories from Navy, Air Force laboratories were the Force Research Laboratory (AFRL) and the USAF School of Aerospace Medicine 311th Human Systems Wing (USAFSAM/311 HSW). The Armed Forces Institute of Pathology (AFIP), a joint DoD research institute, also conducts research for the medical S&T program. The research is organized by threat area with subsequent arrangement of specific research thrusts into the JSTO-CBD capability areas.

Research Category: Nerve Agent Defense

Overarching Research Objective: Explore the development of medical countermeasures (i.e., prophylaxes/pretreatments and treatments) against chemical warfare nerve agents. Research studies range from basic and applied research in nerve agent countermeasures and associated scientific disciplines to research nearing the point of maturity for elevation to Defense Technology Objective (DTO) status. DTO research efforts are designed so that data generated from these efforts meet requirements for transition out of the technology base and are consistent with technical information required by the advanced developer to support the preparation of an Investigational New Drug (IND) application.

The countermeasures, technical barriers, and accomplishments in the medical chemical defense research category of nerve agent defense are outlined below.

Countermeasures:

- Pretreatment and treatment regimens that protect against rapid action and incapacitating effect of nerve agents and non-traditional agents.
- Pharmaceutical and biological pretreatments, treatments, and antidotes.

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 models of all threat agents to understand the mechanism of their unique chemical properties and their effects.
- Potential performance decrement with pretreatments and treatments.

Accomplishments:

The detailed accomplishments that follow are drawn from the basic research, applied research, and advanced technology development investments in research on nerve agent defense. They are organized under JSTO capability areas and major research thrust areas that comprised this portion of the medical chemical defense research portfolio in fiscal year 2004.

Pre-treatment Capability Area

Research thrust: ***nerve agent bioscavenger (chemical warfare agent prophylactic):***

- Determined the pharmacokinetics of chemical warfare agents and the impact of pretreatment in guinea pigs and tested a physiologic pharmacokinetic model of chemical warfare agents.
- Determined the x-ray crystallographic structures of catalytic scavengers.
- Continued pretreatment intervention studies with vectors as a means of delivering bioscavenger genes.
- Characterized animal models to test the efficacy of nerve agent bioscavengers.
- Initiated an evaluation of human protein recombinant scavenger.
- Utilized transgenic animal model to produce adequate amounts of recombinant enzyme scavenger for preclinical studies.

Therapeutics Capability Area

Research thrust: ***development of an advanced anticonvulsant***

- Determined the efficacy of midazolam anticonvulsant and anticholinergic drug combinations against seizures and lethality produced by current nerve agent threat in the guinea pig model.
- Determined the minimal amount of atropine needed to sustain survival in non-human primates exposed to nerve agent.

Research thrust: ***development of a neuroprotectant to protect from exposure to nerve agents***

- Evaluated drug treatment strategies and combinations of therapies for nerve agent-induced seizures.
- Tested Food and Drug Administration (FDA)-approved drugs shown to be neuroprotective in both anatomic and behavioral studies.
- Assessed potential neuroprotectant treatments for nerve agent-induced brain pathology in the guinea pig model.

Emerging Threats Capability Area

Research thrust: ***medical countermeasures for non-traditional agents*:**

- Investigated changes to pulmonary airway resistance and permeability of pulmonary microvessels induced by exposure to various concentrations.
- Identified changes in the global gene expression profile of cultured human epidermal keratinocytes (HEK) in response to non-traditional agent exposure using DNA micro-arrays and genomics techniques to aid in considering strategies leading to medical countermeasures.
- Continued assay development, stability studies, and studies to identify and characterize a surrogate marker for efficacy of candidate oxime(s) for use against traditional and non-traditional nerve agents.
- Determined the effects of non-traditional agents on energy metabolism of cardiac cells and the effectiveness of decontamination on percutaneous non-traditional agents.
- Conducted electrophysiological evaluation of cardiovascular, respiratory, muscular and cortical dysfunction.
- Initiated efficacy and pharmacokinetic (PK) studies of candidate oxime(s) for use against traditional and non-traditional agents in non-human primates and safety/toxicity studies in two animal species.
- Continued the down selection process to identify the best improved oxime candidate for further developmental research.
- Evaluated the efficacy of candidate bioscavengers for protection against non-traditional nerve agents in multiple animal models.

The following DTOs are key efforts in addressing the issues of medical counter-measures for exposure to non-traditional agents.

DTO CB. 48 Improved Oxime
Objectives. The objective is to identify and characterize a candidate broad-spectrum oxime(s) to replace the current oxime in nerve agent therapy. **Payoffs.** Pralidoxime chloride (2-PAM) is an oxime that is currently issued to military personnel in an autoinjector form for emergency treatment of nerve agent intoxication. 2-PAM provides adequate protection against the conventional nerve agents GB and VX but is less effective against other conventional agents (i.e., GA, GD, GF), and emerging threats. The result of this research program will be an improved, broad-spectrum oxime(s) that is significantly more effective than 2-PAM against conventional agents and emerging threats. This medical countermeasure will enhance warfighter survival and sustainability in nerve agent contaminated environments. **Challenges.** Challenges include identifying and characterizing a surrogate marker of the improved oxime efficacy; establishing and clearly articulating the risks and benefits to justify replacing 2-PAM; and developing and qualifying a non-human primate (NHP) model to replace the rhesus monkey. **Milestones/Metrics.** **FY2005:** Continue efficacy studies in NHPs. Complete assay development, safety/toxicity, PK, and stability studies. Complete characterization of a surrogate marker for efficacy and the down selection process. Prepare Investigational New Drug application and for selection of the best candidate, broad-spectrum candidate oxime(s) out of the technology base.

DTO CB. 57 Non-Traditional Nerve Agent Medical Countermeasures
Objectives. This DTO will enable the development of medical countermeasures against non-traditional nerve agent (NTA) intoxication by identifying and characterizing compounds or medical strategies using laboratory and animal models that demonstrate the ability to prevent, interrupt, or terminate the action of NTAs. **Payoffs.** The number and type of chemical warfare agents (CWAs), beyond the conventional CWAs, has significantly increased. NTAs have the potential of being used as chemical weapons against U.S. military forces and it is critically important to determine the toxicity of these agents and the effectiveness of current medical countermeasures against their acute toxicity. The research efforts will be conducted to identify the mechanism of action of the NTAs and any differences in the absorption, distribution, and metabolism of these agents, to evaluate current medical countermeasures for their efficacy against NTAs, to identify new candidate medical countermeasures that are effective against NTAs, to develop animal models that facilitate research for countermeasures to NTAs, and to characterize candidate countermeasures. The major outcome of this research will be to increase the knowledge base on NTAs and provide the scientific basis for identifying medical products that have the potential for effectively countering NTA exposure, thereby enabling their future development and eventual licensure by the Food and Drug Administration (FDA). Effective countermeasures for NTA exposure would substantially reduce the number of casualties or degree of injury among exposed joint service members, deter their use as chemical warfare agents and enable joint forces to sustain operational tempo. **Challenges.** Major technical challenges include: determine the mechanism of action, determine the *in vivo* time-course of NTAs to ensure the duration of action of medical countermeasures exceeds the *in vivo* persistence of NTAs, develop a therapy that works effectively for all non-traditional nerve agents and conventional nerve agents, and develop non-human primate models to extrapolate efficacy test results from animals to man. **Milestones/Metrics.**

DTO CB. 57 Non-Traditional Nerve Agent Medical Countermeasures
FY2005: Evaluate the effectiveness of anticonvulsants against seizures produced by NTAs, *in vivo* persistence of NTAs, and current medical countermeasures against NTAs. Conduct evaluation of respiratory dynamics and lung biochemistry. **FY2006:** Complete evaluation of efficacy of human serum butyrylcholinesterase as a bioscavenger for protection against known NTAs in non-human primates. Compare NTAs and conventional nerve agents for induction of neurochemical changes and conduct studies of NTAs on vascular performance and contractility. Evaluate the pharmacokinetics of improved candidate medical countermeasures for comparison to the *in vivo* persistence of NTAs. Information generated by this research will be used to (1) develop a strategy, in concert with the advanced developer, for development of NTA medical Countermeasures; (2) influence current medical doctrine for countering NTA exposure and (3) to produce a technology development plan for future nonclinical development and FDA licensure of lead candidate.

Research Category: Vesicant Agent Defense

Overarching Research Objective: Explore the development of medical countermeasures (i.e., pretreatments and treatments) against chemical warfare vesicant (blister) agents. Research studies range from basic and applied research in vesicant agent countermeasures and associated scientific disciplines to research nearing the point of maturity for elevation to DTO status. DTO research efforts are designed so that data generated from these efforts meet requirements for transition out of the technology base and are consistent with technical information required by the advanced developer to support the preparation of an IND application.

The countermeasures, technical barriers, and accomplishments in the research category of vesicant agent defense are outlined below.

Countermeasures:

- Products that moderate or improve healing of vesicant injury.
- Medical countermeasures to minimize lethality, morbidity, and incapacitation caused by chemical warfare agents (CWAs).
- Specific casualty management techniques to improve survival and minimize lost duty time.
- Pharmaceutical/biological pretreatments, treatments and antidotes.

Technical Barriers:

- Need for quick-acting and long-lasting pretreatments, treatments and antidotes that are deployable.
- Lack of appropriate experimental model systems for pretreatment and treatment efficacy and safety in humans.
- Need for detailed molecular models of vesicant agents to understand the origin of their unique chemical properties.

Accomplishments:

The detailed accomplishments that follow are drawn from the basic research, applied research, and advanced technology development investments in research on vesicant agent

defense. They are organized under JSTO capability areas and major research thrust areas that comprised this portion of the medical chemical defense research portfolio in fiscal year 2004.

Research thrust: *medical countermeasures for vesicant exposure*

- Identified mechanism of action of vesicant pretreatment compounds.
- Determined the effects of sulfur mustard (HD) on cell structure using multiphoton laser scanning microscopy.
- Analyzed *in vitro* effects of HD on cellular energy metabolism and studied *in vitro* biochemical changes induced by HD.
- Conducted screening of candidate antivesicant compounds and developed *in vitro* and *in vivo* models to support efficacy studies of new antivesicant countermeasures.
- Pursued development of protective agent against HD-induced skin lesions.
- Enhanced the effectiveness of Signal Transduction Methodology Antioxidant Liposomes (STIMAL), also known as Redox Regulating Liposome (RRL), by further product development. Elucidated the pathophysiology of mustard agents in previously developed *in vitro* and *in vivo* models. Explored additional modalitites such as pharmacogenomically-based drugs and complement blockade. Completed initial efficacy studies of STIMAL against HD. Conducted detailed studies on the inhalation of mustards (bis-2-CEES) to determine if oxidative stress is a significant part of the pathophysiology

Research thrust: *cutaneous therapeutics*

- Identified candidate treatment strategies and collated findings in concert with medical experts and relevant research teams. Defined *in vitro*/*in vivo* models and established pathophysiological endpoints and defined cellular and tissue consequences of exposure.
- Began efficacy testing using promising treatment strategies.

Research Category: Chemical Warfare Agent (CWA) Defense

Overarching Research Objective: Explore the development of medical countermeasures (i.e., pretreatments and treatments) against CWAs, to include investigating the potential for transient or sustained toxicity of single, repeated, or sustained low dose exposure(s). Develop effective, field-deployable diagnostic equipment; decontamination products; pharmaceutical treatments; and practical clinical strategies to aid in the clinical management of chemical warfare agent casualties. Research studies range from basic and applied research in CWA countermeasures and associated scientific disciplines to research nearing the point of maturity for elevation to DTO status. DTO research efforts are designed so that data generated from these efforts meet requirements for transition out of the technology base and are consistent with technical information required by the advanced developer to support the preparation of an IND and/or Investigational Device Exemption (IDE) application.

The countermeasures, technical barriers, and accomplishments in the medical chemical defense research category of CWA defense are outlined below.

Countermeasures:

- Pretreatment regimen that protects against cyanide exposure.
- Medical countermeasures to minimize lethality, morbidity, and incapacitation caused

CWAs.
- Specific casualty management techniques to improve survival and minimize lost duty time.
- Pharmaceutical/biological antidotes, or decontaminants/protectants.
- Diagnostics for the effects of exposure to rapidly acting nerve agents, vesicants, cyanide, and non-traditional agents.

Technical Barriers:
- Need for quick-acting and long-lasting pretreatments, treatments and antidotes that are deployable.
- Lack of appropriate experimental model systems for treatment efficacy and safety in humans.
- Need for detailed molecular models of agents to understand the origin of their unique chemical properties.
- Lack of simple and sensitive field-portable diagnostic assays for CWA exposure.

Accomplishments:

The detailed accomplishments that follow are drawn from the basic research, applied research, and advanced technology development investments in research on CWA defense. They are organized under JSTO capability areas and major research thrust areas that comprised this portion of the medical chemical defense research portfolio in fiscal year 2004.

Pre-treatment Capability Area

Research thrust: ***cyanide medical countermeasures***
- Evaluated cyanide toxicity using an inhalation model.
- Investigated the efficacy of sulfur donors and methemoglobin formers as potential cyanide pretreatments.

Therapeutics Capability Area

Research thrust: ***effective methods for removing chemical warfare agents from exposed skin***
- Pursued the development of screening procedures for the evaluation of decontaminants using analytical techniques and animal models.
- Determined the extent HD forms a reservoir in skin using pig and hairless guinea pig skin models.
- Continued the development of skin and wound decontaminants for organophosphate chemical warfare agents.
- Continued to expand decontamination and detoxification efforts by developing HD decontaminants.

Research thrust: ***inhalation therapeutics***
- Investigated enzymatic targets of HD.
- Conducted a dose-response assessment of early acute lung injury in rodents by administering intravascular HD.
- Determined biochemical effects in male and female guinea pigs following exposure to chemical warfare agents.

- Screened clinically available drugs for potential efficacy against HD using the mouse model.

Diagnostics Capability Area

Research thrust: ***develop chemical diagnostic technologies***

- Initiated development of diagnostic applications for miniaturized mass spectrometer.
- Developed diagnostics that can be used to diagnose exposure via the respiratory route.
- Refined analytical methods to measure scopolamine levels in blood and tissue.
- Investigated the applicability of an ocular device for self-examination of the papillary response to chemical warfare agent exposure.
- Developed and tested a non-invasive prototype instrument that measures blood gases via finger, ear, or toe.
- Identified molecular intracellular proteomic changes following HD exposure.

E.1.3 Advanced Development Products

In advanced development, the goal is to obtain FDA approval/licensure of drugs, vaccines, and devices. The JPEO-CBD, through the Joint Project Office for Chemical and Biological Medical Systems (JPM-CBMS) are the materiel developers. Medical chemical defense products now in the advanced development phase are the following:

Product: Advanced Anticonvulsant System (AAS)

After development and FDA approval, the AAS is intended to provide an intramuscular administration of the drug, midazolam, for treatment against nerve agent induced seizures and subsequent neurologic damage. Exposure to nerve agents may produce long lasting convulsions even after treatment with atropine and 2-PAM. Untreated, these convulsions will produce permanent neurologic damage in survivors. The AAS will be a replacement for the currently fielded Convulsant Antidote Nerve Agent (CANA) that uses diazepam. Midazolam is more water-soluble than diazepam (for quicker absorption into the blood stream) and, in animal models, terminates nerve agent-induced seizures more quickly than diazepam. AAS will not eliminate the need for other protective and therapeutic systems. During FY04, pre-clinical investigations continued, and preparations for an IND application were initiated.

Product: Chemical Agent Prophylaxes (Bioscavenger)

Currently, there is no prophylaxis against nerve agent poisoning. Soman Nerve Agent Pretreatment Pyridostigmine (SNAPP) is the current FDA approved pretreatment for soman poisoning. SNAPP must be administered every eight hours as a pretreatment and requires administration of atropine sulfate and 2-pralidoxime after exposure to be effective. The Bioscavenger system is a prophylactic regimen that will protect the warfighter from incapacitation and death caused by organophosphorus nerve agents (e.g., soman, sarin, VX). The plasma-derived and recombinant forms of butyrylcholinesterase (BChE), a serum protein that can bind organophosphorus nerve agents, and the current candidates, for increments I and II respectively, for Bioscavenger. Increment I will be developed through a Phase 1 clinical study and then transitioned to the Department of Health and Human Services; increment II will

be developed through FDA approval. In FY04, a Milestone A decision was approved. The following criteria were established for the current phase of research: (1) demonstrate a viable, reproducible and scalable manufacturing process, and (2) demonstrate animal safety (toxicology) and Phase 1 human safety trials.

Product: Improved Nerve Agent Treatment System (INATS)

INATS is an enhanced treatment regimen against the devastating effects of nerve agent poisoning. Components of INATS are a new oxime to replace the currently fielded oxime (2-pralidoxime chloride or 2-PAM) and use of pyridostigmine bromide (PB), the component of SNAPP, against additional nerve agents. Nerve agents inhibit the enzyme, acetylcholinesterase (AchE), disrupting the routine transmission of messages. PB protects some of the AChE against nerve agent-induced inhibition. Oximes are compounds that react with nerve agent-inhibited AChE to restore normal enzymatic activity. The goal of INATS is to develop a treatment system that offers optimal protection against a broad spectrum of nerve agents. INATS will be licensed by the FDA and will be issued to service members performing military operations where there is risk of nerve agent attack. The new oxime component of INATS will be a replacement of the currently fielded oxime (2-PAM) in the ATNAA. It will not eliminate the need for other protective and therapeutic systems though. In FY04, accomplishments included the initiation of process development and current Good Manufacturing Practices (cGMP) requirements, and initiation of pre-clinical, acute toxicology and stability studies

E.2 MEDICAL BIOLOGICAL DEFENSE RESEARCH

E.2.1 Biological Defense Products

Advances in DoD medical R&D significantly impact the warfighting mission by sustaining unit effectiveness through conserving the fighting strength of our forces and supporting the nation's global military strategy, which requires the ability to effectively deploy and operate in all environments. Medical R&D products (materiel and non-materiel solutions) provide the foundation that ensures the fielding of a flexible, sustainable, modernized force across the spectrum of conflict and in the full breadth and depth of the battlefield. Overcoming medical threats and extending human performance have provided a significant increase in military effectiveness in the past and present the potential for future enhancement of military operational effectiveness. Only two biological defense vaccines are fully licensed by the Food and Drug Administration (FDA) and available for use—Anthrax Vaccine Adsorbed, sold under the trade name BioThrax™ and the smallpox vaccine (Dryvax ™). A Prime Systems Contract, which supports the Joint Vaccine Acquisition Program (JVAP) component of the Chemical and Biological Medical Systems office, is responsible for moving vaccine candidates from the technology base through advanced development to FDA licensure and procurement of baseline stockpiles. Section E.2.2 provides a description of biological defense science and technology base activities, and Section E.2.3. provides a description of medical biological defense advanced development activities. Currently licensed and IND vaccines/biologicals for use in medical biological defense R&D include the following:

Vaccines and Antisera:

- Anthrax Vaccine Adsorbed (licensed) (Sold under the commercial name BioThrax™)
- Smallpox Vaccine (limited stockpile of licensed vaccine, Dryvax ™)
- Botulinum Pentavalent Toxoid Vaccine Adsorbed (IND #3723)
- Botulinum Type F Toxoid Vaccine (IND #5077)
- Equine Heptavalent F(ab')2 Botulinum Antitoxin (Types A, B, C, D, E, F, and G) (IND #3703)
- Botulism Immune Globulin, Human (IND #1332)
- Botulism Antitoxin Heptavalent Equine, Types A, B, C, D, E, F, and G (IND #7451)
- Q Fever Vaccine, Formalin inactivated, CM Extract, Gamma Irradiated (Henzerling Strain) (IND #3516)
- NDC (National Drug Company) (Salk) LVS Tularemia Vaccine (IND #157)
- The Salk Institute (TSI) Smallpox Vaccine (Vaccinia Virus, Cell Culture-derived) (IND #4984)
- Venezuelan Equine Encephalitis Virus Vaccine (attenuated), TC-83 (IND #142)
- Venezuelan Equine Encephalitis Virus Vaccine (inactivated), C-84 (IND #914)
- Eastern Equine Encephalitis Virus Vaccine (IND #266)
- Western Equine Encephalitis Virus Vaccine (IND #2013)
- Vaccinia Immune Globulin, Intramuscular (IND #8429)
- Vaccinia Immune Globulin, Intravenous (IND #9141)
- Vaccinia Immune Globulin, Intravenous (IND#10351,emergency use protocol)

Technical Information and Guidance:

- *Medical Management of Biological Casualties Handbook*, fourth edition, February 2001.
- CD-ROM on "Management of Biological Warfare Casualties," 1999.
- NATO Handbook "Medical Aspects of NBC Defensive Operations, AMedP-6(B), Part II (Biological)," 1998.

E.2.2 Biological Defense Research and Development Accomplishments

The biological defense research and development technical barriers and accomplishments during FY04 are grouped by the following overarching medical defense thrust areas against biological warfare agents:

- Bacterial agent countermeasures
  - Bacterial vaccines
  - Bacterial therapeutics
- Viral agent countermeasures
  - Viral vaccines
  - Viral therapeutics
- Toxin Agent countermeasures
  - Toxin vaccines
  - Toxin therapeutics
- Diagnostic technologies

The Emerging Threats capability area cuts across Pretreatment, Therapeutic, and Diagnostic Capability area lines, and focuses on emerging, novel, or bioengineered threats, both chemical and biological.

Medical biological defense research was managed by the JSTO-CBD in FY04. Following are FY04 technical accomplishments by the United States Army Medical Research and Materiel Command (USAMRMC) laboratories (USAMRIID, USAMRICD, WRAIR), and the contributing laboratories from the Navy (NRL, NMRC), Air Force (AFRL, USAFSAM/311 HSW) and Joint Service Institutions (AFIP). The research is organized by threat area with subsequent arrangement of specific research thrusts into JSTOCBD capability areas.

<u>Bacterial Agent Countermeasures</u>

The countermeasures, technical barriers, and accomplishments in the Bacterial Agent Countermeasures area are outlined below.

Countermeasures:

- Vaccines that confer immunity against bacterial threat agents.
- Therapeutics for treatment of diseases and pathologies caused by exposure to and infection from bacterial threat agents.

Technical Barriers:

- Developing accurate and complete genetic information for all known bacterial threat agents.
- Developing 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 medical products.
- Difficulty in field testing rapid identification/diagnostic kits under natural conditions.
- Difficulty in defining appropriate surrogate markers of protection.
- Necessity to enhance the otherwise limited data on which to base rational drug design and antibody therapies for bacterial agents of interest.
- Necessity to establish and maintain capabilities to assess the known bacterial threats and provide a sufficiently robust technology base to perform research needed to develop countermeasures for new, emerging, and genetically engineered bacterial threats.

Pre-treatments Capability Area

Bacterial Vaccines

Overarching Research Objective: Explore the development of candidate vaccines against bacterial biological warfare threat agents. The principal bacterial threat agents addressed in this research area during FY04 are Burkholderia mallei (glanders), B. pseudomallei (melioidosis), Yersinia pestis (plague), Brucella spp., and Bacillus anthracis (anthrax). Research studies range from basic and applied research in bacterial vaccines and associated scientific disciplines to research nearing the point of maturity for elevation to Defense Technology Objective (DTO) status. DTO research efforts are designed so that data generated from these efforts meet requirements for transition out of the technology base and are consistent with technical information required by the advanced developer to support the preparation of an Investigational New Drug (IND) application.

Basic and Applied Research Accomplishments:

- Continued studies on the molecular mechanisms of pathogenesis of BW threat agents.
- Investigated the development of plant-based subunit vaccines as countermeasures against BW threat agents.
- Developed plant-based subunit vaccines against anthrax and smallpox as counter-measures against BW threat agents. Expressed both proposed vaccines in edible plants using a constitutive expression system based on transgenic recombinant Protective Antigen (rPA) and the B5R protein of the smallpox virus, using a transient expression system based on plant virus vectors. Evaluated immunogenicity of plant-based vaccines in animal models.
- Completed the evaluation of potential subunit and live-attenuated glanders vaccine candidates in small animal models and prepared a technical data package summarizing the glanders research program.
- Initiated a study to identify and characterize novel virulence proteins of *F. tularensis*.
- Identified additional virulence determinants of *Brucella* species.
- Performed preliminary studies toward development of an acellular *Brucella* vaccine candidate.
- Continued to perform animal studies which support transition of potential *Brucella* vaccine candidates to advanced development.
- Performed studies to address the mechanism of protective cellular immunity induced by selected vaccine candidates.

- Continued studies supporting recombinant Protective Antigen (rPA) and recombinant plague F1-V vaccine candidates clinical trials, preclinical development, and progress toward Food and Drug Administration (FDA) licensure.
- Continued to perform *in vitro* and *in vivo* studies to support advanced development of rPA vaccine candidate.
- Completed developmental work on the mouse potency assay in support of rPA vaccine candidate that transitioned to advanced development.
- Developed an oral combination vaccine against anthrax and plague using proprietary technology for attenuated live bacterial vaccines.
- Supported preclinical animal testing of vaccine constructs developed for the oral combination vaccine against anthrax and plague.
- Developed the Helinz-treated vaccine platform, with application in both cancer and infectious disease, including those agents that pose threats to bioterrorism.
- Continued to generate recombinant anthrax antigens, native protective antigen, lethal factor, and capsular antigens and continued to develop conjugated vaccine formulations in a research effort directed toward exploiting nanotechnology and bioadhesion. Continued to construct covalent conjugates and nanoparticles displaying various combinations of anthrax antigens and determine immunogenicity in animals. Continued to conjugate various combinations of anthrax toxins and capsular materials and determine the optimal conjugate for generation protective immune responses.

Therapeutics Capability Area

Bacterial Therapeutics:

Overarching Research Objective: Identify and characterize candidate antibiotics and biologics, using laboratory and appropriate animal models. Demonstrate their capability for reducing mortality or incapacitation in animal models exposed to predicted or presumed battlefield doses of aerosolized bacterial biological warfare agents, to include *Bacillus anthracis* (anthrax), *Yersinia pestis* (plague), *Burkholderia mallei* (glanders), and *Burkholderia pseudomallei* (melioidosis). Research studies range from basic and applied research in bacterial therapeutics to research nearing the point of maturity for elevation to Defense Technology Objective (DTO) status.

Basic and Applied Research Accomplishments:

- Evaluated novel lead antimicrobial compounds in small animal models for anthrax and plague.
- Performed additional *in vivo* studied on efficacy of selected antimicrobial compounds against various bacterial threat agents in small animal models.
- Initiated studies of selected FDA-licensed antibiotics to support consideration for changing label indications against BW threat agents.
- Continued the assessment of selected compounds for safety and efficacy against multiple bacterial threat agents in small animal models.
- Evaluated the protective efficacy in rabbits exposed to lethal doses of aerosolized anthrax using the proprietary anthrax antibody, ETI-204. Assessed the level of bacteremia in treated versus untreated animals.

- Produced and purified milligram quantities of H25 antibody for a 4-liter scale spinner production. Determined functional and biophysical properties of the purified antibody. Confirmed the utility and acceptability of the antibody produced from the cell lines for further product development. Developed analytical transfer method and assays for monoclonal antibodies (Mabs) and heteropolymers (HPs) and conducted animal studies.
- Developed diagnostic and therapeutic antibodies against anthrax and identified new targets associated with anthrax and plague pathology as part of a research effort directed toward developing rapid antibody-based biological countermeasures. Identified additional targets associated with anthrax and plague virulence and screen for novel antibodies to detect and protect against related BW threat agents and discovered novel, validated protein targets. Developed diagnostic antibodies optimized for affinity and selectivity to BW threat agents. Created a collection of human therapeutic antibodies for passive immunity protection against BW threat agents and more effective treatment against pathogens and toxins.

Toxin Agent Countermeasures

The countermeasures, technical barriers, and accomplishments in the Toxin Agent Countermeasures area are outlined below.

Countermeasures:

- Vaccines that produce long-term protective immunity against toxin agents.
- Drugs that can be administered prior to toxin exposure to protect against toxic effects of the agent.
- Therapeutics for treatment of diseases/symptoms caused by toxin agents.

*Technical Barrier*s:

- Development of 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 design and antibody therapies for toxin agents of interest.
- Necessity to establish and maintain capabilities to assess toxin threats and provide countermeasures for new and emerging toxin threats.

Pre-treatments Capability Area

Toxin Vaccines

Overarching Research Objective: Develop candidate prophylactic medical countermeasures (vaccines and pre-treatments), using appropriate laboratory and animal models, and demonstrate their capability for preventing or reducing mortality and morbidity in animals exposed to predicted or presumed battlefield doses of aerosolized toxin biological threat agents. Research studies range from basic and applied research in toxin vaccines to research nearing the point of maturity for elevation to Defense Technology Objective (DTO) status. DTO research efforts are designed so that data generated from these efforts meet requirements for transition out of the technology base and are consistent with technical information required by the advanced developer to support the preparation of an Investigational New Drug (IND) application.

Basic and Applied Research Accomplishments:

- Conducted computational chemistry studies to develop next generation botulinum neurotoxin and recombinant ricin toxin A-chain (rRTA) vaccines.
- Evaluated theoretical feasibility of multivalent vaccines against toxin agents by protein engineering.
- Evaluated the role of glycosylation or other structural modifications in reducing efficacy of botulinum neurotoxin vaccines.
- Initiated studies on the ability of intact catalytic and translocation domains of botulinum neurotoxins (BoNT) to elicit protective immunity in animal models.
- Initiated studies to increase immunogenicity of recombinant BoNT heavy chain (Hc) subunit vaccine candidates by varying adjuvant and/or method of delivery.
- Continued developing in-process and release assays for recombinant BoNT Hc vaccine candidates.
- Qualified *in vivo* and *in vitro* concept model systems for assessment of recombinant ricin vaccine candidate efficacy and surrogate endpoints of human clinical efficacy.
- Produced and characterized inactivated BoNT light chain vaccine candidates and large-scale truncations of BoNT holotoxins.
- Cloned and expressed existing BoNT vaccine candidates using selected plant-based expression systems.
- Initiated studies exploring multivalent vaccine technologies for protection against multiple botulinum neurotoxin serotypes.
- Examined the potential for intradermal (ID) delivery to provide antigen dose-sparing benefits, faster seroconversion, and reduction or elimination of alum.
- Examined the safety and immunogenicity of ID delivery of the anthrax rPA with or without alum adjuvant and compared intramuscular (IM) injection with standard needles.
- Pursued further development of formulation technologies for recombinant protective antigen (rPA) and recombinant staphylococcal enterotoxin B (rSEB) vaccine candidates to provide improved shelf-life stability.

- Developed and tested rapidly reconstituting rPA powders and systems for ID delivery in mouse challenge studies and identified rapidly reconstituting formulations and delivery systems for the rSEB vaccine candidate.

Vaccine Defense Technology Objective (DTO) Research Accomplishments:

Research Toward Alternative Delivery Methods for Recombinant Protein Vaccines (DTO CB.32):

- Proposed formulation/device/route for delivery of combinations of multiple recombinant proteins.
- Performed definitive efficacy studies on monovalent vaccine in a second animal model.
- Evaluated an *in vitro* correlate of immunity.

Research Toward the Development of a Recombinant Ricin Vaccine (CB.46):

- Completed toxicity assays, activity assays, and rodent efficacy studies for lead recombinant ricin toxin A-chain (rRTA) vaccine candidates.
- Conducted laboratory stability studies of the lead rRTA candidate.
- Evaluated the lead vaccine candidate with *in vitro* models for vascular leak syndrome.
- Conducted efficacy studies in non-human primates with the lead rRTA vaccine candidate.

DTO CB. 32 Alternative Delivery Methods for Recombinant Protein Vaccines
Objectives. The objective of this DTO is to explore and evaluate alternatives to the injection of recombinant protein-based vaccines that result in mucosal and systemic immunity to. select validated biological warfare (BW) agent. Technologies that enable respiratory, transdermal, and oral delivery of vaccines will be investigated.
Payoffs. Significant mortality and morbidity are associated with inhalation exposure to threat agents such as staphylococcal enterotoxins (SE), Bacillus anthracis, and Yersinia pestis. Recombinant proteins developed by the tech base for use as vaccine antigens are available for each of these agents, and studies in rhesus monkeys demonstrate that parenterally administered vaccines are effective against inhalational challenge. The SEs are also incapacitants in human subjects. Although parenterally administered SE vaccine candidates protected rhesus monkeys from lethal SE type B challenge, full protection against incapacitation was not obtained. 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 significantly higher levels of mucosal antibodies 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 candidates. Needle-less administration of vaccines reduces health and logistical 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.
Challenges. Major technical challenges include developing animal models and defining endpoints that predict performance of vaccine candidates in humans, selecting the best route of administration to optimize concomitant respiratory and systemic immunity, selecting adjuvant/device combinations that are safe and stimulate protective immune responses, and developing vaccine formulations with sufficient stability for respiratory (aerosol or intranasal), transdermal, or oral delivery.

DTO CB. 32 Alternative Delivery Methods for Recombinant Protein Vaccines
Milestones/Metrics. **FY2005:** Demonstrate proof of concept of the lead needle-less vaccine delivery strategy(ies). Complete program studies and prepare a technology development plan(s) for follow-on nonclinical studies of the lead/optimum delivery strategy(ies).

DTO CB. 46 Recombinant Ricin Vaccine
Objectives. The objective of this DTO is to develop a safe and effective vaccine for protection against aerosol exposure to ricin toxin. A goal is demonstration of 80% (threshold, objective is 90%) survival of vaccinated animals exposed to aerosolized ricin toxin at levels comparable to hypothetical battlefield exposures. Novel ricin A-chain polypeptides produced by recombinant expression vectors will be evaluated as immunogens capable of protecting against ricin toxicity. **Payoffs.** No licensed vaccine, antidote, or other medical therapy is available to protect Service members against ricin toxin. A licensed ricin vaccine will enhance force protection and virtually eliminate the threat of aerosolized ricin as a biological weapon to U.S. forces. **Challenges.** Developing vaccine candidates that do not retain the undesirable characteristics of vaccines produced from the natural toxin, e.g., enzymatic activity, aggregation in the vial, and manufacturing process that did not meet current Good Manufacturing Practices (cGMP) standards. **Milestones/Metrics.** **FY2005:** Conduct a formal review of small animal studies prior to initiating NHP work. Conduct efficacy studies (surrogate marker of clinical efficacy) and adjuvant studies in NHP model. **FY2006:** Complete pathology studies in the NHP model. Provide technical data from completed vaccine research studies to the advanced developer for incorporation into an Investigational New Drug (IND) application.

DTO CB.65 Multi-agent (molecular) vaccines for bio-warfare and genetically engineered agents
Objectives. This DTO will focus on the development of a trivalent vaccine based on a prototype anthrax/ plague DNA vaccine platform. The nature of a bio-attack is such that an aggressor is likely to strike at a time and place calculated to induce maximum terror through mass casualties. In the absence of specific intelligence and integrated real time detection systems the unpredictable nature of such events compels us to develop medical countermeasures capable of protecting the war fighter against multiple bio-threat agents. Anthrax and plague are considered prime bio-threat agents and as such considerable effort is currently being devoted to the development of new licensed vaccines. Research will focus on developing a trivalent vaccine prototype capable of conferring simultaneous protection against anthrax, plague and one other bio-threat agents such as smallpox or *F.tulerensis* in the shortest possible period following minimal dosing. **Payoffs.** The ability to remove the threat posed by bio-weapons from the battle space would enhance operational efficiency by minimizing the logistics footprint and would enable commanders to focus their energies on defeating the enemy. The development of a vaccine capable of protecting against three bio-threat agents would represent a considerable saving in terms of time and cost and would minimize the logistics footprint. It is estimated that it cost approximately $456 million and takes 7 to 12 years to develop and license a new vaccine. Combing three agents in a single formulation would result in substantial savings in terms of cost and time. In addition, once developed this approach has the potential to be extended to include additional bio-threats particularly those posed by genetically engineered strains.

DTO CB.65 Multi-agent (molecular) vaccines for bio-warfare and genetically engineered agents
Challenges. i) Optimization of anthrax/plague DNA platform and immunization schedule. Considerable work has already been undertaken in this area both at the Naval Medical Research Center, USAMRIID and the larger research community. (ii) Identification of the third bio-threat agent vaccine target/targets and their subsequent expression from the vaccine platform. Possible targets which have demonstrated efficacy in the past as DNA vaccine include Ebola and Marburg glycoproteins, Venezuelan equine encephalitis virus structural protein and a number of smallpox structural proteins. It is envisaged that the platform developed at stage I will be used for this purpose. (iii) Demonstrate protective efficacy of individual and combined vaccine targets against injected and ultimately aerosol challenge in a relevant animal model system. Model systems already exist for both anthrax and plague and have been developed or are being developed for the other major threat agents. **Milestones/Metrics.** FY2006: Develop the optimal backbone anthrax/plague vaccine platform: Particular focus will be on DNA vector delivery systems which stimulate protective immunity following minimal dosing. FY2007: Express the select bio-threat agent target from this platform system and assess its immunogenicity in animal models alone and in combination with the anthrax and plague elements. Characterize the underlying immune response FY2008: Determine protective efficacy against injected live agent challenge for each agent. FY2009: Determine protective efficacy against aerosol challenge

Therapeutics Capability Area

Toxin Therapeutics:

Overarching Research Objective: Develop candidate therapeutic countermeasures (therapeutic drugs and immunotherapies), using appropriate laboratory and animal models, and demonstrate their capability for preventing or reducing mortality and morbidity in animals exposed to predicted or presumed battlefield doses of aerosolized biological toxin threat agents, to include botulinum neurotoxins, staphylococcal enterotoxins (SE), and ricin toxin. Efforts target the respiratory tract and other portals of entry and parameters defining the efficacious performance of the therapeutic agent obtained in appropriate animal models of aerosol intoxication. Research studies range from basic and applied research in toxin therapeutics to research nearing the point of maturity for elevation to DTO status.

Basic and Applied Research Accomplishments:

- Continued custom synthesis of structural analogs of lead compounds identified by high-throughput screening assays for botulinum and SE toxins.
- Refined x-ray data for toxin-inhibitor co-crystal structures of most promising botulinum neurotoxin and SE inhibitors. Performed computational chemistry studies to refine lead compound co-crystal structures.
- Identified the impact of BW threat agent pathogens on the human body using computer models and direct protein analysis as part of the "bug-to-drug" research program. Continued to develop counteracting drugs based on a comprehensive understanding of how the potential drug candidates impact the human body, outside of their desired effect against the pathogen.

- Initiated testing of lead inhibitors of SE using *in vivo* model systems for assessment of therapeutic efficacy.
- Standardized *in vivo* model systems for assessment of therapeutic efficacy and surrogate endpoints of human clinical efficacy.
- Standardized *in vivo* concept model systems for assessment of therapeutic efficacy and surrogate endpoints of human clinical efficacy for SE intoxication. Tested FDA-approved drugs for septic shock as adjunct SE therapeutics *in vivo*.

Therapeutics Defense Technology Objective (DTO) Research Accomplishments:

Research toward the development of Therapeutic Strategies for Botulinum Neurotoxins (DTO CB59)

- Investigated recombinant human antibodies as passive immunotherapeutics.
- Synthesized structural analogs of active-site inhibitors identified by high-throughput screening.
- Identified candidate botulinum neurotoxin (BoNT) receptor antagonists as therapeutic candidates.
- Established a central database and compound repository.
- Initiated *ex vivo* evaluation of lead compounds in model systems for therapeutic efficacy.
- Standardized in vivo concept model systems for assessment of therapeutic efficacy and surrogate endpoints of human clinical efficacy for botulinum neurotoxin (BoNT) intoxication.

DTO CB. 59 Therapeutic Strategies for Botulinum Neurotoxins
Objectives. This DTO will enable the future development of Food and Drug Administration (FDA)-licensed therapeutics against the validated biological warfare (BW) threat of botulinum neurotoxin (BoNT) by identifying and characterizing drugs and compounds that counteract the pathophysiological and biochemical effects of BoNT. Research will focus on pretreatment, treatment, and neuronal drug delivery strategies.
Payoffs. BoNT is a potent toxin that is lethal by aerosol exposure. Deliberate exposure of joint service members to BoNT delivered as a BW agent would have severe consequences on mission effectiveness. Identification and characterization of compounds that counteract the effects of BoNT will enable the selection of lead candidates or treatment strategies for subsequent nonclinical and preclinical studies required to obtain FDA licensure. There are currently no FDA-licensed drugs against this toxin threat, and the standard post-exposure treatments for botulinum intoxication (i.e., antitoxins and support with mechanical ventilation) are not available in sufficient quantity to meet joint service requirements. Effective therapeutic countermeasures against BoNT will enhance the operational flexibility of joint forces and facilitate return to duty and restoration of operations.
Challenges. Each serotype of BoNT is likely to require a tailored therapeutic strategy. Emphasis will be on development of countermeasures for BoNT serotypes A, B, E, and F. Other challenges are developing safe neuronal drug delivery systems for post-exposure therapies, and developing appropriate model systems for investigational purposes and extrapolating efficacy data from animal models to humans.
Milestones/Metrics.
FY2005: Continue to evaluate high-affinity recombinant human antibodies against BoNT *in vivo*.

DTO CB. 59 Therapeutic Strategies for Botulinum Neurotoxins
Develop surrogate endpoints of human clinical efficacy for BoNT therapeutics. Test combinations of human monoclonal antibodies against multiple BoNT serotypes in cell-based systems. Expand proof-of-concept for BoNT target rescue and replacement in cholinergic neurons. Evaluate neuronal drug delivery systems for leading BoNT treatment modalities *in vitro* and *ex vivo*. **FY2006**: Develop lead mixtures of human antibodies against BoNT as passive immunotherapeutics *in vivo*. Complete *in vitro* testing of combinations of monoclonal antibodies against multiple BoNT serotypes and proof-of-concept studies with lead BoNT active-site inhibitors and receptor antagonists (*in vivo*) using qualified surrogate endpoints of human clinical efficacy. Information generated by this research will be used to develop a strategy, in concert with the advanced developer, for development of BoNT therapeutic candidates, and will be used to develop a technology development plan for nonclinical studies of optimum therapeutic candidates/treatment modalities.

Viral Agent Countermeasures

The countermeasures, technical barriers, and accomplishments in the Viral Agent Countermeasures area are outlined below.

Countermeasures:

- Vaccines that confer immunity against viral threat agents.
- Antibodies and antiviral drugs for treatment of viral disease.

Technical Barriers:

- Logistical difficulties from the necessity to work with live viral agents in high- and maximum-containment (BL3 and BL4) laboratories.
- Difficulty in optimizing and comparing different expression vectors for recombinant products (vaccines and antibodies).
- Development of 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 under the Animal Rule.
- Development of multivalent vaccines and compatible vaccine platforms to protect against an array of unrelated viral agents.
- Difficulty in defining surrogate markers of protection.
- Necessity to enhance the otherwise limited data on which to base rational drug design 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.

Pre-treatment Capability Area

Viral Vaccines:

Overarching Research Objective: Identify and characterize candidate vaccines, using appropriate laboratory and animal models, and demonstrate their capability to protect or significantly reduce morbidity in animals exposed to predicted or presumed battlefield doses of aerosolized

viral BW threat agents, to include filoviruses (Ebola and Marburg viruses), orthopoxviruses (smallpox) and alphaviruses (equine encephalitis). Focus on molecular virology, applied immunology, and pathogenesis. Research studies range from basic and applied research in viral vaccines and associated scientific disciplines to research nearing the point of maturity for elevation to DTO status. DTO research efforts are designed so that data generated from these efforts meet requirements for transition out of the technology base and are consistent with technical information required by the advanced developer to support the preparation of an IND application.

Basic and Applied Research Accomplishments:

- Completed investigating the role of cytotoxic T cells in the Ebola virus-mouse model.
- Examined the use of virus-like particles (VLP) as antigen for vaccines for filoviruses.
- Initiated research to investigate the role of cytotoxic T cells in the filovirus model in non-human primates.
- Investigated the use of the oligonucleotide CpG as an adjuvant with live attenuated alphavirus vaccine candidates to determine their effect on immunity conferred by the vaccines.
- Developed a multivalent vaccine platform capable of inducing potent humoral and cellular immune responses against two strains of Ebola viruses (bivalent) and three strains of Marburg viruses (trivalent) for biodefense.

Vaccine Defense Technology Objective (DTO) Research Accomplishments:

Research toward the Development of Western and Eastern Equine Encephalitis (WEE/EEE) Vaccine Constructs for a Combined Equine Encephalitis Vaccine (DTO CB.58)

- Initiated applied research to define correlates of immunity that protect against disease from alphaviruses (EEE and WEE viruses).
- Developed DNA and replicon-based vaccine constructs/platforms as WEE and EEE vaccine candidates.
- Initiated the evaluation of candidate vaccine platforms/constructs against a minimum of one of the alphaviruses of concern (WEE or EEE) in the mouse efficacy model.
- Continued research of the development of live attenuated mutant viruses as vaccine candidates for EEE virus infection.
- Established aerosol WEE animal efficacy models for evaluating vaccine candidates.

Research toward the Development of Vaccine Technologies for Protection Against Filovirus (Marburg and Ebola Viruses) Exposure (DTO CB.60)

- Initiated development of animal models of aerosol infection with filoviruses.
- Initiated applied research to define correlates of immunity that protect against disease from filoviruses.
- Developed animal models for Ebola-Sudan virus.
- Conducted preliminary characterization of leading vaccine candidates.
- Developed and improved animal models for evaluating vaccine candidates for protection against Ebola and Marburg viruses.

DTO CB. 58 Western and Eastern Equine Encephalitis Vaccine Constructs for a Combined Equine Encephalitis Vaccine

Objectives. Enable the development of a Food and Drug Administration (FDA) licensed combined VEE/WEE/EEE vaccine by identifying and characterizing WEE and EEE vaccine constructs that would be appropriate to combine into a single vaccine with the already transitioned VEE vaccine candidate V3526, or with alternative VEE vaccine candidates made in the DNA- or replicon-based vaccine platforms. Leading technologies being evaluated under this enabling DTO include live-attenuated vaccines, with engineered attenuating mutations, replicon-based vaccines and DNA vaccines.

Payoffs. Clinical illness associated with VEE, EEE, and WEE includes headache, fever, chills, nausea, vomiting, mental confusion, sleepiness, and sometimes seizures and other neurological signs and symptoms. Mosquito vectors normally transmit these viruses to birds, horses, and humans; however, they are important biological warfare (BW) threats because of aerosol infectivity and stability when freeze-dried. There are no FDA-licensed vaccines for pretreatment protection against the BW threat imposed by the equine encephalitis viruses and treatment for post-exposure infection is limited to supportive therapy. Effective vaccines against the equine encephalitis viruses would decrease the threat of BW and enhance strategic mobility and force protection. An effective combined VEE/WEE/EEE vaccine would add important logistical advantages by reducing the number of vaccines required to obtain protection from the pathogenic equine encephalitis viruses from three to one.

Challenges. Technical challenges include developing appropriate model systems for investigational purposes and extrapolating efficacy data from animal models to humans. Other potential technical barriers include vaccine interference through nonspecific mediators such as interferon or specific immune mechanisms such as cross-reacting antibody. Competition for limited in-house animal resources must also be considered a resource challenge for this project.

Milestones/Metrics.

FY2005: Initiate studies to establish an EEE non-human primate (NHP) efficacy model. Continue evaluating short-term efficacy for various platforms in available animal models, and whether they are compatible with the V3526 vaccine candidate. Continue analysis of mutants with various engineered attenuating mutations.

FY2006: Evaluate new EEE vaccine approaches in animal models in combination with WEE vaccine construct(s) and already transitioned VEE vaccine candidate V3526 or alternate VEE vaccine candidates made in the DNA- or replicon-based vaccine platforms.

FY2007: Initiate duration of immunity studies with lead candidates for each platform, comparing the individual constructs and trivalent formulations.

FY2008: Complete analyses of duration studies. Upon demonstration of preliminary proof-of-concept for combining VEE/WEE/EEE vaccine components into a single vaccine, a technology development plan will be prepared for follow-on nonclinical studies of combined VEE/WEE/EEE vaccine formulations.

DTO CB. 60 Vaccine Technologies for Protection Against Filovirus (Marburg and Ebola Viruses) Exposure

Objectives. Enable the development of Food and Drug Administration (FDA) licensed vaccines against the filoviruses (Marburg and Ebola) by identifying and characterizing vaccine technologies using *in vitro* laboratory and animal models, and demonstrating their capability to reduce mortality and morbidity in animals exposed to predicted or presumed battlefield doses of filoviruses.

Payoffs. Viral hemorrhagic fevers are a diverse group of illnesses caused by RNA viruses from four

DTO CB. 60 Vaccine Technologies for Protection Against Filovirus (Marburg and Ebola Viruses) Exposure
viral families, including the filoviruses (Marburg and Ebola). Marburg and Ebola viruses are of concern as potential BW threats since they have the potential for aerosol dissemination and weaponization. They are highly lethal and intensive supportive care is currently the only available treatment. Although clear evidence of their weaponization does not exist, the former Soviet Union is alleged to have had an effort to produce Marburg virus in quantities sufficient for weaponization as part of its offensive BW program. There are no FDA-licensed vaccines for protection against Marburg and Ebola viruses. Effective vaccines against the filoviruses would provide pre-exposure protection to joint forces, decrease the threat of filoviruses as biological warfare (BW) agents, and enhance strategic mobility. Scientific and technical information developed during the course of this research will enable the identification of lead vaccine strategies for future nonclinical studies designed to bring the optimum vaccine candidates forward for development. **Challenges.** Technical challenges include development of appropriate animal model systems and surrogate markers for investigational purposes, and the identification of appropriate immunogens for use in developing filovirus vaccine candidates. **Milestones/Metrics.** **FY2005:** Test leading vaccine candidates in worst-case scenarios (viral challenge dose, route, pre-existing vector immunity, and variation in viral challenge strain). Incorporate iterative improvements in vaccine candidates as needed. **FY2006**: Evaluate vaccine performance requirements (vaccine dose, route, number of doses, etc.,) in animal models. Determine if putative surrogate markers of protection reliably predict mitigation or prevention of disease. Information generated by these research efforts will be used to develop a technology development plan for future nonclinical studies of optimum vaccine candidates.

Therapeutics Capability Area

Viral Therapeutics:

Overarching Research Objective: Identify and characterize candidate therapeutics/ treatments, using appropriate *in vitro* laboratory and animal models, and demonstrate their capability to reduce mortality and morbidity in animals exposed to predicted or presumed battlefield doses against aerosolized viral biological warfare threat agents, to include filoviruses (Ebola and Marburg viruses) and orthopox viruses. Research studies range from basic and applied research in viral vaccines and associated scientific disciplines to research nearing the point of maturity for elevation to DTO status.

Basic and Applied Research Accomplishments:

- Continued research for development of intervention strategies for filovirus-induced shock and therapeutic approaches that combine antiviral and anti-shock drug therapy.
- Completed research for development of *in vitro* assays utilizing filovirus polymerase as a potential antiviral drug target.
- Generated baculovirus-expressed Ebola virus proteins for use in research studies.
- Identified sequences within Ebola virus genes that are highly susceptible to short interfering RNA-mediated degradation.

- Developed fluorescent-based methods for high-throughput screening for antiviral efficacy and cellular toxicity.
- Continued research to identify pharmacological compounds provided by industry that may intervene in filovirus-induced shock.
- Continued the assessment of the therapeutic action of compounds in mouse models of filovirus infection.
- Completed research for development of a variola animal model at the CDC.
- Completed the evaluation of one antiviral drug formulation for orthopox viruses and continued evaluating a second drug formulation or prodrugs for orthopox viruses.

Vaccine Defense Technology Objective (DTO) Research Accomplishments:

Research toward the Development of a Therapy for Smallpox and Other Pathogenic Orthopox Viruses (DTO CB.54)

- Continued preclinical virology studies (including animal efficacy studies) required for a supplemental New Drug Application for cidofovir and provided technical data and support to the drug license holder.
- Compared the variola animal model to the monkeypox animal model and human monkeypox to qualify models to be proposed under the FDA animal efficacy rule.
- Initiated development of an oral prodrug of cidofovir.
- Completed the assessment of the clinical study site to determine feasibility for use in a field trial of cidofovir to treat human monkeypox.
- Completed an initial dose seeking study using an oral form of cidofovir in the monkeypox primate model.

Research toward the Development of Therapeutic Strategies for Treating Filovirus (Marburg and Ebola Viruses) Infection (DTO CB.63)

- Developed assays methodologies and drug formulations of prodrugs for analysis.
- Evaluated monoclonal antibodies to viral specific proteins for their ability to neutralize virus.
- Identified critical host-cell proteins integral to viral replication, viral budding, or viral entry.
- Generated Ebola virus VP40 and GP mutant constructs as well as a tetra cysteine-fusion of VP40 in mammalian and bacterial expression vectors.
- Determined the basis for the pathogenesis of filovirus-induced shock or toxemia in animal models and identify potential mediators.

DTO CB. 54 Therapy for Smallpox and other Pathogenic Orthopoxviruses
Objectives. The objectives of this DTO are to develop medical countermeasures against smallpox and other orthopoxviruses, focusing on intravenous (IV) cidofovir (Vistide.) as the initial lead candidate but with planned product improvement to an orally active prodrug of cidofovir as the final product. The orally active prodrug will build on the systems developed for and data obtained from the IV cidofovir evaluation. Specifically, research will be performed to develop a therapeutic antiviral drug to treat smallpox and other naturally occurring or genetically modified pathogenic orthopoxviruses. **Payoffs.** Smallpox is highly infectious by aerosol and causes severe disease with high mortality. It is

DTO CB. 54 Therapy for Smallpox and other Pathogenic Orthopoxviruses

highly contagious and release of smallpox would result in a worldwide epidemic unless countered by a combination of vaccinia vaccination, quarantine, and antiviral drug treatment of infected cases. Recent publications on genetically modified ectromelia (mousepox), that contains an inserted mouse cytokine gene expressing IL-4, indicate that the modified virus shows greater pathogenicity than wild type virus. Therapy (pre- and post exposure) based on a drug that inhibits the viral DNA polymerase should still inhibit viral replication and might constitute a first line of defense against either an unmodified smallpox in unvaccinated individuals or genetically engineered smallpox or monkeypox in the entire population. An oral drug could be administered post exposure to large number of troops after a release of genetically modified smallpox as well as protecting the large number of troops for whom vaccinia vaccination is counter-indicated prior to smallpox release.

Challenges. Developing appropriate model systems that emulate human aerosol exposure and infection- if such a demonstration can be made, it can be substituted for a human efficacy clinical trial by using the Food and Drug Administration (FDA) animal efficacy rule. Initial results show that disease can be produced in cynomolgous monkeys with authentic variola virus; however, model development has not been completed. An excellent model using the closely related orthopoxvirus monkeypox in cynomolgous monkeys has been utilized to demonstrate drug and vaccine efficacy. It will be necessary to correlate this model with the variola model. Under the FDA Animal Efficacy Rule, it would be highly desirable to obtain a clinical description of human monkeypox in order to provide correlation to the animal models. The best opportunity is in the Democratic Republic of Congo, currently experiencing ongoing civil strife.

Milestones/Metrics.

FY2005: Continue evaluation of oral prodrug of cidofovir to determine if it is a replacement for IV cidofovir. Complete studies to evaluate drug efficacy in primate models that support the FDA Animal Efficacy Rule. Evaluate activity in two monkeypox primate animal models. If the oral prodrug is non-inferior, transition the research effort to the oral prodrug (oral drug delivery is most desirable method of drug administration for military use).

FY2006: Conduct initial evaluation in pock lesion variola primate model at the Centers for Disease Control and Prevention. Evaluate oral cidofovir prodrug therapeutic window against monkeypox and variola in primate models. Conduct initial studies to determine drug efficacy.

FY2007: Complete studies to evaluate drug efficacy in primate models that support the FDA Animal Efficacy Rule. Compile technical data to provide to the commercial partner to support consideration of the drug candidate for licensure for use as an oral smallpox therapeutic.

DTO CB. 63 Therapeutic Strategies for Treating Filovirus (Marburg and Ebola Viruses)

Objectives. This DTO will enable the development of Food and Drug Administration (FDA)-licensed antiviral therapeutic drugs and treatments against the filoviruses (Marburg and Ebola) by identifying and characterizing candidate therapeutics/treatments using *in vitro* laboratory and animal models and demonstrating their capability to reduce mortality and morbidity in animals exposed to predicted or presumed battlefield doses filoviruses (Ebola and Marburg viruses).

Payoffs. Viral hemorrhagic fevers are a diverse group of illnesses caused by RNA viruses from four viral families, including the filoviruses (Marburg and Ebola viruses). Marburg and Ebola viruses are of concern as potential BW threats since they have the potential for aerosol dissemination and weaponization. They are highly lethal and treatment is limited to intensive supportive care for the most severely ill patients. Although clear evidence of their weaponization does not exist, the former Soviet Union is alleged to have produced Marburg virus in quantities sufficient for weaponization as part of its

DTO CB. 63 Therapeutic Strategies for Treating Filovirus (Marburg and Ebola Viruses)
offensive BW program. There are no FDA-licensed antiviral therapeutic drugs or treatments for Marburg and Ebola virus infection, and none currently in human testing. Effective therapeutics or post-exposure treatments against the filoviruses would decrease the BW threat of filoviruses, enhance strategic mobility of joint forces, and facilitate return to duty and restoration of operations. Information developed during the course of this research will enable the identification of lead antivirals or treatment strategies for future nonclinical studies designed to bring the optimum therapeutic/treatment candidates forward for development. **Challenges.** Technical challenges include development of appropriate animal model systems for investigational purposes and an incomplete understanding of the virus life cycle and viral-viral protein interactions and viral-host protein interactions, which are required for a productive infection. **Milestones/Metrics.** **FY2005:** Identify and test leading antivirals in appropriate animal models. Generate mutant Marburg virus proteins and evaluate their ability to interact with other Marburg virus proteins. Develop information on characteristics distinguishing protective and nonprotective monoclonal antibodies. **FY2006**: Establish an assay to screen drugs that inhibit protein-protein interactions in filovirus infection. Testing lead antiviral drugs/therapeutic antibodies in nonhuman primates. Information generated by these research efforts will be used to develop a technology development plan for nonclinical studies of leading therapeutic candidates.

Diagnostic Capability Area

Countermeasures:

- Portable common diagnostic systems for a broad range of biological threats.
- Field laboratory capability to identify biological threat agents.
- Reference laboratory for confirmatory identification of biological threat agents.

Technical Barriers:

- Development of identification technologies and reagents of sufficient sensitivity and specificity to support early disease diagnosis.
- Development of rapid processing methods that can be used with a broad array of possible clinical specimens, including whole blood, sputum, swabs, feces, and tissues.
- Reduction of laboratory methods to portable devices.
- Lack of available data on genetic variability pertaining to markers used for diagnostic development.
- Inability to type organisms specifically and determine geographic origin.

Diagnostic Technologies:

Overarching Research Objective: Perform research leading to the development of technology candidates (reagents, protocols and devices) for inclusion into a deployable state-of-the-art identification and diagnostic system that integrates multiple methods for the identification of potential biological warfare agents and the diagnosis of diseases they cause. The aim is to develop and integrate technologies so they will be capable of identifying multiple independent biomarkers from different agents simultaneously. The goal is to transition these technologies out of tech base to the advanced developer for development and fielding of a portable,

integrated FDA-approved medical diagnostic system that can be used by medical personnel to identify and confirm health threats and rapidly diagnose disease.

Basic and Applied Research Accomplishments:

- Continued basic research on new diagnostic approaches to the early recognition of infection focusing on technologies compatible with future comprehensive integrated diagnostic systems.
- Continued to develop reagents and assays for appropriate biological markers for early recognition of infection and identify new host and agent-specific biological markers.
- Continued research directed toward new technological approaches for diagnosis of biological threat agents and new sample processing technologies.
- Continued to apply new diagnostic approaches directed toward early recognition of infection, selecting technologies that can be adapted to current and future comprehensive integrated diagnostic systems.
- Continued laboratory and field studies using relevant clinical samples to apply new technological approaches for diagnosis of potential biological warfare threat agents.
- Continued to apply new technological approaches for concentrating and processing clinical samples to support rapid agent identification and to apply research reagents and associated assays for the detection of appropriate biological markers using relevant clinical samples.
- Continued to compare alternative diagnostic technologies in laboratory-based and field-based studies prior to transition to the field medical laboratory.
- Continued to compare overlapping diagnostic technologies that can be integrated into a single comprehensive platform capable of detecting and identifying a broad range of biological threat agents in clinical specimens in laboratory-based and field-based studies.
- Continued to develop, evaluate, and transition diagnostic assays out of the technology base in support of the JBAIDS acquisition program.

Diagnostic Technologies Defense Technology Objective Accomplishments:

Research Toward an Improved Immunodiagnostic Platform (DTO CB.47)

- Completed interlaboratory evaluation of top performing immunodiagnostic technology option.
- Performed a multi-center evaluation trial of the top performing immunodiagnostic platform and prepared a technical data package detailing results of the multi-center trial.
- Recommended immunodiagnostic technologies for incorporation into JBAIDS acquisition program. Completed DTO in FY04.

Research Toward the Development of Methodology to Facilitate Development of Biological Warfare Threat Agent Detection and Medical Diagnostic Systems (DTO CB.56)

- Developed laboratory-based test and evaluation standards for comparing similar diagnostic/detection assays and reagents.
- Elevated assays, previously handed off to advanced development, to consistent test and evaluation standards and prepared technical data packages for these assays/reagents.
- Developed a technical data package format for delivering assays and reagents, in concert with the advanced developer.

DTO CB. 56 Methodology to Facilitate Development of BW Threat Agent Detection and Medical Diagnostic Systems

Objectives. This DTO will identify, characterize, test, and evaluate nucleic acid and antigen detection assays and associated supporting reagents to enable development and fielding of biological agent diagnostic and detection systems.

Payoffs. A principal payoff of this research effort is reliable and timely fielding of medical diagnostic and agent detection assays capable of supporting joint service medical assets in theaters of operation. For medical diagnostic applications, this research will ensure that diagnostics assays receive appropriate testing and validation prior to deployment and fielding, thus enabling obtaining Food and Drug Administration (FDA) approval of these medical devices by the advanced developer. Additionally, this effort will include refinement of BW agent detection and medical diagnostic assays and reagents already transitioned to advanced development, resulting in better performance, sensitivity, and specificity of fielded systems and facilitating a rapid response to changing operational needs and requirements.

Challenges. Key technical challenges include the development of reagent and protocol standards for comparison of similar diagnostic/detection assays and reagents, and the establishment of mutually acceptable technical data package formats for assay and reagent hand-off to the advanced developer.

Milestones/Metrics.

FY2005: Deliver four nucleic acid detection/diagnostic assays and/or supporting reagents to the advanced developer. Deliver four antigen detection assays and supporting reagents to the advanced developer. Continue to elevate previously transitioned assays up to test and evaluation standards established during the first year.

FY2006: Deliver additional four nucleic acid detection/diagnostic assays and/or supporting reagents to the advanced developer. Deliver four antigen detection assays and supporting reagents to the advanced developer. Continue to elevate previously transitioned assays up to test and evaluation standards established during the first year.

FY2007: Deliver additional four nucleic acid detection/diagnostic assays and supporting reagents to the advanced developer. Deliver four antigen detection assays and supporting reagents to the advanced developer. Continue to elevate previously transitioned assays up to test and evaluation standards established during the first year.

DTO CB. 64 Rapid Detection, Threat Assessment and Attribution of Genetically Engineered Biothreat Organisms Using Microarray-Based Resequencing Technologies

Objectives. This DTO will provide for rapid, inexpensive, high-throughput, microarray-based DNA resequencing of biothreat agent genomes, whether naturally occurring, newly arising, or genetically engineered. Knowledge of a biothreat agent's genome sequence provides fundamental information for nucleic acid-based biodefense detection and surveillance systems. Rapid, inexpensive genomic resequencing of biothreat agent genomes enables immediate, definitive identification of the organism, is informative for efforts to determine the attribution of an agent, and will identify genetic signatures characteristic of genetic engineering or naturally-occurring, newly arising strains. This project will provide validated targets for current biodetection systems, while enabling next generation systems that will be based on rapid DNA sequence determination of genomes. We aim to develop the capability to perform lower-cost, whole-genome sequencing in single laboratories with minimal space and personnel requirements.

DTO CB. 64 Rapid Detection, Threat Assessment and Attribution of Genetically Engineered Biothreat Organisms Using Microarray-Based Resequencing Technologies
Payoffs. This effort will provide a rapid, low cost, high-throughput microarray-based resequencing technology, allowing the rapid identification, threat assessment and attribution of genetically engineered and newly arising biothreat agents. Genetic data generated will provide verified targets to speed assay development, and low-cost, rapid resequencing technologies will likely be the basis of next-generation biodefense detection and surveillance platforms.
Challenges. Assembling large, diverse collections of biothreat agents and close relatives is a time-consuming process; while some collections exist, additional systematic sampling to encompass population diversity is necessary. Refining and increasing the throughput of existing microarray-based resequencing technologies is also a time- and labor-intensive effort. It will be important but challenging to create systems for automating data production and transfer to other sites, bioinformatics inference, analysis and decision-making. Considerable effort is needed to develop a deployable platform incorporating emerging sequencing technologies to further improve microarray systems.
Milestones/Metrics.
FY2006: Develop collection procedures and expand biothreat agent strain collection, focusing on Bacillus anthracis and Yersinia pestis. Sequence 6 B. anthracis group genomes; release data to other relevant DoD projects. Demonstrate, evaluate two high-density microarray systems, Affymetrix, Inc. and Nimblegen Systems, as whole-genome resequencing platforms. Develop, implement data analysis pipeline.
FY2007: Demonstrate >3-fold scale up of high-throughput experimental protocols and systems for rapid high-throughput microarray-based resequencing. Resequence 10 B. anthracis and 10 Y. pestis group genomes; release data to other relevant DoD projects. Expand biothreat agent collection. Evaluate microarray feature size reduction/increased density on two platforms.
FY2008: Demonstrate 3-fold scale up of experimental protocols and systems. Resequence 30 B. anthracis and 30 Y. pestis group genomes, releasing data to other relevant DoD projects. Expand strain collection, focusing on agents most relevant to warfighters. Evaluate further microarray feature improvements on two microarray platforms.
FY2009: Demonstrate 3-fold scale up of experimental protocols and systems. Resequence 90 B. anthracis and 90 Y. pestis group genomes, or equivalent numbers of biothreat agent genomes, releasing data to other relevant DoD projects. Deliver high-throughput, microarray-based resequencing system for consideration of DoD procurement and development.

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

Overarching Objective: The objective in this research thrust area is to develop methods and processes supporting medical CBDP objectives while reducing the reliance on animal models. In FY04 the overarching program objective was to develop capabilities and resources to predict protein structure to enable the development of biodefense vaccines and therapeutics. Specific aims included 1) the application of computational strategies toward modeling protein interactions and 2) predicting protein structures and their functions. Accomplishments for FY04 include:

- Specific Aim 1 - Apply computational strategies to modeling protein interactions with ligands, solvent, etc.

  - Modeled at atomic resolution the interactions between botulinum neurotoxin type A (BoNT/A) and substrate-like peptides.
  - Modeled the binding of peptide inhibitors to BoNT/A and compared calculated inhibition constants with those determined from laboratory studies.
  - Determined the effects of protein reorganization from small molecule binding and its implication for structure-based drug design strategies.
  - Developed and applied a new solvent modeling technique for performing protein simulations of protein toxins.
- Specific Aim 2 – Predict protein structures and their functions
  - Determined the accuracy of predicting protein loop conformations for structural genomics.
  - Developed new modeling techniques based on Monte Carlo methods

DARPA Biowarfare Defense Programs: *Pathogen Countermeasures Program*

The focus of this thrust is the development of revolutionary, broad-spectrum medical counter-measures against pathogenic microorganisms and/or their toxinogenic products. The program addresses this focus by identifying those biochemical processes of biological threat agents that are essential for their ability to cause disease and then undermining such processes and/or mechanisms. The medical countermeasures under development will be versatile enough to eliminate biological threats, whether from natural sources or modified through bioengineering or other manipulations. They will also have the potential to provide protection both within the body and at the most common portals of entry (e.g., inhalation, ingestion, and transcutaneous). There is a minor program for developing effective environmentally friendly decontamination countermeasures against broad spectrum of BW threats. Strategies include:

- Identification of novel pathogen vulnerabilities based on fundamental, critical molecular mechanisms of survival and or pathogenesis (e.g., Type III secretion, cellular energetics, virulence modulation);
- Modulation of the advantageous and/or deleterious aspects of the immune response to pathogens or their pathogenic products in the body;
- Discovery of the host factors required by the microorganism or toxin to function in the targeted mammalian cell, simultaneously inactivating both copies of the gene, thereby making it resistant to infection by that particular pathogen;
- Defeat of a pathogen's ability to enter the body, traverse the bloodstream or lymphatics, and enter target tissues.
- Development of a novel decontamination technology resulting in a source of peracetic acid in a solid, stable format. By mixing a small portion (20-100mg/mL) with water, it provides a powerful anti-microbial agent. Sporicidal properties of this agent are currently being explored; in particular, its efficiency against Bacillus anthracis spores are being tested.

The key part of this research is conducted as part of the following DTO.

DTO CB. 27 Therapeutics Based on Common Mechanisms of Pathogenesis
Objectives. This DTO will develop a suite of medical countermeasures against broad classes of biological pathogens (bacterial, viral, bioengineered, etc.) that share common mechanisms of

DTO CB. 27 Therapeutics Based on Common Mechanisms of Pathogenesis
pathogenesis. **Payoffs.** Effective pathogen countermeasures may not eliminate the threat of 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 virulent agents in harmless and ubiquitous microbes is of concern. A recent unclassified CIA report states "Growing understanding of the complex biochemical pathways that underlie life processes has the potential to enable a class of new, more virulent biological agents engineered to attack distinct biochemical pathways and elicit specific effects. 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 immuno-suppression, further increasing both the risk from biological threats and the need for robust immune defenses. **Milestones/Metrics.** **FY2005:** Transition of lead therapeutic candidates to USAMRMC for continued development.

DARPA medical countermeasures research includes efforts in the following ten areas:

1) Enhancement of existing vaccines and creation of new ones that respond to newly discovered targets of microorganisms or protect against many BW pathogens simultaneously;
2) Establishment of a testing facility and developing animal models of infection for BW agents in order to test novel therapeutics, and identification of "high risk" vs. "low risk" subgroups by determining the relative biosignatures which may allow comparative evaluation and identification of host susceptibility/resistance to BW agents;
3) Development of new therapeutics to which resistance may not be developed;
4) Development of a new chemical means for redirecting the immune system immediately and temporarily from one target to another;
5) Developing ways of detecting the biosignatures of infection to permit earlier diagnosis;
6) Development of an artificial immune system to rapidly develop vaccines against BW threats;
7) Induction and or enhancement of resistance to an infection by specific pathogens;
8) Construction of a low-cost, scalable parallel supercomputer and development of a novel computer docking program for simulating molecular interactions between candidate small-molecules and pathogen-specific enzymes, expediting the search of enzyme inhibitors/countermeasures;
9) Development of a broad-spectrum anti-viral treatments by "rewiring" natural intracellular defenses;
10) Investigating the *in vivo* formation of anthrax toxins in order to determine the kinetics of toxin formation, its role in pathogenicity/lethality and targeting for novel countermeasures.

Specific research efforts that correspond to the DARPA research areas are listed below

1a) Among the projects directed toward new or improved vaccines is one providing an improved anthrax vaccine. This project couples an existing DARPA project to develop a synthetic immunostimulant (CpG 7909) with the Anthrax Vaccine, Adsorbed (BioThrax™). CPG 7909 is a 24-mer synthetic oligonucleotide that has been phosphorothioated to inhibit the effects of endogenous nucleases. Strategically placed adjacent cytidine-guanosine bases provide a marked Th-1 immunostimulatory effect when the CPG binds to toll-like receptor 9 of plasmacytoid dendritic cells. BioThrax is the currently licensed product with a known record of safety and effectiveness. The combined product showed a marked improvement in response in animal studies, expediting the time between vaccination and onset of protection. The necessary documentation to support an application for IND status, the first step in the process to obtain FDA approval for human use, was compiled, submitted and accepted by the FDA (IND no. BB-11795). Clinical trials have started at US Air Force Medical Center, Wilford Hall and University of Texas Health Sciences center, San Antonio.

1b) Among the vaccine-oriented projects, efforts are underway to identify new anthrax cell and spore surface targets to enhance vaccine efficacy, develop a single-dose oral/nasal anthrax vaccine, and overcome engineered microorganisms with combinatorial vaccines.

1c) Another project is trying to determine what coding sequences different organisms have in common in order to come up with a vaccine that will be effective against two or more organisms. The focus of this project is plague and anthrax.

1d) Capitalizing on progress in the knowledge of dendritic cells—the initiators and regulators of immunity, or "nature's adjuvants"—DARPA is manipulating direct and *in vivo* enhancement of immunity. These efforts have resulted in protection against pathogens and an increase in vaccine efficacy.

2a) The scarcity of national resources for testing the countermeasures developed by DARPA performers necessitated the establishment of a biosafety level 3 (BSL-3) laboratory. A 3500 square foot laboratory was converted to a BSL-3 facility in which rodent pulmonary models for anthrax, tularemia, plague and cowpox were developed. In addition, chronic infusion models for delivery of short half-life therapeutics that can enhance current therapy for anthrax were also established. The second hurdle for testing of candidate drugs was the lack of availability of rhesus macaques. Sponsoring a bridging study to show equivalency with a cheaper and more available monkey species, the cynomolgous monkey, alleviated this problem. A second bridging study to marmoset species is ongoing at Porton Down, UK.

In developing the animal models for susceptibility/resistance, DNA chip technology and proteomics methodology (Capillary Liquid Chromatography with MS/MS detection) are used to identify resistant and susceptible mouse strains for infection with three different biothreat agents, cowpox, influenza, and anthrax. We are seeking to identify the host pathogen response signaling pathways as the underlying susceptibility mechanisms and the specific proteins responsible for the resistant or susceptible phenotypes. Pinpointing the specific protein(s) responsible for the host responses will allow us to develop specific drugs to convert susceptible to resistant phenotypes.

3a) Phage-derived enzymes that provide specific killing of bacteria in the blood stream with no collateral damage to the host are under development. These are enzymes that selectively destroy biowarfare bacteria, such as *B. anthracis*, *C. botulinum*, and *Y. pestis*. Experiments so far have shown 90% survival rate for mice when challenged with *B. anthracis* (Ames strain) and then treated with Ply-G enzyme.

3b) Thioaptamers are semi-synthetic molecules that specifically bind proteins necessary for controlling the development of pathogenic viruses. Thus far, these molecules have demonstrated improved survival of mice and guinea pigs following a viral infection.

3c) Another project is developing novel drug targets common to more than one BW agent. For instance, the host gene TSG101, which regulates protein trafficking within the cell, is being targeted. TSG101 plays a central role in the life cycle of multiple viruses such as Ebola and HIV. Virus proteins recruit TSG101 to mediate the assembly and release (budding) of mature viral particles from the cell surface, a necessary step in propagation of infection. Targeting host genes such as TSG101 will provide broad-spectrum antiviral inhibitors.

3d) The approach blocks the lethal effect of superantigens by inhibiting its action at the top of the toxicity cascade, before activation of T cells takes place. The antibodies generated in this project could be useful for diagnostics as well as therapeutic purposes. Immunomodulators that prevent death from toxemia are being screened for as well.

4a) The capability is being developed to redirect immune responses, by the development of bi-specific linker molecules designed with one part of their structure to bind to a pre-existent immune response and with a second part of their structure to bind a specific threat being addressed at that moment. The immunity linker molecule, a synthetic, rationally-designed pharmaceutical, would only be administered immediately pre- or post exposure, and would immediately transfer the effects of the natural immune system from one target to another.

5a) Another project is focused on the biosignatures produced by a host and the way they change during the earliest time of infection. Data are being collected by a variety of micro methods to determine changes in DNA, RNA and protein expressions. Since common data sets are generated for different diseases in the participating labs, it is possible to compare and contrast the results across diseases.

5b) Early diagnosis is key to providing effective therapy against BW agents. This could prove difficult since many 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 them from other significant pathogens and identify the pathogen, even in the absence of recognizable clinical signs and symptoms (when the pathogen numbers are low). Several projects in this program are focused on improving our ability to detect disease, particularly in its early stages. One of these is focused on the innate mechanism of the immune system used to sense a pathogen. Several sensing proteins generated by the immune system have been identified. The mammalian toll-like receptors (TLRs) are at the core of innate immune sensing and detection of essentially all bacterial infections. Recent findings point to the existence of novel intracellular signaling pathways that recognize viral infections (dsRNA-species) independent of established signaling pathways involved in host defense (such as Tolls).

Genetic and proteomic methods are being utilized to identify new proteins involved in the initiation of innate immune signals with the ultimate goal of creating an artificial sensor for infection.

6a) The project emphasis is on the construction of an artificial immune system for high-throughput vaccine development and testing. The "system" is the first step towards making an artificial lymph node (ALN) which in turn could shorten the time for development of a functional human vaccine to BW threats. Conformal printing is used to lay down a three dimensional matrix capable of structurally supporting the compartments needed for immunocellular interactions. This matrix releases growth factors to stimulate monocyte migration into and through the ALN, and with appropriate differentiation of the monoctyes. As part of this project, a MEMS cell-sorting device has been designed to isolate multipotent precursor cells that not only are developed into the immunological correct cell types, but that the resulting memory B cells secret the appropriate antibodies at the appropriate times in development. This project incorporates a vaccination site, a cell source site, and the interactive infrastructure necessary for a functionally complete artificial immune system, all of which will be about the size of a microscope slide.

7a) Genetic manipulation for host cell resistance to viral pathogens is a strategy that employs the rationale that virus requires the cooperation of host cell genes to accomplish many of the steps toward propagation/infection. The required host genes have been identified by a novel procedure that enables the selection of cells that consequently become resistant to virus-induced lethality. A series of gene products necessary for infection by African Swine Fever Virus and Foot and Mouth Disease have been identified and are now being tested in a transgenic pig production. For bacterial toxins, cDNA libraries are being screened to produce knock-out mice defective in genes required for toxin effects. Both techniques are being utilized to produce transgenic animals with resistance to toxins, validating the identified genes as targets for prophylactic and/or therapeutic countermeasures to virus or toxin effects.

8a) The new *in silico* tool enables peering into systems biology, predicting 4D structures of proteins, protein-protein and protein-nucleic-acid complexes. It can identify small-molecules and or peptides that could inhibit pathogenic enzymes rendering them harmless. The system has identified chemical inhibitors for Botox zinc endopeptidase, Anthrax lethal factor, a zinc protease and Smallpox E3L, the Z-DNA binding protein. It was also used to develop a series of three-dimensional (3D) models of an enzyme responsible for the replication of the deadly SARS virus. Such data empowers the scientists to search available databases small molecules and discover an anti-SARS drug.

9a) The few available antiviral treatments are generally virus-specific. DARPA has funded the development of an entire family of revolutionary, broad-spectrum therapies for viruses. These treatments redirect natural intracellular defenses against pathogens and takes advantage of the fact that most RNA and DNA viruses produce double-stranded RNA (dsRNA). A double-stranded RNA (dsRNA) activated caspase (DAC) is designed to selectively kill virus-infected cells to prevent further spread of the infection. DACs are coupled to protein delivery tags which enable penetration into human cell lines within 1 hour and preliminary results indicate that DACs are non toxic.

10a) Existing anti-toxin countermeasures for anthrax's protective antigen (PA) target PA83, the native form of PA. Analysis of peripheral blood from infected animals has shown PA-63 complexed with LF, supporting a model wherein the PA63/LF complex is pre-formed before binding to the target cell. It has been clearly demonstrated that there is a serum protease activity in addition to cell-associated proteases that serve to activate or cleave PA-83 to form PA-63. DARPA has also funded an effort to look into the PA20 for its activity in pathogenesis. Findings from this project could pave the way for an early and non-invasive diagnostic method as well as new targets for novel countermeasures.

E.2.3 Advanced Development Accomplishments

The JPEO-CBD is a DoD agency chartered to provide intensive centralized management of medical and non-medical programs to expedite materiel solutions for validated biological defense deficiencies. Vaccine products will be further developed by the Joint Vaccine Acquisition Program (JVAP), an ACAT II program under JPEO-CBD. Vaccines directed against high threat agents will be produced and stockpiled to fulfill a 1.2 million Troop Equivalent Doses (TEDs) requirement (Note: TED = total amount of vaccine required to immunize a service member to protect against a biological warfare agent.) Vaccines against low threat agents will be produced to fulfill a 300,000 TEDs requirement.

E.2.3.1 JVAP Prime Systems Contract

- DynPort Vaccine Company continued to expand their operations, finding appropriate commercial subcontractors to engage in the advanced development of BD vaccines (Recombinant Botulinum vaccine, Botulinum Polyclonal anti sera, Next Generation Anthrax vaccine, recombinant plague vaccine, Venezuelan equine encephalitis vaccine, and Vaccinia Immune Globulin.

E.2.3.2 Contingency Stockpile of Biological Defense (BD) Vaccines

- Testing of potency and other characteristics, continues for legacy EEE, VEE, WEE, Tularemia and Q-Fever vaccines.

E.2.3.3 Advanced Development of the Tularemia Vaccine

- Program terminated due to removal of funding.
- NIAID will continue vaccine development through IND application submission.

E.2.3.4 Advanced Development of the Smallpox Vaccine

- DoD Smallpox vaccine development terminated due to removal of funding
- Filed an annual report with the FDA under IND #8429 to insure continued availability of previously manufactured Vaccine Immune Globulin (VIG).
- DynPort Vaccine Company filed the BLA for a new VIG product for intravenous administration. Licensure is expected by July 2005.

E.2.3.5 Advanced Development of the Plague Vaccine

- Completed a multi-national (U.S. and United Kingdom) test in non-human primates with the United Kingdom's plague vaccine candidate.
- Completed pilot scale manufacturing process development of the U.S. plague vaccine candidate.
- Completed manufacture of cGMP pilot lot for Phase 1 and 2 clinical trials of U.S. plague vaccine candidate.
- Finalized and submitted IND.

E.2.3.5 Advanced Development of the Next Generation Anthrax Vaccine (NGAV)

- Continued first-time-in-humans Phase 1 clinical trial of rPA in cooperation with the Walter Reed Army Institute of Research (WRAIR).

E.2.3.6 Advanced Development Venezuelan Equine Encephalitis Vaccine

- Continued assay development and qualification for VEE IA/B component.
- Continued stability and lot release testing on lot of V3526.
- Completed assay development and qualification for VEE IAB component.
- Completed manufacture and lot release testing of cGMP vaccine for clinical use.
- Finalized and submitted IND.
- Initiated planning for Phase 1 clinical trial.

E.2.3.7 Advanced Development Recombinant Botulinum Toxin Vaccine

- Finalized and submitted IND.
- Initiated Phase 1 clinical trial. Vaccination of first cohort resulted in no serious adverse events.
- Initiated manufacturing scale-up and process validation for serotypes A and B.

E.2.3.8 Anthrax Vaccine Adsorbed (AVA) (BioThrax™) [Procurement]

- Bioport has distributed over 6.5 million doses of BioThrax™ to the DoD as of October 2004.

E.2.3.9 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 United States and Canada signed a bilateral Project Arrangement (PA) under the CBR MOU on 27 March 2003 to co-operatively develop a Smallpox vaccine system with the U.S. as the lead nation. The PA objectives include development and licensure in both the U.S. and Canada of a Smallpox vaccine and a Vaccinia Immune Globulin (VIG) to treat rare cases of adverse reactions. The VIG portion of the PA is expected to be successfully completed in FY04. The Smallpox vaccine portion of the PA is currently under review by both nations in light of the Department of Health and Human Services (DHHS) efforts to develop a Smallpox vaccine.

E.3 MEDICAL RADIOLOGICAL DEFENSE

E.3.1 Medical Radiological Defense Products

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

Currently, there are no licensed non-toxic pharmaceutical agents or diagnostic capabilities suitable for use in military operational environments. An aminothiol compound, amifostine, is FDA approved for use in patients receiving chemotherapy or radiation therapy, but its performance degrading toxic side effects prohibit its use in a fit fighting force. Other pharmacologic agents, such as hematopoietic cytokines for treating bone marrow injury, may be used off-label on a case-by-case basis by an individual physician, but regulatory restrictions for such use make it impractical for treating large numbers of casualties during military operations. Antibiotics are commonly used to treat the infectious sequelae of radiological injuries, but they must be appropriately selected to effectively treat exogenous and endogenous systemic infections while not affecting beneficial intestinal anaerobic bacteria.

In addressing the issue of currently limited medical countermeasure alternatives, a novel compound, 5-androstenediol (5-AED), has been under study the past four years at the Armed Forces Radiobiology Research Institute (AFRRI) in collaboration with a corporate partner. The compound showed good efficacy as a radioprotectant when administered prior to irradiation challenge in a mouse model. An investigational new drug (IND) application was prepared under the FDA's new efficacy rule. Expanded studies in a nonhuman primate (NHP) model during the past year in preparation for the IND application proved the drug is far less effective than in the mouse model when administered as a radioprotectant but yielded good efficacy in the NHP model when administered therapeutically in serial doses shortly following irradiation. The focus of this effort has thus shifted to a therapeutic tack, and an IND application is now anticipated by the end of 2005. The compound, one of a number of pharmacologic solutions under investigation at AFRRI, is well tolerated with minimal toxic side effects. If successful, 5-AED would be an important advancement in the area of medical radiological countermeasures, and it would represent a prelude to the probable transitioning of additional medical countermeasures against radiological injury in the near- and intermediate-term future.

The following is a summary of the materiel and non-materiel solutions currently

available for medical radiological defense:

- Antimicrobials directed at Gram-negative aerobes and facultative Gram-positive bacteria.
- Cytokine-based therapeutic applications to mitigate the two major fatal syndromes—sepsis and uncontrolled bleeding—of acute radiation injury.
- Definitive cytogenetic analytical system that accurately measures radiation exposure doses from blood samples.
- NATO Handbook on the Medical Aspects of NBC Defensive Operations, Volume 1-Nuclear (AMedP-6).
- Medical Management of Radiological Casualties Handbook.
- Medical Effects of Ionizing Radiation (MEIR) Course—Training for approximately 864 Medical Department personnel in FY03.
- Videotapes and CD-ROM of MEIR course lectures produced for distribution to military medical units.

E.3.2 Medical Radiological Defense R & D Accomplishments

The medical radiological defense research and development technical barriers and accomplishments during FY04 are grouped into the following two thrust areas and sub-efforts:

- Medical Radiological Countermeasures
  - Radioprotectants
  - Therapeutics
  - Depleted Uranium
- Diagnostic Biodosimtery
  - Cytogenetic Markers
  - Molecular Markers

Medical Radiological Countermeasures Thrust Area

Countermeasure approaches, technical barriers, and accomplishments in the Medical Countermeasures area are outlined below.

Countermeasure Approaches:

- Pharmacologic agents that neutralize highly reactive oxygen species that are generated in tissues upon the deposition of ionizing radiation and that are a major cause of tissue damage.
- Small molecular weight synthetic agents that modulate cell cycle regulatory checkpoints by reversibly arresting cell division to allow a cell's natural surveillance and repair mechanisms time to correct DNA damage before lethal mutations become incorporated into daughter cells.
- Small molecular weight synthetic molecules that inhibit apoptotic pathways that are activated by ionizing radiation and that lead to programmed cell death.
- Antimicrobial agents to effectively treat systemic infections caused by enteric microorganisms that translocate across damaged intestinal epithelium.
- Recombinant hematopoietic growth factors that stimulate the replication and maturation of bone marrow progenitor cells to help reverse myelosuppression, and restore

circulating polymorphonuclear leukocytes and platelets.
- Recombinant keratinocyte growth factor that stimulates the regeneration of epithelial cells from basal progenitor cells.
- Medical treatment strategies to mitigate injuries induced by protracted exposure to radiation from both external and internal sources.
- 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.

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 drug stability in order to improve bioavailability and enhance therapeutic and prophylactic efficacy.
- Formulating slow-release drug delivery preparations that extend bioavailability and enhance efficacy.
- Engineering pharmacologic means of up-regulating cellular damage surveillance and repair mechanisms.
- Toxicity of chelating agents used to remove internally deposited radionuclides.
- Evolving microbial resistance to antibiotics.
- Developing appropriate animal models and bridging endpoints for extrapolating data from animal studies to human efficacy predictions acceptable to the FDA for licensure of drugs under the new efficacy rule.

Accomplishments:
- Initiated studies on efficacy, toxicity and pharmacology of a novel radioprotectant compound, Ex-Rad ON01210 with a corporate partner under a Congressional mark up.
- Demonstrated that the alpha and delta isomers of tocopherol are more highly radioprotective than the gamma isomer and that the alpha isomer acts in part by reducing radiation induced neutropenia and thrombocytopenia.
- Determined that phenylacetate and epigallocatechin (EGCG) suppresses radiation-induced human cell transformation *in vitro* (i.e, blocks development of pre-cancerous cells).
- Initiated studies on the therapeutic efficacy of probiotics (beneficial bacterial species) that counter invading pathogenic gut microfluora resulting from radiation injury, and demonstrated that the probiotic *Lactobacillus reuteri* is not susceptible to the antibiotic ciprofloxacin used to treat radiation induced infection.

***Medical Radiological Defense Technology Objective (DTO) Research Accomplishments*:**

<u>Research to develop pharmacologic prevention of ionizing radiation injury</u>
- Demonstrated that 5-AED mediates immune system signaling via cytokine modulation in the spleen, thus providing a marker of drug efficacy needed for future FDA approval.

- Identified new vehicle for delivery of 5-AED that reduces local toxic side effects and enhances efficacy.

Research to develop countermeasures against bacterial sepsis after irradiation (DTO MD.29)

- Demonstrated enhanced survival from radiation induced opportunistic infections using the combined treatment regimen of a non-specific biological response modifier (beta-1,3-1,6 glucan) and the antimicrobial agent ceftriazone.

DTO MD.29 Medical Countermeasures against Bacterial Sepsis after Irradiation
Objectives. This DTO will develop combined treatment modalities against lethal or incapacitating radiation-induced bacterial sepsis. Polymicrobial sepsis is the leading cause of death following acute, whole-body irradiation. Ionizing radiation depresses immunity and damages intestinal epithelium, both of which promote microbial translocation from the intestines and sepsis. Effective medical counter-measures for battlefield-sustained radiation mass casualties will require a radically different approach than what is used to manage patients receiving chemotherapy or fractionated radiation therapy under highly controlled conditions. Appropriate antimicrobial therapy is critical because bacteria develop resistance; use of the inappropriate antimicrobial therapy exacerbates the injury. Therapy must target only the endogenous and exogenous bacteria – both Gram-positive and Gram-negative – causing sepsis and not the beneficial gut microflora including anaerobic bacteria. Use of antimicrobial agents alone does not assure recovery from sepsis in an irradiated, neutropenic animal; nonspecific biological response modifiers (BRMs) can improve outcomes by promoting innate resistance to infection. This effort will examine BRMs and antibiotics separately and in combinations in a rodent model to enhance treatment strategies for radiation-induced infections. Findings can be transitioned to preclinical studies to secure an FDA indication for combination therapy for managing bacterial infections in irradiated personnel. Results will allow recommendations for optimal choices for treatment that will enhance survival in military operational environments. **Payoffs**. Successfully achieving the objective will provide a treatment strategy for radiation-induced bacterial sepsis that: (1) Effectively reduces morbidity and mortality; (2) reduces casualty loads at medical treatment facilities; (3) shortens therapeutic intervention and accelerates return to duty; (4) reduces the requirement for prolonged antibiotic therapy, thereby lessening the likelihood of inducing antimicrobial resistance; and (5) helps to sustain a robust fighting force in nuclear or radiological environments. **Challenges.** Technical challenges include: (1) selecting most appropriate antimicrobial agents in the face of continuously changing bacterial causes of sepsis and patterns of antimicrobial resistance; (2) use of selected BRMs to support antimicrobial therapy; (3) evaluating efficacies of therapeutic combinations; and (4) extrapolating animal data to humans. **Milestones/Metrics.** **FY2005**: Determine benefit of BRMs for preventing and alleviating radiation-induced infections in a rodent model. Demonstrate efficacy of BRMs beta-1,3-glucan and 5-androstenediol. Achieve 50% or better survival following a lethal radiation dose combined with a lethal bacterial challenge. **FY2006**: Complete studies in rodent model to identify the best combination BRM/antimicrobial strategy for radiation-induced infections. Achieve 95% or better survival using a combined BRM/antimicrobial strategy following lethal irradiation.

Research to understand the toxicity of embedded depleted uranium

- Determined that DU and Tungsten Alloys (WA) induce mutations in a marker gene (HPRT) *in vitro*; embedded WA causes rabdomyosarcoma in rats; DU can increase incidence of carcinogenicity in susceptible mice.

Research to develop pharmacologic prevention of ionizing radiation injury (DTO MD.37)

- Developed a more effective vehicle for delivery of radioprotectant isoflavones and established the radioprotective dose response curve for the isoflavone genistein in a rodent model.

DTO MD.37 Prevention of Ionizing Radiation Injury by Isoflavones
Objectives. Develop advanced medical strategies for the prevention of radiation injuries. Preliminary findings on the isoflavone, genistein , demonstrate promising radioprotective efficacy with a single subcutaneous injection or multiple oral doses in a rodent model. The soybean and clover isoflavones, genistein and daidzein, will be evaluated in a preclinical animal model for radiation protection. Results will define the decision point for possible transition to clinical testing of preventive treatments designed to maximize protection of personnel against early arising radiation syndromes that result in mortality. **Payoffs.** Products of this effort will give the warfighter a level of protection against radiation-induced injury. Desirable characteristics of the products will include (1) provide additional options for radioprotective therapies that can be used alone or in combination with other agents (e.g., 5-AED). Additive or even synergistic effects may be realized with combinations of drugs. (2) increased survivability and decreased morbidity; (3) reduced casualty loads at medical treatment facilities; (4) ability of commanders to conduct operations in radiation field environments with reduced risk; and (5) reduced psychological impact on personnel tasked to operate in radiation environments. **Challenges.** Major technical challenges include: (1) determining the efficacy of isoflavones alone and in combination as protective treatments against ionizing radiation-induced lethality, (2) determining the optimal routes of nutraceutical administration, and (3) extrapolating results from animal studies to humans. **Milestones/Metrics.** **FY 2005**: Determine radioprotective efficacy by the isoflavone daidzein administered via the subcutaneous route of administration. Demonstrate at least a 20% shift in the radiation dose-response (lethality) curve, or a DRF of 1.2. **FY 2006**: Determine efficacy of genistein and daidzein administered in combined ratios by subcutaneous injection to assess potential synergistic effect. Demonstrate a DRF of a least 1.3 across the entire radiation dose response (lethality) curve. **FY 2007**: Determine radioprotective efficacy of isoflavones following an oral dosing regimen that is maximally effective within 10 days. Demonstrate a statistically significant shift in the radiation dose-response curve with a DRF of at least 1.2.

Diagnostic Biodosimetry Thrust Area

Countermeasure approaches, technical barriers, and accomplishments in the Diagnostic

Biodosimetry area are outlined below.

Countermeasure Approaches:

- Cytologic methods to estimate the absorbed dose of radiation based on microscopic imaging of aberrant chromosome morphologies arising from damage to nuclear DNA.
- Quantitative analytical methods that measure alterations in blood protein levels, cellular messenger RNA levels, or DNA sequences (mutations), the degrees to which correlate with absorbed radiation dose.
- Computer and personal digital assistant (PDA) based software tools for collecting, managing, interpreting and archiving clinical and physical data for individual radiation casualties.

Technical Barriers:

- Difficulty in identifying and calibrating biological markers that correlate quantitatively with absorbed radiation dose and that differentiate between whole-body and partial-body exposures.
- Difficulty in automating sample preparation and reducing sample preparation times for cytogenetic-based biodosimetry tests.
- The challenge of developing automated image analysis software for scoring of chromosome aberrations in definitive cytogenetic-based biodosimetry tests.
- Establishing calibration curves for molecular biomarkers that encompass the entire spectrum of radiation qualities.
- Establishing calibration standards for non-persistent biomarkers that change quantitatively with time following irradiation.
- Validating the performance of novel molecular biomarkers for use in assessing human exposures.

Accomplishments:

- Developed initial version of a casualty management software package in a PDA operating system format for first responders; the "First Responder Radiological Assessment Triage" (FRAT) tool.

***Diagnostic Biodosimetry Defense Technology Objective (DTO) Research Accomplishments*:**

Research to develop a cytogenetic-based diagnostic biodosimetry system (DTO MD.20)

- Completed concept demonstration that verified feasibility of using automated technologies to accelerate sample processing of peripheral blood lymphocytes for biodosimetry analyses in mass casualty situations.
- Continued validation studies of the premature chromosome condensation (PCC) assay for biodosimetry using human samples donated from radiation therapy patients and accident victims; and initiated animal studies to provide highly controlled experimental data to help calibrate the system.
- Optimized sample preparation procedures for the premature chromosome condensation biodosimetry assay to shorten the time to assay completion and to reduce the volume of blood required.

DTO MD.20 Cytogenetic-Based Diagnostic Biodosimetry System
Objectives. This DTO will develop a biodosimetry assay system based on chromosomal aberrations that permits a rapid, high-throughput capability to assess ionizing radiation exposure for large numbers of casualties. **Payoffs.** Symptomatology and physical dosimeters, even when available, do not provide adequate diagnostic information to treat life-threatening radiation injuries. The objective assay system will provide physicians with the ability to definitively triage radiation victims, make appropriate treatment decisions, reduce the uncertainties associated with the variability of individual response to radiation exposure, and discriminate between cases of whole- versus partial-body exposures. **Challenges.** Difficulties include reducing labor-intensive requirements for sample preparation, automating scoring of the chromosomal aberration assay, validating the assay for human use, and incorporating the assay into a rapid field-based system operable by a medical technician. **Milestones/Metrics.** FY2005: Deliver a biodosimetry system ready for Advanced Technology Demonstration.

Research to develop a molecular biomarkers-based diagnostic biodosimetry

- Completed initial animal study showing that radiation-induced changes in levels of gene expression originally identified in *in vitro* experiments can be similarly induced in a quantifiable dose related fashion in a biological system.
- Continued characterization and development of novel nucleic acid markers (gene expression changes and mitochondrial DNA deletions) for radiation dose assessment that can be analyzed within 3 hours using field deployable instrument platforms.

Annex F

Homeland Security and Force Protection Programs

Table F-1. Homeland Security and Force Protection Programs RDA Efforts.

Category	Nomenclature	Status	USA	USAF	USMC	USN
CBRN Defense Homeland Security Programs	- National Guard Weapons of Mass Destruction Civil Support Teams (WMD-CSTs)	RDTE/Prod Fielded*	*Rqmt,*	*Rqmt*	*Rqmt, Interest*	*Rqmt, Interest*
Force Protection/ Installation Protection	- JSIPP - Installation Protection Program	Prod/Fielded* Prod/Fielded*	Joint Joint	Joint Joint	Joint Joint	Joint Joint

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
Defense Technology Objective (Science & Technology Base Program)

CBRN Defense Homeland Security Programs

National Guard Weapons of Mass Destruction Civil Support Teams (WMD-CSTs)

Rationale:

Army requirement. Congress has authorized 55 WMD-CSTs. The first 32 teams authorized through 2001 have achieved the certification required by law and in accordance with Department of Defense criterion. Twelve additional teams were authorized in 2003 and eleven authorized in 2005 are in the process of activation and certification.

Key Requirements:

- The Analytical Laboratory System (ALS) (*shown*) capable of conducting presumptive analysis of unknown or potential agents (Chemical Warfare (CW) agents, Toxic Industrial Materials (TIM), Toxic Industrial Chemicals (TIC) and Biological Warfare (BW) agents) at an incident site and transmit that information electronically through the means of the Unified Command Suite (UCS).
- The UCS provides a full range of communications (both secure and non-secure data) necessary to support the CST mission. It is the primary means of reach back communications for the ALS for the WMD-CSTs, and acts as a command and control hub to provide a common operational picture for planning and executing an incident response.
- Industrial equipment, including individual protection

clothing, survey equipment, detection equipment, and response support equipment.

Description:

The WMD-CST mission is to support civil authorities at a domestic CBRNE incident site by identifying CBRNE agents/substances, assessing current and projected consequences, advising on response measures, and assisting with appropriate requests for state support to facilitate additional resources. The WMD-CST is a high-priority response unit supporting civil authorities in responding to a weapon of mass destruction situation. The unit is made up of 22 full-time National Guard members. It consists of six sections: command, operations, communications, administration/logistics, medical, and survey, who have been specially trained and equipped to provide a technical reach-back capability to other experts. The team is formed specifically to provide advice to the Incident Commander to help make assessments of the requirements for follow-on forces.

United States Army Reserve Domestic Response Casualty Decontamination and Reconnaissance Mission

Rationale:

Army requirement. Defense Reform Initiative Directive Number 25, which created the WMD-CSTs also required the US Army Reserve to train and equip Decontamination and Reconnaissance Elements for Domestic Response.

Key Requirements:

- All 23 Decontamination Capable Chemical companies in the Army Reserve have and train with three platoon sets of Domestic Response Casualty Decontamination Equipment and have trained them.
- All four Chemical Reconnaissance Companies in the Army Reserve have and train with three platoon sets of Domestic Response Reconnaissance Equipment. One company, the 392d Chemical Company, Little Rock, AR, used their skills to great effect when deployed in Operation Iraqi Freedom.

Description:

NBC area reconnaissance and casualty evacuation in NBC-contaminated environments in support of the Lead Federal Agency in domestic and foreign crisis and CM operations. Provide CBRN reconnaissance support operations to include contamination surveys, agent/material sampling, and assistance with casualty search and extraction. Perform dismounted nuclear, biological and chemical (NBC) recon to support domestic response. This HAZMAT training enhances unit capabilities to detect and operate in and around industrial chemicals and non-standard chemical agents. An added benefit was greatly improved Combatant Commander support. Army Reserve smoke and decontamination companies conduct patient decontamination of NBC casualties in support of the Lead Federal Agency for domestic and foreign crisis and CM operations. Perform personnel and casualty decon to support domestic response. Additional training days allows units to add casualty and civilian decon to their capabilities. These enhanced capabilities mean improved support to Combatant Commanders.

Force Protection/ Installation Protection

Joint Service Installation Pilot Program (JSIPP)

Rationale:

Army, Navy, Air Force, and Marine Corps requirement for the outfitting of nine installations, three from each Service Department. The Installations selected by Services are:

- Air Force: Warner-Robbins AFB, Pope AFB, Barksdale AFB,
- Army: Ft Campbell, Ft Lewis, Ft Gordon,
- Navy: NSWC Dahlgren, Naval Base San Diego,
- Marine Corps: Camp Lejeune.

Key Requirements:

- Equip nine diverse DoD installations with CBRN detection equipment.
- Enhance DoD installation emergency response capabilities with emergency responder equipment and training for installation consequence management of CBRN incidents
- Collect data and refine concepts of operations (CONOPS) for CBRN defense of similar DoD installations
- Based on CONOPS refinement, provide recommendations on resource requirements (personnel, equipment, and logistics support) to support development of future joint CB defense requirements to support installation CBRN defense preparedness and CBRN emergency responder needs.

Description:

The purpose of the JSIPP was to provide equipment and training to enhance detection, protection and emergency response capabilities for CBRN incidents on DoD Installations. The JSIPP identified installation CBRN improvements for the military Services' requirements generation process. It included two procurement efforts. The first effort was the procurement and installation of CBRN detection equipment designed to provide the installation commander increased preparedness and situational awareness supporting decision-making during a CBRN incident. The second effort was to equip and train emergency response elements in consequence management procedures for CBRN incidents. JSIPP provided guidance for training and exercises for installation CBRN defense efforts, collecting data and coordinating the assessments to support CBRN requirement recommendations for institutionalization throughout the Services. The JSIPP provided CBRN defense force protection packages at nine installations (three per Service) in FY03-04. It also funded related installation support equipment, integrated logistics support (ILS), and operations and maintenance (O&M) and training. In addition to the CBRN defense force protection package, JSIPP also provided each installation with equipment and training to enhance emergency response capabilities for CBRN incidents on military installations. It involved organizing, equipping, training, and conducting exercises for installation emergency response personnel.

Installation Protection Program (IPP)

Rationale:

- Army, Navy, Air Force, and Marine Corps requirement: Urgent Requirements Capability Document (URC) signed 14 October 2003

Key Requirements:

- Capable of defending installations from CBRN threats
- Capable of preventing disruption of critical missions, rapidly resuming essential operations, and minimizing personnel impact.

Description:

The JPEO-CBD Joint Program Manager (JPM) Guardian Installation Protection Program (IPP) constitutes the DoD's first effort to field a full spectrum of CBRN installation protection capabilities designed as a family-of-systems (FoS) to military installations and DoD-owned or leased facilities. The JPM Guardian plans to procure Government and Commercial-Off-The-Shelf (GOTS/COTS) systems designed to meet the operational requirements as identified in the Urgent Requirements Capabilities Document (URC), 14 October 2003.

The IPP is designed to fill a critical gap in an installation's ability to react to a CBRN incident. This program will provide DoD prioritized installations with an integrated CBRN protection and response capability to reduce casualties, maintain critical missions, and effectively restore essential operations. JPM Guardian has an assigned mission to:

- Provide an effective CBRN detection, identification, warning, and protection system for each installation.
- Ensure integration of CBRN networks with existing Command, Control, and Communications, and augment capabilities to provide effective information management.
- Provide a CBRN capability that will allow for rapid restoration of critical installation operations.
- Protect DoD civilians, contractors, and other persons working or living on U.S. military installations and facilities from a WMD event.

The program is structured using a spiral acquisition strategy to expedite procurement and fielding. Technical risk will be reduced by focusing on mature GOTS/COTS technologies and products. This FoS package will be fielded as a single, integrated system designed to meet the specific needs of the installation. The design will stress flexibility and the capability for future technology insertion.

Emergency Response: Army Medical CBRN Response:

The Army Medical Department (AMEDD) continues to support DoD and federal counter-terrorism initiatives and contingency operations related to CBRN threat agents with elements of the U.S. Army Medical Command (USAMEDCOM). The AMEDD has provided assistance to the following offices and agencies: DoD Special Operations/Low Intensity Conflict (SO/LIC), Assistant Secretary of Defense (Homeland Defense), Assistant Secretary of Defense (Health Affairs), J4 Medical Readiness, Joint-Director of Military Support, U.S. Army Technical Escort Unit, US Department of State, Federal Bureau of Investigation, Department of Health and Human Services, NDMS (National Disaster Medical System, FEMA), DHS and the USMC CBIRF.

The following paragraphs describe activities/programs within the USAMEDCOM that support civil authorities, consequence management, and domestic preparedness.

MEDCOM supports the Army Installation Protection Program (IPP) with the Medical Treatment Facility (MTF) providing support for the Health Service Area (HSA). The Health Service Area Commander (HSA CDR) has the responsibility to conserve the fighting strength of the command area of responsibility. The MTF supports daily force health protection mission requirements (health sustainment, vaccination, health assessments, public health planning and management through the Public Health Emergency Officer, medical appointments, dental readiness, preventive medical testing, MOUs/MOAs for emergency trauma treatment, etc). Each MTF is required by MEDCOM Regulation 525-4 to develop, test, and maintain a Medical Emergency Management Plan that fulfills all emergency management planning requirements of the Joint Commission on Accreditation of Health Care Organizations. MEDCOM Regulation 525-4 also requires MTFs to collaborate with the Installation Management Agency (garrison) and military clinics within the HSA in planning for mass casualty disasters or emergencies, as well as CBRNE consequence management. MEDCOM not only supports consequence management requirements inside MTFs and on Army installations, but also within the local communities nearby in keeping with commanders' authority to provide Immediate Response at the request of appropriate civilian authorities. MEDCOM provides regional medical response assets to meet consequence management requirements of its Major Subordinate Commands (MSCs), including Regional Medical Commands, and to support regional National disasters when tasked by appropriate authority through validated mission authorizations.

Medical Capabilities. The USAMEDCOM organized, trained and equipped Special Medical Augmentation Response Teams (SMARTs) at the MSCs. Designated MSCs will deploy SMARTs in CONUS or OCONUS to provide short duration, medical augmentation to Local, State, Federal and Defense Agencies or Medical Teams responding to disasters, civil-military cooperative actions, humanitarian assistance, WMD and emergencies within 12 hours of notification. Reaction time to and length of OCONUS missions will vary based on the situation.

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

1. Emergency Medical Response (SMART-EMR)
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. Health Systems Assessment and Assistance (SMART-HS).
10. Aero-Medical Isolation (SMART-AIT).
11. Logistics, MEDICAL (SMART-LOG)

SMART Composition. The teams are composed of military officers, warrant officers, enlisted soldiers, civilian employees and appropriate DoD contractors 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 or OCONUS. 11 Types of SMARTs comprise the total of 43 teams, with approximately 267 MEDCOM Personnel designated to respond as SMART members. These teams are specially trained and equipped, and can be alerted and deployed within 12 hours of notification.

MEDCOM provides and sustains standardized patient decontamination equipment, documentation, and associated training for 36 of the command's fixed MTFs. This equipment and training provides limited patient decontamination capability for the MTFs in the event of a disaster or emergency involving CBRN.

All MEDCOM MTFs plan for medical support of their Health Service Areas (HSA). MEDCOM MTFs coordinate with their supported Army Installations for public health emergency response and consultation, for installation support of mass casualty decontamination, and for other medical requirements including those that must be provided by the local community through Memoranda of Agreement or Understanding, to ensure area-wide or regional Force Health Protection. In this manner all MEDCOM MTFs support their installations and local civilian communities.

Additional MEDCOM assets involved in a national military response.

The Medical Chem Bio Advisory Team (MCBAT) is the principal DoD medical advisor to the Commander, CB-RRT and the Interagency Response Task Force. Assets for the MCBAT come from USAMRIID & USAMRICD. Both the MCBAT and regional CB 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 MCBAT also assists in facilitating the procurement of needed resources.

USAMRIID has a 16-bed ward capable of isolating 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. 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. USAMRIID can perform medical diagnostic assays for recognized biological agents.

Medical Support - Nuclear/Chemical Accidents and Incidents. The U.S. Army has the mission to provide direct comprehensive radiological health and medical guidance and specialized services to the COCOM commander, on-scene commander and local medical officials responding to a radiological or nuclear event. This assistance is currently provided by the AMMED through the Radiological Advisory Team (RAMT). Currently by AR 40-13 there are two teams; one at the North Atlantic Regional Medical Command (NARMC) and one at the European Regional Medical Command (ERMC). AR 40-13 is currently under revision and when approved will authorize a third RAMT at the Pacific Regional Medical Command (PRMC).

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Annex G

CBRN Defense Logistics Readiness Data

G.1 BREAKOUT OF SERVICE WAR REQUIREMENTS, STOCKS ON-HAND, AND PLANNED ACQUISITIONS

Tables G-1 through **G-5** display CBRN defense equipment Total Service Requirements, 1-4-2-1 Requirements, FY04 stocks on-hand quantities (as of 30 September 2004), and FY05–06 planned procurements for each of the four Services and the Defense Logistics Agency (DLA). Total Service Requirements and 1-4-2-1 Requirements are based on the results of the Combating WMD Enhanced Planning Process (EPP) study for jointly funded end items and consumables, and on Service recommendations for legacy end items and other consumables bought with Service O&S funds. Requirements for jointly funded items that were specified by an individual Service are identified in the tables. The Services will develop new consumables requirements from the results of the *Joint Chemical and Biological Defense Expendable Equipment Combat Consumption* (E^2C^2) study to meet the operational needs of the 1-4-2-1 force planning construct. Until the E^2C^2 study is complete, requirements developed from previous models have become outdated and are not consistent with the 1-4-2-1 construct. While new consumable requirements are being modeled and validated, numerical requirements not specifically identified by the Services will not be listed in this Annex.

The Services update data provided as the basis for this annex on a frequent basis and consider these working papers rather than a static set of figures. The Services and DLA work through the Joint Service CBRN Defense Logistics Integrated Product Team to update all figures and provide essential information for logistics readiness and sustainment assessments.

In the tables, CBRN defense items listed under "NOMENCLATURE" are currently fielded in the Services. The "STOCKS ON-HAND" represents the total of all serviceable CBRN 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) minus any medical consumable that has been issued to individual service members (this materiel is considered dispensed and is no longer visible in the supply system). This number represents only those items physically "on-hand". Quantities for which a Service or agency has submitted a funded requisition or purchase order in FY04, but has not received the requisitioned items are included in FY05. Finally, the quantities depicted as "PROJECTED DUE-IN" are quantities the Services plan to buy to replace consumption of CBRN defense assets (to include training use and shelf-life expiration), and to buy wartime sustainment stocks. These numbers are based on major command estimates of requirements. Actual procurements are contained within the On-Hand Column. "TOTAL SERVICE REQUIREMENTS" and "1-4-2-1 REQUIREMENTS" are based on the results of the Combating WMD EPP study unless otherwise specified by the Service.

Table G-1a. Army Logistics Readiness Data – Non-Consumables

NOMENCLATURE	NSN	DATA BELOW ARE PENDING VALIDATION OF REQUIREMENTS		FY04 STOCKS ON HAND (as of 30 Sept 04)	PROJECTED DUE IN						
		TOTAL SERVICE REQUIREMENT	1-4-2-1 REQUIREMENT		FY05	FY06	FY07	FY08	FY09	FY10	FY11
INDIVIDUAL PROTECTION COMMODITY AREA											
CB MASK											
MASK, CB, M40/M40A1	4240-01-258-0061-63 4240-01-370-3821/3/4	(included in M40A1) * 1,109,423		295,361 1,075,170	0 6,688	0	0	0	0	0	0
MASK, M42A2, TANK	4240-01-413-4100-02	* 106,306		1,572	1,156	0	0	0	0	0	0
MASK, M43, APACHE	4240-01-208-6966-69	* 1,019		1,938	0	0	0	0	0	0	0
	4240-01-265-2679	(included in above)		897	0	0	0	0	0	0	0
MASK, M45, AVIATOR	4240-01-414-4034-35/-4051-52	* 23,823		18,996	4,906	1,696	999	688	500	200	100
MASK, M45, LAND WARRIOR	4240-01-447-6987-9, 8967	* 3,685		5,812	1,863	861	240	240	240	240	240
MASK, M48, APACHE	4240-01-386-0198/-4686/-0201/-0207	* 2,668		3,498	0	0	0	0	0	0	0
MISC PROTECTION											
PATS, M41	4240-01-365-8241	* 10,458		7,001	900	800	0	0	0	0	0
CONTAMINATION AVOIDANCE COMMODITY AREA											
NUCLEAR DETECTION EQUIPMENT											
AN/PDR-75	6665-01-211-4217	* 9,235		1,880	0	0	0	0	0	0	0
AN/PDR-77	6665-01-347-6100	* 1,026		74	0	0	0	0	0	0	0
AN/UDR-13	6665-01-407-1237	* 37,378		11,833	0	0	0	0	0	0	0
AN/VDR-2	6665-01-222-1425	* 47,385		1,485	0	0	0	0	0	0	0
BIOLOGICAL DETECTION EQUIPMENT											
BIDS, M31	6665-01-392-6191	930	777								
JBAIDS	NOT ASSIGNED	314	157	0	5	80	55	0	0	0	0
JBPDS (MOBILE)	6665-01-452-8643	930	777	0	11	20	35	40	44	44	44
JBPDS (FIXED)	6665-01-453-5385			0	0	0	0	0	0	0	0
CHEMICAL DETECTION EQUIPMENT											
ACADA, M22	6665-01-438-6963	49,409	35,996	21,174	4,509	244	960	1146	1142	1146	0
ALARM, CAA, M8A1	6665-01-105-5623	27,190	19,996	35,000	0	0	0	0	0	0	0
CAM/ICAM	6665-01-357-8502	27,190	19,966	11,000	1,200	1,000	0	0	0	0	0
	6665-01-199-4153			9,700	0	0	0	0	0	0	0
JWARN	NOT ASSIGNED										
MICAD	NOT ASSIGNED			151	0	0	0	0	0	0	0
M21 RSCAAL	6665-01-324-6637			156	0	0	0	0	0	0	0
NBCRS, M93A1	6665-01-372-1303										
STRYKER NBCRV	2320-01-481-8579	418	30	9 (funded)	0	8	5	0	0	0	0
DECONTAMINATION COMMODITY AREA											
DECON APPAR, PDDA, M12A1	4230-00-926-9488	* 523		743	0	0	0	0	0	0	0
A/E32U-8 SANATOR	4230-01-150-8660	(included below)		322	0	0	0	0	0	0	0
L/WT DEC SYS, M17A3	4230-01-346-3122	* 3,877		2,629	0	0	0	0	0	0	0

Table G-1a. Army Logistics Readiness Data - Non-Consumables

NOMENCLATURE	NSN	DATA BELOW ARE PENDING VALIDATION OF REQUIREMENTS		FY04 STOCKS ON HAND (as of 30 Sept 04)	PROJECTED DUE IN						
		TOTAL SERVICE REQUIREMENT	1-4-2-1 REQUIREMENT		FY05	FY06	FY07	FY08	FY09	FY10	FY11
COLLECTIVE PROTECTION COMMODITY AREA											
CHATH, AIR HANDLER	4240-01-423-0915										
CP DEPMEDS	5410-01-479-9727/9730	23	12	12	0	0	0	0	0	0	0
CP DEPMEDS-MRI	5410-01-523-0255/0257			0	2	1	1	1	1	1	1
SHELTER, CB PROTECT	5410-01-441-8054	1,259	1,035	181	38	26	94	180	180	180	180
SHELTER, CP, M20/M20A1	4240-01-166-2254/4240-01-330-7806			1,535	620	472	471	511	472	472	472
MEDICAL COMMODITY AREA											
LITTER, DECONTAMINABLE	6530-01-380-7309			10,205							

* Service-provided Requirements

Table G-1b. Army Logistics Readiness Data – Consumables

NOMENCLATURE	NSN	DATA BELOW ARE PENDING VALIDATION OF REQUIREMENTS		FY04 STOCKS ON HAND (as of 30 Sept 04)	PROJECTED DUE IN	
		TOTAL SERVICE REQUIREMENT	1-4-2-1 REQUIREMENT		FY05	FY06
INDIVIDUAL PROTECTION COMMODITY AREA						
OVERGARMENTS						
CHEM PROT UNDERGARMENT TOP	8415-01-363-8692-00			20,346 +	2,187 +	
CPU DRAWERS	8415-01-363-8683-91			20,346 +	2,187 +	
JSLIST OVERGARMENTS		2,362,022	1,213,966			43,668
Woodland Coat	SEE TABLE G-5			66,738 +	66,372	
Woodland Trousers	SEE TABLE G-5			64,616 +	61,755	
Desert Coat	SEE TABLE G-5			12,514 +	63,183	
Desert Trousers	SEE TABLE G-5			18,073 +	68,507	
SCALP (TAN)	8415-01-333-0987-89			6,357	0	
SCALP (GREEN)	8415-01-364-3320-22			508	0	
SUIT, CP CAMO (BDOs)	8415-01-137-1700-07			15,423+	47	
OVERBOOTS/GLOVES						
JLIST MULO	8430-01-464-9453-84					
BLK/GRN VINYL O/BOOTS	8430-01-317-3374-85			215,229 +	10,433	
	8430-01-049-0878-87			1465+		
CP FOOT COVERS	8430-01-021-5978			60		
CP GLOVES 7 MIL	8415-01-138-2501-04			80,468	240	
CP GLOVES 14 MIL	8415-01-138-2497-00			59,251 +	11,458	
CP GLOVES 25 MIL	8415-01-033-3517-20			129,922 +	4,318	
	8415-01-144-1862			944+	123	
MISC PROTECTION						
2D SKIN, M40 SERIES	4240-01-413-1540-43			193,480	352,769	128,900
BATTERY, BA-5800 (PRO MASK)	6135-01-440-7774			1,766	1,263	
CP HELMET COVER	8415-01-111-9028			219,692 +	25,934	
FILTER CAN, C2A1	4240-01-361-1319			747,982	749,072	977,000
HOOD, M40A1 (QUICK DOFF)	4240-01-376-3152			739,331	850	0
CONTAMINATION AVOIDANCE COMMODITY AREA						
CHEMICAL DETECTION EQUIPMENT						
BATTERY, ACADA BA-5590	6135-01-036-3495			2,037	24	
BATTERY, BA-3517	6135-00-450-3528			20,486	16,892	22,500
BATTERY, ICAM BA-5800	6665-99-760-9742			1,047		
BATTERY, M42 BA3030	6135-00-835-7210			7,090		
DET KIT, M256A1 (Boxes of 10 tickets)	6665-01-133-4964			13,416	36,518	71,000
DET PAPER, M8 (Indiv. Books)	6665-00-050-8529			972,149	616,996	380,000
DET PAPER, M9 (Indiv. Rolls)	6665-01-226-5589			540,913	1,098,292	527,000
MAINT KIT, M312	5180-01-462-7469			2,506	0	0
MAINT KIT, M293	5180-01-379-6409					
MAINT KIT, M273	5180-01-108-1729			514	0	0
NBC MARK SET, M274	9905-12-124-5955			10,733	7,221	10,535
WATER TEST KIT, M272	6665-01-134-0885			9,588	600	2,067
BIOLOGICAL DETECTION EQUIPMENT						
HAND HELD ASSAY	6665-01-504-8534			10,799	0	0

Table G-1b. Army Logistics Readiness Data - Consumables

NOMENCLATURE	NSN	DATA BELOW ARE PENDING VALIDATION OF REQUIREMENTS		FY04 STOCKS ON HAND (as of 30 Sept 04)	PROJECTED DUE IN	
		TOTAL SERVICE REQUIREMENT	1-4-2-1 REQUIREMENT		FY05	FY06
DECONTAMINATION COMMODITY AREA						
DECON KIT, M291 (Box of 20)	6850-01-276-1905			102,051	175,913	48,489
DECON KIT, M295 (Box of 20)	6850-01-357-8456			76,650	92,844	25,100
NITROGEN CYLINDERS	4230-00-775-7541			36,900	0	0
SORBENT DECON SYSTEM	4230-01-466-9095			331,236	0	0
STB, 50 LB	6850-00-297-6653			8,198	0	0
COLLECTIVE PROTECTION COMMODITY AREA						
FILTER, CP, M12A2 (M14 GPFU)	4240-01-365-0981			16,056	4,671	3,104
FILTER, CP, M13 SERIES (M14 GPFU)	4240-00-368-6291			15,813	2,130	6,275
FILTER, CP, M18A1 (M13 GPFU0	4240-01-365-0982			24,651	13,021	6,525
FILTER, CP, M18	4240-00-828-3952			11,154	0	0
FILTER, CP, M19	4240-00-866-1825			19,733	5,744	8,914
FILTER, GP, M48A1	4240-01-363-1311			11,286	26,183	10,015
M98 FILTER SET (M59, M56, SHIPBOARD)	4240-01-369-6533			598	11,692	6,026
M28 Liner, End Section	4240-01-330-8882			24	60	15
M28 Liner, End Section, Type II	4240-01-461-5983			1	5	0
M28 Liner, Center Section	4240-01-330-8884			49	127	0
M28 Liner, Center Section, Type II	4240-01-460-9058			33	5	0
M28 Liner, Vestibule	4240-01-330-8891			46	87	88
M28 Liner, Vestibule, Type II	4240-01-460-9059			8	11	0
M28 Liner, ISO Adapter	4240-01-330-8890			33	15	0
M28 Liner, ISO Adapter, Type II	4240-01-460-9056			0	10	0
MEDICAL COMMODITY AREA						
2-PAM CHLORIDE AUTOINJ	6505-01-125-3248			1,282,990		
ANTID TREAT NERVE AGENT AUT	6505-01-362-7427			205,740	659,500	
ATROPINE AUTOINJ	6505-00-926-9083			1,674,290		
CANA AUTOINJ	6505-01-274-0951			1,403,929		
NAAK, MKI	6505-01-174-9919			1,038,644		
PYRIDOSTIGMINE TAB	6505-01-178-7903			326,955		
SODIUM NITRITE INJ (300 MG) KIT	6505-01-206-6009			2,656		
SODIUM THIOSULFATE INJ (12.5 G) KIT	6505-01-206-6010			147		
SODIUM THIOSULFATE INJ (50 ML AMPULE)	6505-01-334-8781					
ATROPINE 1MG/ML 1 ML VIAL, 25s	6505-00-957-8089			101		
ATROPINE 2MG/ML 25ML VIAL	6505-00-299-9673			189		
POTASSIUM IODIDE TABS 14's BTL	6505-01-116-8198			5,415		
POTASSIUM IODIDE TABS 14's IS	6505-01-496-4916			10,061		
PATIENT WRAPS	6530-01-383-6260			359		
SERPACWA	6505-01-483-7162			265,824		

Table G-1b. Army Logistics Readiness Data – Consumables

NOMENCLATURE	NSN	DATA BELOW ARE PENDING VALIDATION OF REQUIREMENTS		FY04 STOCKS ON HAND (as of 30 Sept 04)	PROJECTED DUE IN	
		TOTAL SERVICE REQUIREMENT	1-4-2-1 REQUIREMENT		FY05	FY06
ATROPINE SULFATE AEROSOL	6545-01-332-1281			2,673		
OTHER TREATMENTS *						
CIPROFLOXACIN (500 mg tabs 50s)	6505-01-272-2385					
(500 mg tabs 100 IS)	6505-01-273-8650					
(500 mg tabs 100s)	6505-01-333-4154			8,864,200		
(500 mg tabs 10 ISs)	6505-01-491-6143					
(500 mg tabs 30 IS)	6505-01-491-2834					
DOXYCYCLINE CAPS (100 mg tabs 500s)	6505-01-153-4335			32,804,450		
(100 mg tabs 30s)	6505-01-491-5506					
ANTIDOTE TREATMENT KIT, CYANIDE	6505-01-143-4641			9,782		
	6505-01-457-8901					
INDIVIDUAL GUIDE TO MBCDM	7610-01-492-7703					

+ Partial data at time of publication. Quantities represent "CDE Go-to-War" assets only.
* The unit of measure on all of these items is "tablets"

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

NOMENCLATURE	NSN	DATA BELOW ARE PENDING VALIDATION OF REQUIREMENTS		FY04 STOCKS ON HAND (as of 30 Sept 04)	PROJECTED DUE IN						
		TOTAL SERVICE REQUIREMENT	1-4-2-1 REQUIREMENT		FY05	FY06	FY07	FY08	FY09	FY10	FY11
INDIVIDUAL PROTECTION COMMODITY AREA											
CB MASK											
MASK, AERP	8475-01-339-9782(S)	33,000	33,000								
MASK, M45, LAND WARRIOR	4240-01-447-6988/6989	450	100	79	7	0	0	0	0	0	0
MASK, MCU-2/P,	4240-01-415-4239-41	260,523	345,856	265,042	0	1,732	0	0	0	0	0
MASK, MCU-2A/P	4240-01-284-3615-17			332	0	0	0	0	0	0	0
MASK, MCU-2A/P (WR) USAF	4240-01-327-3299-01			2,169							
MISC PROTECTION											
PATS, M41	4240-01-365-8241			15							
MASK COMM AMPLIFIER M7	5996-01-381-9012			61							
CONTAMINATION AVOIDANCE COMMODITY AREA											
NUCLEAR DETECTION EQUIPMENT											
ADM 300 - A KIT	6665-01-363-6213NW	900	659	48							
- B KIT	6665-01-342-7747NW			57							
- C KIT	6665-01-320-4712NW			99	2						
- E KIT	6665-01-426-5071NW			34							
BIOLOGICAL DETECTION EQUIPMENT											
JBAIDS	NOT ASSIGNED	332	166	0	5	87	52	0	0	0	0
JBPDS (MOBILE)	6665-01-452-8643	93	72								
JBPDS (FIXED)	6665-01-453-5385	1,165	512								
CHEMICAL DETECTION EQUIPMENT											
ACADA, M22	6665-01-438-6963	3,520	2,579	267	284	18	69	82	82	82	0
ALARM, CAA, M8A1	6665-01-105-5623			4							
CAM/ICAM	6665-01-357-8502			121							
	6665-01-199-4153	1,960	1,435	26	78						
JWARN	NOT ASSIGNED	788	577	10							
MICAD	NOT ASSIGNED			9							
M90 CHEM ALARM	6665-01-408-5108			2							
DECONTAMINATION COMMODITY AREA											
L/WT DEC SYS, M17A2	4230-01-349-1778	324	0	1							
L/WT DEC SYS, M17A3	4230-01-346-3122			1							
COLLECTIVE PROTECTION COMMODITY AREA											
CP DEPMEDS	5410-01-479-9727/9730	21	16								
JOINT EXPEDITION-ARY CP SHELTER	4240-01-346-2564	6,339	4,645								
MEDICAL COMMODITY AREA											
LITTER, DECONTAMINABLE	6530-01-380-7309			1,850							

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

NOMENCLATURE	NSN	DATA BELOW ARE PENDING VALIDATION OF REQUIREMENTS		FY04 STOCKS ON HAND (as of 30 Sept 04)	PROJECTED DUE IN	
		TOTAL SERVICE REQUIREMENT	1-4-2-1 REQUIREMENT		FY05	FY06
INDIVIDUAL PROTECTION COMMODITY AREA						
OVERGARMENTS						
AIRCREWMAN CAPE	8415-01-040-9018			17,010		
CP UNDERCOVERALL	8415-01-040-3136-44					
EOD HGU-65P HOOD	4240-01-338-1646					
EOD M-3 TAP	8415-00-099-6962/68/70					
	8415-01-105-2535					
EOD TAP BOOTCOVER	8430-00-820-6295-6306					
EOD TAP GLOVES	8415-00-753-6550-54					
JSLIST OVERGARMENTS		1,347,912	1,020,552			
Woodland Coat	SEE TABLE G-5			277,154	6,839	59,356
Woodland Trousers	SEE TABLE G-5			280,476	5,534	57,084
Desert Coat	SEE TABLE G-5			191,218	2,894	5,992
Desert Trousers	SEE TABLE G-5			213,379	3,832	19,256
M-2 APRON	8415-00-281-7813-16			6		
M3 COOLING HOOD	8415-00-261-6443					
M3 COOLING SUIT	8415-00-264-2929					
SUIT, AIRCREW, CWU-66/77P	8475-01-328-3434-57			4,389		
SUIT, CP CAMO (BDO)	8415-01-137-1700-07			395,725	65,733	138,887
SUIT, CP CAMO-DESERT 3 clr	8415-00-327-5347-53			36,398	9,927	23,971
SUIT, CP CAMO-DESERT 6 clr	8415-01-324-3084-91			120	12	85
OVERBOOTS/GLOVES						
JLIST MULO	8430-01-464-9453-84					
BLK/GRN VINYL O/BOOTS BVO	8430-01-317-3374-85					
GVO	8430-01-049-0878-87			1,422,398	140,753	743,011
CP FOOTWEAR COVERS	8430-01-118-8172			1,371		
	8430-01-021-5978					
CP GLOVES 7 MIL	8415-01-138-2501-04			75,840	18,769	18,428
CP GLOVES 14 MIL	8415-01-138-2497-00			1,964,421	581,088	542,823
CP GLOVES 25 MIL	8415-01-033-3517-20			1,297		
CP SOCKS	8415-01-040-3169					
DISP FOOTWEAR COVER	8430-00-580-1205-06			16,619		
GLOVE INSERTS	8415-00-782-2809 (S)			1,988,767		
MISC PROTECTION						
FILTER CAN, C2/C2A1	4240-01-119-2315			1,017,736	230,062	47,885
	4240-01-361-1319			947,987	46,634	52,003
FILTER, GP	4240-01-161-3110					
HOOD, MCU-2/P	4240-01-189-9423			1,700,821	46,273	17,175
HOOD, M45, LAND WARRIOR	4240-01-441-0553			52	0	38
HARNESS, HEAD, MCU	4240-01-390-3057			1,001	0	0

Table G-2b. Air Force Logistics Readiness Data - Consumables

NOMENCLATURE	NSN	DATA BELOW ARE PENDING VALIDATION OF REQUIREMENTS		FY04 STOCKS ON HAND (as of 30 Sept 04)	PROJECTED DUE IN	
		TOTAL SERVICE REQUIREMENT	1-4-2-1 REQUIREMENT		FY05	FY06
SECOND SKIN, M45 LAND WARRIOR	4240-01-440-0638, 0555			31	0	0
HARNESS, HEAD, M45	4240-01-441-0562			147	0	0
SECOND SKIN, MCU-2	NOT ASSIGNED	345,856	253,385	30,017	86,000	0
CONTAMINATION AVOIDANCE COMMODITY AREA						
CHEMICAL DETECTION EQUIPMENT						
BATTERY, ACADA BA-5590	6135-01-036-3495			841		
BATTERY, BA-3517	6135-00-450-3528					
BATTERY, ICAM BA-5800	6665-99-760-9742			601		
DET KIT, M18A2	6665-00-903-4767			2		
DET KIT, M256A1	6665-01-133-4964			274		
DET PAPER, M8	6665-00-050-8529			1,061,769	1,492	83
DET PAPER, M9	6665-01-049-8982			236		
	6665-01-226-5589			352,173	10,568	58,427
MAINTENANCE KIT, M312	5180-01-462-7469			109		
MAINTENANCE KIT, M293	5180-01-379-6409			12		
NBC MARK SET, M274	9905-12-124-5955			231		
WATER TEST KIT, M272	6665-01-134-0885			28		
KIT, DOD BIOSAMPLING	6665-01-494-8725			307		
DECONTAMINATION COMMODITY AREA						
CALCIUM HYPOCHLORITE (6 oz)	6810-00-255-0471			748		
CALCIUM HYPOCHLORITE (45 lb)	6840-00-242-4770			4		
CALCIUM HYPOCHLORITE (100 lb)	6810-12-132-2439			13		
DECON KIT, M291 (Box of 20)	6850-01-276-1905			31,799	13,195	4,093
DECON KIT, M295 (Box of 20)	6850-01-357-8456			35,748	9,012	9,915
SODIUM HYPOCHLORITE	6810-00-598-7316					
SORBENT DECON SYSTEM	4230-01-466-9095			8		
STB, 50 LB	6850-00-297-6653			1		
COLLECTIVE PROTECTION COMMODTY AREA						
FILTER, CP M13 SERIES (M14 GPFU)	4240-00-368-6291					
FILTER, GP M48A1	4240-01-363-1311					
M98 FILTER SET (M59, M56, SHIPBOARD)	4240-01-369-6533			18		
CP EMEDS, CB Liner	NOT ASSIGNED					
CP SSS, CB Liner	NOT ASSIGNED					
MEDICAL COMMODITY AREA						
2-PAM CHLORIDE AUTOINJ	6505-01-125-3248			788,661		
ATROPINE AUTOINJ	6505-00-926-9083			740,332		
CANA AUTOINJ	6505-01-274-0951			278,340		
NAAK, MKI	6505-01-174-9919			260		

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

NOMENCLATURE	NSN	DATA BELOW ARE PENDING VALIDATION OF REQUIREMENTS		FY04 STOCKS ON HAND (as of 30 Sept 04)	PROJECTED DUE IN	
		TOTAL SERVICE REQUIREMENT	1-4-2-1 REQUIREMENT		FY05	FY06
PYRIDOSTIGMINE TAB	6505-01-178-7903			58,351		
ANTIDOTE TREATMENT KIT, CYANIDE	6505-01-143-4641			257		
ATROPINE 1MG/ML 1ML VIAL, 25s	6505-00-957-8089			33,973		
ATROPINE 2MG/ML 25ML VIAL	6505-00-299-9673			1,445		
POTASSIUM IODIDE TABS 14's BTL	6505-01-116-8198			1,406		
POTASSIUM IODIDE TABS 14's IS	6505-01-496-4916			263		
***OTHER TREATMENTS** *						
CIPROFLOXACIN 500 MG TAB 100s IS	6505-01-273-8650			3,888,800		
500 MG TAB 100s BTL	6505-01-333-4154					
DOXYCYCLINE TABS, 100 MG, 500s	6505-01-153-4335			6,780,600		
100 MG, 50s	6505-01-095-4175					
INDIVIDUAL GUIDE TO MBCDM	7610-01-492-7703			0		

* The unit of measure on all of these items is "tablets"

Table G-3a. Navy Logistics Readiness Data - Non-Consumables

NOMENCLATURE	NSN	DATA BELOW ARE PENDING VALIDATION OF REQUIREMENTS		FY04	PROJECTED DUE IN						
		TOTAL SERVICE REQUIREMENT	1-4-2-1 REQUIREMENT	STOCKS ON HAND (as of 30 Sept 04)	FY05	FY06	FY07	FY08	FY09	FY10	FY11
INDIVIDUAL PROTECTION COMMODITY AREA											
CB MASK											
MASK, A/P 22P-14(V)	NOT ASSIGNED			6,830	1,070						
MASK, CB, M40A1	4240-01-370-3821-23	26,400		36,302							
MASK, M45, LAND WARRIOR	4240-01-447-6987/89			358							
MASK, M45, AVIATOR	4240-01-414-4034-35/-4051-52			343							
MASK, MCU-2/P	4240-01-175-3443-45										
	4240-01-497-7467 (S)			85							
	4240-01-497-7783 (M)			901							
	4240-01-498-1189 (L)			40							
MASK, MCU-2A/P	4240-01-284-3615-17										
MASK, MCU-2A/P USN	4240-01-327-4148-50			99,552							
CONTAMINATION AVOIDANCE COMMODITY AREA											
NUCLEAR DETECTION EQUIPMENT											
AN/PDR-27	6665-00-543-1435			3,566							
AN/PDR-43	6665-00-580-9646			3,587							
AN/PDR-56	6665-00-086-8060			1,327							
AN/PDR-65	6665-01-279-7516			619							
CP-95	6665-00-526-8645			5,478							
PP-4276	6665-00-489-3106			656							
IM-143	6665-00-764-6395			17,962							
DT-60	6665-00-978-9637			278,405							
AN/PDQ-1 MFR	6665-01-435-0127			9,038	400	476	337	884	0	0	0
OA-9449/PDQ	6665-01-435-0131			6,262							
BIOLOGICAL DETECTION EQUIPMENT											
IBAD	NOT ASSIGNED										
DRY FILTER UNIT	NOT ASSIGNED			683	0						
JBAIDS	NOT ASSIGNED	156	78	0	5	64	0	0	0	0	0
JBPDS (MOBILE)	6665-01-452-8643	1,165	420								
JBPDS (FIXED)	6665-01-453-5385										
CHEMICAL DETECTION EQUIPMENT											
ACADA, M22	6665-01-438-6963	444	160	451	18	1	4	5	5	5	0
ACADA, SHIPBOARD	6665-01-484-7823			720	0						
ALARM, CAA, M8A1	6665-01-105-5623			0	0						
CAPDS	6665-01-294-2556			30	0						
CHEM AGENT MONITOR/ICAM	6665-01-199-4153	1,009	364	1,251	19						
CWDD, AN/KAS-1	5855-01-147-4362			1,260							
IMP POINT DETECTION SYSTEM	6665-LL-HAL-5532			227	27	0	0	0	0	0	0

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

NOMENCLATURE	NSN	DATA BELOW ARE PENDING VALIDATION OF REQUIREMENTS		FY04 STOCKS ON HAND (as of 30 Sept 04)	PROJECTED DUE IN						
		TOTAL SERVICE REQUIREMENT	1-4-2-1 REQUIREMENT		FY05	FY06	FY07	FY08	FY09	FY10	FY11
DECONTAMINATION COMMODITY AREA											
L/WT DEC SYS M17A3 DIESEL	4230-01-346-3122	412	0	8							
COLLECTIVE PROTECTION COMMODITY AREA											
SHELTER, CP, M20/M20A1	4240-01-166-2254			75	0	0	0	0	0	0	0
SHIP CPS BACKFIT	NOT ASSIGNED			0							
JOINT EXPEDITION-ARY CP SHELTER	4240-01-346-2564	2,952	1,065	0							
MEDICAL COMMODITY AREA											
LITTER, DECONTAMINABLE	6530-01-380-7309			1,348							
LITTER, DECON, MASS CASUALTY	6530-01-432-5514			100							

Table G-3b. Navy Logistics Readiness Data - Consumables

NOMENCLATURE	NSN	DATA BELOW ARE PENDING VALIDATION OF REQUIREMENTS		FY04 STOCKS ON HAND (as of 30 Sept 04)	PROJECTED DUE IN	
		TOTAL SERVICE REQUIREMENT	1-4-2-1 REQUIREMENT		FY05	FY06
INDIVIDUAL PROTECTION COMMODITY AREA						
OVERGARMENTS						
APRON, TAP M-2	8415-00-281-7813-16			923		
JSLIST OVERGARMENTS		1,515,635	486,602		41,777	17,503
Woodland Coat	SEE TABLE G-5			84,323		
Woodland Trousers	SEE TABLE G-5			79,171		
Desert Coat	SEE TABLE G-5			106,277		
Desert Trousers	SEE TABLE G-5			101,515		
SUIT, TAP M-3	8415-00-099-6962/68/70			45		
	8415-01-105-2535			0		
SUIT, CP, OG MK3	8415-01-214-8289-92			3,397		
SUIT, CP, SARATOGA	8415-01-333-7573-76			17,100		
SUIT, CP SARATOGA-DESERT	8415-01-333-7577-80			8		
UNDERGARMENTS						
CMU-34 UNDERSHIRTS	8415-01-490-1900/17			25,940		
CMU-35 DRAWERS	8415-01-490-4368/71/72/74/76-84			26,608		
OVERBOOTS/GLOVES						
JSLIST MULO	8430-01-464-9453-84			0		
AIRBOSS LTWEIGHT OVERBOOT	8430-99-869-0395/9			29,423		
BLK/GRN VINYL O/BOOTS BVO	8430-01-317-3374-85			1,293		
GVO	8430-01-049-0878-87			3		
CP FOOTWEAR COVERS	8430-01-118-8172			10,871		
	8430-01-021-5978			31,467		
CP GLOVES 7 MIL	8415-01-138-2501-04			611		
CP GLOVES 14 MIL	8415-01-138-2497-00			3,074		
CP GLOVES 25 MIL	8415-01-033-3517-20			163,904		
AIRBOSS GLOVE	8415-21-921-2167/72			9,490		
CP SOCKS	8415-01-040-3169			50		
DISP FOOTWEAR COVER	8430-00-580-1205-06			1,427		
	8430-00-591-1359			115		
GLOVE INSERTS	8415-00-782-2809			169,559		
CP GLOVE INSERTS	8415-01-138-2494-96			28,112		
MISC PROTECTION						
CP HELMET COVER	8415-01-111-9028			49		
FILTER CAN, C2/C2A1	4240-01-119-2315			117,521		
	4240-01-871-7842			170,729		
HOOD, MCU-2/P	4240-01-189-9423			1,441		
HOOD, M40/42 (ONE-PIECE)	4240-01-260-8723			2		
HOOD, M40A1 (QUICK DOFF)	4240-01-376-3152			586		
SECOND SKIN, MCU-2	NOT ASSIGNED	530,250	190,983	229		

Table G-3b. Navy Logistics Readiness Data – Consumables

NOMENCLATURE	NSN	DATA BELOW ARE PENDING VALIDATION OF REQUIREMENTS		FY04 STOCKS ON HAND (as of 30 Sept 04)	PROJECTED DUE IN	
		TOTAL SERVICE REQUIREMENT	1-4-2-1 REQUIREMENT		FY05	FY06
CONTAMINATION AVOIDANCE COMMODITY AREA						
CHEMICAL DETECTION EQUIPMENT						
DET KIT, M256A1	6665-01-133-4964			7,162		
DET PAPER, M8	6665-00-050-8529			121,550		
DET PAPER, M9	6665-01-226-5589			31,565		
NBC MARK SET, M274	9905-12-124-5955			144		
TUBE PHOSGENE	6665-01-010-7965			660		
WATER TEST KIT, M272	6665-01-134-0885			412		
BIOLOGICAL DETECTION EQUIPMENT						
HAND HELD ASSAYS	6665-01-504-8534			12,000	30,000	
DECONTAMINATION COMMODITY AREA						
CALCIUM HYPOCHLORITE (6 oz)	6810-00-255-0471			8,671		
CALCIUM HYPOCHLORITE (100 lb)	6810-12-132-2439			109		
DECON KIT, M291 (Box of 20)	6850-01-276-1905			74,781		
DECON KIT, M295 (Box of 20)	6850-01-357-8456			36,456		
SODIUM HYPOCHLORITE	6810-00-598-7316			391		
STB, 50 LB	6850-00-297-6653			1,029		
COLLECTIVE PROTECTION COMMODITY AREA						
FILTER, GP, M48A1	4240-01-363-1311			124	91	104
FILTER SET, SHIPBOARD (M98)	4240-01-369-6533			0	3,638	3,414
PRE-FILTER, SHIPBOARD CPE	4240-01-474-8855			27	4,648	4,648
PRE-FILTER, SHIPBOARD CPS	4130-01-474-8851			54	7,344	7,344
LP FILTER, 1000 CFM	4240-01-347-6190			0	217	509
MEDICAL COMMODITY AREA						
2-PAM CHLORIDE AUTOINJ	6505-01-125-3248			156,519		
ATROPINE AUTOINJ	6505-00-926-9083			140,746		
CANA AUTOINJ	6505-01-274-0951			44,374		
NAAK, MKI	6505-01-174-9919			26,719		
PYRIDOSTIGMINE TAB	6505-01-178-7903			41,234		
ANTIDOTE TREATMENT KIT, CYANIDE	6505-01-143-4641			72		
SODIUM NITRITE INJ (300 MG) KIT	6505-01-206-6009			78		
SODIUM THIOSULFATE INJ (12.5 G) KIT	6505-01-206-6010			30		
ATROPINE 1MG/ML 1ML VIAL, 25s	6505-00-957-8089			1,202		
ATROPINE 2MG/ML 25ML VIAL	6505-00-299-9673			10,042		
POTASSIUM IODIDE TABS 14's BTL	6505-01-116-8198			7,770		
POTASSIUM IODIDE TABS 14's IS	6505-01-496-4916			346		
PATIENT WRAPS	6530-01-383-6260					

Table G-3b. Navy Logistics Readiness Data - Consumables

NOMENCLATURE	NSN	DATA BELOW ARE PENDING VALIDATION OF REQUIREMENTS		FY04 STOCKS ON HAND (as of 30 Sept 04)	PROJECTED DUE IN	
		TOTAL SERVICE REQUIREMENT	1-4-2-1 REQUIREMENT		FY05	FY06
OTHER TREATMENTS *						
CIPROFLOXACIN 500 MG TAB 100s IS	6505-01-273-8650			4,546,700		
500 MG TAB 100s BTL	6505-01-333-4154			3,624,200		
DOXYCYCLINE CAPS, 100s	6505-00-009-5060			2,628,800		
500s	6505-00-009-5063			4,934,500		
INDIVIDUAL GUIDE TO MBCDM	7610-01-492-7703			0		

* The unit of measure on all of these items is “tablets”

Table G-4a. Marine Corps Logistics Readiness Data – Non-Consumables

NOMENCLATURE	NSN	DATA BELOW ARE PENDING VALIDATION OF REQUIREMENTS		FY04 STOCKS ON HAND (as of 30 Sept 04)	PROJECTED DUE IN						
		TOTAL SERVICE REQUIREMENT	1-4-2-1 REQUIREMENT		FY05	FY06	FY07	FY08	FY09	FY10	FY11
INDIVIDUAL PROTECTION COMMODITY AREA											
CB MASK											
MASK, CB, M40/M40A1	4240-01-258-0061-63	149,512		160,199							
MASK, M42A2, TANK	4240-01-258-0064-66			25							
MASK, MCU-2/P, -2A/P	4240-01-284-3615-17			17							
MISC PROTECTION											
MASK COMM AMPLIFIER M7	5996-01-381-9012			23,717							
PATS, M41	4240-01-365-8241			233	26						
CONTAMINATION AVOIDANCE COMMODITY AREA											
NUCLEAR DETECTION EQUIPMENT											
AN/PDR-75	6665-01-211-4217			435	6						
AN/VDR-2	6665-01-222-1425			1,771							
BIOLOGICAL DETECTION EQUIPMENT											
JBAIDS	NOT ASSIGNED	98	49	0	5	38	0	0	0	0	0
JBPDS (MOBILE)	6665-01-452-8643	113	80	0							
JBPDS (FIXED)	6665-01-453-5385			0							
CHEMICAL DETECTION EQUIPMENT											
ACADA, M22	6665-01-438-6963	622	441	553	342						
ALARM, CAA, M8A1	6665-01-105-5623			0	3						
CAM 1.5	6665-01-359-9006			0							
CAM 2.0	6665-99-725-9996			1,955	907						
M21 RSCAAL	6665-01-382-1968			105	2						
NBC RECON SYS, M93	6665-01-372-1303			4							
NBC RECON SYS, FOX	6665-01-372-2582			2							
DECONTAMINATION COMMODITY AREA											
DECON APPAR, M11	4230-00-720-1618			9,870							
DECON APPAR, M13	4230-01-133-4124			2,088							
L/WT DEC SYS, M17A1	4230-01-303-5225			6							
L/WT DEC SYS, M17A3	4230-01-346-3122	1,570	0	31	9						
HEAVY FUEL DECON	4230-01-492-1540			819							
COLLECTIVE PROTECTION COMMODITY AREA											
JOINT EXPEDITION-ARY CP SHELTER	4240-01-346-2564			8							
MEDICAL COMMODITY AREA											
LITTER, DECONTAMINABLE	6530-01-380-7309			36							

Table G-4b. Marine Corps Logistics Readiness Data - Consumables

NOMENCLATURE	NSN	DATA BELOW ARE PENDING VALIDATION OF REQUIREMENTS		FY04 STOCKS ON HAND (as of 30 Sept 04)	PROJECTED DUE IN	
		TOTAL SERVICE REQUIREMENT	1-4-2-1 REQUIREMENT		FY05	FY06
INDIVIDUAL PROTECTION COMMODITY AREA						
OVERGARMENTS						
JSLIST OVERGARMENTS		784,992	595,498	91,151	51,126	21,421
Woodland Coat	SEE TABLE G-5					
Woodland Trousers	SEE TABLE G-5					
Desert Coat	SEE TABLE G-5					
Desert Trousers	SEE TABLE G-5					
M-2 APRON	8415-00-281-7813-16			6,499	800	
SUIT, CP, SARATOGA	8415-01-333-7573-76			472,834		
SUIT, CP SARATOGA-DESERT	8415-01-333-7577-80			23,491		
OVERBOOTS/GLOVES						
JLIST MULO	8430-01-464-9453-84			62,212		
BLK/GRN VINYL O/BOOTS BVO	8430-01-317-3374-85			226,070	34,549	
GVO	8430-01-049-0878-87			6,826		
CP FOOT COVERS	8430-01-021-5978			6,562		
CP GLOVES 25 MIL	8415-01-033-3517-20			309,084		
MISC PROTECTION						
2D SKIN, M40 SERIES	4240-01-413-1540-43			98,605	7,866	
FILTER CAN, C2/C2A1	4240-01-119-2315			313,321		
	4240-01-361-1319			0	20,000	
FITLER CAN, M10A1	4240-00-127-7186			0		
FILTER ELEMENT, M13A2	4240-00-165-5026			0		
HOOD, M40	4240-01-376-3152			25,370		
HOOD, M5 FOR M25A1	4240-00-860-8987			0		
HOOD, M6A2 FOR M17	4240-00-999-0420			0		
HOOD, M7 (FOR M24)	4240-01-021-8695			0		
CONTAMINATION AVOIDANCE COMMODITY AREA						
CHEMICAL DETECTION EQUIPMENT						
BATTERY, BA-3517	6135-00-450-3528			0		
BATTERY, ICAM BA-5800	6665-99-760-9742			348		
BATTERY, ACADA BA-5590	6135-01-036-3495			0	49	
DET KIT, M256A1	6665-01-133-4964			4,679	3	
DET PAPER, M8	6665-00-050-8529			130,525		
DET PAPER, M9	6665-01-049-8982			977		
	6665-01-226-5589			14,683	5,000	
NBC MARK SET, M274	9905-12-346-4716			0		
WATER TEST KIT, M272	6665-01-134-0885			597	200	
DECONTAMINATION COMMODITY AREA						
DECON KIT, M291	6850-01-276-1905			34,515	2,424	
DECON KIT, M295	6850-01-357-8456			7		
NITROGEN CYLINDERS	4230-00-775-7541	0		0		

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

NOMENCLATURE	NSN	DATA BELOW ARE PENDING VALIDATION OF REQUIREMENTS		FY04 STOCKS ON HAND (as of 30 Sept 04)	PROJECTED DUE IN	
		TOTAL SERVICE REQUIREMENT	1-4-2-1 REQUIREMENT		FY05	FY06
SORBENT DECON SYSTEM	4230-01-466-9095			88,396	1,000	
STB, 50 LB	6850-00-297-6653			4,738		
COLLECTIVE PROTECTION COMMODITY AREA						
FILTER, CP, M12A2 (M14 GPFU)	4240-01-365-0981			37		
FILTER, CP, M13 SERIES (M14 GPFU)	4240-00-368-6291			38		
FILTER, CP, M18A1	4240-01-365-0982			149	0	
FILTER, CP, M19	4240-00-866-1825			39	0	
FILTER, GP, M48A1	4240-01-363-1311			322	0	
M98 FILTER SET (M59, M56, SHIPBOARD)	4240-01-369-6533			0		
FILTER, HSFS	.4240-01-366-6243			0		
ICPS (MGPTS), CB Liner	8340-09-000-2480			0		
MEDICAL COMMODITY AREA						
2-PAM CHLORIDE AUTOINJ	6505-01-125-3248			76,097		
ANTID TREAT NERVE AG AUT	6505-01-362-7427			0		
ATROPINE AUTOINJ	6505-00-926-9083			97,891		
CANA AUTOINJ	6505-01-274-0951			27,799		
NAAK, MKI	6505-01-174-9919			3,551		
PYRIDOSTIGMINE TAB	6505-01-178-7903			24,145		
ATROPINE 1 MG/ML, 1ML VIAL, 25s	6505-00-957-8089			450		
2-PAM CHLORIDE AUTOINJ	6505-01-125-3248			1,255		
OTHER TREATMENTS						
CIPROFLOXACIN 500 MG TAB 100s IS+	6505-01-273-8650			367,800		
500 MG TAB 100s BTL+	6505-01-333-4154					
DOXYCYCLINE CAPS, 500s +	6505-00-009-5063			1,293,500		
DOXYCYCLINE TABS, 100 MG, 500s +	6505-01-153-4335					
INDIVIDUAL GUIDE TO MBCDM	7610-01-492-7703			0		

* Includes SOF, Training, Chemical Testing, and Surveillance
** Includes Joint Service stocks held for all Services prior to fielding
\+ Unit of measure on these items is "tablets"

Table G-5. Defense Logistics Agency Logistics Readiness Data - Consumables

NOMENCLATURE	NSN	FY04 STOCKS ON HAND (as of 30 Sept 04)	PROJECTED DUE IN FY05	PROJECTED DUE IN FY06
INDIVIDUAL PROTECTION COMMODITY AREA				
OVERGARMENTS				
CAPE, AIRCREWMAN	8415-01-040-9018	174,745	30,000	30,000
CHEM PROT UNDERGARMENT TOP	8415-01-363-8692-00	154,436	10,767	0
CPU DRAWERS	8415-01-363-8683-91	10,342	47,469	0
EOD M-3 TAP	8415-01-105-2535	7,000		
EOD TAP GLOVES	8415-00-753-6550-54	30,000		
JSLIST OVERGARMENTS *			929,463	664,399
Woodland Coat	8415-01-444-1163/-1169/-1200/38/49/65/70	25,521		
Woodland Trousers	8415-01-444-1435/39/-1613-/2308/10/25/38	10,886		
Desert Coat	8415-01-444-5902/05/13/26/-6116/31/38	8,757		
Desert Trousers	8415-01-444-5417/5504/06/-5892/93/98/-5900	5,747		
OVERBOOTS/GLOVES				
JLIST MULO	8430-01-464-9453-84			
BLK/GRN VINYL O/BOOTS	8430-01-317-3374-85	101,523	578,000	555,000
CP GLOVES 7 MIL	8415-01-138-2501-04	105,000	141,000	141,000
CP GLOVES 14 MIL	8415-01-138-2497-00	134,000	741,000	741,000
CP GLOVES 25 MIL	8415-01-033-3517-20	400,000	628,000	628,000
GLOVE INSERTS	8415-00-782-2809	208,000	38,000	38,000
CP SOCKS	8415-01-040-3169	180,590		
DISP FOOTWEAR COVER	8430-00-580-1205-06	21,678	52,704	52,704
MISC PROTECTION				
CP HELMET COVER	8415-01-111-9028	400,000	272,000	272,000
CONTAMINATION AVOIDANCE COMMODITY AREA				
CHEMICAL DETECTION EQUIPMENT				
BATTERY, BA3517	6135-00-450-3528	6,879	15,060	15,060
MAINTENANCE KIT, M293	5180-01-379-6409	1,474	1,102	1,102
TUBE, DET, PHOSGENE GAS	6665-01-010-7965	126	809	809
DECONTAMINATION COMMODITY AREA				
CALCIUM HYPOCHLORITE (6 oz)	6810-00-255-0471	27,071	52,984	52,984
STB, 50 LB	6850-00-297-6653	8,339	684	684
MEDICAL COMMODITY AREA				
2-PAM CHLORIDE, AUTOINJ	6505-01-125-3248			
ATROPINE AUTOINJ	6505-00-926-9083			
CANA AUTOINJ	6505-01-274-0951			
NAAK, MKI	6505-01-174-9919			
PYRIDOSTIGMINE TABLETS	6505-01-178-7903			
LITTER, DECONTAMINABLE	6530-01-380-7309			
ATROPINE SULFATE AEROSOL	6545-01-332-1281			
ANTIDOTE TREAT KIT, CYANIDE	6505-01-457-8901			

* DLA purchases JSLIST overgarments for the Services. Projected Service allocations are included in the individual Service totals.
JSLIST projected due-in (FY05-FY06) are listed as totals for coat/trousers and woodland/desert

G.2 FIELDED CBRN DEFENSE ITEMS - ISSUES AND CONCERNS

CBRN defense items are generally used in combination to form a system or subsystem for a particular function. Therefore, this report will address items used as a system. These systems are categorized into five functional areas: (1) Contamination Avoidance, (2) Individual Protection, (3) Collective Protection, (4) Decontamination, and (5) Medical.

G.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 CB 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 may appear to be initially low in inventory, but their quantities will improve with continued procurement in coming years.

The number of biological detection devices, to include the Biological Integrated Detection System (BIDS), Interim Biological Agent Detector (IBAD), Dry Filter Unit (DFU), and Joint Portal Shield has historically been low as measured against requirements. Automatic biological agent point detectors and stand-off detectors are currently in development, and will not be deployed in significant numbers prior to FY05. 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 (JBPDS), the Marine Corps will not have that capability either. The Navy is fielding the DFU, which is a commercially available system, thus lowering risks sometimes associated with defense industries. The DFU is an environmental air sampling system designed to be used with biological agent assays and confirmatory laboratories to provide a "Detect to Treat" capability for US Naval forces ashore and afloat. It may be employed for periodic environmental sampling to detect covert releases or may be used to collect air samples from a suspected incident scene. The DFU is a high volume air sampler whose purpose is to collect airborne particulate matter as it is drawn through a 1 micron filter. Used filters are removed from the unit and the residue rinsed into a buffer solution. The filters, solution and other items needed to collect particles and perform presumptive testing are packaged in a consumable DFU kit. The sample solution is analyzed via disposable hand held assays (HHAs) for the detection and identification of biological agents. Training and operational HHAs have a shelf life of one year if kept at constant temperature. Shipboard conditions may not be optimal, increasing risk of insufficient quantities being available. The operational and training HHAs received NSNs and the DFU kit has received an NICN. The Navy has begun barcoding to better track items and to reduce risk of spoilage.

The combined total of chemical agent detection systems will improve slowly as the M22 Automatic Chemical Agent/Detector (ACADA) supplements the M8A1 Automatic Chemical Agent Alarm. There is a shipboard variant of the ACADA, the MK 27 Mod 0, which is able to operate in a shipboard environment. 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.

The M93A1 NBCRS is currently fielded according to schedule. 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 adding a supplemental capability.

Traditional consumables in this commodity area (M8 and M9 detection paper, M256A1 kits and M272 water test kits) are usually available in sufficient quantities to meet wartime requirements. Some shortages may 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 meet 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 through the depot system. The Navy has small quantities of older RADIACs still in the inventory, which are being replaced through a modernization program. The Navy is in the process of replacing the AN/PDR-27 and AN/PDR-43 with the AN/PDQ-1 (Multi-Function RADIAC) and OA-9449/PDQ (Gamma Beta Probe). Inventories of legacy equipment are sufficient to meet fielding needs, and the remaining procurement of the AN/PDQ-1 is currently fully funded and programmed to be completed in FY08. The Marine Corps is estimated to have sufficient AN/VDR-2s and about half of the necessary AN/PDR-75s, putting RADIACs in the 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.

G.2.2 INDIVIDUAL PROTECTION

Individual protection equipment is designed to protect against CB warfare threat agents, Toxic Industrial Chemicals (TICs), and Toxic Industrial Materials (TIMs). Past Service-unique requirements led to Service-specific procurements and some duplication in capability resulting in the procurement of six different chemical protective overgarments and six different masks. This has caused difficulties in meeting current needs and exacerbated logistics planning.

The Joint Program Manager for Individual Protection (JPM-IP) has organized his Program Office into 5 teams: Surface Protection Ensembles, Aviation Protection Ensembles, Surface Respiratory Protection, Aviation Respiratory Protection and Universal "Common" Individual Protective Equipment (IPE). Fielding of Joint Individual Protection equipment through these teams has begun to resolve many of these former challenges.

G.2.2.1 Surface Protection Ensembles

Garments. The Services are continuing acquisition of the Joint Service Integrated Suit Technology (JSLIST) overgarments as a replacement for the Battle Dress Overgarment (BDO) and other chemical protective overgarments. As such, the protective overgarments should be viewed as a system with the older overgarments 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. DLA/DSCP has surge clauses in current contracts

that would bring production up to about 120,000 overgarments per month. However, through bilateral agreement DLA/DSCP contractors began to produce more than 128,000 overgarments per month beginning in April 2003. By examining the year-by-year status of protective overgarments, a number of older overgarments still within service life were added to the number of JSLIST overgarments purchased by that year and matched the total against the requirements. In FY04, the total Services' inventory of protective overgarments was at high risk of not meeting projected requirements. Additionally, available inventory will continue to drop as the service life of older protective overgarments, such as BDOs, expires in large quantities. Near term buys will moderate that risk, however. Also, the JSLIST team is taking steps to identify alternative sources for manufacture of JSLIST overgarments, which will add to the overall production capacity.

The 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 typically have sufficient overgarments 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 and Navy until the JSLIST is available in adequate numbers.

Combat Vehicle Crewmen (CVC) and aircrews require special protective ensembles to integrate with their weapon systems. To protect armor crewmen from gross liquid contamination when they exit their vehicles, the Services have developed the Suit Contamination Avoidance Liquid Protection (SCALP), which is available in sufficient quantities. The Joint Protective Aircrew Ensemble (JPACE) is scheduled to replace present protective ensembles for both CVC and aircrew personnel.

Gloves. The Services are expected to have adequate stocks of 14 and 25-mil chemical protective gloves in FY04 for contingency use. In FY03, 7-mil gloves were in short supply. An additional buy will be made to ensure that DLA will have adequate stock on hand. Recent DoD surveillance tests are validating the protective qualities of the existing butyl rubber glove stocks. The status of the Services on-hand inventories has allowed DLA to pursue an Industrial Base Maintenance Contract (IBMC) with both current manufacturers to sustain the industrial base with "War Stopper" funding. The purpose of the IBMC is to maintain the equipment only. The JSLIST Block 1 Glove Upgrade (JB1GU) candidates #508 and #513 are interim replacements for the current butyl rubber gloves and will reduce reliance on them.

Footwear. Chemical Protective Footwear Covers, also known as the "fishtail", 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 completely 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 or suitable boot is fielded in sufficient quantities. Currently, the total DoD inventory shows adequate quantities of protective footwear, resulting in low risk assessment. The Air Force has plans to continue use of current GVOs. The USMC and the Navy are the only services reporting a shortage of footwear, but DLA can fill the shortfall for shore units. The JRO-CBRN Defense has validated a U.S. Navy urgent requirement for chemical protective footwear with a reduced volume that meets shipboard storage constraints. Existing chemical protective footwear volume is too large and the Chemical Protective Footwear Cover is no

longer in production. The Navy has identified a commercial lightweight overboot (Airboss Lightweight Overboot) and has authorized its use by ships requiring replacements for the fishtail, and for new construction ships pending fielding of the Alternative Footwear Solution (AFS). 175,000 pairs of the Airboss Lightweight Overboot will be fielded to the U.S. Navy during FY04 and FY05.

Other: The Chemical Protective Helmet Cover is intended to provide Chem/Bio protection for the standard helmet. It is a one-piece configuration made of butyl coated nylon cloth and gathered at the opening by elastic webbing enclosed in the hem.

G.2.2.2 Aviation Protection Ensembles

Services usually have sufficient numbers of aircrew overgarments to meet minimum requirements, given the smaller total requirements for aircrews (relative to ground troops). An exception is the Chemical Protective Undercoverall, which is now obsolete. For the USAF, it is replaced by the CWU-66/77P Aircrew Chemical Protective Suit. The USN and USMC aircrew are now using the CMU-34/P undershirt and CMU-35/P drawers (formerly known as Navy modified Chemical Protective Undergarment) in conjunction with the flyer's Summer Coverall for adequate protection.

Disposable Footwear Covers are worn over the flyer's boots. They protect the aircrew member from contamination en route between the shelter and the aircraft. They must be removed before entering the aircraft. The footwear covers come in three sizes: medium, large, and extra large. The Aircrew Cape is a large, clear, disposable, 4-mil polyethylene bag worn over the body. The cape protects the aircrew member from liquid contamination en route between the shelter and the aircraft and must be removed before entering the aircraft. It is available in one size. The JPACE is scheduled to replace existing aircrew ensembles for both fixed and rotary wing aircrew personnel.

G.2.2.3 Surface 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 replace the M17 and M25-series masks, respectively. Some Navy shore activities and Navy Expeditionary Air squadrons are also using the M40 series masks.

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 2005. PIP actions included 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 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 eye lens-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-2/P and MCU-2A/P masks are designed to meet the needs of the Air Force ground crews, and Navy shipboard and shore-based support missions. In FY01, due to the

inability of production to keep with demand, the decision was made to transition Navy shore-based expeditionary forces in the more readily available M-40A1 mask. This decision allowed for an increased inventory of MCU-2P masks for shipboard requirements. Additionally, testing of MCU-2/P Masks as part of the Navy Readiness Improvement Program (RIP) have generated failure rates of up to 30%, increasing the production requirement. The addition of new production lines for MCU-2P at the vendor has stabilized the shortage problem for now. The USAF has some shortages in masks. Second skins, which provide complete personal protection, are currently in First Article Testing in preparation for production. The MCU-2/P and MCU-2A/P masks will continue to be the mainstay of these units until the JSGPM is fielded.

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 usually rated as low risk. The MCU-2/P hood also typically has abundant inventory. Second skins for the MCU-2/P and MCU-2A/P are in development and will be issued beginning in FY04. 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. Historically, the Chemical Protective Helmet Cover has also been available in sufficient quantities. The Joint Service General Purpose Mask (JSGPM) will replace the M40/M42 series and the MCU-2/P series of protective mask.

G.2.2.4 Aviation Respiratory Protection

The M43-Type I mask was designed to be used by Apache equipped units. It is being replaced by the M48 (Apache) series mask. The M45 will replace the M24 and the M43 Type II masks as the general aviation mask for Army aircrew (except Apache). This modernization effort is still ongoing; not all units have replaced their M43-series masks. All of these masks are seen as low risk, as the combined numbers of all aviator masks on hand usually exceeds the requirement. The USN & USMC aircrew are currently using the A/P22P-14(V1-4), also known as the NDI Respirator, which is a common man-mounted system with variants to address Naval aircraft oxygen connections. These masks provide increased protection, improved fit and comfort, and compatibility with most Services' weapons systems' optics and sights. The Joint Service Aircrew Mask (JSAM) is scheduled to replace all existing aircrew protective 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.

Key Component Consumables for Respiratory Protection. 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, A/P22P-14(V1-4), and MCU-2/P series masks. The M13A2 filter element will be leaving the inventory with the retirement of the M17-series mask. The M10A1 filter canister used on the M24/25 is in short supply, but these masks will also leave the inventory and will not be a readiness problem.

The Mask Communicator Amplifier, M7 provides effective voice communication between masked personnel enhancing command and control on the NBC contaminated battlefield.

The Second Skin was a pre-planned product improvement that provides liquid agent protection for the M40 mask face blank material. It is a butyl rubber blend that is very durable. A Second Skin is also being fielded for the Navy's and Air Force's MCU-2A/P.

G.2.2.5 Universal "Common" IPE

During the issuing process for Protective Masks it is absolutely essential that the mask be properly fitted to the individual to ensure the highest protective value. The M41 Protection Assessment Test System (PATS) validates proper fit of a mask to the face of the individual. It tests all current military and several commercial masks. The system provides a visual display of the fit achieved by the mask when worn by the individual and requires calibration every 18 to 24 months. It is currently in use by the Army, Air Force and Marines.

The Joint Service Mask Leakage Tester (JSMLT) supplements the M41 PATS in some cases and replaces it in other cases. The Army is to be the user of the M41 PATS and the Navy, Air Force and Marine Corps are to use the JSMLT. However, the Navy, Air Force, and Marine Corps will continue to use the M41 PATS until the JSMLT becomes widely available.

The MQ1A mask tester also validates proper fit of a mask to the face of the individual. It tests currently fielded AF MBU-5/P and MBU-12/P aviator masks and the MBU-13/P and MBU-19/P aviator NBC protective masks. The system provides a visual display of the fit achieved by the mask when worn by the individual. It is currently in use by the Air Force at units supporting the MBU-5/P, MBU-12/P, MBU-13/P and MBU-19/P.

G.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 usually in short supply due to low peacetime demand and low production quantities.

The Air Force has expressed interest in a greater collective protective shelter capability. Combined with the Navy's increasing shipboard collective protection filter requirements due to a continually increasing number of ships with CPS, and the Army and Marine Corps traditional integrated vehicular systems and tactical shelter requirements, the near-term requirements for large carbon-based filters have outpaced current inventories even aided by industrial surge capability. As a result, much of this sector may be 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.

The M51 shelter has been replaced by the Chemical and Biological Protective Shelter (CBPS). All Army M51 shelters have been coded as unserviceable. The CBPS received Milestone C approval and is presently in full rate production. Limited quantities of CBPS were fielded to U.S. Army and U.S. Marine Corps units in support of an Urgent Materiel Release for Operation Enduring Freedom/Operation Iraqi Freedom. Current funding supports the production of 364 of the 779 CBPS systems identified by previous Defense Planning Guidance. CPBS will experience a break in production in FY04 and FY05 due to recent budget adjustments. 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 production of chemically protected heaters and air conditioners was initiated in FY99. Procurement and production of CP DEPMEDS components are ongoing. All components will be assembled into CP DEPMEDS sets at depot. The budget supported the production of 12 of the 18 CP DEPMEDS sets identified by previous Defense Planning Guidance (DPG). No additional funding was programmed beyond FY03. Limited quantities of CP DEPMEDS were fielded to U S Army hospitals in support of an Urgent Materiel Release for Operation Enduring Freedom/Operation Iraqi Freedom. The Collective Protection for Expeditionary Medical Shelter System (CP EMEDS) program is an effort to fill the shortfall by inserting environmentally controlled collective protection into currently fielded hospital Alaska shelters. In FY00, production was initiated for remaining M28 CPE, CB protected water distribution and latrine systems, CB ISO Shelter Seals and Low Pressure Alarms.

The M20/20A1 Simplified CPEs are used to provide a contamination-free, environmentally controlled workspace 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. M20A1 SCPE procurement was initiated in FY03 and production is ongoing. This leads to a reduced risk assessment since production delivery is scheduled to begin in early 2004. The M20/M20A1 Simplified CPE is no longer a free issue item since the class of supply was changed from class VII to a class II secondary major end item and as such is funded by Army Working Capital Funds. 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 shelter outside of the medical community in the inventory.

The Services have continued to improve integrated collective protection systems in armored vehicles, vans, and ships. 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 chassis. Notable progress has been made in providing shipboard collective protection. By the year 2007, 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 meet requirements has not been initiated for all filters primarily due to insufficient funding but also since procurement of such filters is demand-driven. 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 (M98) are being procured in sufficient quantities, although filters are backordered due to current manufacturing limitations (Currently, out of NSWC Dahlgren, there are 3045 200 CFM CBR filter sets on backorder. NSWCDD could easily accept delivery of 1500 filter sets today and still not have enough to fulfill current requirements. There is no war reserve). Continued difficulties in obtaining a strong industrial base in this field compounds the issue of fielding and sustaining these items.

G.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 M100 Sorbent Decontamination System (SDS), as well as pressurized water dissemination systems like the Modular Decontamination System (MDS) and/or the M17 series systems, to eliminate gross contamination. Hot soapy water delivered via such systems are promoted for aircraft decontamination by both the Army and the Air Force. The SDS replaces the M11 Decontamination Apparatus, Portable (DAP) and the M13 DAP, which are being eliminated from all inventories within the U.S. Army and Marine Corps. The M100 began fielding in 2002 and is anticipated to continue beyond 2005. Army Working Capital funded quantities were available for purchase beginning in 2003.

The M17A3 Lightweight Decontamination System (LDS) is used to provide operational equipment decontamination in many battalion-level units and dual-purpose (smoke/ decon–tamination) chemical companies. The Marine Corps is upgrading all of their LDS to the diesel engine. The Air Force employs the M17A3 at the squadron level for operational equipment decontamination. The Air Force is deleting stocks of A/E32-U systems by attrition and procuring additional M17A3s to satisfy shortages. The M17 is assessed as having some risk, due in part to a delay in rebuilding several hundred systems caused by a lack of funding since 1990. The M17 is no longer in production. M17 program risk is being mitigated though the purchase of commercial off the shelf systems in the near term, and through the development of the Joint Service Transportable Decontamination System – Small Scale (JSTDS-SS).

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 typically viewed as high risk because the maintenance requirements due to the age of this item limit its full utilization. The use of commercial off-the-shelf technologies will help lessen the risk of shortages. The Marine Corps is replacing their M12A1 PDDAs with the M17A3 LDS.

Bulk DS-2 stored at Seneca Army Depot (i.e., the Seneca Enclave in Romulus, NY, a storage complex operated by the U.S. Army Chemical Materials Agency) underwent lot testing to ascertain how much has deteriorated and is unusable. As a result of this study and safety assessment, the Army Deputy Chief of Staff (G-3) issued a memorandum on 16 July 2004 declaring, "effective immediately, all existing stocks of DS-2 are excess to the Army's requirements for chemical and biological decontaminants and will be handled in accordance with disposition instructions to be published. After 31 July 2004, DS-2 will not be used for any Army decontamination operations." The Marine Corps followed up on this Army action by issuing a message to all USMC commands in October 2004 stating that, "With the fielding of the M100 SDS, all DS-2 stocks supporting immediate decontamination are obsolete", and by directing: (1) the Marine Corps Combat Development Center (MCCDC) to remove the M11 and M13 DAP, the 1.3 quart can of DS-2, and the 5 gallon drum of DS-2 from their Tables of Equipment; (2) by directing MCCDC to "Ensure future doctrinal publications with applicability to the Marine Air-Ground Task Force (MAGTF) reflect alternative decontaminants and that references to DS-2 are removed; (3) by requesting from the CG, TECOM, that they "Ensure all

necessary programs of instruction are modified to reflect the removal of DS2 from the Marine Corps inventory"; and, (4) by directing all Marine Forces (MARFORS) that, "Upon receipt of disposition instructions from COMMARCORSYSCOM, dispose of all DS-2 inventory." While less hazardous replacement decontaminants, such as sorbent decon are being fielded, the quantities and packaging of current decontaminants present potential risk. The projected stockage of STB has been considered a high-risk category in the past. Slight shortages in calcium hypochlorite and sodium hypochlorite ("household bleach" at 5%-6% concentration) 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 1-4-2-1 construct scenario, and will be further refined. Continued monitoring is recommended.

The M291 Skin Decontaminating Kit is the only personal decontamination kit approved for use on skin in the U.S. military inventory. Although the kit is currently in backorder, projected buys are expected to meet service requirements. Rohm & Haas Co. was the sole supplier of the resin and made over 150,000 boxes in 1990–91 then sold their automated manufacturing line to the U.S. government. Rohm & Haas no longer supplies one of the XE-555 resin components. Since October 1996, Pine Bluff Arsenal, Arkansas, has been the sole producer of the M291 Decontaminating Kit. Over 60,000 pounds of this proprietary resin was purchased by the item manager and is now being provided to Truetech, Inc. for production of XE-555. When the 60,000 pounds are gone, XE-555 can no longer be procured. Block I of the Joint Service Family of Decon Systems (JSFDS) program will field a new skin decon kit to replace the M291 in 2007. The replacement is a Canadian product, Reactive Skin Decon Lotion (RSDL), which will be fielded as the Joint Service Personnel/Skin Decontamination System (JSPDS).

The projected stockage of the M295 Individual Equipment Decontamination Kit typically puts it in a low risk category. The M295 Decontamination Kit used to contain the same resin mix as the M291 Decontaminating Kit, but since January 2000, it contains an alumina-silica sorbent. The sorbent is much cheaper than XE-555 and readily available. Truetech, Inc. is the main producer of this item, with Pine Bluff Arsenal available for surge capability. Increased funding for its procurement would maintain the low risk.

G.2.5 MEDICAL

Medical CB 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 far-term. Quantities of Nerve Agent Antidote Kits (NAAK), and Atropine and 2-PAM Chloride Autoinjectors may fall short of requirements. Convulsant Antidote Nerve Agent (CANA), and Soman Nerve Agent Pyridostigmine Pretreatment (SNAPP) Tablets (also known as PB Tablets) will probably remain at low risk because of continued purchases. This report includes medical treatments for biological warfare agents and cyanide exposure along with the addition of new chemical treatments.

The FDA has approved SNAPP for the Military, in Jan 2003, for the use as a nerve agent pre-treatment for Soman, with a 10-year shelf life. This new material will require periodic testing after it reaches 5 years, but may not be extended beyond its original 10-year shelf life. The use of SNAPP will still require a complete audit trail, all the way to the user. Defense Supply Center – Philadelphia (DSCP) is working with ICN Pharmaceuticals to establish a requirements contract for the manufacture of SNAPP.

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 a 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, Autoinjecttor (ATNAA), which is a multi-chambered injector that began procurement in FY03. ATNAA will replace 2-PAM Chloride Autoinjectors and NAAK over the next 5-7 years. The Atropine Autoinjectors will still be required, but in a smaller quantity.

Patient Chemical Wraps, which are used to transport a patient, who is unable to wear a mask or suit due to their injuries, through an area that may still have a vapor hazard, have not been procured since 1991. The Wraps are made of a special five –layer material that provides protection from a chemical agent, but still allows the required carbon dioxide-oxygen exchange so no additional breathing apparatus is required. The material is no longer produced. The Office of the Surgeon General and the U.S. Army Medical Materiel Agency (USAMMA) with the Natick Soldier Center are currently assessing new material for the patient wrap before initiating new procurement of this item. The current stock of wraps has been tested for extended use and their use has been modified to a maximum of 3 hours. There is a very large stockpile of canvas litters that may 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 of the Army 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 Deployable Force Packages (DFP), which will support various sized groups of personnel, based on location and mission. 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. The status and schedule of the anthrax vaccination program is provided in Table 2-18 in Chapter 2 of this report.

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 Office of the Assistant Secretary of Defense Health Affairs and the Military Medical Departments in response to Congressional concern over the conservation of military medical resources developed the DoD/FDA Shelf Life Program. 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 Mater-

iel 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 re-marks the materiel and maintains it with the unit. The Marines re-mark the materiel at its centralized storage locations. The FDA no longer allows changes to expiration dates to be pen and ink changes. All extended materiel must have a new label, of the same color, font, and points as the original. The complete label may be replaced, or only the Lot with the new expiration date. The DoD/FDA Shelf Life Program has saved an average of $75.00 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 H

DoD Joint Service Chemical and Biological Defense Program Funding Summary

In accordance with 50 USC 1522, *Department of Defense Chemical and Biological Defense Program*, research, development, test and evaluation (RDT&E) and procurement for all DoD chemical and biological 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. 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 FY1996, funding was included in several separate Service and Defense Agency funding lines.

The detailed funding information in this annex is provided annually to Congress in the DoD Joint Service Chemical and Biological Defense Program (CBDP), President's Budget Submission, Research, RDT&E, Defense-Wide and Procurement, Defense-Wide budget exhibits, and in the Department of Defense Extract found in the Budget of the United States. These budget submissions provide a detailed account of prior year accomplishments and planned activities for the budget request period. Table H-1 (and Figure H-1) provides a summary of appropriated and requested funding from FY2004–FY2011. Detailed funding request for FY 2004–2011 are provided separately in the President's FY2006 Budget Submission.

Table H-2 (and Figure H-2) provides a summary of expenditures by the DoD CBDP. 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 H-2 will be updated in following years to show total expenditures of appropriated funds.

Table H-1. CB Defense Program Appropriations Summary.

Program Element (PE) ($ in millions)	FY04‡	FY05‡	FY06*	FY07*	FY08*	FY09*	FY10*	FY11*
0601384BP – Basic Research	46.946	54.056	72.533	52.701	58.910	56.734	51.911	53.167
0602384BP – Applied Research	150.898	168.827	187.787	179.914	174.754	164.819	160.263	159.361
0603384BP – Advanced Tech. Dev.	148.276	181.972	164.481	149.428	149.530	152.027	155.919	149.176
Science & Technology Base Subtotal	**346.120**	**404.855**	**424.801**	**382.043**	**383.194**	**373.580**	**368.093**	**361.704**
0603884BP – Advanced Component Development and Prototypes	128.350	125.718	100.796	74.392	78.009	60.816	60.560	67.832
0604384BP – System Development and Demonstration (SDD)	172.505	145.794	280.908	228.319	282.808	225.868	176.763	108.000
0605384BP – Management Support	56.059	36.434	81.425	81.417	81.380	82.946	77.819	81.483
0605502BP- Small Business Innovative Research (SBIR)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0607384BP – Operational Systems Development	0.000	2.131	10.093	8.137	11.084	19.884	16.986	22.388
RDT&E Subtotal	**703.034**	**714.932**	**898.023**	**774.308**	**836.475**	**763.094**	**700.221**	**641.407**
0208384BP – Procurement Subtotal	**545.379**	**674.576**	**650.659**	**669.230**	**726.210**	**760.959**	**822.298**	**861.781**
CB Defense Program Total	**1248.413**	**1389.508**	**1548.682**	**1443.538**	**1562.685**	**1524.053**	**1522.519**	**1503.188**

‡ Total Obligation Authority (TOA) * Estimated [from FY2006 President's Budget Request]

Table H-2. CB Defense Program Expenditures Summary.†

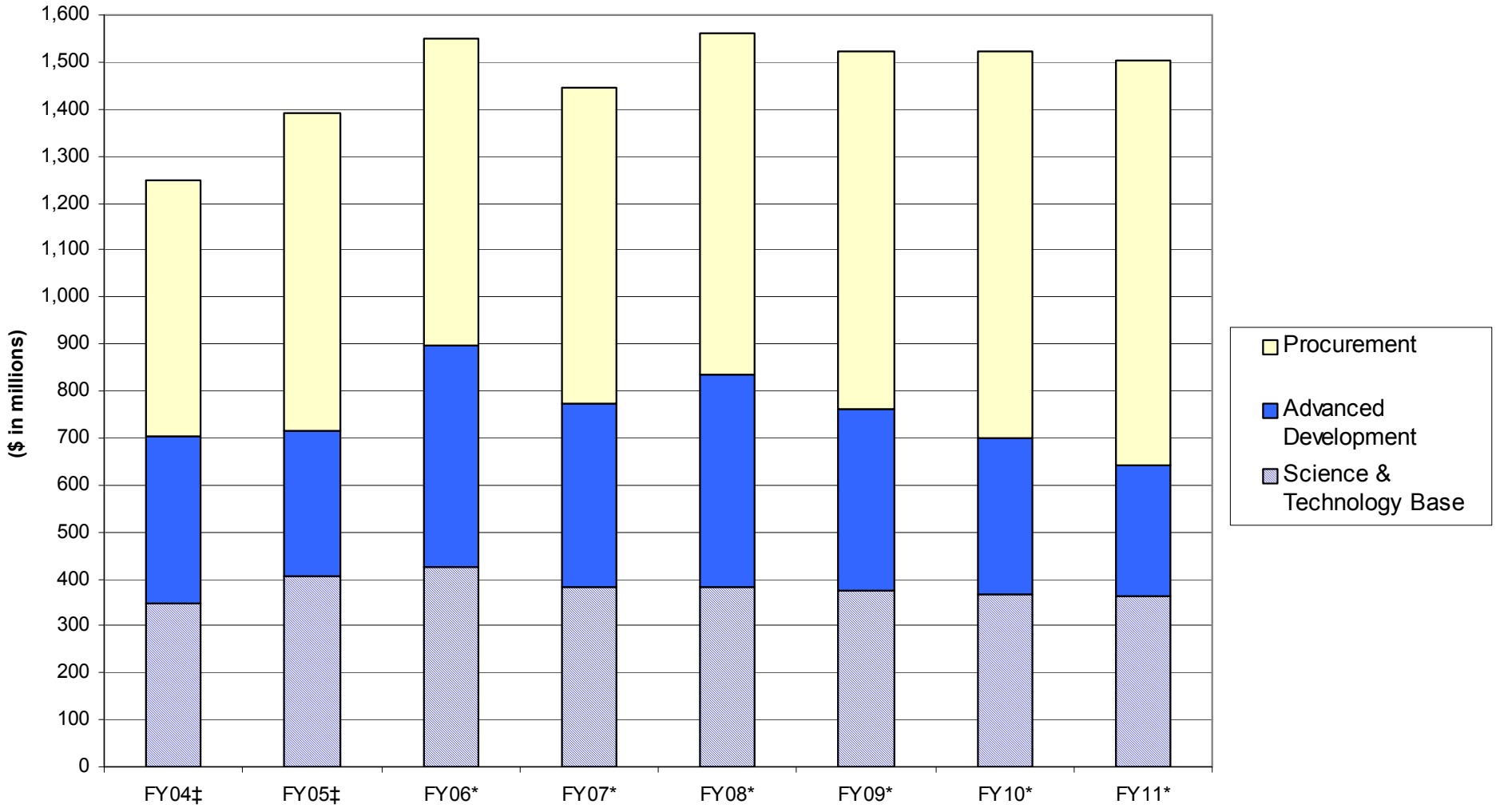
Program Element (PE) ($ millions)	FY98	FY99	FY00	FY01	FY02	FY03	FY04
RDT&E, Defense-Wide	332.120	337.515	382.989	398.007	558.101	524.024	201.556
Procurement, Defense-Wide	230.161	299.849	361.078	456.630	472.196	438.110	150.908
CB Defense Program Total	**562.281**	**637.364**	**744.067**	**854.637**	**1030.297**	**962.134**	**352.464**

† Expenditures as of September 30, 2004

Table H-3. DARPA Biological Warfare Defense Program Appropriations Summary.

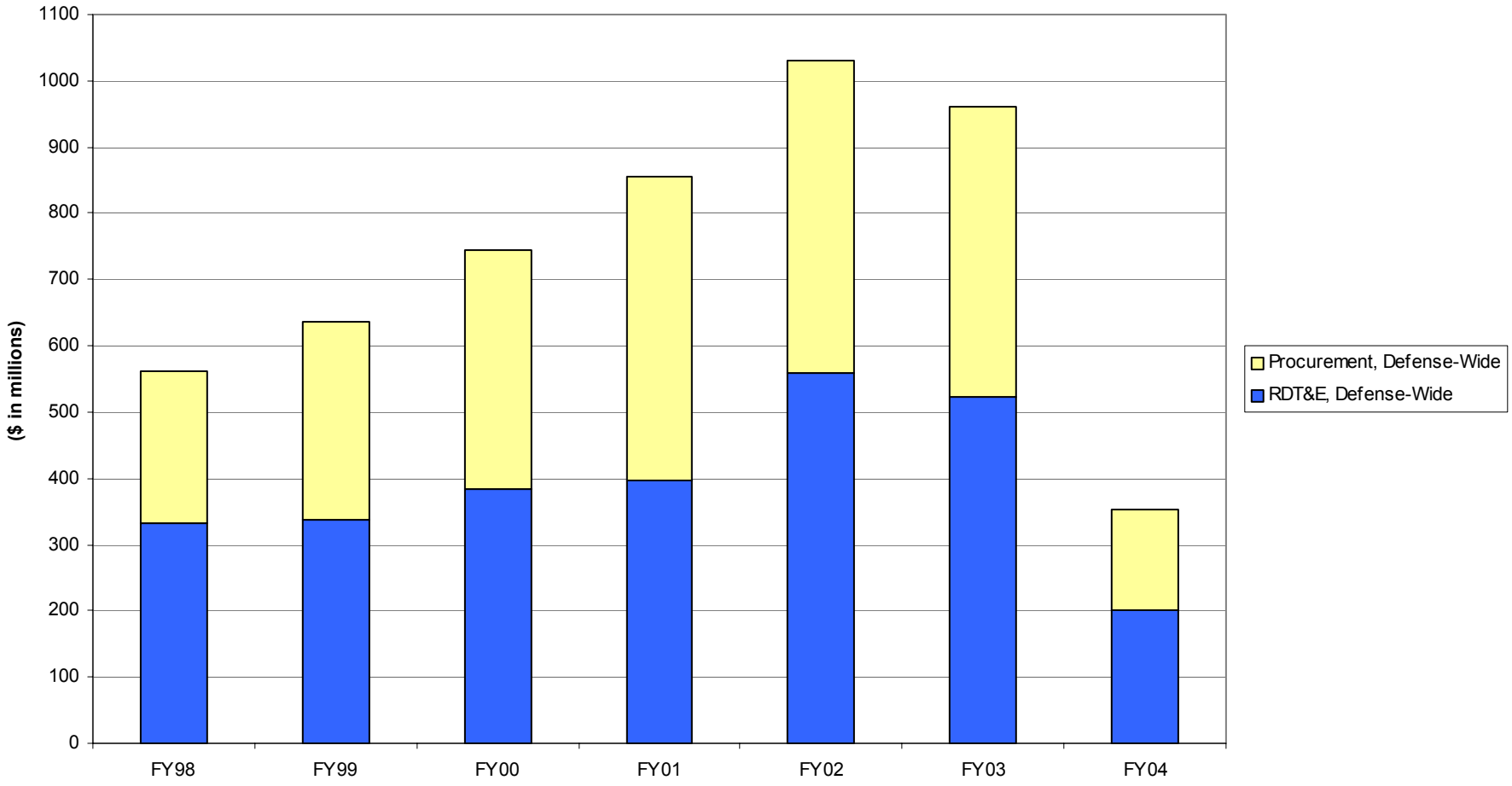
Program Element PE ($ in millions)	FY04‡	FY05‡	FY06*	FY07*	FY08*	FY09*	FY10*	FY11*
PE 0602383E – (BW-01) - Applied Research	141.921	159.567	145.354	144.050	144.615	140.414	140.914	140.914

‡ Total Obligation Authority (TOA) * Estimated [from FY2006 President's Budget Request]



FY04-FY05 = Total Obligational Authority FY06-11 = President's Budget Request
Science and Technology Base include Basic Research, Applied Research, and Advanced Technology Development
Advanced Development includes Advanced Component Development and Prototypes, SDD, Management Support, SBIR, and Operational Systems Development

Figure H-1. CB Defense Program Appropriations Summary.



†as of September 30, 2004 (includes reimbursable expenditures)

Figure H-2. CB Defense Program Expenditures Summary.

Annex I

Statement Regarding Chemical and Biological Defense Programs Involving Human Subjects

The reporting requirement (50 USC 1523) for the annual report to Congress on the DoD Chemical and Biological Defense Program was modified by Section 1086 of the FY98 National Defense Authorization Act. The amendment requires the following information:

> A description of any program involving the testing of biological or chemical agents on human subjects that was carried out by the Department of Defense during the period covered by the report, together with a detailed justification for the testing, a detailed explanation of the purposes of the testing, the chemical or biological agents tested, and the Secretary's certification that informed consent to the testing was obtained from each human subject in advance of the testing on that subject.

While DoD conducted tests involving the tests 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 document 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.

Table I-1 provides a summary of prior and planned tests conducted by the Department of Defense, both directly and 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.

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 that involve the exposure of unprotected human subjects to chemical or biological agents. All individuals involved in training or RDT&E activities involving live chemical or biological agents are fully protected and carefully monitored.

Table I-1. Summary of Experiments and Studies with Human Subjects Involving the Use of Chemical or Biological Agents.

November 25, 1969	–	Human biological agent testing ended
July 28, 1975	–	Human chemical agent testing ended
Since 1969/1975	–	No activities with human subjects involving exposure to biological agents nor chemical agents have occurred since testing ended

As part of the DoD Chemical and Biological Defense Program (CBDP), 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 unprotected 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.

As part of some training and RDT&E activities sponsored by the DoD CBDP and by the Military Departments, simulants are sometimes used to enhance the realism of operations in a chemical or biological contaminated environment. Simulants are not chemical or biological agents, but may simulate some of their properties (e.g., particle size, surface absorption). For all personnel involved in testing with simulants, (a) all personnel are informed of any hazards, if any, associated with the simulant, (b) all personnel are provided with appropriate protective equipment, and (c) all names are carefully recorded, and if at some point in the future it is determined that a simulant used in testing presents a potential health hazard, DoD notifies the personnel of potential risks to their health.

Annex J

Chemical and Biological Test and Evaluation Facilities

J.1 BACKGROUND AND REPORTING REQUIREMENT

In the FY04 Senate Armed Services Committee (SASC) Authorization Report (S. Rpt. 108-46 Report Language, p. 239), the SASC directed the Assistant to the Secretary of Defense for Nuclear, Chemical and Biological Defense Programs (ATSD(NCB)) and the Director, Operational Test and Evaluation (DOT&E) to report on the status of the test and evaluation facilities for chemical and biological (CB) defense programs. This Congressional reporting requirement was addressed in the FY04 report. This annex provides an update to previously provided information based on the planned investments and changes to the test and evaluation (T&E) infrastructure that are incorporated into the FY06 President's Budget Submission.

The development of CB defense equipment and medical countermeasures requires adequate T&E facilities. This annex provides an analysis of the capacity and versatility of the existing non-medical T&E infrastructure to meet the requirements of current and planned CB defense research and development programs, identifies capability shortfalls, and provides a description of the planned investments to correct these shortfalls. Also included is a listing of facilities for testing equipment with live agents and simulants. Facilities are listed which support animal testing and medical testing.

J.2 ANALYSIS OF TEST & EVALUATION INFRASTRUCTURE

J.2.1 Overview

Currently, T&E facilities are not adequate in terms of either capacity or versatility to meet the T&E needs of CBDP equipment. The dynamic nature of the expanding CB threat has exceeded the existing T&E capabilities. The CB Defense Program has a limited ability to test and evaluate equipment against evolving threats. Also, in many cases, state-of-the-art technology and analytical methods are lacking or inadequate. Critical improvements to threat representation of current and projected future threats are planned beginning in FY06. The Deputy Under Secretary of the Army (Operations Research), DUSA(OR), as the DoD CBD T&E Executive, was designated in 2003 to develop programs and integrated approaches to improve the T&E infrastructure to support the CBDP. Recommended programs and approaches have been identified. These recommendations form the basis of the FY06 President's Budget Submission. During 2004, the focus of the T&E program has been to integrate the T&E needs within the acquisition and technology development programs. The FY06 President's Budget Submission includes a planned increase in the investment for T&E facilities that is based on an integrated approach to structure executable CB defense programs. Funding of the T&E capabilities to fully address all the needs described below is being included for the first time in the CBDP, largely due to the priority of the capabilities required to support Combating Weapons of Mass Destruction objectives and the recognition that adequate characterization of CB defense system performance is a key part of each acquisition program. The increase in T&E infrastructure will

support both expansion of existing capabilities as well as development of new state-of-the-art capabilities.

Throughout FY04, the T&E Executive with support of the Joint Program Executive Office and Joint Science & Technology Office orchestrated a community-wide effort to identify CB defense T&E needs and to integrate these needs within CBDP RDT&E acquisition programs. In preparation for the FY06 POM, the CBDP conducted an alignment and synchronization effort for ensuring investment priorities and strategies would result in an executable program, which required improved T&E infrastructure. As a result of this coordinated effort, many of the CB T&E needs were integrated into acquisition and technology development programs during budget planning in summer 2004. In addition, the T&E needs were integrated into the Joint Requirements Office Enhanced Planning Process (EPP), which was presented to OSD to determine resources to support an executable CBDP to meet Warfighter needs for Combating Weapons of Mass Destruction. The EPP results were briefed throughout OSD during August through December 2004 and the study results accepted, which included a $443 million T&E infrastructure enhancement plan over the FY06–11 period. These results, endorsed by the joint CBD community, provide an investment strategy to support essential upgrades to CB T&E capabilities and constitute the first time that CBD T&E needs have been adequately addressed across the entire CBD community. As a result of the coordinated effort, CB T&E infrastructure improvements accounted for a significant portion of the Department's budget adjustments. Thus, the efforts by the CBDP T&E, acquisition, and S&T community to identify and resource CB T&E needs over the next five years, will result in the ability to properly invest for adequate CB defense T&E infrastructure for the first time. These resources will fund early involvement of the operational evaluation community in planning and developmental testing, key test facilities and equipment, development and validation of CB T&E capabilities, and operation of the DoD CB Defense Major Range and Test Facility Base (MRTFB), Dugway Proving Ground.

The funding expected to begin in 2006 will greatly increase the breadth, depth, and capability of the CBDP T&E infrastructure. There will be increased collaboration among R&D labs and T&E organizations to develop and standardize test methods, an increased focus on improved analytical capabilities, and validated use of data to produce operationally meaningful characterizations of systems performance. The FY06 budget also includes the full institutional funding of the DoD MRTFB operating costs in compliance with PL 107-314, Section 232.

J.2.2 Analysis of Capacity

The capacity, described below, has not changed materially since 2003. Significant changes in this capacity are not anticipated until FY06.

J.2.2.1 <u>Description of Selected T&E Facilities</u>. The following is an outline of key T&E facilities that are available to provide test data for the CBDP.

a. <u>Medical research facilities</u>. These facilities primarily provide research data, including animal testing with chemical and biological agents to demonstrate the safety and efficacy of medical products.

   i. *U.S. Army Medical Research Institute of Infectious Disease (USAMRIID)*: USAMRIID investigates infectious diseases that require special containment and provides a critical capability to infectious disease research as the only DoD

laboratory equipped to study highly hazardous viruses at Biosafety Level 4 (BSL-4). The Institute also operates a reference laboratory for definitive identification of biological threat agents and diagnosis of the diseases they produce.

ii. *U.S. Army Medical Research Institute of Chemical Defense (USAMRICD)*: USAMRICD provides extensive, world-renowned research capabilities to support the identification, development, and fielding of medical countermeasures against chemical and toxin agents.

iii. *Navy Medical Research Center (NMRC)*: The Biological Defense Directorate at NMRC provides rapid and confirmatory diagnosis of infectious diseases through analysis of a wide variety of clinical materials. The directorate explores basic and applied microbiological, immunological and related scientific research methodologies for the development of medical diagnostics. Research personnel have designed, developed, and tested a broad variety of methodologies that have allowed for swift and accurate disease diagnosis essential for substantive medical protection and readiness. In addition, researchers have been instrumental in the advancement and refinement of confirmatory diagnostic methods utilizing polymerase chain reaction (PCR) methodologies in tandem with innovative, state of the art biosensor technologies.

iv. Other Government and extramural facilities exist outside of the Department, but which are leveraged by the CBDP, including the National Institute of Allergies and Infectious Diseases (NIAID) and the Centers for Disease Control and Prevention (CDC). Medical testing is conducted in compliance with the rules, regulations, and requirements established by the Food and Drug Administration (21 CFR).

b. <u>Non-medical Research & Development (R&D) and T&E Facilities.</u>

i. *U.S. Army Edgewood Chemical and Biological Center (ECBC)*: BSL-3 and live chemical agent and simulant aerosol particulate bench chambers; CB protective filter and mask testing with live agents and simulants; Small animal live agent testing; Limited field simulant and interferent testing; Two Hazardous Material Explosion Facilities (16,000 cu ft) for testing military unique chemical material and industrial material, which can use one pound of explosives when combined with chemical material, and five pounds of explosives without chemical material; Aerosol stimulant chambers and the Aerodynamic Research Laboratory, comprising approximately 11,000 ft^2 of experimental aerodynamic facilities that include four wind tunnels for component and materials tests; 5 mph Breeze Tunnel, which primarily supports early R&D phases (research on acute and sub-acute toxicity effects of chemical warfare agent surety materials, terrestrial environmental fate and effects, and effects of chemicals of military interest on varying species of the aquatic ecosystem).

ii. *U.S. Army Dugway Proving Ground (DPG)*: DoD Major Range and Test Facility Base (MRTFB) for CB defense: Combined Chemical Test Facility (CCTF) (35,000 sq ft) with 35 test suites supporting live chemical agent liquid, vapor, and aerosol testing; Life Sciences Test Facility (LSTF) with multiple live biological agent test chambers at the BSL-3 level with aerosolization capability, comprising 32,000 sq ft of which 3,500 sq ft is BSL-3 lab space; Materiel Test Facility (MTF) with three

environmentally controlled, vehicle-size live chemical agent chambers, the largest of which is 30 x 50 x 50 ft; Environmental permits, test grids, and instrumentation for chemical and biological simulant field and chamber tests; Ambient Breeze Tunnel for biological stimulant system tests. Initial capability for transportable instrumentation to support simulant tests and operational tests in off-site environments. As the DoD MRTFB for chemical and biological defense testing, the operating costs are institutionally funded by the CBDP. Through FY05, this level of funding has only covered 40 to 50 percent of the actual operating costs, with the remainder being passed to customers by means of an overhead charge, as shown in **Figure J-1**. In FY06, the MRTFB operating costs not attributable to a particular test program will be fully institutionally funded as required by law. This is critical to ensuring the stability of the MRTFB and the capacity of its T&E facilities to support CBDP testing. The MRTFB institutional funding comprises civilian work force (63%), range operations (11%), chamber operations for the CCTF, MTF, and LSTF (8%), contractor labor (7%), guards for surety material (7%), and miscellaneous overhead (4%).

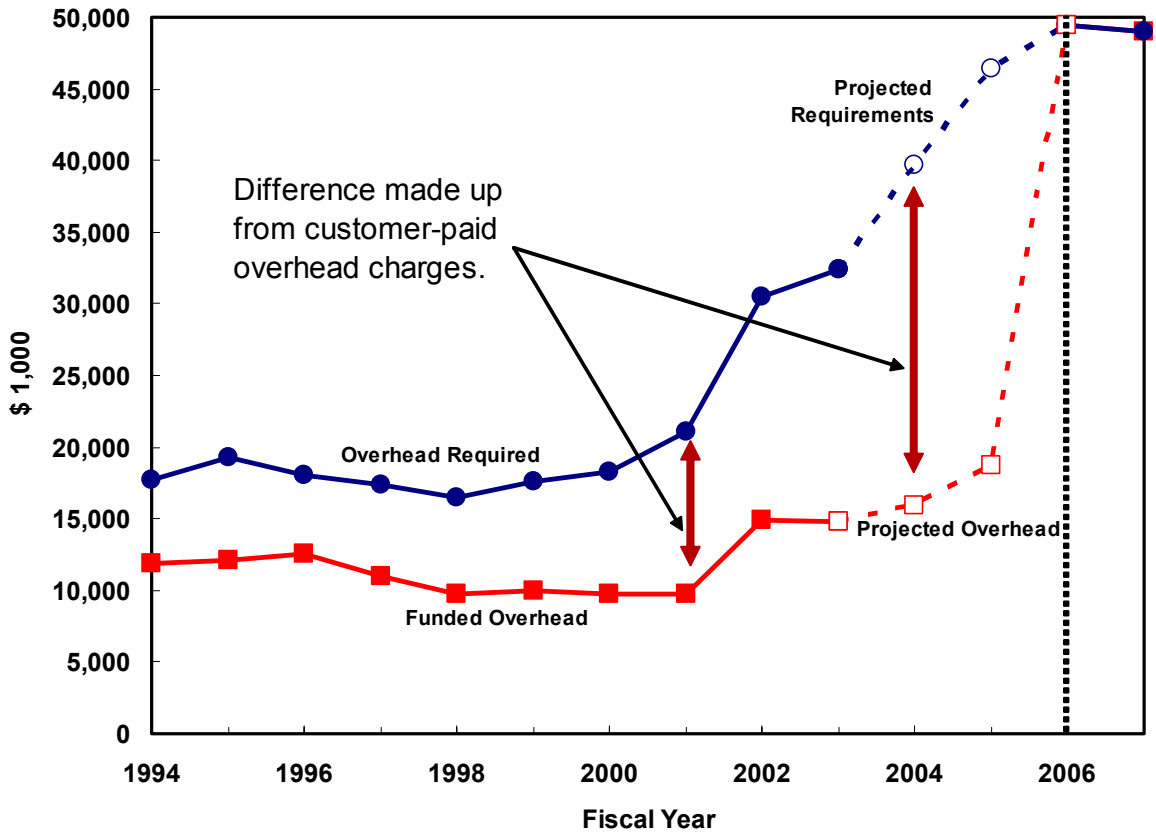


Figure J-1. Requirements and Funding for Overhead for Dugway Proving Ground (MRTFB) (Program Element PE 0606384 BP, Project DW6).

iii. *Air Force Operational Test & Evaluation Center (AFOTEC)*: Utilizes BSL-1 lab for simulants at Eglin Air Force Base (AFB); Environmental permits for chemical and biological simulants at Eglin AFB; Capabilities include simulant vapor challenge test chambers and several test ranges, including outdoor decontamination pad for

use with chemical simulants. Air Force Research Lab (AFRL): BSL-3 lab and chemical simulant testing, component and material level.

iv. *Naval Surface Warfare Center (NSWC), Dahlgren*: BSL-3 lab and chemical agent simulants only; Ship wash-down decontamination test facility with simulant; Small scale component and material decontamination tests using simulants; Collective protection development systems for development and simulant testing of airlocks and filter assemblies; over water stimulant testing.

v. *U.S. Navy Operational Test & Evaluation Force* and the *Marine Corps Operational Test & Evaluation Agency*: These facilities provide limited field tests in support of the CBDP; however, they do not possess instrumentation nor facilities to utilize chemical or biological agent, nor simulants. Navy and Marine operational tests leverage DPG or other mobile capabilities if required to use simulants in a field test.

vi. Other Government/International and extramural facilities exist outside of the CBDP that are leveraged to the fullest extent possible on a case by case basis, including: Nevada Test Site (outdoor field tests), Defence Research Establishment (DRES) Canada, and Porton Down United Kingdom (chamber and field tests); Battelle Memorial Institute, Geomet, Southern Research Institute, Arvin/Calspan, Environmental Technologies Group, ITT Research Institute, Midwest Research Institute, and Truetech also have small-scale agent and simulant test capabilities. Other R&D facilities include Los Alamos National Lab (research on biological and radiological defensive systems), MIT Lincoln Labs (laser technology research for defensive biological systems), and Research Triangle Institute (R&D of chemical and biological defense systems).

J.2.2.2 <u>Analysis of T&E Facilities' Capacity</u>.

In total, the test facilities possessed by and accessible to the CBDP are not currently adequate in terms of capacity, given the expanding requirements to test whole systems; however, investments are being targeted to increase capacity during FY06 – 11. Myriad R&D, component, and simulant capabilities exist. The test capabilities at R&D facilities do not provide significant additions to the total capacity for full system T&E, in that their capabilities are research-oriented and primarily component or material focused. The gravest T&E shortfalls lie in the full systems and platform test chambers and supporting instrumentation and fixtures. This instrumentation and the test fixtures must be able to introduce and adequately control live chemical and biological agent challenges and provide a range of environmental and challenge conditions to simulate evolving threats, while performing end-to-end systems operations of CBD equipment. Shortfalls in instrumentation and methodology to support multiple and diverse concurrent natural environmental, full systems operational tests also exist. Specifically, tests for full systems decontamination capabilities, moving platform biological and chemical long range detectors, and full scale battlefield hazard mitigation of protective ensembles do not currently exist, but are planned to be developed in the long term.

Requirements for CBDP-related T&E capabilities for which funding has not been programmed have been frequently identified over the past decade, resulting in a rolling backlog of unimproved or unavailable test facilities, thus resulting in limited capabilities. To address the most serious deficiencies, DOT&E, through the Central Test and Evaluation Investment Program (CTEIP), has initiated and funded the Contamination Avoidance Detector Test Suite

(CADTS). This multi-year project, scheduled to complete in FY07, provides the most immediate needs for testing contamination avoidance equipment. Among the capabilities included in the test suite are: Joint Ambient Breeze Tunnel (JABT) scheduled for completion in FY05, Active Standoff Facility (ASC) scheduled to complete in FY06, and a near real-time Polymerase Chain Reaction (PCR) referee system scheduled to complete in FY06. Planned improvements will begin to build on this initial investment and are planned to be available starting in FY08.

J.2.3 Analysis of Versatility.

CBDP T&E capabilities are not sufficiently versatile to provide full decision support to the warfighter commander to address current threats with operational realism, nor to address evolving threats. T&E capabilities are presently not sufficiently versatile to provide advanced technology test systems and methodologies, to provide the intellectual infrastructure necessary to maintain a core of expertise to plan for test capabilities and program tests, nor to provide fully validated characterization data of the CB battlespace.

For the DoD T&E facilities accessible to support the CBDP (see §J.2.2.1), there has been no integrated approach to ensure documentation, validation, and repeatability of test procedures in many cases; no basis or mechanism to standardize procedures among labs; and no advanced planning nor investment for evolving threats and testing of diverse battlespace conditions and missions. This has resulted in specific compartmentalized test capabilities and a lack of versatility. Additionally, correlations of agents and simulants required to support assessment of system performance against live agents based on testing with simulants have not been established.

In the past, the acquisition programs have sponsored expedited applications of existing test capabilities (either in government or commercial facilities) in order to meet immediate urgent needs. This has often resulted in test systems with limited versatility that were only suitable for very specific testing applications.

In FY06, investments will be initiated to obtain:

- advanced T&E capabilities to test CB defense equipment against Non Traditional agents and new collective and individual protection technologies,
- comprehensive modeling and simulation to establish T&E parameters expand systems analyses,
- live chemical and biological agent full system test chambers,
- expanded simulant range capabilities,
- T&E capabilities to address decontamination efficacy and systems performance post-decon operations, and
- T&E capabilities for advanced battlespace management (*Shape*) information systems.

The T&E infrastructure in terms of intellectual capital/personnel resources required to support the CBDP is currently not adequate; however, the coordinated efforts in submitting the FY06 CBDP budget have resulted in establishing the funding to provide for these resources. As required by Public Law 103-160, Section 1703, all CBDP T&E funds are provided through a defense-wide account, thus the Services may not independently support the T&E infrastructure through Service research, development, test and evaluation (RDT&E) accounts. Other than the individual direct test programs, much of the current Operational Test Agency (OTA)

infrastructure that supports the CBDP has limited or no funding from each Service, thus hampering the ability to perform early T&E methodology planning and continuous evaluation. The OTA intellectual infrastructure is critical for the advanced planning and development of versatile test capabilities adequate to address the diversity of threat and scenario types expected to be encountered.

J.2.4 Path Forward.

J.2.4.1 Integrated Approach to Plan for T&E Infrastructure.

In 2003, the DoD T&E Executive was established to develop an integrated approach to plan for and obtain the T&E infrastructure required to support the CBDP. Funding has been identified to develop and sustain this infrastructure, along with the improvements and new test methods required to support a capabilities-based acquisition approach, resolve community-identified shortfalls, and address evolving threats. An assessment of funding needs has been conducted as the basis for the development of the FY06 President's Budget Submission. Based on the expected level of funding, the following CBDP objectives to improve T&E can be met:

- Establish single integrated approach to planning joint service test and evaluation capability and methodology needs.
- Streamline the Test and Evaluation Management Plan approval and issue resolution process.
- Establish a fully integrated test and evaluation investment strategy.
- Establish common set of test processes and standards for conducting joint test and evaluation activities.
- Identify test and evaluation capability gaps and intellectual infrastructure required for chemical, biological, radiological and nuclear defense needs and resource these within Department of Defense guidance and strategy, using a capabilities-based approach and a focus on T&E requirements to address evolutionary threats
- Develop new test procedures and capabilities to increase the breadth, depth, and capacity of the CBDP T&E infrastructure to address evolutionary threats and expanded operational environments.

The T&E infrastructure requirements have been synchronized with technology transition and acquisition programs' T&E requirements. The planned T&E infrastructure investment will target synergistic capabilities that have multiple utilities and leverage among test technologies and characterization of physical phenomena and interaction of variables affecting CBD system performance. A key focus is to develop the models and analytical methods necessary to provide commanders' guidance for effective CBD operations and equipment use. A critical element of the developmental T&E work required across all functional areas is the correlations of agents and simulants performance tailored to each type CBD system. Much work to increase critical operational test capabilities (outdoor stimulant testing) is planned as well.

In addition to the synchronization of the S&T, acquisition, and T&E infrastructure budget planning, process improvements have been made to establish integrated T&E approaches. As an example of the status of the T&E integration, AFOTEC conducted field testing of the biological detection systems as a Multi-Service Operational Test & Evaluation (MOT&E), which involved all OTAs including DPG support, and completed an integrated

MOT&E report. In several programs, a single Evaluation Report was completed reflecting results of all Services' evaluations. These efforts by AFOTEC, the U.S. Navy Operational T&E Force, the Army Test & Evaluation Command (ATEC), and the Marine Corps Operations T&E Agency (MCOTEA) reflect the spirit of the joint integrated T&E infrastructure approach and indicate a sound direction in establishing a common set of processes and procedures for joint CBDP T&E.

J.2.4.2 Specific T&E Needs.

Efforts have been completed to fully identify T&E infrastructure shortfalls critical to the CBDP, counter-terrorism, and to increase operational realism of T&E and address evolving threats. T&E capabilities improvements planned include advanced ground-truth sampling systems, realistic threat chemical and biologic challenge dissemination and characterization, aerosol and surface sampling methods, and hazard analysis models relating test data to actual toxicological data. Following is a description of activities and capabilities planned starting in 2006 to address the full scope of ongoing and planned T&E needs.

J.2.4.2.1 Whole System Live Agent Testing. The Deputy Under Secretary of the Army Operations Research (DUSA(OR)) and the Director, Operational Test & evaluation (DOT&E) have identified the requirement to conduct Whole System Live Agent Testing (WSLAT) of biological agent point detection systems with live biological agent aerosols. Currently, active agent testing is conducted only at the subcomponent level, due to size constraints associated with existing aerosol containment chambers. Whole system testing is currently conducted solely with a single biological agent simulant. Simulants have not been validated for many types of biological agents. While the current approaches have met minimal requirements to test and field detectors, a WSLAT chamber is required to provide data sufficient for system evaluation. Initial efforts in 04 to 05 will be to further characterize and relate component performance among agents and various types of simulants, to validate additional simulants, and to establish an M&S whole system analysis process. Based on currently planned funding, a WSLAT chamber test is planned to be available for 2009 testing.

J.2.4.2.2 Field Trials. Since more than thirty years have passed since the last outdoor test with live chemical agent, much of the infrastructure for field testing of chemical detectors no longer exists or is seriously outdated. The currently budgeted improvements in T&E infrastructure will greatly improve both developmental and operational field testing of full systems, with better representation of threats and characterization of system response.

J.2.4.2.3 Live Agent Test Chamber. A test chamber and validated methods adequate to perform live CB agent testing of active standoff CB detectors is a critical need of the CBDP program. Work with actual agents is necessary for both development and testing to establish the library of algorithms for the system to detect CB agents, and to test the efficiency of detection. An active system test chamber for chemical agents is currently being defined and will be timed to support standoff acquisition programs along with a military construction project in FY08. There are technical risks associated with the safe implementation of a large scale live agent capability for standoff detection that could delay testing and limit the ability for full system testing.

J.2.4.2.4 Emerging Threats. For all functional areas, test methods are required to address emerging threats, including Non-Traditional Agents (NTAs), Toxic Industrial Materials (TIMs), and dusty agents. The CBDP will fund a dedicated NTA chamber, along with the

studies needed to provide data to safely operate it, and specific test fixtures tailored to each type of test. The CBDP will develop and validate advanced technology tests to address Toxic Industrial Materials effects on protective materials and systems.

J.2.4.2.5 Decontamination Testing. The testing of decontaminants and decontamination systems is hampered by the lack of any acceptable simulants for field testing and training and lack of agent-simulant correlations. Due to the unique qualities of chemicals and biologics, even within the same family, no two chemicals or biologics act the same when exposed to the same decontaminant or environment. Decontamination is a physical process that will always be dependent upon the exact chemical or biologic present. Testing is currently conducted with small components or panels of hardware in test chambers. The CBDP will provide updated decontamination system test methods which address decon system efficacy, as well as system degradation from decon processes.

The decontamination pad used at Dugway Proving Ground was contaminated in the 1980s with C8 Emulsion decontaminant. The area is a Solid Waste Management Unit regulated under RCRA. This limits the type and quantity of testing that can be done there. This pad will be to be replaced with an environmentally sound system that will collect all run-off.

J.2.4.2.6 Simulants and Agent Characteristics. Agent/simulant correlations are a cross-commodity testing need in the CBDP. Also in this category are analysis procedures and agent simulation correlation methods for NTAs, aerosol chemical agents, and TIMs (chemical, biological, and radiological).

J.2.4.2.7 Individual Protection Testing. A critical requirement exists for a whole system live agent CB ensemble test supported by modeling to allow integration of toxicological data into valid estimates of casualty predictions. Whole ensemble testing is currently conducted with one simulant that has been determined to be safe for human use. Methodology studies are needed to characterize physical properties affecting protection and to understand the interactions among variables that affect protection in order to link all the tests in an analysis and model to predict hazard levels in order to optimize CB ensemble design and deployment. There is no established, quantifiable correlation between the simulant leakage and that of either chemical or biological agents, nor among protection test data and toxicological hazard data. For both individual and collective protection equipment testing, fixtures used to test swatches of material for leakage against chemical agents are outdated and were not designed to represent field wear conditions. Fixtures containing new sample cells that will more accurately sample the air behind the protective material, provide dynamic subsystem tests, and enable tests to characterize the effects of high winds on system protection are technologically feasible and have been designed, but require funding to develop and validate.

J.2.4.2.8 Updating T&E Infrastructure. Test infrastructure for other CBDP systems in development meet minimal testing requirements, but in most cases are either outdated, incapable of a high degree of reproducibility or precision, underfunded, or otherwise inadequate to meet schedule or quality requirements for operational evaluations or commanders' guidance. Most testing currently performed is neither as operationally relevant, or based on actual threat scenarios as the warfighters require.

The development of all CBDP materiel—from detectors, individual protective gear, and decontaminants—require test validation against actual chemical warfare agents (CWAs) in systems validated with animal models. Inhalation exposures are the most likely exposure route

for volatile CWAs and a likely route for weaponized agents. Such exposures, to either vapor or aerosol forms of CWA, require specialized equipment found in few areas of the world and expert personnel to supervise and run the exposure trials. At a minimum, expertise is required in inhalation toxicology, analytical chemistry and respiratory physiology. An inhalation agent testing capability has been firmly established at ECBC in accordance with all DoD safety, surety, security and Association for Assessment and Accreditation of Laboratory Animal Care (AAALAC) requirements and in compliance with Good Laboratory Practices (GLP) in the new state of the art Life Sciences Research facility.

This current state of the art research facility is underfunded in terms of its maintenance, routine replacement, and capacity to meet current increased needs. Lack of continued maintenance funds could deteriorate these capabilities. As with overall T&E infrastructure, sustainment and instrumentation costs have been passed to CBDP research programs that are not adequately budgeted for these expenses.

Animal Test Research that supports the CBDP requires work with chemical surety materials will require an increase in scope to support specific hazard definition and protective ensemble performance. Simulant research cannot accurately predict biomedical outcomes of chemical warfare agents. By Federal Law chemical surety materials, including dilute agents, must be under DoD/Department of the Army control. The animal research test facilities at the U.S. Army ECBC and USAMRIID must be augmented to meet these requirements.

For CB defense medical countermeasures, Annex E provides a detailed description of technical barriers for the various prophylaxes, therapeutics, and diagnostics, and outlines T&E needs to be overcome to ensure development of FDA licensed medical products.

J.3 ACTIONS NEEDED TO MEET TESTING REQUIREMENTS

This section supplements section J.2.4.2 above. The following is a list of specific T&E capabilities which will be initiated in FY06. These shortfalls primarily comprise needs for tests that do not presently exist, but also include tests that require improvement in order to provide data adequate for evaluator, decision maker, and Combatant Commander information needs. In addition, continued identification and development of CBDP T&E intellectual and capabilities infrastructure is required as a significant investment of the CBDP. T&E needs below are organized according to the Joint Enabling Concept/functional area they support, that is, Sense, Shape, Shield, and Sustain.

J.3.1 SHIELD: Individual/Collective Protective Equipment (IPE/CPE).

- Tests to address NTAs, TIMs, and dusty agents.
- Development of modeling and analysis methods to characterize system protection in terms of toxicological hazard levels to give commanders guidance for effective CB ensemble use.
- Whole system live agent testing of CB protective ensembles.
- Next Generation Man-in-Simulant Test (MIST): Provide near real-time sampling technology for material and system tests to better characterize CB performance and provide operationally useful information regarding effects of changing battlefield conditions and warfighter movement. The current test capacity and challenge types for system testing of CB ensembles needs to be improved to meet the rising test demands of new RDA Plan systems, including liquid challenges and expanded processing

capability. Increase the test aerosol CB simulant challenges beyond the present capability of 1-2 subjects per trial. Current IPE systems being tested require a larger chamber and increased test capacity. Also, a larger and more controlled range of particle sizes will be available to better simulate a range of dusty CB agents.

- Obtain CB ensemble subsystem tests with live agents (CB gloves, footwear, and masks) to include testing of CB masks with biological challenges and with a wider range of helmets and respiratory conditions.

J.3.2 SENSE: CB Standoff Detection.

- Implementation of the National Academy of Science (NAS) test requirements that require environmental modeling be used to augment live-agent testing, as outlined in *Review of Testing and Evaluation Methodology for Biological Point Detectors*, Final Report, The National Academies Press, Washington, D.C., 2004.
- Better characterized threats for realistic threat scenarios for developmental and operational tests. This needs to include the ability to establish the relationship between lab agent performance and field simulant performance.
- Provide additional ground truth instrumentation, including augmenting the ability to exploit future advances in imaging spectrometer and Raman light detection and ranging (LIDAR) technologies.
- Provide for improved data collection, archiving, and automated processing of trial results to enable test schedules to proceed and for test conditions to be adjusted as necessary to account for previous trial data. This significantly improves the ability to characterize system performance over a wider and better-defined set of operational conditions and greatly lessens lost data and repeated trials required.

J.3.3 SENSE: Chemical Point Detection.

- Provide technological improvements that reduce cost, improve test schedules and efficiency, and minimize test performance impacts.
- Relocate detector test fixtures from the current Materiel Test Facility (MTF) chamber, which is required to test new systems.
- Correlate chamber agent performance with field simulant performance with additional detectors, decontaminants, and protective materials that establish ground truth data comparing agent and simulant under comparable conditions.
- Full characterization of the chemical agents of varying grade or quality, interferent, and development and documentation of more effective test methods for non-traditional agents.
- Improved and accelerated development of referee systems, sampling and analysis, validation testing, and Test Operating Procedures. Final studies on uniform dissemination and reproducibility of dusty challenge materials also will be accelerated and completed.
- Building upgrades (test fixture mechanical systems, safety systems, controls, and data systems) need to be funded, which will result in shorter and less expensive tests and more efficient test operations at reduced direct cost to customers.

J.3.4 SENSE: Biological Point Detection.

- Purchase equipment for modular BSL-3 laboratory space to support WSLAT.

- Projects that validate and expand current Polymerase Chain Reaction (PCR) technologies, characterize interferent challenges, develop improved chamber bioaerosol dissemination methods, develop encapsulated simulants, and develop robust simulants.

J.3.5 SUSTAIN: Decontamination.

- Replace and enlarge decon pad to support both developmental and operational testing.
- Support full-system, end-to-end decontamination procedure development and demonstration, including means to determine success of decontamination, characterization of decon chemistry and mechanisms, and agent-simulant correlation for use in field testing and training.
- Accepted methods for measuring chemical agent vapor and contact hazards, and determining decontaminability of RDA systems exposed to agents of biological origin.
- Tests and models to characterize degradation of system function by decontamination processes

J.3.6 Sustainment of Existing Infrastructure.

- Prepare sustainment plans and finance sustainment for existing CBDP laboratories, test facilities, chambers and outdoor test grids.
- Includes sustainment plans and funding for new test capabilities developed under the CTEIP or Modernization Programs.
- Fund all Direct Test Support requirements at Dugway Proving Ground.

J.3.7 New T&E Technologies.

Examples of requirements and test conditions for which test technology must be developed and validated include: unique agent challenge profiles, jet aircraft flight conditions, and simulated effective respiratory rates in CB mask protection agent tests; and expanded environmental and agent challenge conditions for individual protection materials and systems. Test technology will also provide agent (lab) and simulant (lab and field) challenge generation and control, agent-simulant correlations, and near real-time measurements of CBD systems responses. Provide mobile, deployable test capabilities to perform field simulant testing in multiple natural environments to ensure that CBD systems are effective, suitable, and survivable across the range of environments in which they will be deployed.

Capabilities to enable testers to provide evaluators and unit commanders specific information about how to properly use the CBD systems tested to mitigate risks in the CB environment, and also to provide system developers the information required to adequately develop and mature the systems. Test infrastructure will be adequate to ensure that data are available to certify that critical CBD systems are ready for operational tests and to identify any potential vulnerabilities.

Establish the test methods, instrumentation, and Test Operating Procedures (TOPs) required to meet evaluator data requirements for lab CB agent testing and outdoor simulant testing in multiple environments. Validation trials will be conducted on initial general capabilities to support finalization of the TOPs.

Annex K

Congressional Reporting Requirement: 50 USC 1523

Text of Public Law Mandating Report on
The Department of Defense Chemical and Biological Defense Program

Title 50 of the U.S. Code, Sec. 1523. Annual report on chemical and biological warfare defense
Implemented by Public Law 103-160, The FY94 National Defense Authorization Act

(a) Report required

The Secretary of Defense shall include in the annual report of the Secretary under section 113(c) of title 10, a report on chemical and biological warfare defense. The report shall assess--

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

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

(b) Matters to be included

The report shall include information on the following:

(1) The quantities, characteristics, and capabilities of fielded chemical and biological defense equipment to meet wartime and peacetime requirements for support of the Armed Forces, including individual protective items.

(2) The status of research and development programs, and acquisition programs, for required improvements in chemical and biological defense equipment and medical treatment, including an assessment of the ability of the Department of Defense and the industrial base to meet those requirements.

(3) Measures taken to ensure the integration of requirements for chemical and biological defense equipment and material among the Armed Forces.

(4) The status of nuclear, biological, and chemical (NBC) warfare defense training and readiness among the Armed Forces and measures being taken to include realistic nuclear, biological, and chemical warfare simulations in war games, battle simulations, and training exercises.

(5) Measures taken to improve overall management and coordination of the chemical and biological defense program.

(6) Problems encountered in the chemical and biological warfare defense program during the past year and recommended solutions to those problems for which additional resources or actions by the Congress are required.

(7) A description of the chemical warfare defense preparations that have been and are being undertaken by the Department of Defense to address needs which may arise under article X of the Chemical Weapons Convention.

(8) A summary of other preparations undertaken by the Department of Defense and the On-Site Inspection Agency to prepare for and to assist in the implementation of the convention, including activities such as training for inspectors, preparation of defense installations for inspections under the convention using the Defense Treaty Inspection Readiness Program, provision of chemical weapons detection equipment, and

assistance in the safe transportation, storage, and destruction of chemical weapons in other signatory nations to the convention.

(9) A description of any program involving the testing of biological or chemical agents on human subjects that was carried out by the Department of Defense during the period covered by the report, together with a detailed justification for the testing, a detailed explanation of the purposes of the testing, the chemical or biological agents tested, and the Secretary's certification that informed consent to the testing was obtained from each human subject in advance of the testing on that subject.

Annex L

Acronyms and Abbreviations

Note: The acronyms and abbreviations in this annex reflect an extensive, though not exhaustive, list of terms related to the various and diverse CB defense activities. The acronyms might have different meanings in other contexts.

–A–

AAALAC – Association for Assessment and Accreditation of Laboratory Animal Care
AAAV – Advanced Amphibious Assault Vehicle
AAE – Army Acquisition Executive
AAR – after action review
AB – Air Base
ABDU – Aviation Battle Dress Utilities
ABV – Assault Breacher Vehicle
AC – Active Component
ACAA – Automatic Chemical Agent Alarm
ACADA – Automatic Chemical Agent Detector Alarm
ACAT – Acquisition Category
ACD&P – Advanced Component Development & Prototypes
ACPLA – agent containing particle per liter of air
ACPM – Aircrew Protective Mask
ACTD – Advanced Concept Technology Demonstration
ADC – Agile Development Center
AEL – Allowance Equipage List
AEPS – Army Electronic Product Support
AERP – Aircrew Eye/Respiratory Protection
AFB – Air Force Base
AFCESA – Air Force Civil Engineer Support Agency
AFI – Air Force Instruction
AFIP – Armed Forces Institute of Pathology
AFMAN – Air Force Manual
AFOTEC – Air Force Operational Test & Evaluation Center
AFRL – Air Force Research Laboratory
AFRRI – Armed Forces Radiobiology Research Institute
AFS – Alternative Footwear Solution
AFTH – Air Force Theater Hospital
AFTTP – Air Force Tactics, Techniques and Procedures
AIDET – Aircraft Interior Detector
AIT – Aeromedical Isolation Team or Advanced Individual Training
ALN – artificial lymph node
ALS - Analytical Laboratory System
AMAD – Automatic Mustard Agent Detector
AMC – U.S. Army Materiel Command
AMD – Average Monthly Demand
AMEDD – Army Medical Department
AMEDDC&S – Army Medical Department Center & School
AMSAA – Army Materiel Systems Analysis Activity
AMSNY – Associated Medical Schools of NY
ANBACIS – Automated Nuclear Biological and Chemical Information System
ANCOC – Advanced NCO Course
ANG – Air National Guard
AN/UDR-13 – Compact, digital whole body radiation meter
AN/VDR-2 – Portable dose-rate gamma/beta radiation meter
APC – Armored Personnel Carrier
APOD – Aerial Port of Debarkation
ARNG – Army National Guard
ASA(ALT) – Assistant Secretary of the Army for Acquisition, Logistics, & Technology
ASAP – Advanced Situational Awareness Program
ASBREM – Armed Services Biomedical Research Evaluation and Management
ASD(HA) – Assistant Secretary of Defense for Health Affairs
ASD(HD) – Assistant Secretary of Defense for Homeland Defense
ASD(SO/LIC) – Assistant Secretary of Defense for Special Operations and Low-Intensity Conflict
ASF – Active Standoff Facility
ATD – Advanced Technology Demonstration
ATG – Afloat Training Group
ATH – Air Transportable Hospital
ATNAA – Antidote Treatment Nerve Agent Autoinjector
ATRRS – Army Training Requirements & Resources System
ATRv6 – Atmosphere Transport of Radiation Version 6
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
AU – Air University
AVA – Anthrax Vaccine Adsorbed
AV/DP – Amalgam Virgo/Determined Promise
AVIP – Anthrax Vaccine Immunization Program

–B–

B. anthracis – Bacillus anthracis (anthrax)
B. mallei– Burkholderia mallei (glanders)
BAT – Biodosimetry Assessment Tool
BCA – Baseline Capability Assessment
BCTP – Battle Command Training Center, or an emulsion made from water, soybean oil, Triton X 100 detergent, and the solvent trin-butyl phosphate
BD – biological detector (*also,* biological defense)
BDO – Battledress Overgarment
BDRD – Biological Detection Research Department
BDTF – Biological Defense Task Force
BDU – Battledress Uniform
BECC – Basic Engineering Core Course
BES – Budget Estimate Submission
BGAD – Blue Grass Army Depot
BIDS – Biological Integrated Detection System
BIODET – biological detection
Bio-OPT – Biological Operational Planning Team
BL – Biosafety Level
BLA – Biologics Licensing Application
BNCOC – Basic Non-Commissioned Officer Course
BOI – basis of issue
BoNT – Botulinum Neurotoxin
BoNT/A – Botulinum Neurotoxin A
BRMs – biological response modifiers
BSM – Business System Modernization
BTN – below the neck
BuChE – butyrylcholinesterase
BVO/GVO – black vinyl overboot/green vinyl overboot
BW – biological warfare
BWD – Biological Warfare Defense
BWDC – Biological Warfare Detection Course

–C–

C2 – Command and Control
C2PC – Command and Control Personal Computer
C3 – Command, Control, & Communications
C4I – command, control, communication, computer, and intelligence
C4ISR – command, control, communication, computer, intelligence, surveillance, and reconnaissance
CA – Commodity Area
CAA – Chemical Agent Alarm
CA/D – Chemical Activity/Depot
CADTS – Contamination Avoidance Detector Test Suite
CaE – carboxylesterase
CAM – Chemical Agent Monitor (*also,* Commodity Area Manager)
CANA – Convulsant Antidote Nerve Agent autoinjector
CAPDS – Chemical Agent Point Detection System
CASPOD – Contamination Avoidance at Sea Ports of Debarkation
CatOx – catalytic oxidation
CB – chemical and biological (*also,* C/B)
CBAT – Chemical Biological Advisory Team
CBAWM – Chemical Biological Agent Water Monitor
CBCS – Chemical and Biological Contamination Survivability
CBD – chemical and biological defense
CBDE – CB defense equipment
CBDP – Chemical/Biological Defense Program
CBIAC – Chemical and Biological Information Analysis Center
CBIRF – Chemical Biological Incident Response Force
CBMS – hemical biological mass spectrometer
CBMS – Chemical Biological Medical Systems
CBNP – Chemical Biological Nonproliferation Program
CBPR – Chemical and Biological Portable Radar
CBPS – Chemical Biological Protective Shelter or Chemical Biological Protected Shelter
CBR – Chemical, Biological, and Radiological
CBR-D – Chemical, Biological, and Radiological Defense
CBRD TAVMS – CBRD Total Asset Visibility Management System
CBRMOU – Chemical, Biological, and Radiological Memorandum of Understanding
CBRN – Chemical, Biological, Radiological, and Nuclear
CBRNC – Chemical, Biological, Radiological, and Nuclear Countermeasures
CBRND – Chemical, Biological, Radiological, and Nuclear Defense
CBRNDP – Chemical, Biological, Radiological, and Nuclear Defense Program
CBRNE – Chemical, Biological, Radiological, Nuclear, and High-Yield Explosives
C/B-RRT – Chemical/Biological Rapid Response Team
CbtWMD – Combating Weapons of Mass Destruction

CBU – Chemical and Biological Umbrella
CBW – chemical and biological warfare or counter biological warfare
CBWA – chemical and biological warfare agent
CBW-CFX – CB Warfare Computational Fluid Effects
CCA – Contamination Control Area
C-CBRNE – Counter Chemical, Biological, Radiological, Nuclear, and High-Yield Explosive
CcrM – cell-cycle regulated methyltransferase
C-CW – Counter Chemical Warfare
CDC – Centers for Disease Control and Prevention
cDNA – Complementary Deoxyribonucleic Acid
CD-ROM – Compact Disk - Read Only Memory
CDTF – Chemical Defense Training Facility (at the U.S. Army Chemical School)
CE – Civil Engineer
CEES – half mustard (2-chloroethyl ethylsulfide)
CENTCOM – Central Command
CESM – Chemical Environment Survivability Mask
C-EW – Counter High-Yield Explosive
CFD – Computational Fluid Dynamic(s)
CFM – cubic feet per minute
CFR – Code of Federal Regulations
CFS – Consolidated Storage Facilities
CFX – computational fluid effects
cGLP – current Good Laboratory Practices
cGMP – current Good Manufacturing Practices
cGy – cent-Gray
CHAMP – Chemically/biologically Hardened Air Management Plant
CHATH – Chemically/Biologically Hardened Air Transportable Hospital
ChE – Cholinesterase
CHEMRAT – Chemical Hazard Estimation Method Risk Assessment Tool
CIA – Central Intelligence Agency
CIL – Critical Item List
CJCS – Chairman of the Joint Chief of Staff
CM –Consequence Management, crisis management, or countermeasures
CNS – Central Nervous System
C-NW – Counter Nuclear Warfare
COC – Combat Operations Center
COCOM – Combatant Commander
COLPRO – Collective Protection
CoM – Consequence Management
CONOPS – Concept of Operations
CONUS – continental United States
COTS – Commercial Off-the-Shelf
CP – chemical protective (*also,* collective protection, command post, *or* counterproliferation)
CPDEPMEDS – Chemically Protected Deployable Medical System
CPE – Collective Protection Equipment
CPEMEDS – Collective Protection for Expeditionary Medical Support
CPO – Chemical Protective Overgarment
CPRC – Counterproliferation Review Council
CPS – Collective Protection System
CP-SSS – Collective Protection for Small Shelter System
CPU – Chemical Protective Undergarment
CPX – Command Post Exercise
CREST – Casualty and Requirements Estimation Tool
CRG – Compliance Review Group
CRP – Critical Reagents Program
C-RW – Counter Radiological Warfare
CSF – Consolidated Storage Facilities
CSSC – Civil Support Skills Course
CTEIP – Central Test and Evaluation Investment Program
CTR – Cooperative Threat Reduction
CUGR - CBRN Unmanned Ground Reconnaissance
CUGV – CBRN Unmanned Ground Vehicle
CVC – Combat Vehicle Crewmen
CW – Chemical Warfare
CWA – Chemical Warfare Agent
CWC – Chemical Weapons Convention
CWDD – Chemical Warfare Directional Detector (AN/KAS-1A)
CWIWG – Chemical Weapons Agreements Implementation Working Group
CWNAVSIM – Chemical Warfare Naval Simulation
CY – Calendar Year

–D–

D2PC – Dynamic Two Phase Commitment
DAE – Defense Acquisition Executive
DAIG – Department of the Army Inspector General
DAP – Decontaminating Apparatus Portable
DARPA – Defense Advanced Research Projects Agency
DASD/FHP&R – Deputy Assistant Secretary of Defense (Force Health Protection and Readiness)
DASG-HCF – Department of the Army Surgeon General-Directorate of Health Care Operations
DATSD(CBD) – Deputy Assistant to the Secretary of Defense for Chemical/Biological Defense
DAWN – Deposition and Weathering of a Chemical Attack on a Vessel
DC – Dentists
DCA – Damage Control Assistant

DC CD – Deputy Commandant for Combat Development
DC-OSIMS – Damage Control-Operating Space Items Management System
DCTE – Defensive Chemical Testing Equipment
DDC – Defense Distribution Center
DDG – Guided Missile Destroyer
DEA – Data Exchange Agreement
DED – Diesel Engine Driven
DEPMEDS – Deployable Medical Systems
DepSecDef – Deputy Secretary of Defense
DERF – Defense Emergency Response Fund
DFP – Deployable Force Packages
DFU – Dry Filter Unit
DHS – Department of Homeland Security
DHHS – Department of Health and Human Services
DLA – Defense Logistics Agency
DMRTI – Defense Medical Readiness Training Institute
DMSMS – Diminishing Manufacturing Sources and Material Shortages
DMSS- Defense Medical Surveillance System
DNA – Deoxyribonucleic Acid
DNWS – Defense Nuclear Weapons School
DOC – Department of Commerce
DoD – Department of Defense
DODI – Department of Defense Instruction
DODIG – Department of Defense Inspector General
DoE – Department of Energy
DON – Department of Navy
DoS – Department of State
DOT&E – Director, Operational Test and Evaluation
DOTMLPF – Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel, and Facilities
D(PA&E) – Director, Program Assessment and Evaluation
DPE – Demilitarization Protective Ensemble
DPG – Defense Planning Guidance (*also,* Dugway Proving Grounds)
DRES – Defense Research Establishment
DRF – dose reduction factor
DRI – Defense Reform Initiative
DRID – Defense Reform Initiative Directive
DRMO – Defense Reutilization and Marketing Office
DRMS – Defense Reutilization and Marketing Service
DS – Diplomatic Security
DS2 – Decontamination Solution 2
DS/ATA – Diplomatic Security/Antiterrorism Assistance
DSCA – Defense Support to Civilian Authorities
DSCP – Defense Supply Center, Philadelphia
DSP – digital signal processing
DsRNA – double standard RNA
DT – Dental Techs
DTAP – Defense Technology Area Plan
DTIRP – Defense Treaty Inspection Readiness Program
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
DTT – Doctrine and Tactics Training
DU – depleted uranium
DUSA(OR) – Deputy Under Secretary of the Army for Operations Research
DVC – Dynport Vaccine Company

–E–

E^2C^2 – Expendable Equipment Combat Consumption
EAU – Equipment Assessment Units
EBO – Ebola virus
ECBC – Edgewood Chemical & Biological Center
ECLA – electrochemilluminescense assay
ECTA – Embedded Common Technical Architecture
ECU – Environmental Control Unit
ECV – Expanded Capacity Vehicle
ED – ethyl dichlorarsine
EEE – Eastern Equine Encephalomyelitis
EFV – Expeditionary Fighting Vehicle
EMAT – Emergency Management Team
EMPRC – Emergency Medical Preparedness/Response Web-based Course
EMT – Emergency Medical Technician
EMW – Expeditionary Maneuver Warfare
EOC – Emergency Operation Center
EOD – Explosive Ordnance Disposal
EPA – Environmental Protection Agency
EPP – Enhanced Planning Process
ESLI – end of service life indicator
ETE – Education, Training, and Exercise
EUCOM – European Command
EZ – Exchange Zone

–F–

F1 – Fraction 1
F1-V – Fraction 1 - "V" Antigen
FAA – Federal Aviation Administration
FAR – Federal Acquisition Regulations
FBI – Federal Bureau of Investigations
FCBC – Field Management of Chemical and Biological Casualties Course

FCS – Future Combat Systems
FCT – Foreign Comparative Testing
FDA – Food and Drug Administration
FDTE – Force Development Testing and Experimentation
FEST – Foreign Emergency Response Team
FHPC – Force Health Protection Council
FLEETEX – Fleet Exercise(s)
FM – Field Manual
FNA – Functional Needs Analysis
FORCEM – Force Evaluation Model
FORSCOM – Forces Command
FoS – family of systems
FP1 – Force Package 1
FPA – focal plane array
FR – flame resistance
FRAT – First responder Radiological Assessment Triage
FSA – Functional Solutions Analysis
FSTR – Full Spectrum Threat Response
FTX – Field Training Exercise
FUE – First Unit Equipped
FY – fiscal year
FY99 – Fiscal Year 1999
FYDP – Future Years' Defense Plan

–G–

G8 – Army Deputy Chief of Staff for Programs
GA – tabun, a nerve agent
GAO – General Accounting Office
GB – sarin, a nerve agent
GD – soman, a nerve agent
GF – cyclosarin, a nerve agent
GIDEP – Government Industry Data Exchange Program
GLOC – G-force induced loss of consciousness
GLP – Good Laboratory Practices
GMP – Good Manufacturing Practice
GOTS – Government Off The Shelf
GOCO – Government-Owned/Contractor-Operated
GP – glycoprotein
GPFU – Gas Particulate Filter Unit
GPRA – Government Performance and Results Act
GUARDIAN – DoD-JPEO Readiness Installation Protection Program
GVO/BVO – Green Vinyl Overboots/Black Vinyl Overboots
GWOT – Global War on Terror

–H–

HAZMAT – Hazardous Material
HAZWOPER – Hazardous Waste Operations and Emergency Response
HD – sulfur mustard, a blister agent, or homeland defense
HEK – human epidermal keratinocytes
HEPA – high efficiency particulate
HHA – Hand Held Immunochromatographic Assay
HLA – high level architecture
HM – Hospital Corpsman
HMMWV – High Mobility Multipurpose Wheeled Vehicle
HN – Host Nation
HP – heteropolymer
HPAC – Hazard Prediction Assessment Capability
HQ – headquarters
HSA – Health Service Area
HSACDR – Health Service Area Commander
HSC/YA – Human Systems Program Office
HSO – Heath and Safety Orientation (Course)
HTA – high threat area
HTH – High Test Hypochlorite
HVAC – heating, ventilation, and air conditioning

–I–

IAB – Interagency Board
IAV – Interim Armored Vehicle
IAW – In Accordance With
IBAD – Interim Biological Agent Detector
IBMC – Industrial Base Maintenance Contract
ICAM – Improved Chemical Agent Monitor
ID – intradermal
IDC – Independent Duty Corpsmen
IDE – integrated digital environment or Investigational Device Exemption
IDLH – Immediate Danger to Life and Health
IET – Initial Entry Training
IFS – Integrated Footwear System
IIDP – Industry Initiated Demonstration Products
ILS – Integrated Logistics Support
IM – intramuscular
IMP – Industrial Preparedness Measure(s)
IMS – Ion Mobility Spectroscopy
IND – Investigational New Drug
IOC – Initial Operational Capability
IOT&E – Initial Operational Testing & Evaluation
IP – intraperitoneal or Individual Protection
IPDS – Improved (chemical) Point Detection System
IPE – Individual Protective Equipment
IPM – Industrial Preparedness Measures
IPP – Installation Protection Program
IPR – In-Process Review
IPT – Integrated Product Team
IR - Infrared
IR&D – Independent Research & Development
ISD – Individual Soldier Detector
ISO – International Standards Organization
ISS – Individual Survival Standards

ITAP – Improved Toxicological Agent Protective Ensemble
IV – intravenous

–J–

J-8 – Force Structure, Resources, and Assessment Directorate, the Joint Staff
JABT – Joint Ambient Breeze Tunnel
JASQ – JSLIST Alternative Source Qualification
JB1GU – JSLIST Block 1 Glove Upgrade
JB2GU – JSLIST Block 2 Glove Uprgrade
JBAIDS – Joint Biological Agent Identification and Diagnostic System
JBPDS – Joint Biological Point Detection System
JBSDS – Joint Biological Standoff Detection System
JBTDS – Joint Biological Tactical Detection System
JCAD – Joint Chemical Agent Detector
JCBAWM – Joint Chemical Biological Agent Water Monitor
JCBRAWM – Joint Chemical Biological Radiological Agent Water Monitor
JCBRN – Joint CBRN
JCBRN CIIT – Joint CBRN Defense Capabilities Improvement Initiative Team
JCBRNFC – Joint Chemical, Biological, Radiological, and Nuclear Familiarization Course
JCD – Joint Combat Developer
JCE – Joint Chemical Ensemble
JCHEMRATES – Joint Chemical Defense Equipment Consumption Rates
JCID – JWARN Component Interface Device
JCPE – Joint Collective Protection Equipment
JCS – Joint Chiefs of Staff
JEAP – Joint Equipment Assessment Program
JEAU – Joint Equipment Assessment Unit
JECP – Joint Expeditionary Collective Protection
JEM – Joint Effects Model
JEWC – Joint Electronic Warfare Center
JFCOM – Joint Forces Command
JFIRE – Joint CB Protective Firefighter Suit
JFOC – Joint Future Operational Capabilities
JFSC – Joint Forces Staff College
JLAS – Joint Land, Aerospace, and Sea Simulation
JLSP – Joint Logistics Support Plan
JMAR – Joint Medical Asset Repository
JMCBDRP – Joint Medical Chemical and Biological Defense Research Program
JMCBDS – Joint Modular Chemical and Biological Detection System
JMCDRP – Joint Medical Chemical Defense Research Program
JMET – Joint Mission Essential Task
JMNBCDST – Joint Medical NBC Decision Support Tool
JMPAB – Joint Materiel Prioritization Allocation Board
JOEF – Joint Operational Effects Federation
JORD – Joint Operational Requirements Document
JPACE – Joint Protective Aircrew Ensemble
JPDS – Joint Portable Decontamination System
JPEO – Joint Program Executive Office
JPEO-CBD – Joint Program Executive Office for Chemical and Biological Defense
JPID – Joint Platform Interior Decontamination System
JPM – Joint Program Manager
JPM-CBMS – Joint Program Manager for Chemical and Biological Medical System
JPM IP – Joint Program Manager for Individual Protection
JPM IS – Joint Program Manager for Information Systems
JPMO – Joint Project Management Office
JPO – Joint Program Office
JPS – Joint Portal Shield
JRCAB – Joint Readiness Clinical Advisory Board
JRO – Joint Requirements Office
JROC – Joint Requirements Oversight Council
JRO-CBRN – Joint Requirements Office for Chemical, Biological, Radiological, and Nuclear Defense
JSAM – Joint Service Aircrew Mask
JSCESM – Joint Service Chemical Environment Survivability Mask
JSFDS – Joint Service Family of Decontamination Systems
JSGPM – Joint Service General Purpose Mask
JSIPETWG – Joint Service Individual Protective Equipment Technical Working Group
JSIPP – Joint Service Installation Pilot Project (*or,* Joint Service Installation Protection Program)
JSLC – Joint Senior Leaders Course
JSLIST – Joint Service Lightweight Integrated Technology (individual protection)
JSLNBCRS – Joint Service Light NBC Reconnaissance System
JSLSCAD – Joint Service Lightweight Stand-off Chemical Agent Detector
JSMLT – Joint Service Mask Leakage Tester
JSNBCDEAP – Joint Service NBCD Equipment Assessment Program
JSNBCRS – Joint Service NBC Reconnaissance System
JSPDS – Joint Service Personnel/Skin Decontamination System
JSSDS – Joint Service Stationary Decontamination System

JSSED – Joint Service Sensitive Equipment Decontamination
JSTDS – Joint Service Transportable Decontamination System
JSTO – Joint Science & Technology Office
JSTO-CBD – Joint Science & Technology Office for Chemical/Biological Defense
JTAV – Joint Total Asset Visibility
JTAV-RW – Joint Total Asset Visibility Reporting Warehouse
JTF – Joint Task Force
JTS – Joint Training System
JVAP – Joint Vaccine Acquisition Program
JWARN – Joint Warning and Reporting Network
JWSTP – Joint Warfighting S and T Plan

–K–

KFE – Kunsan Focused Effort
KPP – Key Performance Parameter

–L–

L – lewisite, a vesicant agent
LAV – Light Armored Vehicle
LDS – Lightweight Decontamination System
LFADD – Large Frame Aircraft Decontamination Demonstration
LHA – general purpose amphibious assault ship
LHD – general purpose amphibious assault ship (with internal dock)
LIDAR – LIght Detection And Ranging
LIPT – Logistics Integrated Product Team
LL – Lincoln Laboratories
LLCWG – Low Level Chemical Warfare Agent Working Group
LMS – Lightweight Multipurpose Shelter
LNBCRS – Light NBC Reconnaissance System
LSCAD – Lightweight Stand-off Chemical Agent Detector
LSD – landing ship, dock
LSP – Logistics Support Plan
LTA – Low Threat Areas

–M–

M&S – Modeling & Simulation
Mabs – monoclonal antibodies
MACOM – Major Command
MAGTF – Marine Air Ground Task Force
MAJCOM – Major Command
MANAA – Medical Aerosolized Nerve Agent Antidote
MARFORPAC – Marine Force Pacific
MAT – Medical Analysis Tool
MBDRP – Medical Biological Defense Research Program
MBGV – *marburg* virus
MC - Physicians
MCBAT – Medical Chem-Bio Advisory Team
MCBC – Management of Chemical and Biological Casualties Course
MCBDRP – Medical Chemical and Biological Defense Research Program
MCCDC – Marine Corps Combat Development Command
MCHF (LDS) – Marine Corps Heavy Fuel LDS
MCLB – Marine Corps Logistics Base
MCO – Marine Corps Order
MCPE – Modular Collective Protection System
MCPU – Modified Chemical Protective Undergarment
MCS – Maneuver Control System or Mobility Capability Study
MCTTP – Marine Corps Tactics, Techniques and Procedures
MCU-2A/P – a chemical protective mask
MCWP – Marine Corps Warfighting Publication
MDA – Milestone Decision Authority
MDAP – Major Defense Acquisition Programs
MDS – Modular Decontamination System
MED – Medical
MEDCOM – Medical Command
MED/NBC WG – NATO Medical NBC Working Group
MEF – Marine Expeditionary Force
MEFEX – Marine Expeditionary Force Exercise
MEI – Major End Item
MEIR – Medical Effects of Ionizing Radiation
MES – Medical Equipment Set
MESO – Multi-community Environmental Storm Observatory
MEU – Marine Expeditionary Unit
MFR – Multi-Function Radiac Set (*or,* Multi-Function Radiation Detector)
MHS – Military Health System
MICAD – Multipurpose Integrated Chemical Agent Detector
MICAS – Mobility Inventory Control and Accounting System
MIDAS-AT – Meteorological Information and Dispersion Assessment System Anti-Terrorism
MIL STD – Military Standard
MITS – Medical Identification and Treatment Systems
MLRS – Multiple Launch Rocket System
MMS – Multimission Sensor (Program)
MNBCDM – Medical Nuclear Biological Chemical Defense Materiel
MNDRP – Medical Nuclear Defense Research Program
MOA – Memorandum of Agreement
MOPP – Mission Oriented Protective Posture

MOT&E – Multi-Service Operational Test & Evaluation
MOU – Memorandum of Understanding
MPDS – Multi-Purpose Decontamination System
MPF – Maritime Prepositioning Forces
MPH – miles per hour
MPS – Mission Performance Standard (*also,* Multipurpose Protective Sock)
MRMC – Medical Research and Materiel Command
MRTFB – Major Range and Test Facility Base
MS – Mass Spectrometry (*or,* milestone)
MSC – Military Sealift Command or Mesenchymal Stem Cells or Medical Service Corps Officers or Major Subordinate Command
MSCA – Military Support to Civil Authorities
MSR – Minimum Sustaining Rates
MSTP – MEFEX/MAGTF Staff Training Program
MTA – Medium Threat Area
MTF – Medical Treatment Facility, or Material Test Facility
MTO&E – Modified Table of Organization & Equipment
MTT – Mobile Training Team
MTTP – Multiservice Tactics, Techniques, and Procedures
MTW – Major Theater War(s)
MULO – Multi-purpose Overboot
mCPU – Modified Chemical Protective Undergarment

–N–

NAAK – Nerve Agent Antidote Kit
NAPP – Nerve Agent Pyridostigmine Pretreatment
NATO – North Atlantic Treaty Organization
NATOPS – Naval Air Training and Operating Procedures Standardization
NAVMED – Naval Medical
NAVSEA – Naval Sea Systems Command
NBC – Nuclear, Biological, and Chemical
NBCC – Nuclear, Biological, Chemical and Conventional
NBCCS – NBC Contamination Survivability
NBCD – NBC Defense
NBCDT – NBC Defense Training

NBCRS – NBC Reconnaissance System (Fox Vehicle)
NBCRV – (Stryker) NBC Reconnaissance Vehicle
NC – Nurses
NCBR – Nuclear, Chemical, Biological, and Radiological
NCO – Non-Commissioned Officer
NDAA – National Defense Authorization Act
NDC – National Drug Company
NDI – Non-Developmental Item
NDU – National Defense University
NEC – Navy Enlisted Code
NET – New Equipment Training
NFPA – National Fire Protection Association
NGAV – Next Generation Anthrax Vaccine
NGB – National Guard Bureau
NGS – Next Generation Sensor
NHP – non-human primates
NIAID – National Institute of Allergies and Infectious Diseases
NICP – National Inventory Control Points
NIH – National Institute of Health
NIOSH – National Institute for Occupational Safety and Health
NMR – New Material Release
NMRC – Navy Medical Research Center
NO – nitric oxide
NORAD – North American Aerospace Defense Command
NORTHCOM – Northern Command
NP – Nurse Practitioner
NRC – National Research Council
NRL – Naval Research Laboratory
NRP – National Response Plan
NRSW – Navy Region South West
NSC – National Security Council
NSN – National Stock Number
NSTM – Naval Ships Technical Manual
NSWC – Naval Surface Warfare Center
NTA – Novel Threat Agent or Non-Traditional Agent or Non-Traditional Chemical Agent
NTTP – Naval Tactics, Techniques, and Procedures
NURA – Naval Unit Resiliency Analysis
NYSADC – New York State Academic Dental Centers
NWP – Naval Warfare Publication

–O–

O49 – Joint Contact Point and Test Project
O&M – Operations & Maintenance
O&S – Operations & Sustainment
OAG – Operational Advisory Group
OCONUS – Outside the continental United States
OEA – Operational Effectiveness Assistance
OFW – Objective Force Warrior (Program)
OG – Overgarment
OIF – Operation Iraqi Freedom
OIF/OEF – Operation Iraqi Freedom/Operation Enduring Freedom
OIPT – Overarching Integrated Product Team or Overarching Integrated Process TeamOMFTS – Operational Maneuver From the Sea
OOTW – Operations Other Than War

OPCW – Organization for the Prohibition of Chemical Weapons (in The Hague)
OPLAN – Operational Plan
OPNAV – Office of the Chief of Naval Operations
ORD – Operational Requirements Document
ORM – Operational Risk Management
OSD – Office of the Secretary of Defense
OSHA – Occupational Safety and Health Administration
OSUT – One Station Unit Training
OT – Operational Testing
OTA – Operational Test Agency
OTSG – Office of the Surgeon General

–P–

2-PAM - pralidoxime
P3I – Pre-Planned Product Improvement
PA – protective antigen, or physician assistant
PACAF – Pacific Air Forces
PACOM – Pacific Command
PAIO – Program Analysis and Integration Office
PAM – Preventative and Aerospace Medicine
PATS – Protective Assessment Test System
PB – President's Budget or pyridostigmine bromide
PBA – Pine Bluff Arsenal
pBuChE – plasma-derived human butylcholinesterase enzyme
PCC – Premature Chromosome Condensation
PCPS – Portable Collective Protection System
PCR – polymerase chain reaction
PCRA - polymerase chain reaction assay
PD – phenyl dichlorarsine
PDDA – Power Driven Decontamination Apparatus
PDM – Program Decision Memorandum
PE – Program Element
PEGEM – Post Engagement Ground Effects Module
PEO-CBD – Program Executive Office for Chemical and Biological Defense
PICS – Personal Ice Cooling System
PIP – Product Improvement Program
PK – pharamacokinetic
P.L. 103-160 – Public Law 103-160, *The National Defense Authorization Act of FY94*
PM – Program Manager
PMCS – Preventative Maintenance Checks and Services
PME – Professional Military Education
PMO – Product Management Office
POI – Program of Instruction
POL – petroleum, oil, and lubricant
POM – Program Objective(s) Memorandum
PQS – Personnel Qualification Standard
PSA – Pressure Swing Adsorption

–Q–

QDR – Quadrennial Review
QEF – Quality Evaluation Facility
QMS – Quality Management System
QNFT – Quantitative fit testing
QPL – Qualified Products List

–R–

R&D – Research and Development
R&T – Research and Technology
RADIAC – Radiation
RAMAN – Regional Atmospheric Measurement and Analysis Network
RAPID – Ruggedized Advanced Pathogen Identification Device
RC – Reserve Component
RD – Radiation Decontamination
RDA – Research, Development, and Acquisition
RDD – Radiological Dispersal Device
RDECOM – Research Development and Engineering Command
RDTE (Also, RDT&E) – Research, Development, Test (&) Evaluation
RestOps – Restoration of Operations
RIP – Readiness Improvement Program
RMC – Regional Medical Commands
RNA – Ribonucleic Acid
ROM – Rough Order of Magnitude
ROTA – Release Other Than Attack
rPA – recombinant protective antigen
RRL – Redox Regulating Liposome
RSCAAL – Remote Sensing Chemical Agent Alarm
RSDL – Reactive Skin Decontaminating Lotion
RSEB – recombinant staphylococcal enterotoxin B
RSOI – Reception, Staging, Onward Movement and Integration
RTI – Research Triangle Institute
RW – radiological/nuclear warfare

–S–

S&T – Science & Technology Base
SACPS – Selected Area Collective Protection System
SAG – Study Advisory Group
Saratoga – a CB protective overgarment
SASC – Senate Armed Services Committee
SBA – Simulation Based Acquisition
SBCCOM – Solider, Biological and Chemical Command (U.S. Army)
SBIR – Small Business Innovative Research
SCALP – Suit Contamination Avoidance Liquid Protection
SCPE – Ship Collective Protective Equipment

SD – Stand-off Detector
SDD – System Development and Demonstration
SDK – Skin Decontamination Kit
SDS – Sorbent Decon System
SE – *staphylococcal enterotoxins* or status ellepticus
SEA – Staphylococcal Enterotoxin A
SEABEE – Construction Battalion
SEB – Staphylococcal Enterotoxin B
SecDef – Secretary of Defense
SERPACWA – skin exposure reduction paste against chemical warfare agents
SERT – Smallpox Epidemic Response Team
SLAM – Strategic Logistics Asset Management
SLS – Senior Level Seminar
SMART-AIT – Special Medical Augmentation Response Team-Aero-Medical Isolation
SMART-B – Special Medical Augmentation Response Team-Burn
SMART-EMR – Special Medical Augmentation Response Team-Emergency Medical Response
SMART-HS – Special Medical Augmentation Response Team-Health Systems Assessment and Assistance
SMART-LOG – Special Medical Augmentation Response Team-Logistics
SMART-MC3T – Special Medical Augmentation Response Team-Medical Command, Control, Communications, Tele-medicine
SMART-NBC – Special Medical Augmentation Response Team-Nuclear/Biological/Chemical
SMART-PC – Special Medical Augmentation Response Team-Pastoral Care (clinical)
SMART-PM – Special Medical Augmentation Response Team-Preventative Medicine
SMART-SM – Special Medical Augmentation Response Team-Stress Management
SMART-V – Special Medical Augmentation Response Team-Veterinary
SMAT – small molecule anti-genomic therapeutics
SME – Subject Matter Expert
SN – Strategic National
SNAPP – Soman Nerve Agent Pretreatment Pyridostigmine
SOF – Special Operations Forces
SO/LIC – Special Operations and Low Intensity Conflict
SOPS – Standing Operating Procedures
SORTS – Status of Resources and Training System
SORTS-C – Status of Resources and Training System-Chemical
SPG – Strategic Planning Guidance
SPOD – Seaport of Debarkation
SSBA – Spectral Sensing of Biological Aerosols
SSE – Sensitive Site Exploitation
STAFFS – Simulation Training and Analysis for Fixed Sites
STANAG – standardization agreement
STB – Super Tropical Bleach
STEPO – Self-Contained Toxic Environment Protective Outfit
STIMAL – Signal Transduction Methodology Antioxidant Liposomes
STOM – (Sea Basing) Ship to Objective Maneuver
SVP – Smallpox Vaccination Program
SWA – Southwest Asia

–T–

T&D – Transport & Diffusion
T&E – Test & Evaluation
TABMS – Total Asset Visibility Management System
TACOM ILSC – Tank-Automotive Armaments Command Integrated Logistics Support Center
TAP – Toxicological Agent Protective boots and gloves
TARA – Technology Area Review and Assessment
TARDEC – Tank and Automotive Research, Development and Engineering Center
TAV – Total Asset Visibility
TB – Technical Bulletin
TBM – Transportation of Biomedical Materials or Tactical Ballistic Missiles or Theater Ballistic Missiles
TBMCS – Theater Battle Management Core Systems
TCPS – Transportable Collective Protection Systems
TDA – table of distribution and allowances
TE – Technical Escort
TED – Troop Equivalent Dose
TEI – Technical Equipment Inspection
TEMP – Test and Evaluation Master Plan
TEMPER – Tent Extendable Modular Personnel
TES – Tactical Engagement Simulation
TEU – Technical Escort Unit
TIC – Toxic Industrial Chemical
TIM – toxic industrial material
TLR – toll like receptors
TOF – Time of Flight
TOPs – Test Operating Procedures
TRADOC – Training and Doctrine Command
TRANSCOM – Transportation Command
TRL – Technology Readiness Level
TS – Technical Secretariat
TSC – Training Simulation Capability
TSG – The Surgeon General
TSI – The Salk Institute
TSP – Topical Skin Protectant

TSWG – Technical Support Working Group
TTP – Tactics, Techniques, and Procedures

–U–

UCS – Unified Command Suite
UFL – Ulchi Focus Lens
UGVS – Unmanned Ground Vehicle System
UID – Unique Item Identifiers
UJTL – Universal Joint Task List
UNWD – Unconventional Nuclear Warfare Defense
URC – Urgent Requirements Capabilities Document
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
USAFSAM/311th HSW – U.S. Air Force School of Aerospace Medicine 311th Human Systems Wing
USAF/XO – United States Air Force, Director of Operations
USAMEDCOM – U.S. Army Medical Command
USAMEDDC&S – U.S. Army Medical Department Center & School
USAMMA – U.S. Army Medical Materiel Agency
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
USAR – US Army Reserve
USC – United States Code or University of Southern California
USCG – United States Coast Guard
USCENTCOM – US Central Command
USD(AT&L) – Undersecretary of Defense (Acquisition Technology & Logistics)
USD(Policy) – Under Secretary of Defense for Policy
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
USS – United States Ship
USSOCOM – United States Special Operations Command
USTRANSCOM – United States Transportation Command
UTC – Unit Type Code
UV – ultra-violet

–V–

VCA – Voice Communication Adapter
VEE – Venezuelan Equine Encephalomyelitis
VENM – Ventilation Model
VERTS – Virtual Emergency Response Training System
VIG – Vaccinia Immune Globulin
VLP – virus-like particles
VLSTRACK – Vapor, Liquid, and Solid Tracking Model
VPS – Virtual Prototyping System
VTC – Video Teleconference
VTT – Video Teletraining
VX – a nerve agent

–W–

W&R – Warning & Reporting
WAARS – Wide Area Aerial Reconnaissance System
WCF – Working Capital Fund
WDTC – West Desert Test Center
WDTIC – West Desert Technical Information Center
WEE – Western Equine Encephalomyelitis
WG – Working Group
WIPT – Working Integrated Process Team
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
WSLAT – Whole System Live Agent Testing

–X–

XBLAST- External Blast

–Y–

Y. pestis – *Yersinia pestis* (Plague)

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