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Can naval surface forces operate under chemical weapons conditions?

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THESIS

CAN NAVAL SURFACE FORCES OPERATE UNDER CHEMICAL WEAPONS CONDITIONS?

by

Adriane A. Stebbins

June 2002

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The acquisition and modernization of chemical warfare (CW) capabilities by state and non-state actors, coupled with the vulnerability of ships restricted in maneuverability to chemical weapons attacks, makes CW defense an increased priority for the U.S. Navy. Adversaries may be deterred from using chemical weapons against naval forces if the U.S. Navy demonstrates that it can continue operations under CW conditions.

In order to conduct a psychological operations campaign that will achieve the desired result, naval forces must be prepared to conduct operations in CW environments while simultaneously protecting personnel from the effects of chemical weapons. This thesis applies the principles of chemical defense outlined in Joint Publication 3-11—contamination avoidance, protection, and decontamination—to requirements for naval operations. It then compares the current doctrine, training, organization, and equipment of the U.S. Navy to the requirements generated by the Department of Defense.

This thesis argues that the ability of the U.S. Navy to conduct military operations in CW environments could be improved through expanded operational doctrine, a reorganization of shipboard roles for CW defense, integrated and realistic unit training, and additional procurement of collective protection systems. Implementation of these modest recommendations can dramatically increase the CW preparedness of the U.S. Navy.

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CAN NAVAL SURFACE FORCES OPERATE UNDER CHEMICAL WEAPONS CONDITIONS?

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LIST OF ACRONYMS AND ABBREVIATIONS

—#—

2 PAM Cl	—	Pralidoxine Chloride

—A—

ACADA	—	Automatic Chemical Agent Detector and Alarm
ACPG	—	Advanced Chemical Protective Garment
ATNAA	—	Antidote Treatment Nerve Agent Auto Injector System

—C—

CAPDS	—	Chemical Agent Point Detection System
CANA	—	Convulsant Antidote for Nerve Agents
CBDP	—	Chemical and Biological Defense Program
CBR-D	—	Chemical, Biological, and Radiological Defense
CCA	—	Contamination Control Area
CCS	—	Casualty Control Station
CMWDS	—	Countermeasures Washdown System
CNO	—	Chief of Naval Operations
CO	—	Commanding Officer
COMNAVAIRPAC/LANT	—	Commander Naval Air Force Pacific Fleet and Commander Naval Air Force Atlantic Fleet
COMNAVSURFOR	—	Commander Naval Surface Forces
COMPTUEX	—	Composite Training Unit Exercise
CPFC	—	Chemical Protective Footwear Covers
CPO	—	Chemical Protective Overgarment
CPS	—	Collective Protection System
CW	—	Chemical Warfare
CWC	—	Chemical Weapons Convention
CWDD	—	Chemical Warfare Directional Detector

—D—

DASD(CB)	—	Deputy Assistant to the Secretary of Defense for Chemical and Biological Defense
DC	—	Damage Control
DCA	—	Damage Control Assistant
DoD	—	Department of Defense
DoN	—	Department of the Navy

—E—

EA	—	Executive Agent

—F—

FDA	—	Food and Drug Administration
FEP	—	Final Evaluation Period
FLIR	—	Forward Looking Infrared
FY	—	Fiscal Year

—G—

GPO	—	Government Printing Office

—H—

HEPA	—	High Efficiency Particulate Air

—I—

IDTC	—	Interdeployment Training Cycle
INSS	—	Institute for National Strategic Studies
IPDS	—	Improved Point Detection System
IPE	—	Individual Protective Equipment
IPG	—	Individual Protective Garment

—J—

JCAD	—	Joint Chemical Agent Detector
JCS	—	Joint Chiefs of Staff
JP	—	Joint Publication
JSFXD	—	Joint Service Fixed Site Decontamination
JSGPM	—	Joint Service General Purpose Mask
JSLIST	—	Joint Services Lightweight Integrated Suit Technology
JSLSCAD	—	Joint Service Lightweight Standoff Chemical Agent Detector
JTFEX	—	Joint Task Force Exercise
JWARN	—	Joint Warning and Reporting Network

—L—

LP	—	Limited Protection

—M—

MEFEX	—	Marine Expeditionary Force Exercise
MOPP	—	Mission Oriented Protective Posture

—N—

NAAK	—	Nerve Agent Antidote Kit
NAPP	—	Nerve Agent Pretreatment Pyridostigmine
NAVSEA	—	Naval Sea Systems Command
NBC	—	Nuclear, Biological, and Chemical
NBCWRS	—	NBC Warning and Reporting System

NDU	—	National Defense University
NEC	—	Navy Enlisted Classification
NFC	—	Numbered Fleet Commanders
NSF	—	Naval Surface Forces
NSTM	—	Naval Ships' Technical Manual
NWP	—	Naval Warfare Publication
—O—		
OPNAV N7	—	Deputy Chief of Naval Operations (Resources, Warfare Requirements and Assessments)
OPNAV N70CP	—	Special Assistant to the CNO for Counterproliferation
—P—		
PQS	—	Personnel Qualification Standard
PSYOP	—	Psychological Operations
—R—		
RSCAAL	—	Remote Sensing Chemical Agent Alarm
—S—		
SACPS	—	Selective Area Collective Protection System
SERPACWA	—	Skin Exposure Reduction Paste Against Chemical Warfare Agents
SPOD	—	Seaport of Debarkation
SWOS	—	Surface Warfare Officers School
—T—		
TP	—	Total Protection
TTP	—	Tactics, Techniques, and Procedures
TSTA	—	Tailored Ship's Training Availability
—U—		
UAV	—	Unmanned Aerial Vehicle
—W—		
WMD	—	Weapons of Mass Destruction
—X—		
XO	—	Executive Officer

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I. INTRODUCTION

A. MOTIVATION

Kanagawa Prefecture, Japan, 2005.[1] In the early hours before dawn, a helicopter rises from a nondescript civilian airfield north of Tokyo Bay. The helicopter looks ordinary, except for the extra tanks affixed to each skid and the gas masks worn by its pilots. It moves southward, low over the water to blend into the crowded bay.

Meanwhile, the crew of the *USS Kitty Hawk*, CV 63, watch the Japanese shore slowly recede. The carrier has been ordered from its homeport in Yokosuka to the Yellow Sea to defuse rising tensions between North and South Korea. Soon after leaving port, the *Kitty Hawk* receives word that North Korean soldiers have crossed the DMZ in an attempt to retake South Korea.

The air supervisor in the *Arleigh Burke* class destroyer escorting the *Kitty Hawk* marks the helicopter as an unknown contact as it appears on his radar screen. The helicopter moves to within two nautical miles upwind of the battlegroup. Its crew releases the VX nerve agent contained in its spray tanks, making several passes, then quickly turns the helo around. Several minutes later, they land and hide the helicopter on one of the many oil tankers transiting the bay.

By this time, the VX vapors have reached the *Kitty Hawk* battlegroup. A fine mist settles on the deck of the aircraft carrier. Air intakes pull the agent inside the ship, depositing a thin coating of VX on the interior surfaces. Two hours later, the port and starboard lookouts begin to sweat and drool. The entire bridge watchteam, including the Commanding Officer, is soon incapacitated. The Executive Officer of the *Kitty Hawk* orders all hands to don their chemical protective equipment. The countermeasures washdown system is activated to spray the superstructure with seawater, but the VX has already soaked into the paint and nonskid coatings on the upper levels of the ship. Half an hour passes before the agent is identified and the Commander, Seventh Fleet can be notified. Without a collective protection system, the crew of the *Kitty Hawk* cannot

[1] The following scenario is modeled after *Assessment of the Impact of Chemical and Biological Weapons on Joint Operations in 2010* (McLean, Va.: Booz Allen & Hamilton, November 1997).

remove their protective masks and clothing to eat or rest. Their decontamination equipment is ineffective against the soaked-in, persistent agent. They cannot continue steaming for more than a day (the maximum amount of protection provided by their suits), much less conduct flight operations off the North Korean coast. The admiral has no choice but to order the carrier to return to Yokosuka.

B. DISCUSSION

The preceding scenario illustrates the vulnerability of U.S. naval surface forces (NSF) to chemical weapons attack. Chemical weapons are a dangerous addition to modern warfare. Blood, choking, and most nerve agents work immediately to kill unprotected personnel, while blister agents create painful blisters on exposed skin, the eyes, and inside the lungs. Specialized equipment is required to detect chemical weapons and determine what type of chemical agent has been used in a chemical warfare (CW) attack. Naval policy is to operate chemical detection equipment only in areas of high threat,[2] leaving NSF vulnerable to covert attacks such as the one just described.

The large number of groups believed to possess CW capabilities is of concern to U.S. forces. The Department of Defense (DoD) identifies ten countries that are believed to have chemical weapons programs: China, India, Iran, Iraq, Libya, North Korea, Pakistan, Russia, Sudan, and Syria.[3] Non-state organizations also have the ability to produce chemical agents, using the scientific literature and online sources for information and ordering precursor chemicals in small quantities. State and non-state actors acquire chemical weapons because they provide a means for a weaker enemy to potentially defeat a larger foe.

Forward deployed NSF are attractive targets for CW attack. Naval surface forces are often the first military assets to respond to crises around the world. They patrol the coastline of several countries with CW programs, including Iran and China. A CW attack

[2] U.S. Department of Defense (DoD), *Multiservice Procedures for Contamination Avoidance and the NBC Warning and Reporting System (NBCWRS)*, FM 3-11.3, final coordinating draft (Washington, D.C.: U.S. GPO, January 2002), B-7.

[3] U.S. DoD, *Proliferation: Threat and Response* (Washington, D.C.: U.S. Government Printing Office [GPO], January 2001).

that incapacitated the U.S. first response to a region would give potential adversaries more time to conduct their own, unopposed military operations. Chemical warfare attacks against amphibious ships could prevent U.S. forces from conducting land operations in hostile territory.

U.S. naval surface forces, therefore, have a need for protection against CW attacks. One of the five principles for protecting U.S. armed forces from CW attack outlined in Joint Publication (JP) 3-11, *Joint Doctrine for Operations in Nuclear, Biological, and Chemical (NBC) Environments*, is psychological operations (PSYOP). When conducting PSYOP, the United States selectively projects true statements to enemy targets to cause a desired outcome. If the enemy were convinced that U.S. forces could successfully conduct operations in CW environments, any perceived advantage gained from using chemical weapons would be lower. The risks of employing CW might then outweigh the benefits, leading to the outcome desired by the United States—that enemies equipped with chemical weapons would refrain from using them against U.S. forces. However, in order to conduct an effective PSYOP campaign, NSF must actually be well prepared to conduct effective military operations under CW conditions. This thesis seeks to answer the question, "Can the U.S. Navy conduct operations in a CW environment?"

C. KEY FINDINGS

This thesis examines the distinction between surviving a chemical warfare attack and conducting sustained operations in a CW environment. Current naval doctrine, organization, training, and equipment focuses on chemical warfare defense, assuming that military operations in a CW environment will automatically be enabled as well. Unfortunately, this is not necessarily the case. Four specific proposals are made to improve the ability of the U.S. Navy to operate under CW conditions.

First, *the Navy should consolidate tactics, techniques, and procedures (TTPs) for operations in a CW environment*. Commanding officers set forth individual TTPs for CW defense in their chemical, biological, and radiological defense (CBR-D) bill. The ship's CBR-D bill should be standardized by ship class to provide common procedures for warning other units of CW attack, distributing chemical protective equipment and medical items, and prioritizing and conducting decontamination operations.

Second, *the Navy should create a CBR-D officer billet on all surface ships*. Current shipboard organization for operations in a CW environment creates a conflict for the Damage Control Assistant (DCA). The DCA must coordinate both damage control (DC) actions and CBR defense actions. The creation of a CBR-D officer would resolve this conflict.

Third, *the Navy should broaden the scope of unit training to include operations under CW conditions*. Current CW defense exercises are stand-alone drills, ending before operational exercises in CW environments can be practiced. By integrating realistic military operations with CW defense exercises, naval forces will better understand the demands imposed by chemical protective equipment.

Finally, *the Navy must increase funding for collective protection systems (CPS)*. Collective protection systems are critical for enabling operations in a CW environment. They allow personnel to eat, sleep, and receive medical treatment. Collective protection systems also provide an area for personnel to change their individual protective garments (IPG). The exchange of IPG is critical for sustained operations under CW conditions because even the advanced Joint Service Lightweight Integrated Suit Technology (JSLIST) garments provide protection for only twenty-four hours of continuous wear. Currently, only 35.8 percent of surface combatants are equipped with CPS (not including aircraft carriers), while the percentage of amphibious forces with CPS is 48.8 percent, and of support ships (not including salvage ships) is 33.3 percent. None of the mine warfare ships or aircraft carriers in the U.S. Navy is outfitted with CPS. The Navy should also act to increase its supply of the charcoal filters and prefilters used by shipboard CPS. Recommendations concerning equipment are limited to collective protection systems. Planned developments in detection, individual and medical protection, and decontamination equipment will improve naval preparedness for operations in CW environments.

D. ORGANIZATION

This thesis consists of five chapters. Chapter I introduces the motivation, research question, and argument of the thesis. Chapter I argues that adversaries may be prevented from using chemical weapons against the United States if the United States can successfully demonstrate that it is well prepared to continue operations under CW conditions. Chapter II discusses the CW threat to NSF. It outlines the types of chemical agents and delivery methods, countries suspected of possessing chemical weapons, and scenarios for chemical weapons employment. Without the proper capabilities, NSF are vulnerable to disrupted operations resulting from CW attack. Chapter III examines the requirements articulated in JP 3-11 for chemical defense, and compares those requirements to naval operations. It finds that a successful CW defense is insufficient to allow NSF to conduct operations in a CW environment. Chapter IV describes the doctrine, organization, training, and equipment currently available to naval forces for operations in a CW environment. Chapter V evaluates the preparedness of NSF for conducting operations under CW conditions. Naval surface forces are well equipped and trained in the use of individual protective equipment, and can conduct decontamination operations using the countermeasures washdown system (CMWDS) if given adequate warning. In the long term, naval detection and warning of CW attacks will improve as the Joint Warning and Reporting Network (JWARN) and compatible sensors are fielded to all services. Naval ability to conduct operations in CW environments is limited by the insufficient number of ships equipped with CPS. Chapter V also provides four practical recommendations for improving the ability of the U.S. Navy to conduct operations under CW conditions.

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II. THE CHEMICAL WARFARE THREAT TO NAVAL SURFACE FORCES

You can take the most beat-up army in the world, and if they choose to stand and fight, you are going to take casualties; if they choose to dump chemicals on you, they might even win.

H. Norman Schwartzkopf, *The Autobiography: It Doesn't Take a Hero*

A. INTRODUCTION

The use of chemical weapons provides adversaries with the ability to offset the superior conventional capabilities of the United States. Chemical weapons are viewed as an asymmetric threat for three reasons. First, as a signatory to the Chemical Weapons Convention (CWC), the United States has given up its ability to respond to a CW attack in kind.[4] Second, adversary use or even the threat of adversary use of chemical weapons seriously degrades the operational tempo of U.S. forces. Third, chemical warfare can induce panic in unprepared military forces and civilians.

The equipment required to produce CW agents is dual use, meaning that it can be employed in military or civilian industries. As a result, the United States faces two challenges. First, it is difficult to monitor the CW programs of states and other groups. With many adversaries potentially equipped with chemical weapons, the origin of a CW attack may be less clear than a nuclear attack.[5] Therefore, a CW-capable adversary may be more inclined to use chemical weapons against the United States.

A second problem for the United States is that dual-use equipment provides a veneer of legitimacy for covert chemical weapons production facilities. This impedes the ability of the United States to conduct preemptive strikes against suspected adversary chemical weapons production sites. One report released by the U.S. government states, "The greatest similarities occur between pesticide and nerve agent production units

[4] Barry R. Schneider, *Future War and Counterproliferation: U.S. Military Responses to NBC Proliferation Threats* (Westport, Conn.: Praeger, 1999), 70.

[5] Kenneth F. McKenzie, Jr., "The Rise of Asymmetric Threats: Priorities for Defense Planning," in *QDR 2001: Strategy Driven Choices for America's Security*, ed. Michèle A. Flournoy (Washington, D.C.: National Defense University [NDU] Press, 2001), 82.

because these compounds are so closely related."[6] In November 2001, the Bush administration acknowledged that a fertilizer plant in Mazar-i-Sharif, suspected as a site of Al Qaeda chemical weapons production, was not destroyed during U.S. military operations because of its dual use nature. The *New York Times* reported, "the decision not to strike the suspect sites appears to result from…the possible unintended political and diplomatic consequences of attacks on dual use facilities."[7]

The U.S. Navy is not immune to chemical warfare. Chemical weapons can be used to kill naval personnel or to slow the rate of shipment of troops and equipment at a seaport of debarkation (SPOD). They could be used against naval bases located in the United States or forward deployed forces.[8] This chapter provides background information on the four types of CW agents and associated delivery methods. It discusses the possible actors in a conflict involving chemical weapons, and scenarios in which NSF might face the use of chemical weapons. Information regarding the CW threat is necessary to plan for defense and operations in a CW environment, both of which are further explored in chapter III.

B. TYPES OF AGENTS

Chemical warfare agents, the first type of weapon of mass destruction (WMD), were developed for use in the First World War. In general, chemical weapons are still the first kind of WMD acquired by countries.[9] Chemical warfare agents are toxic chemicals designed to kill or incapacitate. Chemical warfare agents vary in toxicity, persistency, and the effects they cause to the body. There are four main types of CW agents: blister, blood, choking, and nerve.

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6 *The Biological & Chemical Warfare Threat* (Washington, D.C.: U.S. GPO, 1999), 32.

7 James Risen and Judith Miller, "A Nation Challenged: Chemical Weapons; Al Qaeda Sites Point to Tests of Chemicals," *New York Times*, 11 November 2001, 1B.

8 U.S. DoD, *Quadrennial Defense Review Report* (Washington, D.C.: U.S. GPO, 30 September 2001), 32; Schneider, *Future War and Counterproliferation*, 92; U.S. DoD, *Proliferation: Threat and Response,* 1, 4.

9 Albert J. Mauroni, *America's Struggle with Chemical-Biological Warfare* (Westport, Conn.: Praeger, 2000), 7.

Examples of blister agents include mustard, mustard nitrogen, and lewisite. Blister agents cause damage to the skin, eyes, and lungs. Symptoms from blister agents (except for lewisite) do not appear until two to twenty-four hours after exposure. Blister agents are not generally classified as lethal, although a large enough exposure could certainly result in death.[10]

The most common blood agents are hydrogen cyanide and cyanogen chloride. Blood agents inhibit the ability of red blood cells to transport oxygen, causing rapid damage to body tissues and eventual death. Blood agents are absorbed primarily through the lungs and work quickly to degrade the effectiveness of protective mask filters. Therefore, they can be used in conjunction with other types of agents to increase the overall effectiveness of a CW attack.[11]

Choking agents, such as chlorine and phosgene, are the oldest class of CW agents. Exposure to choking agents causes respiratory membranes to secrete fluid, which fills the lungs. This results in death sometimes referred to as "dry land drowning."[12]

Examples of nerve agents include tabun, sarin, soman, cyclosarin, VX, and fourth generation agents known as "Novichoks." Nerve agents interfere with the transmission of nerve impulses, causing death through paralysis of the respiratory muscles. The production of nerve agents is similar to that of many pesticides, making it difficult to distinguish a factory from an agent production facility. Novichoks are especially dangerous, as they were created to foil established detection and protection measures.[13]

The following table summarizes the four types of agents and provides additional information on their persistence and rate of action.

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[10] *The Biological & Chemical Warfare Threat,* 29; U.S. Deputy Assistant to the Secretary of Defense for Chemical and Biological Defense [DASD(CB)], *Chemical and Biological Defense Primer* (Washington, D.C.: U.S. GPO, October 2001), 9.

[11] *The Biological & Chemical Warfare Threat*, 28; U.S. DASD(CB), *Chemical and Biological Defense Primer*, 8—9.

[12] *The Biological & Chemical Warfare Threat*, 28; U.S. DASD(CB), *Chemical and Biological Defense Primer*, 10.

[13] *The Biological & Chemical Warfare Threat*, 29; U.S. DASD(CB), *Chemical and Biological Defense Primer*, 8; U.S. DoD, *Proliferation: Threat and Response*, 4.

Class of Agent	Symbol	Symptoms	Effects	Rate of Action
Blister	HD HN HL L	No early symptoms. Searing/stinging of eyes and skin.	Blisters delayed hours to days; eyes and lungs affected more rapidly. Immediate pain, delayed blisters. Persistent and a contact hazard.	Vapors—4 to 6 hours Skin—2 to 48 hours
Blood	AC CK	Rapid breathing, convulsions, and coma.	Kills in sufficient dosage. Non-persistent and an inhalation hazard.	Immediate
Choking	CG DP	Difficulty breathing; tearing of the eyes.	Damages and floods lungs. Death can result. Non-persistent and an inhalation hazard.	Immediate to 3 hours
Nerve	GA GB GD GF VX	Difficulty breathing, sweating, drooling, convulsions, dimming of vision.	Incapacitates at low concentrations. Kills in sufficient dosage. VX is persistent and a contact hazard. The other agents are non- persistent and present an inhalation hazard.	Vapors—seconds to minutes Skin—2 to 18 hours

Table 1. Chemical Agents and Their Effects[14]

C. DELIVERY METHODS

Agents must be coupled with delivery systems in order to create viable chemical weapons. Delivery systems are classified by the dispersal pattern they produce—point attack systems initially release agent in a circular area which then spreads in a plume downwind of the detonation, while area attack systems produce rectangular areas of contamination. Point attack systems include ballistic and cruise missiles, artillery, mortars, mines, and multiple rocket launchers. Area attack systems involve sprayers that can be employed from the air; for example, on unmanned aerial vehicles (UAVs), fixed wing aircraft, or helicopters. Sprayers can also be used from the ground by special operations forces.[15] Because delivery methods are varied, it is difficult for U.S. forces to detect a CW attack with sufficient time to warn affected units.

[14] U.S. DASD(CB), *Chemical and Biological Defense Primer*, 7.

[15] Brian G. Chow et al., *Air Force Operations in a Chemical and Biological Environment* (Santa Monica: RAND, 1998), 40; U.S. DoD, *Proliferation: Threat and Response*, 4.

D. CHEMICAL WARFARE ACTORS

1. States

The 2001 edition of *Proliferation: Threat and Response* lists ten countries that have established or are believed to be establishing chemical weapons capabilities: China, India, Iran, Iraq, Libya, North Korea, Pakistan, Russia, Sudan, and Syria. The level of CW programs ranges from Russia, which possesses the largest stockpile in the world of chemical agents, to Libya and Syria, which are dependent on foreign countries to provide precursor chemicals and production equipment. The following table summarizes the CW capability of each of the previously mentioned countries and their status regarding the CWC.

Country	Ratified CWC?	CW Assessment
China	Yes	Has the ability to quickly mobilize the chemical industry to produce a wide variety of chemical agents and delivery means. Probably has not divulged full nature of chemical warfare program.
India	Yes	Acknowledged chemical warfare program in 1997 and stated that related facilities would be open for inspection. Has sizeable chemical industry, which could be source of dual-use chemicals for countries of proliferation concern.
Iran	Yes	Began chemical warfare program during Iran-Iraq war; employed limited amounts of agent against Iraqi troops. Possessed weaponized stockpile of agents; capable of agent delivery; trains military forces to operate in contaminated environment. Seeking to improve chemical precursor production capability.
Iraq	No	Rebuilt some of its chemical production infrastructure allegedly for commercial use. UNSCOM discovered evidence of VX persistent nerve agent in missile warheads in 1998, despite Iraqi denials for seven years that it had not weaponized VX. May have begun program reconstitution in absence of UN inspections and monitoring.
Libya	No	Produced blister and nerve agents in 1980s at Rabta; employed chemical agents against Chadian troops in 1987; attempted to construct underground chemical agent production facility at Tarhunah. Rabta and Tarhunah believed to be inactive, although chemical program not completely abandoned.
North Korea	No	Believed to possess large stockpile of chemical precursors and chemical warfare agents. Probably would employ chemical agents against U.S. and allied forces under certain scenarios.
Pakistan	Yes	Improving commercial chemical industry, which would be able to support precursor chemical production.
Russia	Yes	Declared the world's largest stockpile of chemical agents. Has developed a new generation of chemical agents.
Sudan	Yes	Allegations of chemical warfare use against rebels in southern Sudan unconfirmed. Known VX precursor chemical discovered near a pharmaceutical facility in Khartoum.
Syria	No	Possesses and is capable of delivering nerve agents: may be developing more advanced VX nerve agent. Making improvements to chemical infrastructure.

Table 2. Chemical Warfare Capabilities of Selected Countries[16]

[16] U.S. DoD, *Proliferation: Threat and Response*.

Precedents for the use of chemical weapons by states can be found in the 1980-1988 Iran-Iraq War. Iraq began using chemical weapons against Iran in 1983. Although initial attacks were militarily ineffective because of poor agent quality and flawed tactics, by 1988 Iraq was able to successfully integrate chemical weapons into offensive military operations.[17] Iran first used chemical weapons against Iraq during 1984-1985, with no appreciable military effect. Iran may also have employed chemical weapons against Iraqi forces in 1987 and against Kurdish civilians in March 1988.[18]

2. Non-State Organizations

Non-state organizations include criminal, terrorist, and religious groups. Richard Falkenrath, Robert Newman, and Bradley Thayer argue in *America's Achilles' Heel* that non-state use of chemical weapons is governed by three factors. First, non-state actors must be capable of chemical weapons acquisition. Second, they must be interested in causing mass casualties. Finally, they must want to use chemical weapons to achieve their goals. Falkenrath, Newman, and Thayer believe that developments in each factor increase the probability that non-state actors will use chemical weapons against the United States.[19]

It is generally agreed that the barriers to acquisition of chemical weapons are becoming smaller. Instructions for synthesis of CW agents can be pieced together from an ever-growing body of scientific literature. George Tenet, the Director of Central Intelligence, notes, "terrorist groups worldwide have ready access to information on chemical, biological, and even nuclear weapons via the Internet…."[20] Instability and

[17] Timothy V. McCarthy and Jonathan B. Tucker, "Saddam's Toxic Arsenal: Chemical and Biological Weapons in the Gulf Wars," in *Planning the Unthinkable: How New Powers Will Use Nuclear, Biological, and Chemical Weapons,* ed. Peter R. Lavoy, Scott D. Sagan, and James J. Wirtz (Ithaca: Cornell University Press, 2000), 63—64.

[18] Gregory F. Giles, "The Islamic Republic of Iran and Nuclear, Biological, and Chemical Weapons," in *Planning the Unthinkable*, ed. Peter R. Lavoy, Scott D. Sagan, and James J. Wirtz (Ithaca: Cornell University Press, 2000), 91.

[19] Richard A. Falkenrath, Robert D. Newman, and Bradley A. Thayer, *America's Achilles' Heel: Nuclear, Biological, and Chemical Terrorism and Covert Attack* (Cambridge, Mass.: MIT Press, 1998), 168—69.

[20] George J. Tenet, "Worldwide Threat—Converging Dangers in a Post 9/11 World," testimony before the Senate Select Committee on Intelligence, 6 February 2002, 2.

poor economic conditions in Russia have combined to create a surfeit of scientists with CW expertise who may be willing to work with terrorist or criminal organizations.

To justify their claim that non-state violence is becoming increasingly lethal, Falkenrath, Newman, and Thayer cite five trends. The first is that violence and terrorism by religious groups is increasing. Secondly, opposition to U.S. presence and influence in the Middle East is rising. Third, right wing terrorism is becoming more prevalent. Fourthly, terrorism is becoming more spontaneous and therefore terrorists have fewer behavioral constraints. Finally, racism and ethnic hatred are mounting in conflicts around the world.[21]

Falkenrath, Newman, and Thayer offer several possible motives for the use of chemical weapons by non-state groups. Non-state actors could desire to cause high casualties, either out of psychological disturbance or because they perceive a large casualty rate as the best way to draw attention to their cause. Non-state groups could embrace chemical weapons use as a means to mimic state functions and thus increase their legitimacy as a ruling body. They could possess a fascination with exotic weapons, or the desire to imitate or outdo a previous incident of terrorism.[22]

An often-cited precedent for non-state use of chemical weapons is that of the Japanese religious group Aum Shinrikyo. Aum conducted its first CW attack against three judges in the town of Matsumoto in 1994. The judges survived, although seven town residents were killed and six hundred Japanese eventually became ill. On 20 March 1995, group members ruptured bags filled with the nerve agent sarin on five Tokyo subway cars. This attack killed twelve people and caused more than five thousand to seek medical attention (several hundred people were actually injured). The group attempted additional attacks on the subway system on 5 May 1995 and 4 July 1995, but alert police officers were able to intercept the delivery devices.[23]

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[21] Falkenrath, Newman, and Thayer, *America's Achilles' Heel*, 181—202.

[22] Ibid., 202—213.

[23] Jessica Stern, "Terrorist Motivations and Unconventional Weapons," in *Planning the Unthinkable*, ed. Peter R. Lavoy, Scott D. Sagan, and James J. Wirtz (Ithaca: Cornell University Press, 2000), 208—9.

As part of the "war on terror" initiated by the George W. Bush administration, the United States has accused the Al Qaeda network of attempting to manufacture chemical weapons. The *New York Times* reported in November 2001 that Al Qaeda used a laboratory in the Afghan village of Derunta to produce cyanide gas. Additionally, a fertilizer plant in Mazar-i-Sharif under Al Qaeda control allegedly had the capability to produce chemical weapons.[24] On 28 November 2001, the Pentagon announced that it was testing over 40 sites in Afghanistan for evidence of WMD production.[25] The press coverage indicates that the DoD is concerned about the possible CW capabilities of Al Qaeda.

E. EMPLOYMENT SCENARIOS

Potential adversaries can employ chemical weapons against naval surface forces to achieve a variety of military objectives. Chemical warfare attacks could employ the "anti-access" strategy. A key tenant of the anti-access strategy is that chemical weapons are more effective at the start of a conflict when the United States is building forces and coalition support in a region.[26] A chemical weapons attack on a troop or equipment transport would slow the movement of supplies and personnel from a SPOD. Chemical weapons attacks against aircraft carriers would prevent the United States from launching air strikes during the first part of a military campaign. An attack on U.S. naval bases in the continental United States would have an adverse affect on naval forces preparing to deploy overseas. In addition to decontaminating ships and cargo, DoD assets would also be tasked with investigating the attack and treating civilians working on the base.[27]

Chemical weapons could also be used as a force multiplier to degrade U.S. or allied military capabilities. Chemical weapons can cause casualties when used against

[24] Risen and Miller, "A Nation Challenged," 1B.

[25] William Walker, "U.S. Tests Afghan Sites for Chemical Weapons," *Toronto Star*, 28 November 2001, A07.

[26] Robert G. Joseph and John F. Reichart, *Deterrence and Defense in a Nuclear, Biological, and Chemical Environment* (Washington, D.C.: NDU Press, 1999), 11.

[27] Rebecca Hersman and W. Seth Carus, *DoD and Consequence Management: Mitigating the Effects of Chemical and Biological Attack*, Institute for National Strategic Studies (INSS), Strategic Forum no. 169 (Washington, D.C.: NDU Press, December 1999), 3.

unprotected personnel. Even if an attack is anticipated, chemical weapons have adverse psychological effects on personnel. Attacks against naval command and control facilities, located on ships in theater, could slow the decision-making cycle of naval commanders.

F. CONCLUSIONS

Each of the four types of CW agents—blister, blood, choking, and nerve—can cause serious harm to sailors and civilians. Blister agents can affect unprotected personnel hours after they are exposed. Blood agents degrade the effectiveness of chemical protective mask filters, and can be used to increase the casualties caused by other types of CW agents. Choking agents cause lung damage to unprotected personnel. Nerve agents are quick-acting and closely resemble pesticides. Chemical warfare agents are combined with delivery vehicles to create chemical weapons.

Chemical weapons are becoming more easily available to interested parties for a variety of reasons. One aid to proliferation is the fact that CW agent production facilities can resemble legitimate commercial plants. Information on the manufacturing of chemical agents on the Internet is another resource for would-be proliferators. The growing number of actors with chemical weapons, coupled with the range of motives for their use, increases the risk that U.S. NSF will face a CW attack. The next chapter discusses the prerequisites for naval forces to defend against CW attacks and conduct sustained operations in CW environments.

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III. CHEMICAL WARFARE DEFENSE VS. OPERATIONS

In wargames, either everyone is wiped out as a result of a surprise C[hemical and] B[iological] attack or everyone survives unscathed because all their protective masks and suits worked perfectly. There is no understanding of the costs or benefits of NBC defense equipment, because it just gets too complicated to model in the effects.

Albert J. Mauroni, *America's Struggle with Chemical-Biological Warfare*

A. INTRODUCTION

Joint Publication 3-11, *Joint Doctrine for Operations in Nuclear, Biological, and Chemical Environments*, provides the U.S. military with guidance for facing the CW threat as discussed in chapter II. It states, "The Armed Forces of the United States must be prepared to conduct prompt, sustained, and decisive combat operations in NBC environments."[28] In order to conduct operations in chemical environments, naval forces must be able to defend themselves against the effects of chemical weapons. However, actions taken for defense may limit the operational resources and performance of a unit. A dilemma then arises: are NSF capable of simultaneously defending themselves and accomplishing their mission in spite of the presence of chemical weapons?

This chapter examines the three principles of NBC defense set forth in JP 3-11: contamination avoidance, protection, and decontamination. For each principle, the requirements and underlying assumptions are stated. The principle is then applied to naval operations and analyzed for its effect on operational tempo. Contamination avoidance, while offering the greatest potential return on investment, requires a temporary disruption in operations. The work/rest cycles required because of heat buildup associated with individual protective equipment (IPE) also slow operational tempo. In contrast, neither collective nor medical protection has an adverse effect on operations. Immediate and operational decontamination can be performed without detracting from operations, although thorough decontamination requires more substantial tradeoffs with mission accomplishment. The requirements set forth in this chapter are

[28] U.S. Joint Chiefs of Staff (JCS), *Joint Doctrine for Operations in Nuclear, Biological, and Chemical Environments,* JP 3-11 (Washington, D.C.: U.S. GPO, 11 July 2000), III-1.

compared against the descriptions provided in chapter IV of naval doctrine, organization, training, and equipment for operations in CW environments to produce a mission readiness assessment.

B. CONTAMINATION AVOIDANCE

Contamination avoidance is the first principle of NBC defense. It includes those actions that take personnel and equipment away from areas where chemical agents are present. In order for contamination avoidance to be successful, units must be capable of movement. They must have the ability to detect chemical agents both at long and short range.[29] Naval forces should monitor for chemical agents at all times, to avoid the possibility of a covert attack. In order to conduct full time monitoring, detection equipment that will produce a minimum of false positives is needed. Detection equipment should be automated as much as possible, so that additional personnel are not required to monitor the equipment. Full time operation of detection equipment will require personnel to perform additional maintenance to keep the equipment functional.

Most, but not all, ships are able to meet the mobility requirement and are therefore capable of contamination avoidance in the open ocean. However, support facilities for naval surface forces are fixed, including port facilities, ships in dry dock, aircraft undergoing repairs, and naval construction units. Although some degree of avoidance is possible when the locations of fixed sites are initially selected, once placed a fixed site cannot execute contamination avoidance. Along the same lines, certain ships may find themselves in situations of restricted mobility. Restricted mobility may be caused by physical constraints, such as shallow water, straits, and canals, or by operational constraints such as amphibious landings.[30] Chemical warfare threats are located near many of these areas, such as the Strait of Hormuz.

Joint Publication 3-11 correctly points out that ships at sea are "inherently able to maneuver to avoid identified NBC threats."[31] This satisfies the mobility requirement.

[29] Ibid., III-6 to III-7.

[30] Ibid., III-18.

[31] Ibid., III-18.

However, contamination avoidance also depends on adequate knowledge of the threat. Joint Publication 3-11 suggests that units may be able to put to sea to avoid chemical threats much as they currently do to avoid hurricanes and typhoons.[32] The problem with this paradigm is that storms can be tracked as they approach using proven equipment and warning signs. A meteorological network exists worldwide for atmospheric measurements. In contrast, a covert delivery of CW agents does not have traceable warning signs. The detection equipment for chemical agents is not nearly as developed or connected as weather observation equipment. Therefore, meeting detection requirements for contamination avoidance is a challenge for all NSF.

Contamination avoidance is the preferred method of response to a NBC attack because it is the least disruptive of operations. Contamination avoidance reduces the amount of time personnel must spend in IPE and eliminates the need for decontamination. Saltwater quickly hydrolyses most chemical agents, but it is reasonable to assume that operations will be suspended for several hours while the ship maneuvers to avoid chemical contamination.[33]

C. PROTECTION

Protection is the second principle of NBC defense. It includes the measures taken to keep personnel and equipment safe during exposure to NBC hazards.[34] Individual protection enables personnel to survive and perform tasks in chemical environments. Collective protection provides a safe area for personnel to rest, eat, and receive medical treatment. Medical protection, such as pretreatments and antidotes, provides relief to personnel from the symptoms of exposure to chemical agents.

According to JP 3-11, protection requires “the planning, preparation, training, and execution of physical defenses to negate the effects of NBC weapons and hazards on personnel and materiel.”[35] Naval equipment for individual protection should reduce heat

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[32] Ibid., III-18.

[33] Ibid., III-16.

[34] Ibid., GL-9.

[35] Ibid., III-7.

stress to the wearer as much as possible. Personnel should train to don and conduct operations in individual protective equipment so that they are confident and comfortable performing these tasks. Individual protection equipment should be stored in multiple, easily accessible locations so that personnel can quickly protect themselves in an emergency. Commanding officers should be trained to make decisions regarding mission oriented protective posture (MOPP) levels that maximize operational capabilities while minimizing the risk of chemical weapons exposure to personnel.

All surface combatants should be equipped with a collective protection system. Collective protection systems should be operated at all times, to minimize contamination in a covert CW attack. Personnel are required to maintain CPS equipment and monitor its functionality.

Medical pretreatments and antidotes should be effective against all types of chemical agents. Personnel should be frequently trained to administer medical treatment to themselves and others. Ships should have adequate medical personnel to treat casualties resulting from a CW attack.

Naval forces are limited in their ability to provide individual, collective, and medical protection to sailors. Current IPE technology provides only twenty-four hours at most of protection in a contaminated environment. Ships carry a limited number of protective suits. If a ship is also equipped with a CPS, nonessential personnel can remain sheltered, reducing the number of chemical protective garments needed for topside evolutions. However, not all ships are currently equipped with collective protection systems.[36] Medical pretreatments and antidotes exist for nerve agents, but not for blister, blood, or choking agents.

The use of individual protective equipment can cause severe degradation in mission performance. Protective clothing is impervious to chemical agents, but it is also bulky and heat retentive. Significant amounts of time in protective clothing, especially when ambient temperatures are warm, can cause heat stress. Protective masks limit vision and reduce voice communications. Protective gloves can interfere with tasks that

[36] Ibid., III-18. See Chapter IV for additional information on surface combatants outfitted with CPS.

require fine motor skills. Individual protective equipment can also interfere with other protective clothing worn aboard ship, such as firefighting equipment.[37] A tradeoff is involved between the mission performance facilitated by individual protective equipment and the tasks that it limits.

Because collective protection systems on ships are built in, activating collective protection measures requires minimal sacrifice in mission performance. Individuals must wait a few minutes for airlocks to cycle before transiting between areas of collective protection and other areas of the ship. Similarly, few operational tradeoffs are involved in taking a pretreatment tablet or using an autoinjector containing a nerve agent antidote.

D. DECONTAMINATION

Decontamination is the third principle of NBC defense. Decontamination restores forces and operations to a near normal capability. Immediate decontamination removes chemical agents from exposed skin, individual protective equipment, and frequently touched equipment surfaces. Operational decontamination includes individual MOPP gear exchange and operator washdown for mission essential equipment. Thorough decontamination techniques for personnel, equipment, and aircraft allow the reduction of the MOPP level of a unit.[38] Naval forces should have sufficient personnel trained to activate the CMWDS and to man decontamination stations. All personnel should be trained to transit through decontamination stations to reduce the spread of chemical contamination throughout the ship. Decontaminants should be developed for use on open wounds, sensitive equipment and aircraft, and large areas such as flight decks. Decontamination equipment should be stored in easily available locations for emergency use. Commanding officers should be trained to make decisions that maximize decontamination efforts without degrading the operational performance of a unit.

Decontamination at sea offers unique advantages over decontamination ashore. Seawater is readily available to ships for use in washing down equipment. The CMWDS

[37] U.S. Naval Sea Systems Command (NAVSEA), *Shipboard BW/CW Defense and Countermeasures*, Naval Ships' Technical Manual chap. 470 rev. 3 (Washington, D.C.: U.S. GPO, 6 August 1998), 5-23.

[38] U.S. JCS, *Joint Doctrine for Operations in NBC Environments*, III-10.

consists of valves that can be opened to spray the superstructure of a ship with seawater. Ships are also capable of moving to uncontaminated areas to purge their ventilation systems. On the other hand, the decontamination equipment and detectors required to perform thorough decontamination are only available when ships return to a port facility.

The three levels of decontamination impact naval operations to different degrees. Immediate decontamination is performed quickly to minimize casualties, save lives, and limit contamination exposure.[39] Immediate decontamination is also essential to protect medical personnel from exposure to chemical agents. The CMWDS is activated before or immediately after a chemical agent cloud is encountered to limit the extent to which agent can soak into paint and nonskid coatings. The CMWDS impacts operations by reducing the amount of pressure in the fire main and also can cause corrosion to aircraft present on the deck of a ship or aircraft carrier.[40] Otherwise, immediate decontamination minimally degrades operations.

Operational decontamination allows forces to continue operations after encountering chemical agents. Operational decontamination limits the spread of contamination and therefore can augment protection systems. Commanding officers must determine areas of a ship that are priorities for operational decontamination, as personnel assigned to decontamination will not be available to perform other functions. If units leave the area to purge with clean air, operations may be affected. Operational decontamination is performed as the mission permits. Operations must be completely halted to perform thorough decontamination because of the need for land-based equipment.

E. CONCLUSIONS

Chemical warfare defense, while important, can interfere with the conduct of operations in a CW environment. Naval surface forces may not be able to perform contamination avoidance because of physical and operational constraints on mobility and limitations of current detection equipment. However, contamination avoidance is the

[39] Ibid., III-9.

[40] U.S. NAVSEA, *Shipboard BW/CW Defense and Countermeasures*, 7-2.

least detrimental for mission accomplishment. Individual protection degrades mission performance by causing heat stress and interference with communications and other tasks. Collective protection has minimal impact on operational performance. However, not all ships are equipped with a CPS. Medical protection does not detract from operational performance, although pretreatments and antidotes are limited to use against nerve agents. Decontamination of ships is facilitated by the availability of seawater and the CMWDS. Immediate and operational decontamination can be performed in the course of mission accomplishment, while thorough decontamination requires a ship to return to port and cancel operations entirely. Taking these requirements into account, the next chapter examines the current capability of the U.S. Navy to conduct operations under CW conditions.

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IV. NAVAL CAPABILITIES FOR OPERATIONS UNDER CHEMICAL WARFARE CONDITIONS

Inside the gas-mask my head booms and roars—it is nigh bursting. My lungs are tight, they breathe always the same hot, used-up air, the veins on my temples are swollen. I feel I am suffocating.

Erich Maria Remarque, *All Quiet on the Western Front*

A. INTRODUCTION

The 1991 Gulf War exposed serious inadequacies in the preparedness of U.S. armed forces to conduct operations in a CW environment. Military personnel were unfamiliar with the use of chemical detection and decontamination equipment. Individual protective equipment was ill fitted for the hot desert climate. In some cases, protective masks had dry rotted, while others were missing their protective filters.

During the six-month buildup, U.S. forces improved their ability to conduct CW defense. After the war, the DoD placed increased importance on preparations for CW defense. New equipment such as JSLIST, JWARN, and the Artemis standoff detection system is currently in research or production stages. The question is not whether chemical defense equipment has improved, but rather is the improvement sufficient, and how well integrated is the new equipment with military operations?

This chapter examines NSF doctrine, organization, training, and equipment for operations in a CW environment. It provides a starting point from which to evaluate the preparedness of NSF to conduct operations under CW conditions. Chapter V continues the analysis by comparing the requirements described in chapter II for successful operations in CW environments against current capabilities to arrive at a mission readiness assessment.

B. DOCTRINE

Naval Warfare Publication (NWP) 3-20.31 revision A, *Surface Ship Survivability*, was published in January 2000.[41] It contains operational doctrine for CBR defense in chapter eleven, and chemical warfare defense in chapter twelve. *Surface Ship Survivability* Appendix B provides a sample ship's CBR-D bill. The CBR-D bill is maintained by the DCA and tailored to the requirements of the individual ship. It contains the responsibilities of key shipboard personnel (discussed in the organization section of this chapter) both before and during a CW attack. In addition, the CBR-D bill:

- Describes procedures for issuing chemical decontamination kits, protective mask canisters, chemical protective suits, and medical supplies for CW first aid treatment.
- Lists equipment to be worn and actions to be taken in MOPP levels 1-4.
- Assigns personnel to operate the ship's countermeasures washdown system (discussed in the equipment section of this chapter).
- Assigns personnel to set material condition "Circle William" to limit the flow of contaminated air through the ship's ventilation system.
- Designates internal and external survey routes and checkpoints to determine the extent of the ship's exposure to chemical weapons.
- Designates areas to post M8 and M9 paper and conduct vapor checks with the M256A1 kit to monitor for the presence of liquid and vapor chemical agents (equipment descriptions are found in the equipment section of this chapter).
- Designates locations, routes, and manning for contamination control areas (CCAs), where personnel are assisted in the removal of contaminated chemical protective equipment.

[41] "Updates are planned for the Navy publications NWP 3-20.31 *Surface Ship Survivability* and NSTM 470 *Shipboard BW/CW Defense and Countermeasures* to improve interoperability with the USMC during amphibious operations and to revise biological defense procedures." U.S. DoD, Chemical and Biological Defense Program (CBDP), *Annual Report to Congress*, vol. 1 (Washington, D.C.: U.S. GPO, April 2002), 98.

- Lists equipment required at each CCA and describes procedures for entering the CCA.
- Designates casualty control stations (CCS) where personnel exposed to chemical weapons can receive medical treatment.
- Lists mission essential spaces in order of priority for decontamination.
- Describes procedures for aircraft decontamination, if applicable.

Naval Ships' Technical Manual (NSTM) Chapter 470, *Shipboard BW/CW Defense and Countermeasures*, sets forth technical information pertaining to chemical and biological defense equipment and procedures. This information includes procedures for conducting interior and exterior surveys of chemical contamination, donning and doffing chemical protective equipment, and purging the ventilation system of a ship. The third revision was published 6 August 1998.[42]

The *U.S. Navy CBR Defense/U.S. Marine Corps NBC Defense Handbook*, OPNAV P-86-1-95, was published in April 1995. It provides information on the organization of U.S. Navy CW defense, as well as operational and tactical doctrine for detection, identification, and reporting of CW attacks, individual and collective protection, decontamination procedures, and medical considerations. It was intended to be a comprehensive source of CBR-D information, including references, and is referenced in the most recent revision of JP 3-11.

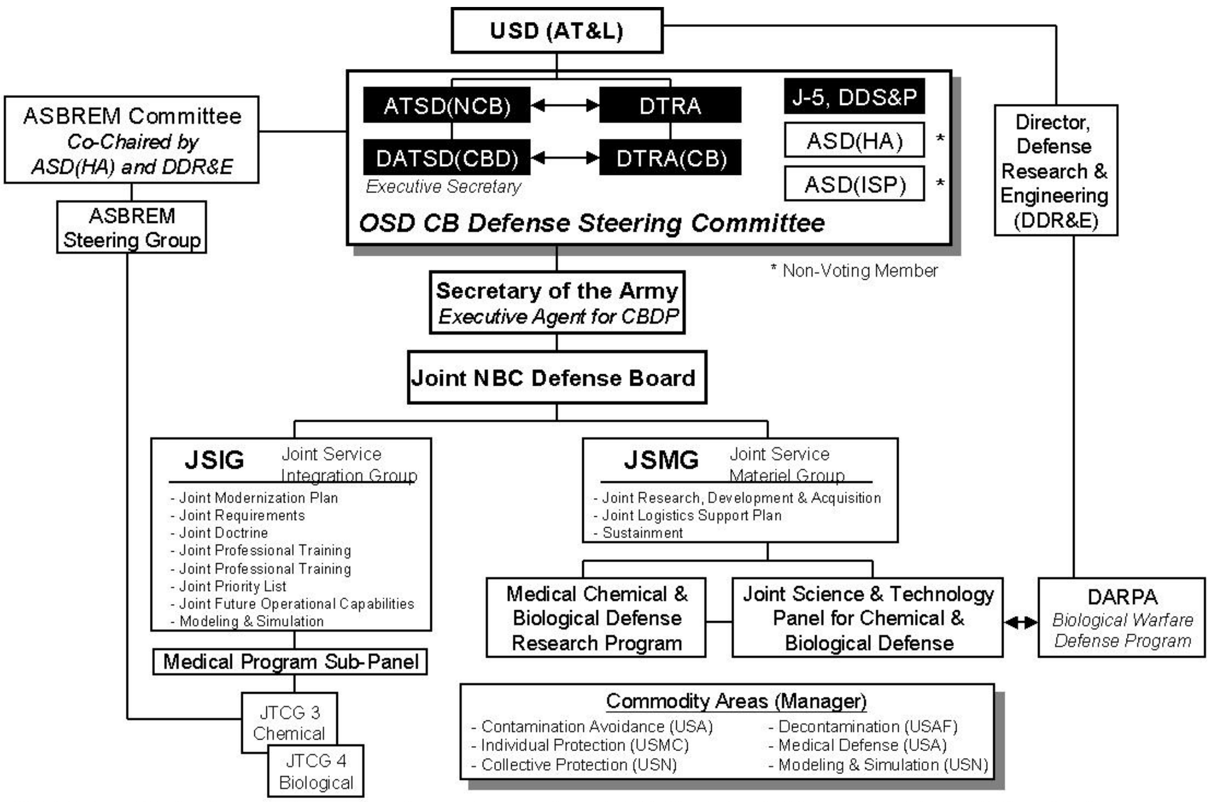
C. ORGANIZATION

Within the Department of Defense, the Navy is the service with the least force structure for conducting operations in CW environments. Therefore, descriptions of CW defense organization begin at the joint service level and continue through shipboard organization.

[42] See previous page.

1. Chemical and Biological Defense Program

Public law 103-160, the fiscal year (FY) 1994 National Defense Authorization Act, directed that a single office within the Department of Defense would oversee the chemical and biological defense programs of all four services. The Chemical and Biological Defense Program (CBDP) is under the direction of the Undersecretary of Defense for Acquisition, Technology and Logistics. The CBDP coordinates service chemical and biological research, development, and acquisition. The CBDP publishes an annual report to Congress. The organization of the CBDP is outlined in Figure 1.



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

Figure 1. Chemical and Biological Defense Program Organization[43]

[43] U.S. DoD CBDP, *2002 Annual Report to Congress*, 14.

The CBDP benefits the Navy in three ways. First, it ensures that future Navy chemical warfare defense equipment is similar to Army, Air Force, and Marine Corps equipment. Standardized equipment will allow Navy ships to act on information received from land or air based chemical weapons detection systems. During amphibious operations, naval personnel can process embarked Marine Corps and Army soldiers through contamination control areas (CCAs) more quickly. Naval ships can supply amphibious forces with protective equipment if necessary.

A second benefit of the CBDP is the elimination of redundant research efforts. A central body serving all branches of the Armed Forces manages research and development funds. Thirdly, the standard reporting to Congress allows government officials to more easily compare the efforts of individual services to prepare for chemical warfare defense. In areas where a service may be deficient, corrective action can be taken. For example, in 1998 the Deputy Secretary of Defense directed the Navy and Marine Corps to assess their ability to perform amphibious assaults in a chemical warfare environment.

2. Department of the Navy Chemical Defense Organization

Complete descriptions of responsibilities for CBR defense within the Department of the Navy (DoN) can be found in OPNAVINST 3400.10F, *Chemical, Biological and Radiological (CBR) Defense Requirements Supporting Operational Fleet Readiness*, published 22 May 1998. The responsibilities of specific offices are highlighted below.

- *The Deputy Chief of Naval Operations (Resources, Warfare Requirements and Assessments)* (OPNAV N7) is the CNO Executive Agent (EA) for CB defense. The EA is responsible for identifying Navy requirements for CBR defense, ensuring the CNO is represented at CBR defense meetings, and ensuring naval input is provided during the development and revision of joint and service CBR doctrine, studies, plans, and programs.

- *The Special Assistant to the CNO for Counterproliferation* is OPNAV N70CP. OPNAV N70CP manages chemical and biological passive defense, active defense, counterforce, and consequence management.[44]

The organization for chemical and biological warfare defense within the Department of the Navy is outlined in Figure 2. This organizational structure divides responsibility for CW defense and operations into several commands within the DoN. The extent to which these differing commands communicate and cooperate to identify equipment and doctrinal requirements is questionable. For example, although OPNAV N70CP is in charge of chemical passive and active defense, the Naval Sea Systems Command (NAVSEA) supervises the installation of collective protection systems.

[44] U.S. Chief of Naval Operations (CNO), Navy Counterproliferation Office, *U.S. Navy Chemical-Biological Defense*, 13 November 2001, <http://chembiodef.navy.mil> (21 May 2002).

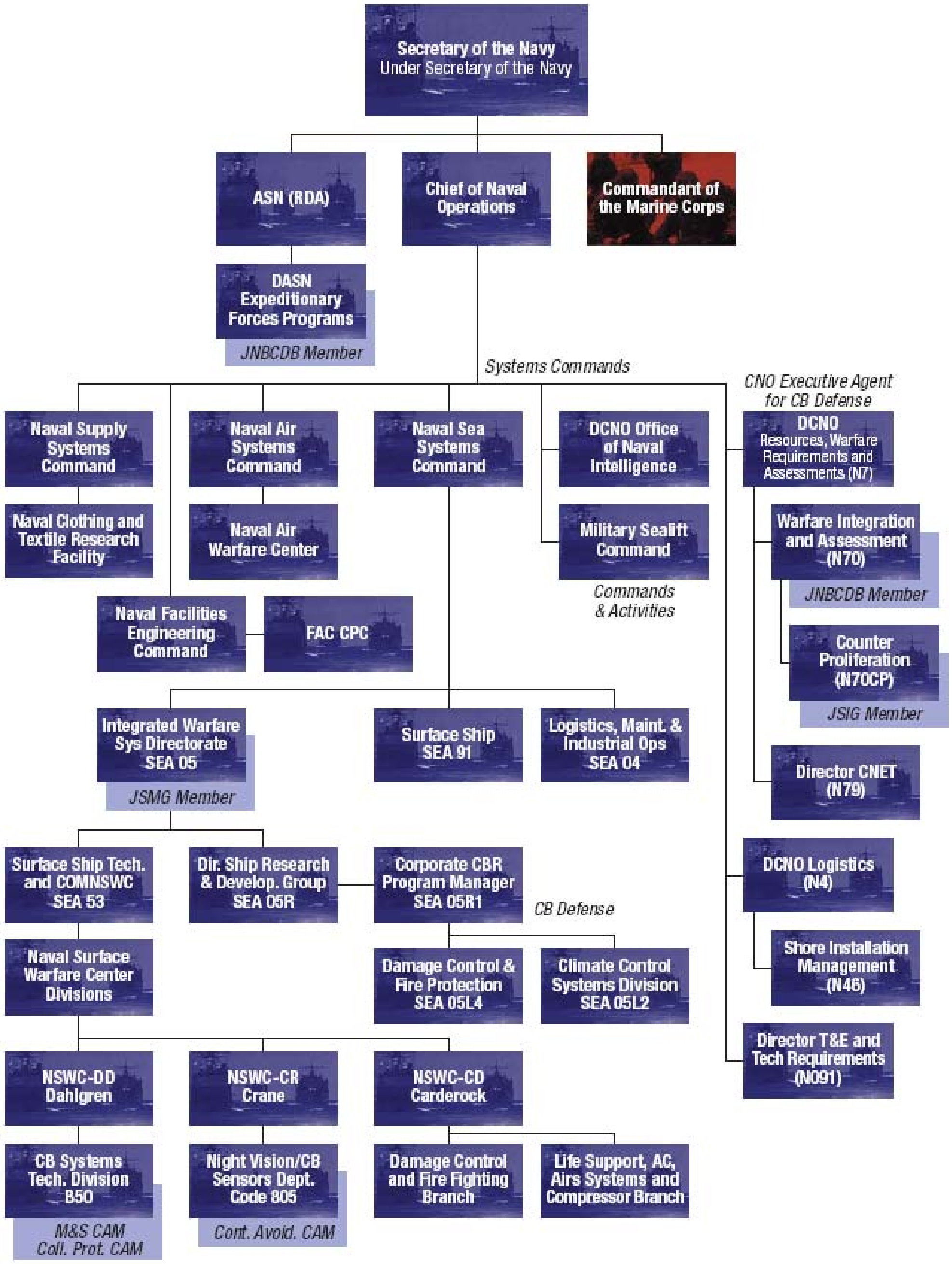


Figure 2. Department of the Navy Organization for Chemical and Biological Defense[45]

3. Shipboard Organization for Chemical Defense

Detailed descriptions of the responsibilities of individuals aboard ship for CBR defense can be found in OPNAVINST 3120.32C CH-4, *Standard Organization and*

[45] U.S. DoD CBDP, *FY00-02 Overview* (Washington, D.C.: U.S. GPO, August 2001), 74.

Regulations of the U.S. Navy, as well as the *U.S. Navy CBR Defense/U.S. Marine Corps NBC Defense Handbook*. The responsibilities of specific officers aboard ship are highlighted below.

- *The Commanding Officer* (CO) is responsible for maneuvering the ship to avoid chemical agent contamination. The CO designates the ship's MOPP level and orders decontamination when tactically feasible. The CO has overall responsibility to ensure that the crew is trained in CBR defense.

- *The Executive Officer* (XO) directs and coordinates shipboard CBR defense training. The XO advises the CO of the ship's survivability readiness, and supervises all damage control and preattack survivability actions.

- *The Engineer Officer* is the technical assistant to the XO for carrying out CBR defense procedures. The Damage Control Assistant reports to the Engineer Officer. The DCA is the ship's CBR officer. Should the ship come under CW attack, the DCA is responsible for identifying CW agents, identifying and isolating contaminated areas, ensuring the setting of the proper material condition, and advising the CO concerning the operation of the ship's ventilation systems. Under normal conditions, the DCA supervises CBR-D training of the ship's crew and is responsible for all CBR-D equipment not specifically owned by other departments. The DCA maintains the ship's CBR-D bill.

- *The Operations Officer* is the principal advisor to the CO for actual or potential CBR hazards. The Operations Officer prepares reports for transmission in accordance with standards for the Nuclear, Biological, and Chemical Warning and Reporting System (NBCWRS, discussed in the equipment section of this chapter). The Operations Officer also maintains plots of actual and potential CBR hazards and recommends course changes to avoid contaminated areas.

- *The Medical Officer* is responsible for treating casualties and inspecting the ship's food and water supplies immediately following a CW attack. The

Medical Officer maintains CBR antidotes and advises personnel on the medical aspects of CBR-D training.

- *The Supply Officer* is responsible for securing food and drink after a CW attack until examined by the medical officer. The Supply Officer provides clean clothing for personnel exiting decontamination stations.

- *Department heads* are responsible for ensuring that all personnel in the department are trained in CBR defense. The department heads coordinate the assignment of personnel to repair lockers in accordance with the ship's CBR-D bill.

- *Division officers* are the principal assistants to the DCA for divisional CBR-D training. They appoint a divisional Damage Control Petty Officer, who assumes responsibility for the CBR-D training.

D. TRAINING

1. Individual Training

Enlisted personnel receive two hours of classroom instruction focused on CBR defense and personal protection and one hour of lab time, including a CBR confidence chamber exposure, during their initial training. Within six months of reporting to designated units, all afloat personnel must complete damage control Personnel Qualification Standard (PQS) NAVEDTRA 43119-H watchstation 306, "Basic Chemical, Biological, and Radiological Defense."[46] The hands-on training provided in this watchstation includes transiting through a decontamination station and donning and doffing the chemical protective ensemble. Selected personnel also complete NAVEDTRA 43119-H watchstation 309, "Advanced Chemical, Biological, and Radiological Defense Person."

[46] U.S. Department of the Navy (DoN), Commander Naval Surface Forces (COMNAVSURFOR), *Surface Force Training Manual*, COMNAVSURFORINST 3502.1 (Washington, D.C.: U.S. GPO, 27 February 2002), D-2.

CBR defense training is incorporated into the following enlisted schools:

- Damage Control "A" School
- Senior Enlisted Damage Control
- Hospital Corpsman "A" School
- Independent Duty Corpsman
- Repair Party Leader

Additionally, the Navy has designated two Navy Enlisted Classifications (NECs) for shipboard CBR-D training: DC-4805, Shipboard CBR Defense Operations and Training Specialists, and DC-4811, Senior Enlisted DC Program Management and Training Specialists. Training for both NECs is provided by the Navy Construction Training Center Detachment at the U.S. Army Chemical School, Fort Leonard Wood, Missouri. Graduates of the courses provide unit training for their assigned ship, or as part of an afloat training group.

Officers initially receive two hours of classroom training focused on CBR personal protection. Officers are required to complete DC PQS NAVEDTRA 43119-H watchstation 306, "Basic Chemical, Biological, and Radiological Defense," as part of their Surface Warfare Officer qualifications.

The Surface Warfare Officers School (SWOS) in Newport, Rhode Island, incorporates CBR defense training into the following schools for officers:

- Division Officer
- Damage Control Assistant
- Repair Party Officer Short Course
- Department Head
- Executive Officer
- Commanding Officer

2. Unit Training

Ships conduct CBR-D training during the basic, intermediate, and advanced phases of the interdeployment training cycle (IDTC). COMNAVSURFORINST 3502.1, *Surface Force Training Manual*, provides guidance for the basic phase of training. Ships required to complete a simulated chemical attack exercise during the basic phase of training include surface combatants (*Ticonderoga, Spruance, Arleigh Burke*, and *Oliver Hazard Perry* classes); amphibious ships (*Blue Ridge, Tarawa, Wasp, Austin, Anchorage, Whidbey Island, Harpers Ferry*, and *Newport* classes); mine warfare ships (*Avenger, Osprey*, and *Iwo Jima* classes); and support ships (*Raleigh, Austin, Sacramento, Supply*, and *Safeguard* classes).[47] The ship CBR-D drill is a stand-alone event conducted during Tailored Ships Training Availability (TSTA), and not included in the Final Evaluation Period (FEP). Aircraft carriers (*Kitty Hawk, John F Kennedy, Enterprise*, and *Nimitz* classes) complete three simulated chemical or biological attacks during the basic phase of training.[48] One of the exercises is scheduled during FEP, but it is conducted during a separate General Quarters drill. Throughout the intermediate and advanced phases of training, carriers must conduct a chemical or biological attack exercise every six months.

A description of the chemical or biological attack exercise executed by Naval Surface Forces can be found in FXP-4, *Mobility, Logistics, Fleet Support Operations, Non Combat Operations, and Explosive Ordinance Disposal Exercises*, Revision A, change 3 (published February 2001). In the exercise, the ship receives simulated intelligence reports warning that a chemical or biological attack is probable. Training personnel specify the amount and phase (liquid, vapor, or aerosol) of the agent, and designate personnel as having been exposed to the agent. The ship is graded on its actions before, during, and after the attack.[49]

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47 U.S. DoN COMNAVSURFOR, *Surface Force Training Manual*, A-21.

48 U.S. DoN, Commander Naval Air Force Pacific Fleet and Commander Naval Air Force Atlantic Fleet (COMNAVAIRPAC/LANT), *NAVAIRPAC and NAVAIRLANT Aircraft Carrier Training and Readiness Manual*, COMNAVAIRPAC/LANT INST 3500.20C (Washington, D.C.: U.S. GPO, 30 August 2000), app. 1, p. 17.

49 U.S. CNO, *Mobility (MOB), Logistics (LOG), Fleet Support Operations (FSO), Noncombat Operations (NCO), and Explosive Ordnance Disposal (EOD) Exercises,* FXP-4, rev. A, change 3, ex. MOB-D-15-SF (Washington, D.C.: U.S. GPO, February 2001), 4-58.

Intermediate and advanced training is the responsibility of Numbered Fleet Commanders (NFC). CBR-D training is incorporated into intermediate training such as Marine Expeditionary Force Exercises (MEFEX) or Composite Training Unit Exercises (COMPTUEX) and advanced training Joint Task Force Exercises (JTFEX) at their discretion.

E. EQUIPMENT

1. Current Equipment

a. Detection and Warning

Equipment carried by ships for detection of chemical agents can be broadly classified into three areas: standoff detection, shipboard point detection via electronic instruments, and shipboard point detection via chemical indicator materials. Currently, the only standoff detection system available for U.S. ships is the AN/KAS-1A Chemical Warfare Directional Detector (CWDD). The CWDD is capable of detecting nerve agents at distances up to ten kilometers. It contains a Forward Looking Infrared (FLIR) sensor and spectral filters of specific frequencies, which are applied by the CWDD in series to test suspected nerve agent vapor clouds. The CWDD is a portable unit with a remote video hook up to allow monitoring from a second location.[50]

Shipboard electronic point detection systems include the Chemical Agent Point Detector System (CAPDS), the Improved Point Detection System (IPDS) and the shipboard Automatic Chemical Agent Detector and Alarm (ACADA). The CAPDS is permanently installed in an upper superstructure level of the ship and can detect nerve agent vapors. The CAPDS samples and ionizes external air, along with any vapor molecules that may be present. Heavy ions are collected, and, when a predetermined potential is reached the unit sounds alarms at the port and starboard remote control units and the bridge.[51]

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[50] U.S. CNO, *U.S. Navy CBR Defense/U.S. Marine Corps NBC Defense Handbook*, OPNAV P-86-1-95 (Washington, D.C.: U.S. GPO, April 1995), 5-3; U.S. DoD, *Multiservice Procedures for Contamination Avoidance*, B-7.

[51] U.S. CNO, *CBR-D Handbook*, 5-3; U.S. DoD, *Multiservice Procedures for Contamination Avoidance*, B-7.

The IPDS improves on the capabilities of the CAPDS. Like the CAPDS, the IPDS is permanently mounted on the port and starboard superstructure. The IPDS is capable of detecting both nerve and blister agent vapors. It uses Ion Mobility Spectroscopy to monitor external air, and an algorithm library and embedded data processing to reject common shipboard interference.[52]

The shipboard ACADA can detect nerve and blister agent vapors. It is a portable unit used to conduct shipboard surveys.[53]

Shipboard point detection equipment based on chemical indicators includes M8 and M9 Chemical Agent Detector Paper, Civil Defense Draeger Tubes, and the M256A1 Chemical Agent Detector Kit. M8 and M9 paper are used to detect liquid nerve and blister agents. M8 paper changes color to indicate the type of agent present: dark green for V-series nerve agents, yellow for G-series nerve agents, and red for blister agents. M9 paper changes to a red or reddish brown color when exposed to either nerve or blister agent liquid. M9 paper is more sensitive than M8 paper and reacts more quickly.[54]

Draeger tubes are mainly used for gas-free engineering, but can also be used to detect the choking agent phosgene. A handheld bellows pump is used to draw air across a hermetically sealed glass tube containing silica gel and a chemical reagent. The Draeger tube changes to a blue-green color in the presence of phosgene gas.[55]

The M256A1 kit can detect nerve, blister, or blood agent vapors. The kit contains twelve disposable sampler-detector cards. Each sampler-detector card has a test spot and two associated ampoules containing reagents for nerve, blister, and blood agents. The operator applies both reagents to the test spot and waits for a specific color change to indicate the presence of the agent. A complete M256A1 test takes

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[52] U.S. CNO, *CBR-D Handbook*, 5-3; U.S. DoD, *Multiservice Procedures for Contamination Avoidance*, B-7.

[53] U.S. DoD, *Multiservice Procedures for Contamination Avoidance*, B-8.

[54] U.S. CNO, *CBR-D Handbook*, 5-4 to 5-5; U.S. DoD, *Multiservice Procedures for Contamination Avoidance*, B-4.

[55] U.S. CNO, *CBR-D Handbook*, 5-3.

approximately twenty minutes; consequently, the kit is used for monitoring of chemical agents and not detection.[56]

The NBCWRS allows all services to exchange information regarding CW attacks. The six types of NBCWRS messages are as follows:[57]

- NBC 1 Report- an initial report submitted by units directly affected by a CW attack. This report is sent with FLASH level precedence.
- NBC 2 Report- a report used to send processed data. This report is sent by collection centers after two or more NBC 1 reports are received.
- NBC 3 Report- a report warning of predicted hazard and contamination areas. The NBC 3 report is usually sent by higher command authorities.
- NBC 4 Report- this report provides the results of CW monitoring and surveys. It is submitted by field level units.
- NBC 5 Report- this report relays information on areas of chemical contamination. It is issued by collection centers.
- NBC 6 Report- this report provides more detailed information about the CW attack. It is submitted by units at the request of higher command levels.

b. Individual Protection

Individual protective equipment for afloat naval personnel includes masks, chemical protective suits, gloves and footwear covers, and medical treatments. The MCU-2 A/P and MCU-2P mask provide respiratory protection against chemical agents using a C2 canister to filter incoming air. The MCU-2 A/P mask is equipped with a front voicemitter/micmitter assembly, which allows the wearer to connect the mask to radio communication circuits. The MCU-2P lacks micmitter capability, but otherwise is

[56] U.S. NAVSEA, *Shipboard BW/CW Defense and Countermeasures*, 4-8.

[57] U.S. CNO, *CBR-D Handbook*, 5-18.

identical to the MCU-2 A/P. Both masks are available in small, medium, and large sizes, and can be fitted directly to a canteen.[58]

The Chemical Protective Overgarment (CPO) is worn over the uniform to provide protection against chemical agent vapors and liquids. The CPO consists of a smock and trousers, both constructed with an inner layer of activated charcoal to absorb agents and an outer layer of modacrylic-nylon to aid in the evaporation of liquid agents. The CPO is available in sizes small, medium, large, and extra-large. It can be worn in a contaminated environment for six hours, or up to 100 hours within 30 days in an uncontaminated environment. The CPO cannot be laundered.[59]

The CPO is in the process of being replaced by the Joint Services Lightweight Integrated Suit Technology Chemical Protective Garment, also known as the Advanced Chemical Protective Garment (ACPG). The ACPG protects the wearer against chemical agents in vapor, aerosol, or liquid form. The jacket and trousers are made with a nylon-cotton outer shell treated to repel water and oil and an inner layer of activated carbon. The ACPG jacket and trousers are packaged separately. Both are available in sizes small-short, medium-regular, medium-long, large-regular, and large-long. The ACPG can be worn in a contaminated environment for twenty-four hours, or up to 45 wear days within 120 days in an uncontaminated environment. ACPGs worn in uncontaminated environments may be laundered up to six times.[60]

Chemical Protective Gloves, made of 25-millimeter thick butyl rubber, protect hands against liquid and vapor chemical agents. The gloves come in sizes extra small, small, medium, large, and extra large, and are worn with a cotton inner glove to absorb perspiration. The gloves can be worn in a contaminated environment for up to six hours.[61] Chemical Protective Footwear Covers (CPFCs) provide foot protection against chemical agents. The CPFC is made of butyl sheet rubber with a nonskid sole and is

[58] Ibid., 6-2.

[59] U.S. NAVSEA, *Shipboard BW/CW Defense and Countermeasures*, 5-9.

[60] Ibid., 5-11 and 5-17.

[61] Ibid., 5-18.

worn over standard shoes. CPFCs come in sizes small and large and provide up to twenty-four hours of protection in a contaminated environment.[62]

c. Collective Protection

The shipboard Collective Protection System is installed on new construction ships in the *Arleigh Burke, Wasp, Whidbey Island*, and *Supply* classes.[63] CPS provides two types of zone protection: Total Protection (TP) and Limited Protection (LP). Air in both zones passes through a High Efficiency Particulate Air (HEPA) prefilter and a charcoal filter (200 CFM M6). TP zones are overpressurized to two inches water gauge, allowing personnel inside to remove all chemical protective equipment including masks. Positive pressure is maintained during normal operations unless otherwise specified by the CO.[64] In contrast, LP zones are maintained at normal pressure. Personnel in LP zones must wear masks, and, if a percutaneous vapor hazard exists chemical protective clothing is also required. Machinery spaces are generally designated as LP zones because they require high ventilation, making overpressurization impractical.[65] The area covered by both TP and LP zones on a ship is used to determine the level of CPS it provides. Level I (shelter envelope) ships provide TP for berthing, messing, sanitary, and battle dressing facilities for 40 percent of the crew. Level II (minimum operational envelope) ships provide Level I protection plus additional coverage to perform key operational functions. Level III (maximum operational envelope) ships provide sufficient coverage to perform all operational functions except flight deck and well deck operations. The CNO determines the CPS level for all new construction ships.[66]

The Selected Area Collective Protection System (SACPS) program retroactively installs or upgrades collective protection on a ship.[67] SACPS provides only

[62] Ibid., 5-18.

[63] U.S. DoD CBDP, *2002 Annual Report to Congress*, 54.

[64] U.S. NAVSEA, *Shipboard BW/CW Defense and Countermeasures,* 6-6 and 6-8.

[65] Ibid., 6-12.

[66] Ibid., 6-1 to 6-2.

[67] U.S. DoD CBDP, *2002 Annual Report to Congress*, 54.

TP zones, which are supplied with air filtered using the same procedures as the CPS. TP zones are pressurized between .5 and 1.5 inches water gauge. The SACPS is operated only when a ship is in CW hazard areas.[68] SACPS installations have been completed on one *Tarawa* class ship and four *Wasp* class ships.[69]

d. Medical Protection

First aid items for nerve agent poisoning are issued to naval personnel, including the Nerve Agent Antidote Kit (NAAK), the Antidote Treatment Nerve Agent Auto Injector System (ATNAA), the Convulsant Antidote for Nerve Agents (CANA), and Nerve Agent Pretreatment Pyridostigmine (NAPP). Both the NAAK and the ATNAA contain the same chemicals, atropine and pralidoxine chloride (2 PAM Cl). In the NAAK, the chemicals are delivered via separate autoinjectors, while in the ATNAA the atropine and 2 PAM Cl are contained in separate compartments of the same autoinjector. The ATNAA will replace the NAAK as the shelf life for the NAAK is reached.[70]

The CANA is an autoinjector containing 10 mg diazepam. Diazepam controls convulsions caused by nerve agent poisoning and protects against brain injury. The CANA is administered by medical personnel or another service member, not the victim.[71]

The NAPP consists of 21 tablets each containing 30 mg pyridostigmine bromide. One tablet is taken every eight hours before nerve agents are encountered. NAPP treatment enhances the effects of atropine and 2 PAM Cl.[72]

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68 U.S. NAVSEA, *Shipboard BW/CW Defense and Countermeasures,* 6-13 to 6-14.

69 Stan Enatsky, "RE: CPS and SACPS Information," 14 May 2002, personal email (6 June 2002).

70 U.S. DoD, *Multiservice Procedures for Nuclear, Biological, and Chemical (NBC) Protection*, FM 3-11.4, final coordinating draft (Washington, D.C.: U.S. GPO, December 2001), A-21 to A-22.

71 U.S. DoN, *Treatment of Chemical Agent Casualties and Conventional Military Chemical Injuries*, NAVMED P-5041 (Washington, D.C.: U.S. GPO, 22 December 1995), 2-13.

72 U.S. DoN, *Treatment of Chemical Agent Casualties*, 2-15 to 2-17.

e. Decontamination

Shipboard decontamination equipment is designed for one of three uses: personnel decontamination, personal equipment decontamination, or ship decontamination. The M291 skin decontamination kit is used to remove chemical agents from personnel. Each kit contains six applicator pads—enough for three complete skin decontamination cycles. The applicator pads are rubbed against the skin. The M291 kit is not used to decontaminate the eyes, mouth, or open wounds.[73]

The M295 Individual Equipment Decontamination Kit is used to remove chemical contamination from masks, gloves, and footwear. It consists of nonwoven polyester pads and decontaminating powder. The M295 kit can decontaminate approximately 1200 square feet.[74]

A solution of 24 percent calcium hypochlorite is diluted with water in varying concentrations and mixed with detergent to decontaminate equipment such as overshoes and gloves as well as large areas of the ship. Air capable amphibious ships and carriers carry a minimum of 192 six ounce bottles of calcium hypochlorite solution, while all other surface ships carry at least 144 six ounce bottles. Calcium hypochlorite is highly corrosive to steel and aluminum, therefore it is necessary to rinse after application. Calcium hypochlorite is not used to decontaminate aircraft.[75]

A ship's countermeasures washdown system consists of a series of pipes and valves that cover the superstructure with seawater. The CMWDS is used to prevent absorption of chemical agents by paint and nonskid coatings when activated before the ship enters a CW hazard area and during CW attack. When activated after an attack, the CMWDS can aid in decontamination. The CMWDS is most effective when the ship steers a zigzag course to prevent dry spots and pooling of water on the ship's decks.[76]

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73 U.S. NAVSEA, *Shipboard BW/CW Defense and Countermeasures,* 7-9.

74 U.S. DoD, *Multiservice Procedures for NBC Protection*, A-18.

75 U.S. NAVSEA, *Shipboard BW/CW Defense and Countermeasures,* 7-8 to 7-9; U.S. CNO, *CBR-D Handbook*, 7-2.

76 U.S. NAVSEA, *Shipboard BW/CW Defense and Countermeasures,* 7-3; U.S. CNO, *CBR-D Handbook*, 6-9.

2. Future Equipment

a. Detection and Warning

The Joint Warning and Reporting Network is a command and control network that will integrate information from shipboard and field sensors and provide analyzed information to JTF commanders. JWARN will decrease the time required for formatting and transmission of NBC reports to two minutes.[77]

The Joint Service Lightweight Standoff Chemical Agent Detector (JSLSCAD) will replace the M21 Remote Sensing Chemical Agent Alarm (RSCAAL). Unlike the M21 RSCAAL, the JSLSCAD will be operational on ships. It will detect chemical agents at distances of up to five kilometers. Production will begin in FY02.[78]

Production of the Artemis (formerly the Joint Service Warning and Identification LIDAR Detection system) will begin in FY06. The Artemis system will provide a standoff detection capability for chemical agent vapors, aerosols, and droplets and will interface with JWARN.[79]

Production of the Joint Chemical Agent Detector (JCAD) will begin in FY04. The JCAD is a handheld, pocket-sized detector capable of detecting and identifying chemical agents. The JCAD will be operational on ships and will interface with JWARN.[80]

b. Individual Protection

Testing of the Joint Service General Purpose Mask (JSGPM) is scheduled to begin in FY03. The JSGPM will lower breathing resistance and decrease heat stress for the user.[81] Joint protective gloves, overboots, and socks are also in development.[82]

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[77] U.S. DoD, *Multiservice Procedures for Contamination Avoidance*, I-15.

[78] U.S. DoD CBDP, *FY00-02 Overview*, 22—23.

[79] Ibid., 10—11.

[80] Ibid., 18—19.

[81] Ibid., 36—37.

[82] Ibid., 38—39.

c. Collective Protection

SACPS will be installed on an additional three *Wasp* class ships, four *Tarawa* class ships, and three *Whidbey Island* class ships (LSD 41 through 43).[83]

d. Medical Protection

Research began in FY00 for the Skin Reduction Exposure Paste Against Chemical Warfare Agents (SERPACWA). SERPACWA is a topical skin protectant that is applied before exposure to chemical warfare agents. It provides a protective barrier for high-risk skin areas such as the wrists, neck, and ankles. SERPACWA will be used in addition to standard chemical protective equipment.[84]

e. Decontamination

The Joint Service Fixed Site Decontamination (JSFXD) program will provide a family of decontamination agents to be used at fixed sites including ports, airfields, and command and control centers. Block I (procurement FY02-FY04) will provide decontaminants that can be used with existing application systems. Block II (development and testing FY03-FY04) will supply additional application systems necessary to decontaminate fixed sites. Block III (Food and Drug Administration [FDA] testing FY03-FY05) will develop decontaminants to be used on skin with open wounds.[85]

F. CONCLUSIONS

Doctrine, organization, training, and equipment provide NSF with the capability to conduct operations under CW conditions. Commanding officers of individual ships are responsible for articulating their own tactics, techniques, and procedures for CW defense in their CBR-D bill. Naval doctrine for operations under CW conditions is supplemented by *Shipboard BW/CW Defense and Countermeasures*, the *CBR-D Handbook*, and JP 3-11, discussed in chapter III.

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[83] Enatsky, "RE: CPS and SACPS Information."

[84] U.S. DoD, *Multiservice Procedures for NBC Protection*, A-23.

[85] U.S. DoD CBDP, *FY00-02 Overview*, 52—53.

The Joint Service Chemical and Biological Defense Program has overall responsibility for developing doctrine, equipment, and tactics for fighting in chemical warfare environments. At the strategic naval level, OPNAV N7 is responsible for chemical warfare defense. At the tactical level, the CO is responsible for chemical agent avoidance and CBR defense training. The DCA is the ship's CBR officer and advises the CO during a CW attack.

Training is conducted at the individual and unit levels. Individuals receive training at their initial entry into the Navy, through PQS, and subsequently through schools they may attend. Ships conduct CBR defense drills during the basic, intermediate, and advanced phases of the training cycle.

Naval equipment for detection of CW attack currently is limited, but the development of the JWARN system and associated detectors will provide NSF with a standoff detection capability. Naval surface forces use the ACPG for individual protection against CW agents. Collective protection is available on selected surface ships. Medical protection consists of pretreatments and antidotes for nerve agents. Naval surface forces use the CMWDS and calcium hypochlorite for shipboard decontamination. The next chapter evaluates the preparedness of NSF to conduct operations in a CW environment.

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V. DISCUSSION AND CONCLUSIONS

A. INTRODUCTION

This chapter builds on the doctrine, organization, training, and equipment descriptions provided in chapter IV. It highlights areas where the U.S. Navy is highly capable of CW defense and operations, resulting from the frequency of its CW defense training and the development of the JWARN system. It also points out areas where NSF can continue to improve, such as providing collective protection equipment to surface combatants. The chapter concludes with recommendations for strengthening the chemical defense program of the U.S. Navy.

B. STRENGTHS OF CURRENT CAPABILITIES

The Navy has identified a need to revise current doctrine for operations in a CW environment. Revisions are planned for *Surface Ship Survivability* and *Shipboard BW/CW Defense and Countermeasures.* The Navy is also working to address issues of completeness by developing doctrine for amphibious operations in CW environments. These measures will improve both the timeliness and the scope of naval doctrine.

Naval doctrine supports contamination avoidance by providing procedures for reporting CW attacks in the *CBR-D Handbook* and for operating detection equipment in *Shipboard BW/CW Defense and Countermeasures*. In support of requirements for protection, *Shipboard BW/CW Defense and Countermeasures* sets forth procedures for donning and doffing chemical protective equipment, while the CBR-D bill provides procedures for distributing IPE. *Shipboard BW/CW Defense and Countermeasures* provides information on correctly operating the shipboard CPS. Also, *Treatment of Chemical Agent Casualties* describes procedures for the use of medical protective equipment. Naval doctrine supports decontamination by providing procedures for operating the CMWDS and CCAs and decontaminating the ship using calcium hypochlorite. The ship's CBR-D bill designates personnel to operate the CMWDS, perform surveys to identify the extent of chemical contamination, man CCAs, and conduct decontamination operations. It also identifies areas to be decontaminated in order of priority.

Naval organization for operations in a CW environment clearly delineates the responsibilities for the chain of command from the CO through the XO and Engineer Officer to the DCA. Responsibilities are also specified for other key personnel in ship CBR-D actions. The delegation of responsibility is important for a coordinated response to CW attack and continued operations in a CW environment.

Shipboard organization supports contamination avoidance requirements through tasking the operations officer billet with warning and reporting CW attacks. The *Standard Organization and Regulations of the U.S. Navy* delegates responsibility to the CO for maneuvering to avoid CW hazards if possible. It also specifies that the medical officer is responsible for monitoring food and water on board a ship after a CW attack. Shipboard organization supports protection requirements by tasking the CO with setting the appropriate MOPP level and material condition for the ship. The *CBR-D Handbook* also specifies that the DCA is responsible for advising the CO regarding ventilation systems and CW defense actions taken by the ship. Shipboard organization supports decontamination by providing that the CO is responsible for directing decontamination actions.

The two main strengths of naval training for operations in a CW environment are its frequency and its ability to provide hands-on experience to trainees. Officers receive CW defense training at SWOS throughout each stage of their careers. The damage control PQS that all hands must complete offers individual training with practical application. Unit training during the basic phase of the IDTC reinforces individual training and provides practice for ship-wide actions for CW defense, such as activating the CMWDS and setting "Circle William."

Naval training supports contamination avoidance requirements by familiarizing personnel with the use of chemical detection equipment and formatting NBCWRS reports during the chemical attack drill. In support of protection requirements, naval personnel receive individual training in donning and doffing chemical protective equipment and transiting through a CCA both during initial entry training and the PQS process. Personnel are also trained to use medical protective equipment for exposure to nerve agents. The chemical attack drill provides training for operating the CMWDS, conducting internal and external surveys to determine the extent of chemical contamination, and performing decontamination operations.

Naval ability to conduct operations in CW environments will be enhanced as the future equipment described in chapter IV becomes available. JWARN in particular will markedly improve the CW attack detection and warning capabilities of all services by integrating standoff detection equipment and individual unit sensors. In the area of individual protection, the JSGPM will decrease heat stress, extending the ability of the wearer to perform operations in a CW environment. The protection provided by SERPACWA will augment the protection provided by current chemical protective suits. Retrofits of SACPS on *Wasp, Tarawa,* and *Whidbey Island* class ships will increase the amount of collective protection available to amphibious forces. Decontamination systems developed by the CBDP will aid in restoring ports and other fixed sites to operational capability, and reduce the effects of chemical weapons on personnel.

Naval equipment supports contamination avoidance requirements by providing the capability to perform standoff and shipboard point detection of chemical agents. The JWARN system will decrease the number of personnel required for monitoring detection equipment and will provide a more accurate picture of the CW battlefield through networked sensors. Individual, collective, and medical equipment all support requirements for protection. The ACPG provides personnel with twenty-four hours of chemical protection while reducing heat stress. Collective protection systems, when installed, provide personnel with a safe haven to rest, eat, and receive medical treatment. Medical protection provides personnel with treatments for nerve agents such as NAPP and the ATNAA. The CMWDS, calcium hypochlorite, and shipboard fire hoses aid personnel in meeting decontamination requirements.

C. AREAS FOR IMPROVEMENT

Although the scope of naval doctrine is expanding, the service still lacks specific TTPs for operations in a CW environment. Currently, the commanding officer is responsible for creating operational procedures articulated in the ship's CBR-D bill. While each ship class is unique, procedures contained in the ship's CBR-D bill such as entrance through CCAs, distribution of chemical protective equipment, and decontamination procedures would benefit from standardization. Additionally, naval TTPs should address procedures for recognizing and responding to covert delivery of chemical weapons, as well as for notifying other units of chemical weapons attack.

A potential problem in organization rests with the DCA, who is responsible for a large portion of CW defense actions taken during an attack. The DCA must identify the type and extent of chemical contamination on the ship, ensure the proper material condition is set, and advise the CO regarding the ship's ventilation system. However, the primary role of the DCA is to coordinate all damage control action taken by the ship. The DCA must ensure the ship is safe from fires, flooding, and other structural damage before turning his or her attention to CW defense. Compounding the problem, the CW defense drills conducted by the ship do not provide practice for the DCA in prioritizing actions for both structural damage and CW defense.

One solution to resolve the conflict between the Damage Control Assistant role and the CBR-D Officer role would be to provide training situations where the DCA can practice conducting damage control and CW defense operations simultaneously. However, additional training would add to the demands of what is already a substantial billet. A better solution would be to separate the roles into two billets, creating a ship's CBR-D Officer. The CBR-D Officer would carry out the responsibilities previously described for the DCA during CW attack and operations in a CW environment. During normal operations, the CBR-D Officer would train crewmembers in CW defense and supervise the maintenance of CW detection equipment, protective clothing, collective protection systems, and decontamination equipment.

While the frequency of naval training for operations in CW environments is commendable, its content does not adequately address the integration of CW defense operations with other shipboard operations; for example, a main space fire or the launching and recovering of aircraft. Integration of several drills would make training for operations in a CW environment more difficult and possibly more dangerous. The added effort and risk is justified by the high probability that ships will need to conduct operations in CW environments. Naval surface forces cannot accomplish their mission in CW environments if their training stops with CW defense actions.

Naval collective protection equipment remains deficient in two important areas. First, the number of ships provided with collective protection systems, as a percentage of the total naval surface forces, is low. It can be argued that amphibious ships are at the highest risk of facing a CW attack, yet when retrofits are complete only a total of 20 ships will have collective protection systems.[86] The remaining amphibious ship classes that are required to conduct CW attack drills—*Blue Ridge, Austin, Anchorage, Harpers Ferry*, and *Newport*—yet are without collective protection systems, compose a total of 21 ships. The total percentage of amphibious ships with collective protection systems is thus calculated to be 48.8 percent. Mine warfare ships, like amphibious ships, frequently conduct operations close to shore. None of these ships have collective protection systems, making it next to impossible for them to conduct sustained operations in a CW environment.

Among the surface combatants, only *Arleigh Burke* class ships are built with CPS. There are 33 commissioned DDGs, two DDGs soon to be commissioned, and another nine DDGs building. If all DDGs are counted, the total number of surface combatants with collective protection is 44 ships. Surface combatants without collective protection—the *Ticonderoga, Spruance*, and *Oliver Hazard Perry* classes—total 79 ships. As the *Spruance* class is decommissioned, the percentage of surface combatants with collective protection systems will increase from its current level of 35.8 percent. These totals do not include the thirteen U.S. aircraft carriers, none of which are outfitted with a collective protection system.

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[86] Ship counts are taken from Stephen Saunders, ed., *Jane's Fighting Ships 2001-2002*, 104th ed. (Alexandra, Va.: Jane's Information Group, 2001), 791.

Of the support ships required to conduct CW attack drills—the *Raleigh, Austin, Sacramento, Supply*, and *Safeguard* classes—three of a total thirteen ships are outfitted with collective protection systems. To be fair, this category of ship includes four *Safeguard* class salvage ships. Excluding the *Safeguard* class, the percentage of support ships with collective protection is 33.3 percent. Collective protection systems enable personnel to rest, eat, and receive medical treatment. Ships without collective protection systems do not provide crewmembers with enough protection to carry out sustained operations in CW environments.

The supply of filters used in CPS and SACPS is a second area of concern. In order to fight two major theater wars, the 2002 CBDP report estimates the Navy requires 6,800 M56 CBR filters and 7,481 prefilters. The Navy currently has 114 M56 filters on hand and 462 prefilters.[87] Without the proper filters, collective protection systems cannot function effectively. The Navy must increase its supply of collective protection filters if it expects to be able to conduct operations in a CW environment.

D. RECOMMENDATIONS

In summary, naval capabilities to conduct operations under CW conditions would be improved by:

- *The development of TTPs for naval operations in a CW environment.* TTPs should include, at a minimum, procedures for warning other units of CW attack, distributing chemical protective equipment, transit of personnel through CCAs, and decontamination of essential spaces and equipment, including aircraft.
- *The creation of a CBR-D officer billet*. The ship's CBR-D officer would perform the chemical warfare defense actions currently the responsibility of the DCA. The DCA would then be free to focus on the considerable task of directing damage control actions.

[87] U.S. DoD CBDP, *2002 Annual Report to Congress*, F-11.

- *The incorporation of realistic military operations into CW defense training exercises*. Ships should train for operations such as firefighting, line handling, and recovering aircraft under CW conditions to ensure their ability to carry out these mission-critical tasks.
- *The expansion of SACPS retrofits*. The *Blue Ridge, Austin, Anchorage*, and *Newport* classes of amphibious ships, as well as surface combatants (including aircraft carriers), mine warfare ships, and support ships should be outfitted with some form of CPS. The Navy should also procure additional CPS filters for use in existing collective protection systems.

If these recommendations are followed, the U.S. Navy can significantly improve its ability to conduct operations under CW conditions. The Navy will then be in an improved position to conduct psychological operations against adversaries equipped with chemical weapons. Prevention of CW attacks, such as the scenario described in chapter I, is a necessity for U.S. naval forces in the 21st century.

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