CHAPTER 13

CHEMICAL, BIOLOGICAL, AND RADIOLOGICAL DEFENSE

If we do not stem the proliferation of the world's deadliest weapons, no democracy can feel secure... One of our most urgent priorities must be attacking the proliferation of weapons of mass destruction, whether they are nuclear, chemical or biological.

—President Bill Clinton
1993

As a member of the Navy, you need a good working knowledge of chemical, biological, and radiological defense (CBR-D). CBR-D is defined as *defensive measures taken against the effects of a chemical, a biological, or a nuclear weapons attack*. Training in defensive measures lets the command maintain operational readiness and complete its mission.

Throughout history, countries and factions have developed and used chemical, biological, and radiological (CBR) warfare. In WWI, chlorine gas was used, which forced the development of the gas mask. In WWII, nuclear weapons were used for the first time. During WWII, many nations began developing chemical and biological agents as a warfare tool. More recently, a nerve agent was used in Japan's subway system, and blister agents were used on the Kurds during the Iraq and Iran war. The use of CBR clearly demonstrates the need for a positive defensive posture within our Navy.

United States national policy prohibits our being the first to use chemical agents against an attacking nation. The approval for our initial use of chemical weapons must come from the President of the United States.

The United States **will not use** biological agents, including toxins, regardless of source or manner of production, or other methods of biological warfare under any circumstances. The United States strictly limits its biological and toxin research program to defensive measures, such as production of vaccines, antidotes, treatment, and protective equipment.

An aggressive nation might decide using a chemical or biological (CB) weapon first is to its advantage, perhaps as a surprise attack. Therefore, all members of the U.S. Navy must be highly trained in CBR-D. CBR-D training allows Navy units to survive CBR attacks and continue to fight and defend their ship or unit under CBR-contaminated conditions.

The need for training in CBR-D is never ending. The Navy has developed and continues to develop different countermeasures against many possible CBR applications that an enemy might think of. Because possible enemies continually develop CBR applications, training programs using information about the greatest CBR threats are developed to train naval personnel. These programs include disaster preparedness drills and personnel qualification standards (PQS). Don't take this training lightly; it may save your life.

CHEMICAL, BIOLOGICAL, AND NUCLEAR WARFARE OPERATIONS

Learning Objectives: When you finish this chapter, you will be able to—

- Recognize chemical, biological, and radiological (CBR) attack methods.
- Recognize the need for CBR defense.
- Identify terms used with CBR.

The primary purpose of nuclear weapons is the mass destruction of targets and personnel. The primary purpose of biological and chemical attacks is the mass casualties of personnel, livestock, and/or crops. These weapons are called *weapons of mass destruction* because they destroy large areas or kill and disable large segments of the population.

In chemical warfare (CW) operations, chemical agents can kill or disable personnel by affecting their blood, nerves, eyes, skin, lungs, or stomach. Biological warfare (BW) operation agents include microorganisms, fungi, toxins, and microtoxins to cause diseases that will kill or produce other casualties. Nuclear weapons produce explosions of great force and heat and release nuclear radiation.

Many types of weapons and methods may be used to deliver chemical and biological agents and nuclear bombs. The use of two or more different types of weapons to deliver these agents may be used at the same time. Missiles having long-range attack capability provide a means of delivering chemical, biological, and nuclear weapons that can be launched in almost any manner by land, sea, and/or air units.

Chemical agents have been placed in projectiles and used effectively. A similar possibility exists with biological agents; however, for technical reasons it appears that the most probable method of delivery is by aerosol.

CHEMICAL WARFARE

Learning Objectives: When you finish this chapter, you will be able to—

- Identify terms used with chemical warfare (CW).
- Identify types of CW.
- Identify the effects of CW agents.
- Identify self-aid and first-aid methods for countering nerve, blister, and choking agents.

CW agents are used to produce death, injury, temporary incapacitation, or irritation effects. Broadly speaking, there are two types of antipersonnel agents—casualty and incapacitating. Some of the types of CW agents are described in table 13-1.

Table 13-1.—Characteristics of Selected CW Agents

Agent Name	Agent Type	Physical Properties	Physiological Effects	Relative Rate of Action
Sarin	Nerve	Colorless odorless, volatile liquid	Difficulty breathing, excessive contraction of the pupil of the eye (miosis), blurred vision, headache and nausea leading to respiratory distress, convulsions, and eventually death.	Rapid (within minutes)
VX	Nerve	Colorless odorless, low volatility, oily liquid	Difficulty breathing, miosis, blurred vision, headache and nausea leading to respiratory distress, convulsions, and eventually death.	Relatively rapid (within 30 minutes)
Mustard	Blister	Garlic odor, medium volatility, oily liquid	Blisters or irritates skin, eyes, and lungs.	Delayed onset (4-6 hours)
Hydrogen cyanide	Blood	Almond odor, highly volatile gas	Prevents the normal transfer of oxygen from the blood to body tissue resulting in respiratory paralysis.	Rapid (within minutes)

Student Notes:

CASUALTY CW AGENTS

Casualty CW agents can cause death or severely incapacitate personnel for long periods of time. Casualty agents can be either persistent or nonpersistent. They are classed as blood, choking, nerve, and blister agents, all of which can inflict serious injury or death.

Some casualty agents have a cumulative effect, which means that successive doses add to the effect of each preceding dose. You might receive a nonlethal dose of a nerve agent, for example, followed within a few hours by another nonlethal dose. However, the cumulative effects of the two exposures could kill you.

INCAPACITATING CW AGENTS

Incapacitating CW agents temporarily disable personnel but do not create permanent injury. They can produce physiological and/or psychological effects. These effects make individuals incapable of performing duties for hours or days even after exposure has ceased.

Some incapacitating agents have effects that typically last for significant periods of time but do not seriously endanger life; for example, riot control agents. Riot control agents produce only temporarily irritating or incapacitating effects when used in normal concentrations. Complete recovery is usually expected without medical treatment.

EFFECTS OF CW AGENTS

CW agents will make you a casualty when your body comes in contact with a bigger dose than it can withstand. The limits of tolerance of the human body vary from short periods of exposure and low concentrations of certain agents to extended periods of exposure and high concentrations of certain other agents. Furthermore, the limits of tolerance to specific agents vary with individuals. Your principal concern is recognizing the symptoms and relieving the effects of exposure before the limit of exposure is exceeded.

Nerve Agents

Poisoning by nerve agents affects bodily functions. The disruption of nerve impulses produces different effects on different body systems. It's important for you to recognize both mild and severe signs and symptoms of nerve agent poisoning. Mild symptoms will become severe if personnel are repeatedly or continually exposed to low concentrations of a nerve agent. High concentrations of nerve agent poisoning will cause rapid onset of severe symptoms, possibly without any mild symptoms at all. The symptoms of nerve poisoning are shown in the following chart:

MILD SYMPTOMS	SEVERE SYMPTOMS
• Unexplained runny nose	• Strange or confused behavior
• Unexplained sudden headache	• Wheezing, difficult, or labored respiration and cough
• Excessive sudden drooling	• Severely pinpointed pupils
• Difficulty seeing (reduced vision or miosis)	• Red eyes with tearing
• Tightness in chest, difficulty breathing	• Vomiting
• Localized sweating and muscular twitching in the area of contaminated skin	• Severe muscular twitching and general weakness
• Stomach cramps	• Involuntary urination and defecation
• Nausea	• Convulsions
	• Unconsciousness
	• Respiratory failure

Student Notes:

NOTE

Some symptoms of heat stress are similar to symptoms of nerve agent poisoning.

The rapid action of nerve agents calls for immediate administration of the antidotes atropine and pralidoxime chloride (2-PAM C1). Atropine acts to dry up secretions in the respiratory tract and to stimulate the central respiratory functions, and 2-PAM C1 simultaneously relieves muscle paralysis, especially in the respiratory tract. Both antidotes are self-injected into the lateral thigh muscle by the use of automatic injectors.

Blister Agents

Blister agents act on the eyes, mucous membranes, lungs, and skin. Blister agents include mustard vapors and mustard liquids. Mustards burn and blister the skin they contact, damage the respiratory tract when inhaled, and cause vomiting and diarrhea when absorbed. The degree of damage depends on the type and concentration of the agent, the weather, the amount of activity of the individual, and amount of exposure time. Blister agents are effective even in small quantities and produce both immediate and delayed injuries.

Mustard vapors burn any area of the skin; but, the burn is most severe in moist areas, such as the neck, genitals, groin, armpits, bends of knees, and elbows. Redness of the skin follows in 1/2 to 36 hours after exposure. This condition may be accompanied by intense itching, and blisters may then appear. Stiffness, throbbing pain, and swelling may also occur.

A few hours after breathing the mustard vapor, a victim experiences irritation of the throat, hoarseness, and coughing. After severe exposure, the lining of the respiratory system swells and interferes with breathing. Frequently, pneumonia develops.

If the whole body is exposed to mustard vapor, the body goes into a state of shock. This reaction is accompanied by nausea and vomiting.

Personnel who suspect contamination of their eyes or face must seek overhead shelter and flush the eyes with potable (drinkable) water from a canteen or shower. Mild exposure to skin can be treated by applying calamine lotion or topical steroid creams. All blisters should be opened, drained, and cleansed with tap or saline water. Any exposure to mustards require medical care by a corpsman or medical personnel.

Blood Agents

Blood agents inhibit the action of an enzyme responsible for transferring oxygen from the blood to the cells of the body. Thus the cells become starved for oxygen. Inhalation is the usual route of entry for blood agents.

The symptoms produced by blood agents depend on the concentration of the agent and the duration (length of time) of the exposure. Typically, either death occurs rapidly or recovery takes place within a few minutes after removal of the victim from the toxic atmosphere. High concentrations of blood agent cause labored breathing within a few seconds, violent convulsions, followed by cessation (stoppage) of breathing completely. Finally, the heart stops only a few minutes after initial exposure. The symptoms of exposure to blood agents are shown in the following chart:

INITIAL SYMPTOMS	ADVANCED SYMPTOMS
• Increased respiration	• Convulsions
• Headache	• Coma
• Giddiness	• Death
• Dizziness	
• Increased pulse rate	
• Red, flushed skin	

Student Notes:

If you're exposed to a blood agent, immediately don (put on) a protective mask. Speed is essential! Blood agents act so rapidly that within seconds, the effects of exposure can make it impossible for individuals to don their own mask. If this happens, the nearest person should help those who can't don their mask. Medical personnel should administer medications.

Choking Agents

In low concentration, choking agents produce an action on the respiratory system that results in the accumulation of fluid in the lungs. Accumulation of fluid in the lungs can cause death. High concentrations produce death for the same reason, but the upper respiratory tract may be involved as well. Exposure to choking agents may produce immediate dryness of the throat, coughing, choking, tightness across the chest, headache, nausea, and at times, irritated and watery eyes. However, symptoms are usually delayed, and it's possible that no immediate symptoms will appear when exposed to a fatal dose.

Even a mild exposure to a choking agent that is accompanied by immediate symptoms may cause fluid to accumulate in the lungs within 2 to 24 hours after exposure. Shallow and rapid breathing, a hacking and painful cough, frothy saliva, and an ashen gray color of the skin indicate the presence of fluid in the lungs.

After exposure to a high dose of a choking agent, it's important to begin medical treatment quickly to prevent accumulation of fluid in the lungs. It's important to keep the victim at rest and warm. Cough suppressant and pain relievers can be given as long as the doses don't interfere with respiratory functions.

Riot Control Agents (RCAs)

RCAs are classified as either tear agents or vomiting agents and are characterized by very low toxicity and brief action. They are used to produce temporary misery and harassment. Most personnel exposed to RCAs don't require medical attention and casualties are rare. Tear agents act rapidly on nerve ends in the cornea and mucous membranes of the eye. Vomiting agents cause local inflammation of the respiratory tract, sinuses, and eyes. The symptoms of exposure to RCAs are shown in the following chart.

First aid for personnel exposed to tear agents includes providing a supply of fresh air as soon as possible and changing exposed clothing. If symptoms

SYMPTOMS OF TEAR AGENTS	SYMPTOMS OF VOMITING AGENTS
• Violent burning sensation of the eyes • Reddening of the eyelids • Uncontrollable winking • Excessive tearing • Intolerance to light • Burning sensation of the throat, with developing pain and a sensation of choking • Sneezing • Nausea • Diarrhea • Headache • Burning sensation of the skin	• Irritation of the eyes, mucous membranes of the mouth and nose • Runny nose, sneezing, and coughing • Headache • Tightness and pain in the chest • Nausea and vomiting

Student Notes:

continue, the eyes, mouth, and skin should be flushed with large amounts of water. Although the effects of vomiting agents can be dramatic, personnel can usually perform duties despite their effects. Personnel should continue to wear a face mask even though coughing, sneezing, salivating, and nausea occur. (The mask can be lifted from the face briefly to allow for vomiting and to drain saliva from the face piece). Analgesics can be given to relieve headache and general discomfort.

REVIEW 1 QUESTIONS

Q1. What term is used to describe weapons that destroy large areas or kill and disable large segments of a population?

Q2. What is the most probable delivery method for chemical or biological weapons?

Q3. List the two types of antipersonnel agents.

a.

b.

Q4. The use of nerve agents produces symptoms that are similar to what other, more common condition?

Q5. What part of the body is most affected by blister agents?

Q6. If you are exposed to a blood agent, what action should you take first?

Q7. True or false. Cough suppressant and pain relievers can be given to a victim of a choking agent.

BIOLOGICAL WARFARE

Learning Objectives: When you finish this chapter, you will be able to—

- Recall the terms used with biological warfare (BW).
- Identify the types of BW.
- Identify the effects of BW.

Biological warfare (BW) is the intentional use of living organisms, toxins, and microtoxins to disable or to destroy people and domestic animals, damage crops, or deteriorate supplies. BW might be used on a large scale; therefore, biological immunizations of military forces and the development of detection equipment, such as the Interim Biological Agent Detection System (IBADS), are being used. Some of the types of BW agents and their symptoms are described in table 13-2.

Do not underestimate BW as a weapon. BW agents can be produced on a scale not considered possible in the past. Even small nations with modern, adequate research facilities can produce large quantities of BW toxins and microtoxins more cheaply than they can produce other types of weapons. These toxins and microtoxins are hundreds to thousands times stronger than today's chemical weapons. The disadvantage of BW agents is that many are rapidly degraded when exposed to certain environmental conditions, such as ultraviolet radiation, visible radiation, heat, dryness, or humidity.

Animals, insects, and rodents can be used as carriers to spread BW agents. Saboteurs can also infect large numbers of people by contaminating a water supply. Infecting water, milk, and food supplies with microorganisms can spread diseases, such as anthrax, typhoid fever, cholera, and influenza.

In the early stages of any biological disease, the general symptoms include fever, malaise, and inflammation.

Student Notes:

Table 13-2.—Characteristics for Selected BW Agents

Disease (common name)	Causative Agent	Physiological Effects	Time to effect
Anthrax	Bacillus anthracis	Mild fever and fatigue, worsening to severe respiratory disorders, high fever and excessively rapid pulse rate. Death can occur within 5-12 days of exposure if left untreated. Pulmonary anthrax is fatal more than 90% of the time.	1-5 days
Plague	Yersinia pestis	Fever, headache, and rapid heart rate, followed by pneumonia and hemorrhaging in the skin and mucous membranes. Untreated plague pneumonia fatalities approach 100%, but early treatment can reduce mortality to as low as 5%.	2-3 days
Tularemia	Francisella tularensis	Symptoms include fever, chills, headache and muscular pain. Untreated tularemia can result in 30-60% mortality; treated, the mortality rate is reduced to 1%.	3-5 days
Botulinum Toxin	Clostridium botulinum	Initial symptoms include extreme weakness, nausea, headaches, and intestinal pain leading to respiratory paralysis that may cause death.	2-26 hours

The degree of **fever** varies with the individual, depending on the person's resistance. However, fever does serve as a rough guide to the severity of infection. Often a violent chill precedes the fever. Whether the chill occurs or not, fever is usually one of the earliest symptoms.

Malaise is a feeling of bodily discomfort and weakness. There may be nausea, dizziness, loss of appetite, and general aches and pains.

Inflammation is caused by the reaction of body tissues combating and sealing off an infection. In almost every case there is pain, redness, and swelling. Some types of infection result in a characteristic rash, making it possible for a doctor to make an early diagnosis.

REVIEW 2 QUESTIONS

Q1. BW is the intentional use of

(a) _________________ to disable or

destroy (b) __________________.

Q2. What is the disadvantage an enemy has when using BW agents?

Q3. List the symptoms of biological disease in its early stages.

a.

b.

c.

NUCLEAR WARFARE

Learning Objectives: When you finish this chapter, you will be able—

- Recall the terms used with nuclear warfare.
- Identify the types of nuclear warfare and the effects of nuclear weapons.
- Identify self-aid and first-aid methods for countering the effects of nuclear radiation.
- Recall the difference between radiological and radiation contamination.

Student Notes:

In one way, nuclear weapons are no different from ordinary high-explosive bombs—both are designed to cause destruction by blast and shock effects. Of course, nuclear weapons have a much greater destruction capability than conventional high-explosive weapons, with the added effects of nuclear radiation.

Nuclear explosions are classed according to the point of detonation with relationship to the surface of the earth—a high altitude blast, an air blast, a surface blast, and a subsurface blast.

HIGH ALTITUDE BLAST

A high altitude blast (fig. 13-1) is defined as a blast that takes place above 100,000 feet. The major aim of this blast is to destroy or interrupt satellites and communication systems through the effect of an electromagnetic pulse (EMP). Basically, the EMP is an intense electrical surge that affects electronic or electrical equipment in a burnout that's equivalent (equal) to that caused by a lightning strike.

AIR BLAST

An air blast (fig. 13-2) is one in which the fireball is below 100,000 feet and doesn't touch the earth's surface. The radiation effects from an air blast are minimal. The main reason for using an air blast is its destructive value produced in the expansion and compression phases of weapon detonation. The blast causes an over pressurization that crushes everything in its path. The front of the blast is called the *mock front*. An air blast would be most effective to use against a battle group at sea because it would structurally damage and/or sink many ships.

SURFACE BLAST

A surface blast (fig. 13-3) is one in which the fireball touches the earth's surface. Most of the damage caused by a surface blast is due to the shock (or blast) wave that accompanies the explosion. Large amounts of surface materials are vaporized and taken into the fireball. As the fireball rises, more debris is sucked up by the strong after winds. Much of this debris returns to earth as radioactive fallout.

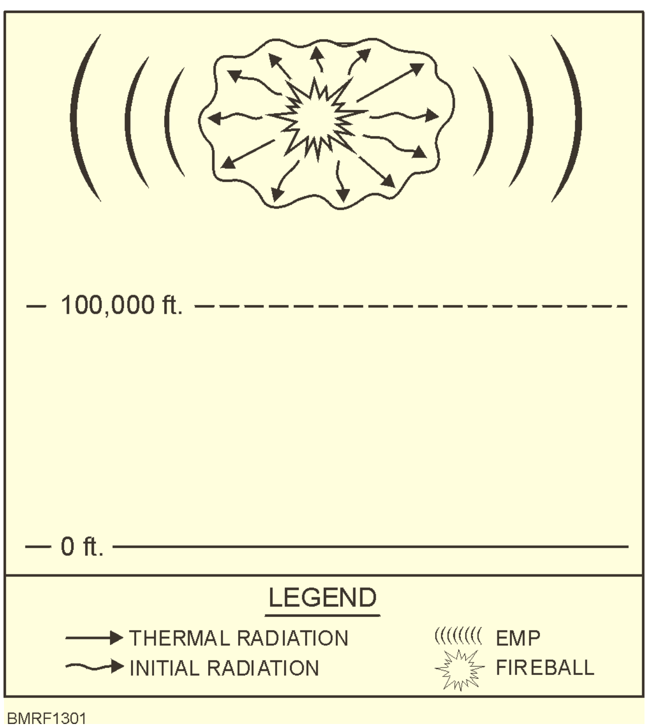

Figure 13-1.—A high altitude blast.

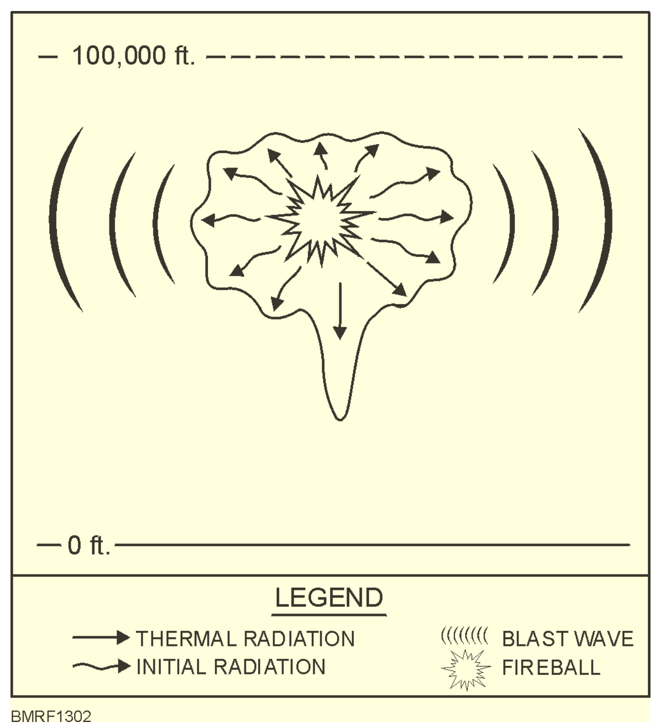

Figure 13-2.—An air blast.

Student Notes:

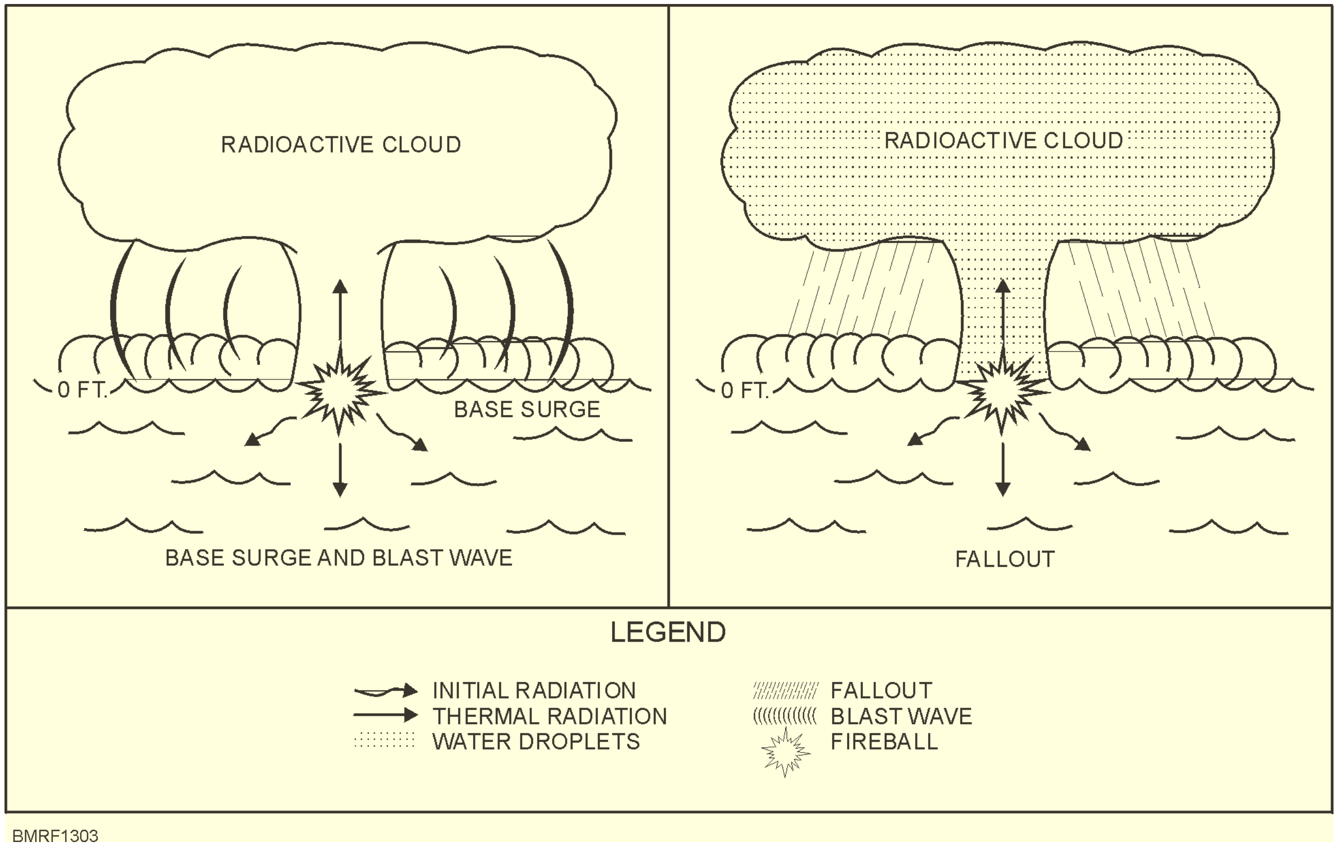

Figure 13-3.—A surface blast.

The effective range of blast damage is less than that from an air blast because much of the energy is transmitted in the form of a ground or water shock wave. Near ground zero, however, the severity of the shock wave is greater than that of the blast wave. The distance at which thermal radiation (heat) is hazardous is slightly less than that from an air blast.

Nuclear radiation is of two types—initial and residual.

Initial Radiation

Initial radiation occurs within the first minute after an explosion; residual radiation occurs thereafter. In most instances, initial radiation is of little consequence because the lethal range of its effects is less than that of the blast wave.

Residual Radiation

Residual radiation for a surface burst is dangerous because the large amount of surface material drawn into the cloud is heavy enough to fall while still highly radioactive. Additionally, the fallout area of a surface blast is much larger than the area affected by heat and shock.

SUBSURFACE (UNDERWATER) BURST

In an underwater burst (fig. 13-4) a fireball is formed. However, it's smaller than the fireball of an air burst and is not normal. The explosion creates a large bubble (cavity) that rises to the surface where it expels steam, gases, and debris into the air. Water rushing into the cavity is thrown upward in the form of a hollow column that may reach a height of several thousand feet. When the column collapses, a circular cloud of mist, called the *base surge*, is formed around the base of the

Student Notes:

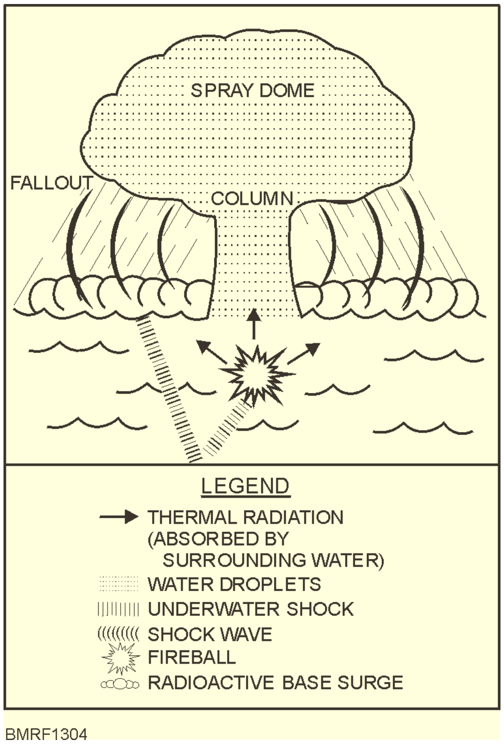

Figure 13-4.—A subsurface burst.

column. The base surge billows upward to a height of several hundred feet and expands rapidly outward to a distance of several thousand yards. Then it gradually rises from the surface and merges with the cloud formed by the escaping fireball.

EFFECTS OF NUCLEAR WEAPONS

Detonation of the nuclear bomb creates a blast wave that travels outward in all directions at an initial speed much greater than the speed of sound. When the wave strikes the earth's surface, another wave is formed by reflection. At some distance from ground zero (depending on the height of the blast), the primary and reflected waves combine to form a reinforced blast wave. Pressure at the wave front, called *overpressure*, is many times that of normal atmospheric pressure and is what causes most of the physical damage. Additionally, underwater bursts create large water waves, some of which reach heights of over 90 feet within a few hundred feet from the blast. The water waves travel outward at high speed for a distance of several miles, gradually diminishing in size. The overpressure decreases as the distance from the blast increases, but it can cause damage many miles from the blast.

Nuclear weapons produce explosions of great force and heat and release nuclear radiation. Their primary purpose is the mass destruction of property and personnel. Their effects are divided into three categories—blast waves or shock waves, incendiary, and radiation.

Blast Waves or Shock Waves

Injuries caused by blast waves can be divided into primary (direct) injuries and secondary (indirect) injuries.

PRIMARY BLAST INJURIES.—Primary blast injuries result from the direct action of the air shock wave on the human body. The greater the weapon's size, the greater the blast wave's effective range, with a subsequent increase in casualties.

SECONDARY BLAST INJURIES.—Secondary blast injuries are caused by strong blast winds reaching hundreds of miles per hour collapsing buildings and timber and flinging debris about. Personnel may also be hurled against stationary objects or thrown to the ground by high winds accompanying the explosion.

At sea, the shock wave accompanying an underwater burst produces various secondary injuries. Causalities resemble those caused by more conventional underwater weapons, such as mines and depth charges. Instead of being localized, the casualties extend over the entire ship. Also, injuries result from personnel being thrown against fixed objects or structures. Unsecured objects can act as missiles and cause many injuries.

Incendiary

There are two general ways fires can originate in a nuclear explosion.

1. First, kindling fuels can be ignited as a direct result of the absorption of thermal radiation.
2. Second, fires can be started from electrical short circuits, broken gas lines, or other interrupted heat sources as an indirect effect of the blast wave.

Student Notes:

Interaction of the blast wave, fire, and extent of blast damage are important factors in determining fire spread.

Flash burns are likely to occur on a large scale as a result of an air or surface blast of a nuclear weapon. Because thermal radiation travels in straight lines, it burns primarily on the side facing the explosion. But under hazy atmospheric conditions a large proportion of the thermal radiation may be scattered, resulting in burns received from all direction. Depending on the size of the weapons, second-degree burns may be received at distances of 25 miles or more.

The intense flash of light that accompanies a nuclear blast may produce flash blindness, even at a range of several miles. Flash blindness is normally temporary, though, the eyes can recover in about 15 minutes in the daytime and in about 45 minutes at night. A greater danger lies in receiving permanent damage to your eyes caused by burns from thermal radiation, which may occur 40 miles or more from a large-yield nuclear weapon.

Under some conditions, individual fires created by a nuclear explosion can come together into mass fires with great potential for destruction. The most significant types of mass fires are divided into two categories—firestorms and conflagrations.

FIRESTORMS.—In a firestorm, many fires merge to form a single column of hot gas that rises from the burning area. Strong, fire-induced, radial winds are associated with the column. Therefore, the fire front is essentially stationary and the outward spread of fire is prevented by the in-rushing wind. Virtually everything combustible within the firestorm area is destroyed.

CONFLAGRATIONS.—Conflagrations have moving fire fronts driven by the wind. Conflagrations can spread as long as there is fuel. Unlike firestorms, conflagrations can develop from a single ignition.

Radiation

Nuclear radiation hazards consist of alpha and beta particles, gamma rays, and neutrons.

ALFA PARTICLES.—Alpha particles have little skin-penetrating power and must be taken into the body through ingestion or cuts to be injurious.

BETA PARTICLES.—Beta particles can present a hazard to personnel if the emitters of these particles (carried in contaminated dust, dirt, or bomb residue) come into contact with the skin or get inside the body. Beta particles with enough intensity cause skin burns (radiation burns).

GAMMA RAYS.—Gamma rays are pure energy and not easily stopped. They can penetrate every region of the body. In fact, many gamma rays will pass right through a body without touching it. However, gamma rays that do strike atoms in the body cause the atoms to ionize. The ionization may result in any number of possible chemical reactions that damage the cells of the body.

NEUTRONS.—Of all the nuclear radiation hazards, neutrons have the greatest penetrating power. When the neutron is captured in the atoms of various elements in the body, atmosphere, water, or soil, the elements become radioactive and release high-energy gamma rays and beta particles.

Initial radiation contains both gamma and neutron radiation. Residual radiation, our greatest concern, contains both gamma and beta radiation.

EFFECTS ON SHIPS AND SHIPBOARD SYSTEMS

Ships close to a detonation point may sustain considerable material damage from air blast, underwater shock, water waves, and possibly thermal radiation. There will be a ship kill zone around ground zero. Outside ground zero, there will be a much larger damage-survival zone. Here, ships will receive severe, moderate or light topside damage as well as operational and equipment damage.

Damage from an Air Blast

Depending on the weapon yield, the blast wave from nuclear detonations can cause damage to ships miles from the blast. Damage will be inflicted primarily on the superstructure and the hull above the waterline. Some examples of damage from an air blast might include the warping or buckling of the flight deck; a distortion of airplane elevators, hull girders, deck

Student Notes:

machinery and radar antennas; and the cracking of seams above and below the waterline.

Damage from Underwater Shock

The pressure pulse created in water by an explosion on or below the surface is called an *underwater shock*. It travels much faster than an air blast and can inflict damage to ships at a distance of several miles. Possible effects include damage to the hull, heavy machinery, gun mounts, and electronics systems.

Damage from Water Waves

An underwater nuclear burst may result in waves over a hundred feet in height, but water waves are seldom the primary source of ship damage. The impact of water waves may cause distortion of the superstructure, carry away deck gear, or flood through damaged weather doors.

Damage to Ships Tactical Systems

Nuclear detonation can cause considerable damage to tactical systems, including electrical and electronic systems, sonar, radar and communications. Such damage can be a result of an electromagnetic pulse (EMP), transient radiation effects on electronics, blueout, or blackout.

ELECTROMAGNETIC PULSE (EMP).—Shipboard damage occurs when metal conductors, such as electrical cables, antennas, and sensors, absorb EMP. Computers and other equipment using solid-state components are most vulnerable to EMP. Vacuum-tube equipment is less susceptible. Personnel aren't directly injured by EMP, but they may suffer electrical shock if they are in contact with a large conductor of electrical energy.

Preventive measures to protect or *harden* equipment against damage by EMP include metal shielding, good grounding, use of surge arresters, and the proper arrangement of electrical wiring.

TRANSIENT RADIATION EFFECTS ON ELECTRONICS (TREE).—TREE occurs in electronics systems as a result of exposure to gamma or neutron radiation. The actual effects are determined by the characteristics of the circuits in the electronics package, the components in the circuits, and the construction techniques and materials used to make the components. In general, radios, radar, computers, cables and wiring, and inertial guidance systems are susceptible to TREE. The response of such systems to radiation depends on the nature of the radiation and on the specific components and operating status of the systems.

BLUEOUT.—Blueout is the prolonged disturbance of an underwater nuclear detonation and is caused by ocean basin shock reverberations that interfere with passive sonar systems. The noise resulting from the initial nuclear weapon detonation (the interaction of steam and water and the pulsations of the steam bubble) masks out all other sound for a short period of time making it impossible for sonar operators to listen for target data. The effects of blueout are temporary.

BLACKOUT.—Blackout, caused by an atmospheric nuclear explosion, is the interference of radio transmissions through ion fields formed in a detonation. In a tactical situation, straight-line communications (radar and radio transmissions) between ships on opposite sides of the fireball will be lost. Following a high altitude detonation, satellite communications may be affected or lost. Blackout alters or inhibits radar or radio waves and affects all frequency bands.

Procedures to counteract the effects of blackout include providing alternate paths for communications, shifting radio operating frequencies, changing transmission modes, and waiting for blackout effects to diminish.

REVIEW 3 QUESTIONS

Q1. List the four types of nuclear weapon explosion classification.

a.

b.

c.

d.

Student Notes:

Q2. Describe why residual radiation is more dangerous than initial radiation.

Q3. Describe how a secondary blast can cause injuries.

Q4. List the nuclear radiation hazards.

a.

b.

c.

d.

Q5. List the measures that should be taken to protect electronic equipment from the effects of EMP.

a.

b.

c.

d.

CONTAMINATION, DETECTION, AND IDENTIFICATION

Learning Objectives: When you finish this chapter, you will be able to—

- Identify the purpose of CBR monitoring and decontamination teams.
- Identify the markers used to indicate CBR contamination.
- Recall the purpose of the markers used to indicate CBR contamination.

For a ship or station to retain its offensive power and carry out its mission, immediate detection and identification of radiation and BW and CW agents are of great importance. However, the nature of radiation and BW and CW agents makes it difficult to detect and identify them. Here are some examples.

You know a nuclear attack is taking place because you can see it, hear it, and feel it. But, you can't see the nuclear radiation. Nuclear radiation is just as deadly over a period of time as the blast itself. A biological and chemical attack can be just as invisible. You might not know about them until it's too late. Because CBR attacks might be invisible, you need to recognize symptoms of radiation and BW and CW contamination.

SURVEY TEAMS

After a CW, BW, or nuclear attack, survey teams go through the ship to determine the extent and location of any contamination. Rapid detection and identification are vital so that effective defense measures may be taken immediately. A survey team, or monitoring party, consists of a minimum of three people—a monitor, a recorder, and a messenger.

The **monitor** is in charge of the party. The monitor carries high-range and low-range survey meters. The monitor is responsible for the safety of the team and for determining intensities and locations of contamination.

The **recorder** maintains a record of intensity readings (obtained by the monitor), time of the readings, location of the hazardous areas, and specific hazards. Also, the recorder may act as a marker, using line to rope off hazardous areas and chalk to mark on bulkheads and decks the intensities of contamination found during the survey.

The **messenger** reports to damage control central (DCC) the contaminated areas and the readings obtained by the monitor. In DCC, personnel plot the reports from the various teams to get a general outline of contaminated areas, to pinpoint hot spots (areas of higher-than-average intensities), and to establish stay times for specific areas (fig. 13-5).

Student Notes:

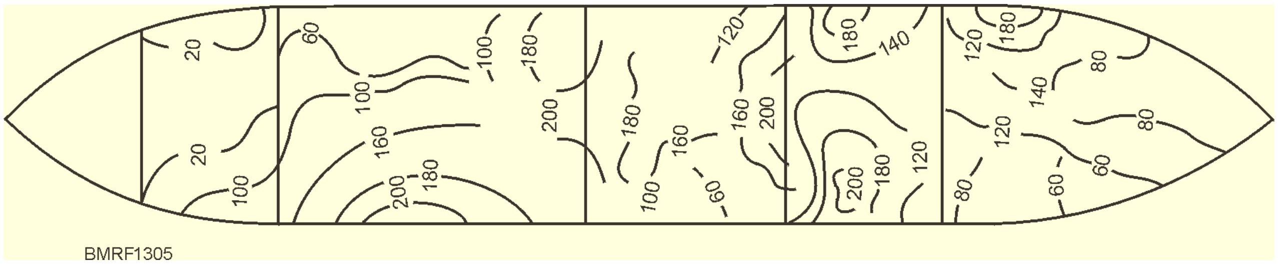

Figure 13-5.—General outline of contaminated areas on weather decks.

Two types of surveys are usually conducted—a rapid, or gross, survey and a detailed survey.

The **rapid survey** is a preliminary reconnaissance. Limited numbers of readings are taken in a minimum amount of time. The purpose of the rapid survey is to obtain a quick estimate of radiation levels at specified locations to determine the possibility of keeping stations manned.

A **detailed survey** is used to determine the effectiveness of decontamination measures. All accessible areas and equipment are surveyed in a slow, methodical manner. Special attention is paid to areas that tend to hold contamination (rust spots, caulking in wood decks, canvas, rope, and so on).

Each member of a monitoring team wears a protective mask and clothing and is equipped with both a pocket dosimeter and a high-range casualty dosimeter. No member with an open cut or wound should enter any contaminated area. Smoking, drinking, and eating are prohibited in contaminated areas.

CBR CONTAMINATION MARKERS

A standard system is used to mark areas contaminated by CW, BW, or nuclear agents. Look at figure 13-6, which shows CBR contamination markers. The markers are triangular in shape, with a base of approximately 11 1/2 inches and sides of about 8 inches. Each type of contamination is readily identified by the color of the marker. Additionally, they are labeled GAS, BIO, or ATOM, as appropriate. The front of the marker indicates the safe limits of the contaminated area. **Never go beyond the markers without permission**. The front of each marker also contains information about the contaminated area, such as the date and time of detection and the type of agent.

NUCLEAR RADIATION

When a ship is exposed to radiation or is radiologically contaminated (such as from a base surge or fallout), surveys are made to determine the degree of contamination.

During surveys, two types of measurement are made—intensity (dose rate) of the radiation field and the total amount (dose) received. This information is used to calculate (find) the safe entry time (time after exposure when an area may be entered safely) and stay time (length of time a person may remain in an area without exceeding permissible radiation exposure levels). Dose rate is expressed in roentgens (gamma ray measurement only). The total dose is expressed in rads (any type of radiation).

One measurement instrument is the radiac meter (radiac stands for *radioactivity detection, indication, and computation*). Usually, only qualified damage control (DC) personnel use the radiac meter; therefore, only the personnel dosimeter is covered here.

Measurements are made using two basic types of personnel dosimeters—self-reading and nonself-reading.

The self-reading pocket dosimeter (fig. 13-7) is about the size and shape of a fountain pen and comes in the following ranges:

0 to 5 roentgens

0 to 200 roentgens

0 to 600 roentgens

0 to 200 milliroentgens

Self-reading instruments measure exposure to radiation over a period of time, not dose rates at any given time. Hold the dosimeter up to a light source and

Student Notes:

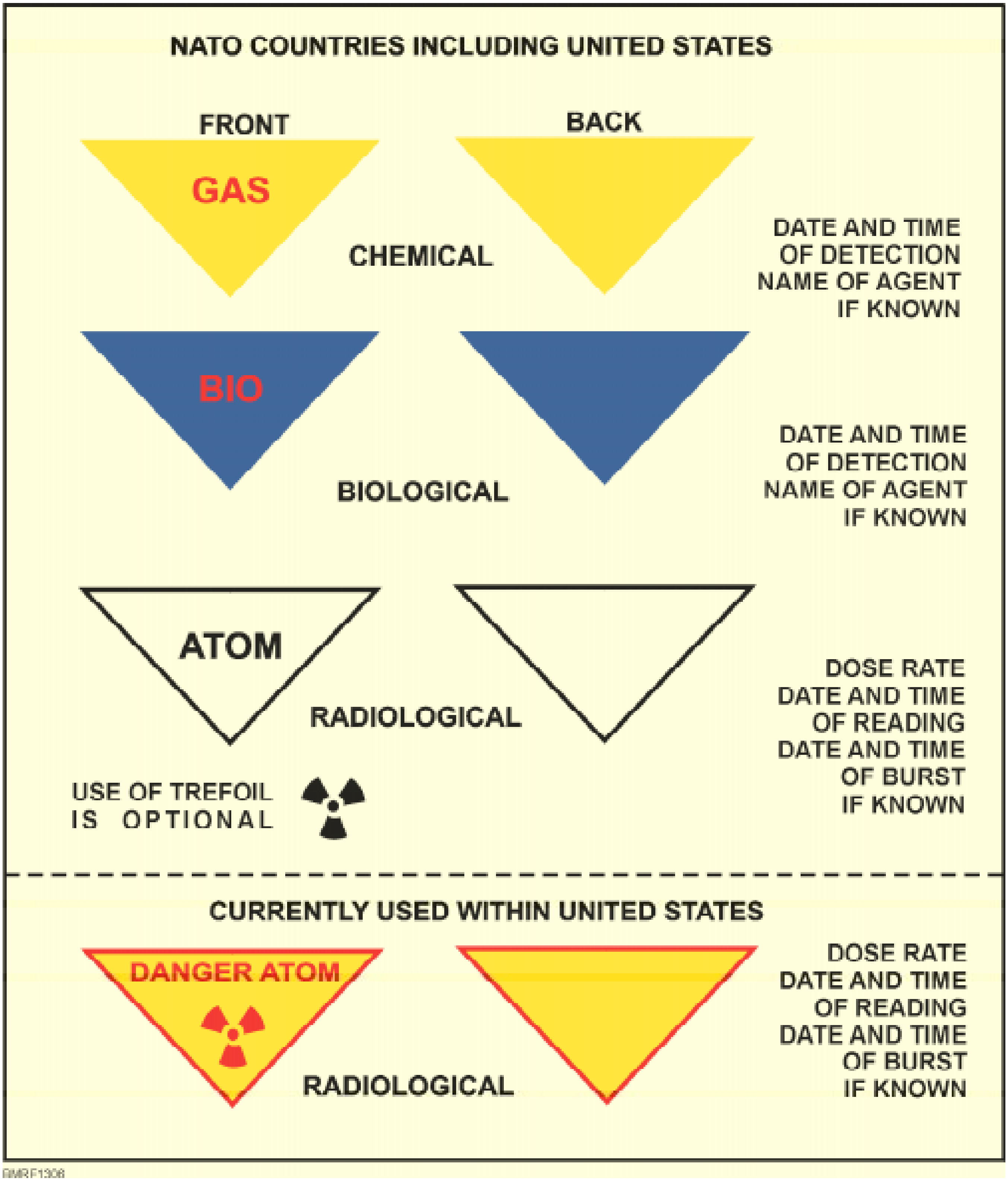

Figure 13-6.—CBR contamination markers.

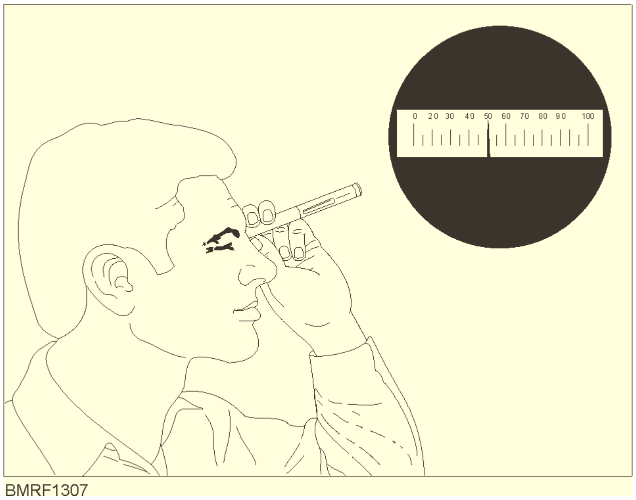

Figure 13-7.—Self-reading pocket dosimeter.

look through the eyepiece; the total radiation dose received is read directly on the scale. After each use, the dosimeter is recharged and the indicator line set to zero.

The nonself-reading category is a high-range casualty dosimeter (fig. 13-8). To determine the total amount of gamma radiation the wearer has been exposed to, it's put in a special radiac computer-indicator. Its range is 0 to 600 roentgens.

BIOLOGICAL AGENTS

No simple or rapid method can be used to detect BW contaminants. The only known method consists of two phases—a sampling phase conducted by a CBR survey team and a laboratory stage conducted by medical personnel.

Samples of material are taken from a wide area. Samples include air, surfaces of bulkheads and decks, clothing, equipment, water, food, or anything else suspected of being contaminated. Then the samples are shipped to a medical laboratory for identification of the agent.

CHEMICAL AGENTS

Warning of a CW attack based on detection by the physical senses alone is not only dangerous but would probably be too late. This is particularly true if fast-acting nerve agents were used. Special detection equipment, such as the M256A1 vapor sample detector kit and the M8 and M9 liquid chemical agent papers, is used to detect CW agents. Also, draeger tubes are used to detect the presence of phosgene gas. Other pieces of

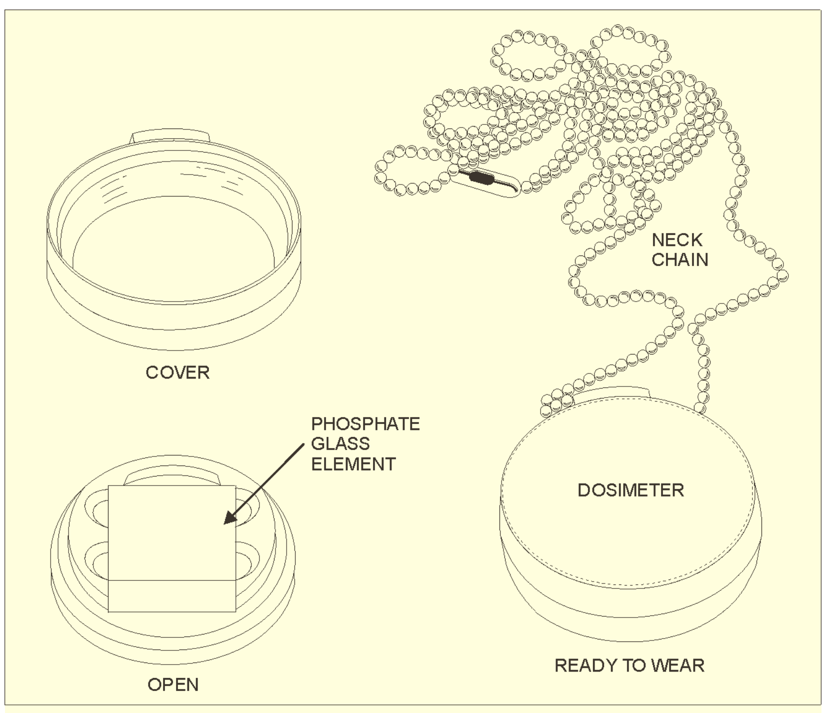

Figure 13-8.—High-range casualty dosimeter, DT-60/PD.

Student Notes:

CW detection equipment used by Navy personnel include the portable AN/KAS-1A chemical warfare directional detector (CWDD) and the permanent chemical agent point detector system (CAPDS). No one piece of equipment can detect all CW agents, which is why the Navy uses several different methods of CW detection.

M256A1 detector kits are used to check areas suspected of being contaminated, to test an area after decontamination operations, and to indicate when masks might be removed. The kits are not designed to indicate when it is necessary to don (put on) gas masks.

REVIEW 4 QUESTIONS

Q1. A survey team consists of—

a.

b.

c.

Q2. What are the two types of surveys?

a.

b.

Q3. Biological markers are (a) what color with (b) what color inscription?

a.

b.

Q4. To calculate safe entry time and stay time in a radiologically contaminated area, you need what two measurements?

a.

b.

Q5. Describe the only known method for detecting BW contaminants.

Q6. To check areas suspected of being contaminated by CW agents, you should use what kit?

CBR DEFENSE PROTECTIVE MEASURES

Learning Objective: When you finish this chapter, you will be able to—

- Recognize the procedures to follow in case of a CBR attack.

For a ship or shore activity to be able to continue its mission after a CW, BW, or nuclear attack, personnel must be protected. Protective measures include both individual and group actions. Individual protection is an immediate concern. What you do in the first few moments of a CW, BW, or nuclear attack may keep you alive!

WHAT TO DO IN A CBR ATTACK

In a nuclear attack, defensive measures are much the same as the general damage control precautions taken against any explosion. These measures are to keep things squared away, maintain watertight integrity, make repairs as quickly as possible, protect yourself with your clothing and protective mask, be ready to fight fires ignited by the blast, and be ready to administer first aid to shipmates who are injured or burned. What you learned about damage control and firefighting in chapter 12 also applies to the damage and fires caused by nuclear weapons.

General Precautions to Follow in a CBR Attack

As soon as the initial effects of the explosion are over, you should then take the following precautions:

1. Put on your mask immediately or cover your nose and mouth with a handkerchief or cloth.

Student Notes:

2. Adjust your clothing to cover exposed skin (battle dress).
3. Slip on a protective cover, if you have one, or cover yourself with anything at hand.
4. Keep upwind of the explosion, if possible.
5. Administer first aid to yourself and to others.
6. If you are not a casualty, report to your duty station or to the designated area where you can take a shower and get clean clothes.
7. Keep your hands away from your face, particularly your mouth.
8. Don't eat, chew, drink, or smoke until the items are checked by a medical officer.
9. Don't stir up dust or step into puddles.
10. Don't brush against or touch decks, bulkheads, structures, or objects in the contaminated area.

Breathing radioactive particles is dangerous. Take shelter from dust clouds raised by wind, by aircraft, or by moving vehicles. Otherwise, use a protective mask or a handkerchief for protection.

Nuclear Attack

If there is warning of a nuclear attack, the word is passed to take cover. When the word is passed, go to your designated shelter as quickly as possible. At the sound of the alarm, get your protective mask ready. If you are ordered to a shelter, remain there until the all-clear signal is given.

In general, the farther you are below the main deck (deep shelters), the better the protection from nuclear radiation. To reduce the contamination from the base surge and from fallout, secure the appropriate Circle W fittings. All topside openings will be closed for as long as the ship is in the danger area.

BW or CW Attack

If you are in a BW or CW attack, avoid the spray, mist, or cloud if you can. Wear your mask, cover your body as much as possible, and seek shelter. Assume that all surfaces in the vicinity of the attack are contaminated; leave the area quickly, and follow the route to the closest decontamination area. Report any sickness promptly, and do not eat, drink or smoke. Since BW and CW agents can sometimes enter your body through the skin, cover any cuts or scratches. As with nuclear warfare protective measures, if you have no mask with you, cover your nose and mouth with your handkerchief or cloth (such as a rag or shirt).

PROTECTIVE EQUIPMENT

The protective equipment described here includes the MCU-2P mask, clothing, and antidotes for certain chemical agents.

- You should know how to use a MCU-2/P protective mask and how to apply antidotes.
- Two types of clothing are useful, to varying degrees, in CBR defense—wet-weather clothing and ordinary work clothing

MCU-2/P Protective Mask

The protective mask, or gas mask, is your most important piece of protective equipment against CBR agents. It protects your face, eyes, nose, throat, and lungs. The reason it is so important is because inhaling CBR agents is much more dangerous than getting them on the outside of your body. Without filtration of some kind, a large amount of contamination could be inhaled in a short time.

The mask serves two functions:

1. It filters the air, removing particles of dust that may be radioactive or otherwise contaminated.
2. It purifies the air of many poisonous gases.

The mask does not produce oxygen. Therefore, it doesn't provide protection against smoke or against toxic gases, such as carbon monoxide, carbon dioxide, and ammonia. Therefore, it may be used for emergency escape only as a last resort. When entering a compartment containing such gases, you must use an oxygen breathing apparatus or an air hose mask.

The operation of the mask is simple. On inhalation (breathing in), the air passes through a filter system that filters and absorbs the CBR agents. Exhaled (breathing out) air is expelled through a one-way valve.

Student Notes:

From the moment you hear the alarm or suspect a CBR attack, hold your breath until you can put on the mask. You should be able to don (put on) and adjust your mask within 10 seconds. If your eyes or face becomes contaminated before you can get the mask on, the contamination should be taken care of first, provided the necessary materials are readily available. The most important action is to don the mask immediately; then, proceed with decontamination.

The MCU-2/P protective mask is designed to provide full protection. It provides protection against tactical concentrations of chemical and biological agents, toxins, and radiological fallout particles. The MCU-2/P mask also accommodates the use of the tri-service/NATO canisters.

The MCU-2/P protective mask (fig. 13-9) is built with a silicone rubber facepiece. It has the following features:

- Two voice emitters
- A drinking tube
- A flexible lens that lets you use binoculars, gunsights, and other optical equipment; and the option to put the filter canister on either side

The mask can be worn over approved mask-compatible glasses. You can order compatible glasses through your medical department. The large lens size provides the user with a good all-around view.

CBR Protective Clothing

Basically, any clothing or coverall that covers the body can provide a degree of protection from CBR contaminants. However, the type of clothing and its proper wear determine the amount of protection.

CHEMICAL-PROTECTIVE OVERGARMENT.—The chemical-protective overgarment consists of two pieces—a smock and trousers (fig. 13-10). The smock has two layers of materials: inner (antigas) and outer (monacrylic/nylon). The smock is generously cut to allow complete freedom of movement. It has a large front flap pocket for gloves, and so forth, and a sleeve patch where you can place detector paper for easy visibility. You can make quick and easy adjustments with hook-and-pile fasteners at the wrist and waist. The trousers are made of the same two layers of material and have suspender-type fittings located at the waist and across the shoulders. Hook-and-pile fasteners are located at the base of each leg for adjustment. The chemical-protective overgarment is issued in a plastic envelope that is

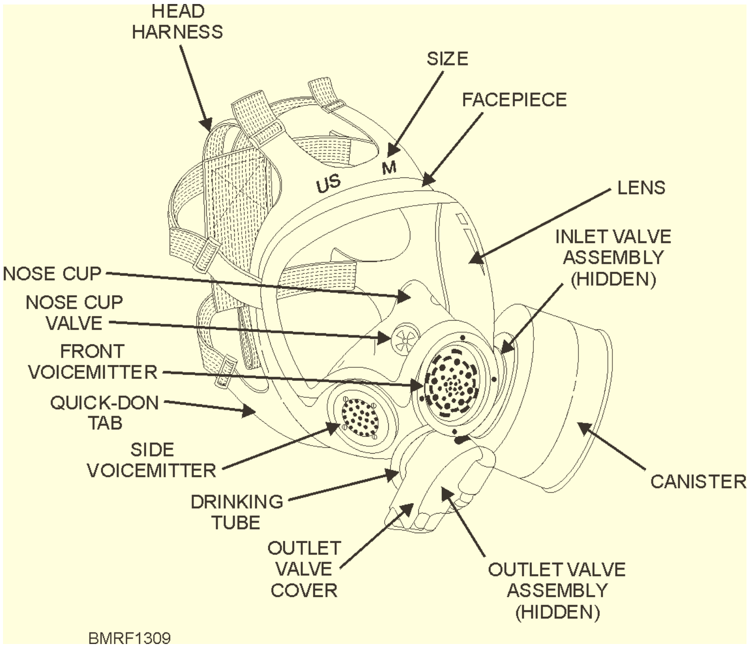

Figure 13-9.—MCU-2/P protective mask.

Student Notes:

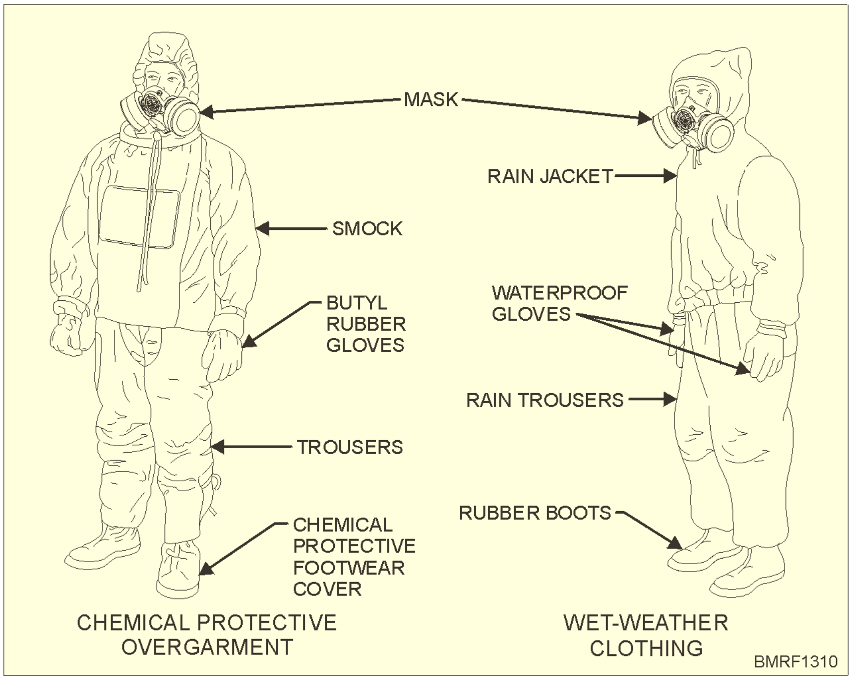

Figure 13-10.—Types of chemical-protective overgarments.

pressure packed, air evacuated, and heat sealed. It is then placed in a polyethylene bag and heat sealed. The overgarment has a shelf life of 5 years when unopened.

The protective overgarment protects against all CBR agents and is permeable to water vapor. Once removed from its protective envelope, it has a shelf life of 14 days in a nonchemical environment. If it is opened but uncontaminated, keep it for training purposes. Once exposed to chemical contamination, the overgarment provides 6 hours of continuous protection, after which it should be discarded.

CHEMICAL-PROTECTIVE FOOTWEAR COVERS.—The chemical-protective footwear covers (overboots) are worn over the standard work shoe and provide protection to the feet against exposure to all known concentrations of nerve and blister agents. The overboots are made of loose-fitting, impermeable, butyl sheet rubber and have a premolded, nonslip, butyl rubber sole. The overboot is approximately 16 inches high with a grommet lace closure, including five eyelets to allow lacing around the foot. The overboots are available in two sizes and can be worn on either foot. They are issued in a polyethylene bag with two pairs of laces and an instruction sheet. Upon contamination, the overboots provide 6 hours of protection from agent penetration.

CHEMICAL-PROTECTIVE GLOVE SET.—The chemical-protective glove set is worn to protect the hands against nerve and blister agents, liquids, and vapors. The set consists of an outer glove to provide chemical protection and an inner glove to assist in absorption of perspiration. The five-finger outer glove is made of impermeable, unsupported, black butyl rubber and is manufactured for both the right and left hand. The thin, white cotton inner glove can be worn on either hand. The glove set is issued in a clear polyethylene bag with an instruction sheet.

The black outer glove protects against chemical agent vapors, aerosols, and small droplets. Upon contamination, the set provides at least 6 hours of protection from agent penetration. These gloves, in good condition, can be decontaminated and reissued.

Wet-Weather Clothing

Wet-weather clothing (refer back to fig. 13-10) is often described as impermeable or rubberized clothing. Its value results from the fact that the previously described impregnated/protective clothing can be

Student Notes:

partially penetrated by all but the smallest droplets of liquid agents, especially in relatively high winds. Moreover, the impregnated/protective clothing is not equally efficient in neutralizing all liquid CW agents. On the other hand, wet-weather clothing is resistant to all liquid CW agents for a limited amount of time, provided that the closures at the neck, wrists, and protective mask are well adjusted or taped.

Wet-weather clothing provides a measure of protection against CBR contaminants when worn over ordinary clothing; but it provides the most complete protection when worn over impregnated or protective clothing. Gradual penetration of the synthetic rubber layer of the wet-weather clothing will eventually occur unless CW agent contaminants are promptly removed. The contaminants are removed by frequent and thorough flushing of the surface with a seawater washdown or an equivalent, such as jury-rigged topside seawater showers, or by swabbing with liquid hypochlorite.

In warm weather or during periods of increased physical activity, wet-weather clothing has a major disadvantage in that it can only be tolerated for relatively short periods of time. Tolerance is limited because no air can pass through the clothing to cool the wearer's body by the evaporation of perspiration.

Perspiration is normally accumulated inside an impermeable suit. Underclothing, gloves, socks, and shoes may become saturated. Sweating can be reduced and tolerance times lengthened by reducing the exercise rate, by using water-spray cooling, and by reducing exposure to direct sunlight.

Ordinary Work Clothing

Special protective clothing is not required for all personnel. Ordinarily, only the personnel of monitoring and decontamination teams who must work in or near hazardous areas wear it. All other personnel working near these areas should wear two layers of ordinary clothing, which provide partial protection against agents and radioactive particles.

REVIEW 5 QUESTIONS

Q1. True or false. Eating food after a CBR attack is okay as long as the food was in a sealed container before the attack.

Q2. Aboard ship, the safest place to be during a nuclear attack is ____________________.

Q3. What are the two functions of an MCU-2/P mask?

a.

b.

Q4. How long should it take you to don and adjust an MCU-2/P mask?

Q5. List the types of clothing that are useful for CBR defense.

a.

b.

MISSION ORIENTED PROTECTIVE POSTURE (MOPP)

Learning Objective: When you finish this chapter, you will be able to—

- Recall the procedures for protection at each level of mission oriented protective posture (MOPP).

Mission oriented protective posture (MOPP) is a means of establishing levels of readiness. MOPP is a flexible system of protection against chemical agents

Student Notes:

and is used in CW defense to help accomplish the mission.

The MOPP doesn't require that personnel wear protective clothing all the time. Duty requirements, body heat buildup, and basic human needs will prevent you from using full protective equipment for an infinite period of time. The MOPP does, however, give the CO the option of no protection to full protection, depending on the threat to the ship.

All operations are conducted under the MOPP system, even when there is no threat. There are four levels of MOPP—from Level-1, the least protection, to Level-4, the most protection.

MOPP Level-1

1. Individual protective equipment and medical supply items are issued to shipboard personnel and maintained at respective battle stations. Protective masks are fitted for immediate use.
2. Inventory stowed chemical/biological defense equipment and supplies.
3. Set readiness Condition III and material condition YOKE, if not already set.

MOPP Level-2

1. For both chemical and biological threats, protective mask is in a carrier and worn on the person.
2. Preposition decontamination supplies in decon stations and at repair lockers. Preposition stowed detection and monitoring equipment, supplies, and empty canteens as specified in the ship's CBR Defense Bill.
3. Set material condition ZEBRA (modified).

MOPP Level-3

1. Install new filter canisters on protective masks, maintain in a carrier and on the person. Provide wet-weather gear for donning over other protective clothing and equipment for weather deck activities. Don overgarment trousers and coat with hood down. Don chemical-protective overboots. Stow personnel decontamination kit in mask carrier. Stow chemical-protective glove set and medical supply items in pocket on overgarment coat. Initiate pyridostigmine pretreatment regimen.
2. Go to general quarters (GQ) (readiness Condition I may be relaxed and readiness Condition II set at CO's discretion); set material condition ZEBRA.
3. Fill prepositioned canteens with potable water.
4. Activate decontamination stations and contamination control areas (CCAs) and assure operability. Post detection and monitoring teams.
5. Post and monitor detection equipment and materials as designated by the ship's CBR Defense Bill.
6. Activate countermeasures washdown system intermittently.

MOPP Level-4

1. Don protective mask and secure hood over head and around mask. Don chemical-protective glove set.
2. Direct ship to GQ (if not previously in effect).
3. Initiate continuous monitoring and operation of detection equipment.
4. Set CIRCLE WILLIAM.
5. Activate countermeasures washdown system to operate continuously.

The setting of MOPP levels may be different at various locations around the ship. This depends on the mission, work rate, and heat buildup in these battle station areas (engine rooms, combat information center, flight deck, and so on).

REVIEW 6 QUESTIONS

Q1. What does the acronym MOPP stand for?

Q2. There are how many levels of MOPP?

Student Notes:

Q3. What MOPP level provides the most protection?

Q4. At what MOPP level is material condition ZEBRA (modified) set?

DECONTAMINATION

Learning Objectives: When you finish this chapter, you will be able to—

- Recall the procedures for area decontamination afloat.
- Identify the purpose of the decontamination station.

There are four levels of decontamination—emergency personnel decontamination, limited operational decontamination, operationally complete decontamination, and complete decontamination.

LEVELS OF DECONTAMINATION

Level 1—Emergency personnel decontamina- tion. Emergency personnel decontamination is decontamination necessary to save your life. It is your responsibility. The primary purpose of emergency personnel decontamination is to safeguard you in protective gear that includes the following items:

- Mask
- Protective overgarment
- Boots
- Gloves

However, if a chemical attack takes place before you don all of the protective gear, you **need to** destroy, neutralize, or remove the chemical agents from inside your protective gear and from exposed skin area. Personnel decontamination kits (M291) give you the ability to decontaminate skin surfaces. The cleansing/decontamination stations used for entering and leaving the ship's interior provide soap, detergent, and shower facilities.

Level 2—Limited operational decontamination. Limited operational decontamination is decontamination necessary to let you, while in protective clothing and/or masks, do your job with a minimum risk of contact, pickup, and transfer of chemical agent contamination. Initial contamination is most likely to be on the upper-outer surfaces of structures and equipment. Further contamination may be picked up and/or transferred to noncontaminated areas. The two types of contamination hazards are—

1. Pickup hazards. A chemical agent on a surface that is touched by an individual, contaminating himself/herself.
2. Transfer hazards. A chemical agent picked up, transferred, and then deposited on an otherwise uncontaminated area.

The objective of limited operational decontamination is to destroy, neutralize, or remove persistent chemical agents that are located on structures and/or equipment in places where they constitute a contact hazard.

Level 3—Operationally complete decontamination. Operationally complete decontamination (also known as *full decontamination*) is decontamination so that the contamination of personnel, structures, and equipment is reduced to a level that results in a significant operational benefit. Level 3 decontamination reduces contamination to the lowest level possible. However, it should only be conducted when there is a reasonable chance that work can be performed without masks or gloves for limited periods, and the ship's mission can be completed without undue hazards to personnel.

One hundred percent decontamination can't be accomplished on each and every item suspected of being contaminated. Level 3 decontamination isn't a fixed level of decontamination. It depends on the ship's operating schedule and the urgency of the assigned mission. Decontamination at sea or by ship's personnel will be of this type.

Level 4—Complete decontamination. Complete decontamination is a degree of decontamination where

Student Notes:

appropriate chemical tests fail to give a positive response for a residual agent. Decontamination at naval shipyards, advanced bases, or by shore-based personnel will normally be of the 100% chemically complete type. This level is **not** mission essential for shipboard units.

DECONTAMINATION OF THE SHIP

The purpose of decontamination is to remove or reduce CBR contamination so that the ship can carry out its mission without danger to the life or health of its crew. Each type of contamination requires different decontamination procedures. Radiological (nuclear) contamination may be removed by washing it over the side; CW agents may be neutralized; BW agents must be destroyed.

Nuclear Radiation Decontamination

Complete decontamination of a ship usually requires the service of a shipyard. However, radiation levels can be reduced by shipboard personnel to the point where radiation no longer presents a serious hazard to the crew. Most of the radioactive particles can be removed by washing down the ship. Two washdown methods are used—mechanical and manual.

MECHANICAL METHOD.—The mechanical method, called the *ship's water washdown system*, consists of a system of piping and nozzles that spray water over all weather surfaces. Water is supplied by the fire main.

NOTE

> The washdown system actually is a preventive measure against fallout, rather than a decontamination method, because normally the system is activated before the ship enters the fallout area.

The water spray carries away the radioactive particles as they fall on the ship. At the same time, the flowing water fills in the cracks and crevices so that the particles that do get through the spray cannot settle into the cracks and crevices.

MANUAL METHOD.—If parts of the ship are contaminated before the washdown system is turned on, water from the sprinklers may not effectively reduce the radioactivity because the slowly flowing water doesn't have enough force to wash away the particles. The areas of heavy contamination must be hosed down with water under pressure. Hosing and scrubbing down the ship is the manual method.

Decontamination teams are formed to hose and scrub down the ship. A team usually consists of six people—the monitor, who is in charge; two hosemen; and three other team members. The hosemen wash down the hot spots with fire hoses, moving from the areas of less contamination toward areas of greater contamination, and working from top to bottom. Then the areas are scrubbed by the remaining team members with soap or detergent and water and are rinsed by hosing (fig. 13-11). The hosing-scrubbing-hosing continues until monitoring shows that contamination is removed or at least reduced to a safe level. Keep the contaminated water away from vent systems, doors, and hatches, because washing away the particles does not destroy them; they are simply being moved over the side.

BW and CW Decontamination

BW decontamination means eliminating the sources of infection. Using a chemical disinfectant is the most effective way to decontaminate BW agents. The type of disinfectant depends on the agent, the material to be decontaminated, and sometimes the area. Other methods include burning, dry heat, and moist heat. Burning usually is unsatisfactory because it naturally destroys surface material. An example of dry heat is a hot air oven set at 180°. Moist heat includes hot water or steam under pressure. Sunlight also is effective in reducing BW contamination. The ultraviolet rays of the sun kill most BW agents.

In **CW decontamination**, weather alone is the simplest means. Bright sunlight is a decontaminant, even in cold weather. However, lack of time, unfavorable weather, or contamination of critical areas may require a faster method. Enclosed spaces can be steamed. All spaces can be treated with liquid detergents. Water alone is often satisfactory as a flushing agent; hot water or steam is better than cold water.

Student Notes:

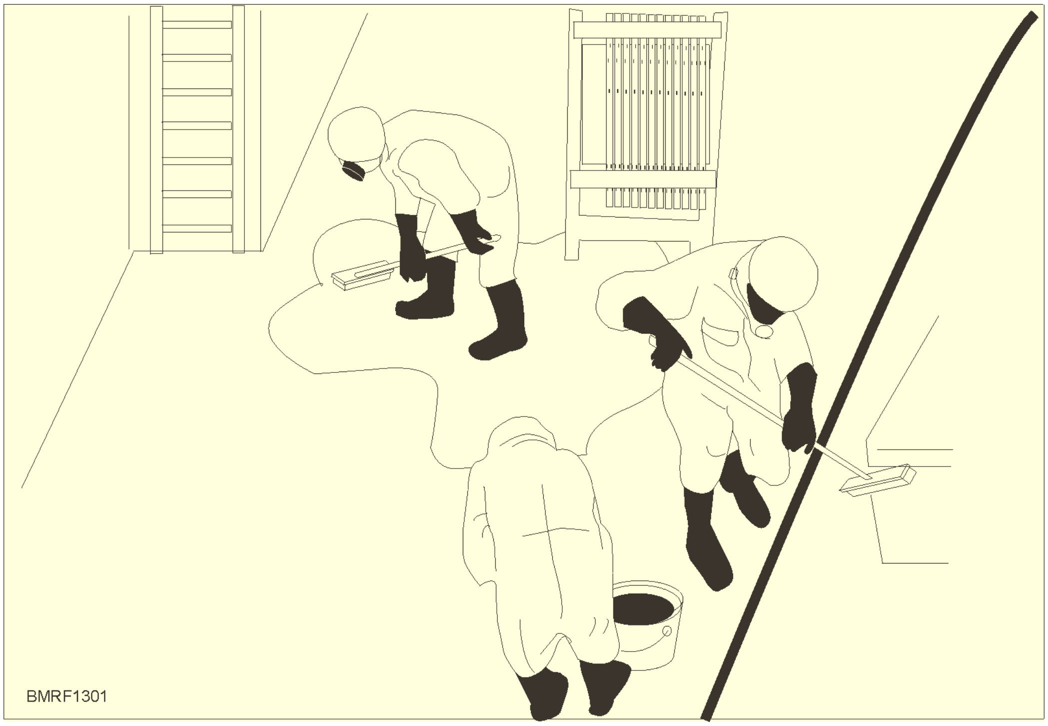

Figure 13-11.—A decontamination team at work.

PERSONNEL DECONTAMINATION

Each ship has a special area designated as a decontamination (decon) station. Personnel exposed to CBR agents are processed through these decon stations. Aboard ship, the decon stations are shower rooms, one forward and one aft. Large ships have more stations. Each decon station is divided into three parts—

1. A contaminated or an unclean area
2. A washing area
3. A clean area

Whenever practicable, the clean and unclean sections have separate access routes and entrances. Undressing is done in the unclean area, and containers are located there for the disposal of contaminated clothing. A box containing a mixture of sand and bleach may be located at the entrance to the undressing area; if so, scuff your feet in the box before entering the station.

The following are some general decontamination procedures you should remember:

1. Enter the undressing area after scuffing your feet in the box. Then, sit on a bench with both feet on the unclean side. Remove your shoes, swing your legs to the clean side of the bench, and remove your outer clothing only. In case of a BW or CW attack, keep your protective mask on. (Remove your protective mask only when told to do so.) Carefully remove your clothing to prevent the possible rise of a secondary aerosol. After placing your outer clothing in the containers, proceed to another section, remove your underwear and socks, and place them in the appropriate containers.

2. Proceed to the washing area. You should spend at least 5 minutes soaping, scrubbing, and rinsing. Give special attention to the hair, nails, skin creases, and ears, using a brush on the nails. You should rinse, soap, and scrub; then rinse again.

3. Proceed to the dressing area and dry off. (If nuclear contamination is involved, you will be monitored and required to repeat the shower until you are free of contamination.) Dress in clean clothing and proceed as directed.

Remember that showering doesn't destroy nuclear agents or many of the BW agents—it merely washes them away. Therefore, you should immediately report any illness (however minor) to medical personnel.

Student Notes:

M291 Decontamination Kit. The purpose of the M291 decontamination kit is to decontaminate skin and selected personnel equipment contaminated with chemical agents. The kit contains six sealed foil packets, enough for three complete skin applications.

Each packet contains a folded applicator pad with a handle on one side. The pad is filled with the black decontaminating powder, which is a reactive and absorbent resin that is not toxic but may be slightly irritating to the skin or eyes.

New and/or improved CBR defense and decontamination kits, clothing, and equipment are being introduced rapidly. Check with your supervisor to see if any new or improved articles are available.

Atropine and oxime are used to counteract the effects of and to relieve the symptoms of nerve agents only. At the appropriate level of readiness, each crew member will be issued three atropine autoinjectors and two oxime autoinjectors. To use the injectors, remove the safety caps and press the injectors against the thigh or buttocks. The pressure on the end of the injector causes the automatic injection of the contents. As soon as the symptoms of nerve agent poisoning are noticed, immediately inject one atropine autoinjector and one oxime autoinjector. Wait 10 to 15 minutes; if symptoms are still present, inject another atropine and oxime autoinjector.

CAUTION

Use atropine and oxime only against nerve agents.

THE COLLECTIVE PROTECTION SYSTEM

Learning Objective: When you finish this chapter, you will be able to—

- Identify the purpose and use of the collective protection system (CPS) decontamination station.

The collective protection system (CPS) protects specific areas of the ship from the effects of CBR contamination by filtering the air supply and maintaining an overpressure to prevent the penetration of contaminants. The system is divided into two protection zones:

1. The total protection (TP) zone, which provides a pressurized, toxic-free environment
2. The limited protection (LP) zone, which isn't pressurized and doesn't provide protection against gaseous chemical agents

The extent of CPS coverage varies. Some ships have only one or two TP zones and no LP zones. Other ships may have different numbers of protection zones. The level of protection is determined by the ship's mission, operational requirements, and the overall cost of installation. The following are the three levels of protection:

Level I—the shelter envelope. Level I provides protection for messing, berthing, sanitary, and battle dressing functions for 40% of the crew.

Level II—the minimum operational protection envelope. Level II provides at least the same protection as level I, but also includes protection for key operational functions.

Level III—the maximum operational protection envelope. Level III provides sufficient protection of the ship for mission requirements, but does not include launching aircraft or troops.

REVIEW 7 QUESTIONS

Q1. There are how many levels of decontamination?

Q2. Describe the primary purpose of level 1 decontamination.

Q3. What are the two types of contamination hazards?

a.

b.

Student Notes:

Q4. What is the most effective way to remove radioactive particles from the ship?

Q5. What is the most effective way to decontaminate areas exposed to BW agents?

Q6. Decon stations are divided into what three areas?

a.

b.

c.

SUMMARY

In this chapter, you have learned about CBR defense. During a major conflict, an enemy who uses weapons of mass destruction will find a way to get these weapons through our defenses. The U.S. Navy has spent many years and a considerable amount of money developing protective systems, equipment, and measuring devices that are available to us today. These systems give us the ability to defend ourselves and our units against CBR attacks and the ability to continue as a combat-capable force. These systems, devices, and equipment will work if used properly and at the right time. The continued training on procedures, techniques, systems, and equipment will ensure the maximum protection available.

REVIEW 1 ANSWERS

A1. **Weapons of mass destruction** are weapons that can be used to destroy large areas or kill and disable large segments of a population.

A2. The most probable delivery method for chemical or biological weapons is by **aerosol**.

A3. The two types of antipersonnel agents are—

a. **Casualty**

b. **Incapacitating**

A4. The use of nerve agents produces symptoms that are similar to **heat stress**, which is a more common condition.

A5. **Moist areas** of the body are most affected by blister agents.

A6. The first action you should take if exposed to a blood agent, is to **don (put on) a protective mask**.

A7. True**, cough suppressant and pain relievers can be given to a victim of a choking agent.**

REVIEW 2 ANSWERS

A1. BW is the intentional use of (a) **living organisms, toxins, and microtoxins** to disable or destroy (b) **people, domestic animals, crops, or supplies**.

A2. The disadvantage an enemy has when using BW agents is that **BW agents degrade rapidly when exposed to environmental conditions such as ultraviolet light, radiation, heat, dryness, or humidity**.

A3. The symptoms of biological disease in its early stages include—

a. **Fever**

b. **Malaise**

c. **Inflammation**

REVIEW 3 ANSWERS

A1. The four types of nuclear weapon explosion classification are—

a. **High altitude blast**

b. **Air blast**

c. **Surface blast**

Student Notes:

d. **Subsurface burst**

A2. Residual radiation is more dangerous than initial radiation because **residual radiation is caused by large amounts of surface material drawn up into the cloud, which falls back to earth as radioactive fallout and affects a large area**.

A3. A secondary blast can cause injuries by **its strong winds that collapse structures and trees**.

A4. Nuclear radiation hazards include—

a. **Alpha particles**

b. **Beta particles**

c. **Gamma rays**

d. **Neutrons**

A5. The measures that should be taken to protect electronic equipment from the effects of EMP are—

a. **Metal shielding**

b. **Good grounding**

c. **Surge arresters**

d. **Proper arrangement of electrical wiring**

REVIEW 4 ANSWERS

A1. A survey team consists of a—

a. **Monitor**, a

b. **Recorder**, and a

c. **Messenger**

A2. The two types of surveys include—

a. **Rapid** and

b. **Detailed**

A3. Biological markers are (a) **blue** and have (b) a **red inscription**.

A4. To calculate safe entry time and stay time in a radiologically contaminated area, you need to know the—

a. **Dose rate**

b. **Dose**

A5. The only known method for detecting BW contaminants is **to gather samples and ship them to a laboratory**.

A6. To check areas suspected of being contaminated by CW agents, you should use an **M256A1 kit**.

REVIEW 5 ANSWERS

A1. **False**, eating food after a CBR attack is **not** okay.

A2. Aboard ship, the safest place to be during a nuclear attack is **below the main deck.**

A3. The two functions of an MCU-2/P mask are to—

a. **Filter air**

b. **Purify**

A4. It should take you **10 seconds** to don and adjust an MCU-2/P mask.

A5. The types of clothing that are useful for CBR defense are—

a. **Wet-weather clothes**

b. **Ordinary work clothes**

REVIEW 6 ANSWERS

A1. The acronym MOPP stands for **Mission Oriented Protective Posture**.

A2. There are **four** MOPP levels.

A3. **MOPP level 4** provides the most protection.

A4. At **MOPP level 2** material condition ZEBRA (modified) is set.

REVIEW 7 ANSWERS

A1. There are **four levels** of decontamination.

A2. The primary purpose of level 1 decontamination is t**o safeguard you in protective gear that includes mask, overgarment, boots, and gloves.**

A3. The two types of contamination hazards are—

a. **Pick up hazards**

b. **Transfer hazards**

A4. **Washdown** is the most effective way to remove radioactive particles from the ship.

A5. Chemical disinfectant **is the most effective way to decontaminate areas exposed to BW agents.**

A6. Decon stations are divided into an—

a. **Unclean area**, a

b. **Washing area**, and a

c. **Clean area**