U.S. ARMY SERGEANTS MAJOR ACADEMY (BNCOC)

W324/ LEADER'S RESPONSIBILITIES IN A CHEMICAL ENVIRONMENT — OCT 04

BNCOC

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TRAINING SUPPORT PACKAGE (TSP)

TSP Number / Title	W324 / LEADER'S RESPONSIBILITIES IN A CHEMICAL ENVIRONMENT
Effective Date	1 Oct 2004
Supersedes TSP(s) / Lesson(s)	W324, NBC Operations, dated, Oct 03
TSP Users	The following course uses this TSP: 600-BNCOC Basic Noncommissioned Officer Course
Proponent	The proponent for this document is the Sergeants Major Academy.
Improvement Comments	Users are invited to send comments and suggested improvements on DA Form 2028, *Recommended Changes to Publications and Blank Forms.* Completed forms, or equivalent response, will be mailed or attached to electronic e-mail and transmitted to: COMDT USASMA ATTN ATSS DC BLDG 11291 BIGGS FIELD FT BLISS TX 79918-8002 Telephone (COMM) (915) 568-8875 Telephone (DSN) 978-8875 E-mail atss-dcd@bliss.army.mil
Security Clearance / Access	Unclassified
Foreign Disclosure Restrictions	FD5. This product/publication has been reviewed by the product developers in coordination with the USASMA foreign disclosure authority. This product is releasable to students from all requesting foreign countries without restrictions.

PREFACE

Purpose

This Training Support Package provides the instructor with a standardized lesson plan for presenting instruction for:

Task Number	Task Title
Individual	
031-503-1007	Decontaminate Your Skin And Personal Equipment Using An M258a1 Decontamination Kit
031-503-1015	Protect Yourself From NBC Injury/Contamination With Mission-Oriented Protective Posture (MOPP)
031-503-1018	React To A Nuclear Hazard
031-503-1019	React To Chemical Or Biological Hazard/Attack
031-503-2001	Use M256 Or M256A1 Chemical Agent Kit
031-503-4002	Supervise Unit Preparation For NBC Attack
031-503-4003	Control Unit Radiation Exposure
031-510-4001	Conduct Operations In An NBC Environment

This TSP Contains

TABLE OF CONTENTS

LEADER'S RESPONSIBILITIES IN A CHEMICAL ENVIRONMENT
W324 / Version 1
1 Oct 2004

SECTION I. ADMINISTRATIVE DATA

All Courses Including This Lesson	**Course Number**	**Version**	**Course Title**
	600-BNCOC	1	Basic Noncommissioned Officer's Course

Task(s) Taught(*) or Supported	**Task Number**	**Task Title**
	Individual	
	031-503-1007 (*)	Decontaminate Your Skin And Personal Equipment Using An M258a1 Decontamination Kit
	031-503-1015 (*)	Protect Yourself From NBC Injury/Contamination With Mission-Oriented Protective Posture (MOPP)
	031-503-1018 (*)	React To A Nuclear Hazard
	031-503-1019 (*)	React To Chemical Or Biological Hazard/Attack
	031-503-2001 (*)	Use M256 Or M256A1 Chemical Agent Kit
	031-503-4002 (*)	Supervise Unit Preparation For NBC Attack
	031-503-4003 (*)	Control Unit Radiation Exposure
	031-510-4001 (*)	Conduct Operations In An NBC Environment

Reinforced Task(s)	**Task Number**	**Task Title**
	031-503-4002	Supervise Unit Preparation For NBC Attack
	031-503-4003	Control Unit Radiation Exposure

Academic Hours

The academic hours required to teach this lesson are as follows:

	Resident Hours/Methods
	2 hr / Conference / Discussion
Test	0 hrs
Test Review	0 hrs
Total Hours:	2 hrs

Test Lesson Number

	Hours	**Lesson No.**
Testing (to include test review)	3 Hrs	E303

Prerequisite Lesson(s)

Lesson Number **Lesson Title**

None

Clearance Access

Security Level: Unclassified
Requirements: There are no clearance or access requirements for the lesson.

Foreign Disclosure Restrictions

FD5. This product/publication has been reviewed by the product developers in coordination with the USASMA foreign disclosure authority. This product is releasable to students from all requesting foreign countries without restrictions.

References

Number	Title	Date	Additional Information
FM 25-51	Battalion Task Force Nuclear Training	16 Jun 1991	Jun 91 Chapter 2
FM 3-11.4	Multiservice Tactics, Techniques, and Procedures for Nuclear, Biological, and Chemical (NBC) Protection	June 2003	
FM 3-3	Chemical and Biological Contamination Avoidance [FMFM 11-17] This Item is Included on EM 0019	16 Nov 1992	Change 1, 29 Sep 94

Student Study Assignments

Before class--

- Read Student Handout 1.
- Read FM 3-3, Chemical and Biological Contamination Avoidance, Chapter 3, pages 3-0 and 3-1 and Chapter 4, pages 4-0 thru 4-9 (SH-2).
- Read FM 3-11.4, Multiservice Tactics, Techniques, and Procedures for Nuclear, Biological, and Chemical (NBC) Protection, Chapter II (SH-3).
- Read FM 25-51, Battalion Task Force Nuclear Training, Chapter 2 (SH-4).

During class--

- Participate in the class discussion.

After class--

- Turn in recoverable references after the examination.

Instructor Requirements

1:16, SFC, BNCOC graduate, ITC, and SGITC qualified

Additional Support Personnel Requirements

Name	Stu Ratio	Qty	Man Hours
None			

Equipment Required for Instruction

ID Name	Stu Ratio	Instr Ratio	Spt	Qty	Exp
559359 SCREEN PROJECTION	1:16	1:1	No	1	No
673000T101700 PROJECTOR, OVERHEAD	1:16	1:1	No	1	No
702101T134520 DEL CPU, MONITOR, MOUSE, KEYBOARD	1:16	1:1	No	1	No
7110-00-T81-1805 DRY ERASE BOARD	1:16	1:1	No	1	No
SNV1240262544393 36 INCH COLOR MONITOR W/REMOTE	1:16	1:1	No	1	No
SOFTWARE-2 WINDOWS XP, LATEST GOVERNMENT APPROVED VERSION	1:16	1:1	No	1	No

* Before Id indicates a TADSS

Materials Required

Instructor Materials:

- TSP
- FM 3-3, Chemical and Biological Contamination Avoidance, FM 3-11.4, Multiservice Tactics, Techniques, and Procedures for Nuclear, Biological, and Chemical (NBC) Protection, FM 25-51 Battalion Task Force Nuclear Training (SH-2 thru SH-4).
- VGTs-

Student Materials:

- Pencils or pens and writing paper.
- Student Handouts.

Classroom, Training Area, and Range Requirements

CLASSROOM GP SMALL-GROUP INSTR 16-PN MINIMUM

Ammunition Requirements

Id	Name	Exp	Stu Ratio	Instr Ratio	Spt Qty
None					

Instructional

NOTE: Before presenting this lesson, instructors must thoroughly prepare by

Guidance

studying this lesson and identified reference material.

Before Class --

- Read and study all TSP material and be ready to conduct the class.
- This TSP has questions throughout to check on learning or generate discussion among the group members. You may add any questions you deem necessary to bring a point across to the group.
- You must know the information in this TSP well enough to teach from it.
- This TSP presents references to allow you to inform your students where they would look in the reference to follow your instruction.
- Instructor: Issue all materials NLT three days prior to class.

During class—

- Facilitate group process IAW this TSP.

After class—

- Report any lesson discrepancies to the senior instructor. Conduct an after action review for the lesson.

Proponent Lesson Plan Approvals

Name	**Rank**	**Position**	**Date**
Benjamin M. Salcido	GS-09	Training Specialist	
Phillip W. King	GS-11	Course Manager, B/ANCOC	
Agnes D. Bennett-Green	SGM	Chief, B/ANCOC	
Marion Lemon	SGM	Chief, CDDD	

SECTION II. INTRODUCTION

Method of Instruction: Conference/Discussion
Technique of Delivery: Small Group Instruction (SGI)
Instructor to Student Ratio is: 1:16
Time of Instruction: 5 mins
Media: VGT-1

Motivator **SHOW VGT-1, NBC OPERATIONS**

Understanding the fundamentals of NBC defense is crucial to survival on today's battlefield. According to Army doctrine, you can expect the enemy to use NBC weapons/agents across vast areas of the battlefield. The number of casualties suffered will depend on how well you train your soldiers. It is the squad/section leader's responsibility to train those critical NBC tasks necessary for his troops to know and recognize the varied characteristics and effects of NBC weapons. This lesson will provide the basic knowledge needed to help you protect and defend your soldiers before, during, and after an NBC attack.

Terminal Learning Objective

NOTE: Inform the students of the following Terminal Learning Objective requirements.

At the completion of this lesson, you [the student] will:

Action:	Direct the actions necessary to function in a Nuclear, Biological and Chemical (NBC) environment on the battlefield.
Conditions:	As a small unit leader in a company or battalion level unit.
Standards:	Identified the basic characteristics, effects, and actions necessary to function in a Nuclear, Biological, and Chemical (NBC) environment on the battlefield IAW FM 25-51, FM 3-3, FM 3-11.4.

Safety Requirements

None

Risk Assessment Level

Low

Environmental Considerations

NOTE: It is the responsibility of all soldiers and DA civilians to protect the environment from damage.

None

Evaluation

During this course, you will take a 50-question examination. The examination will include questions on the ELOs and TLO from this lesson. You must correctly answer at least 35 questions to receive a GO. A GO is a graduation requirement.

Instructional Lead-In

Even though the U.S. Armed Forces have no recent real life experiences of NBC warfare on the battlefield, we as leaders are still responsible for training our soldiers on those NBC skills necessary to fight and win future battles. The United States may use nuclear weapons first to terminate a conflict at the lowest level of hostility and to warn other nations that they cannot attack us with conventional weapons without risking nuclear war. On the battlefield it is too late to train; we must teach these skills in peacetime.

REMOVE VGT-1

SECTION III. PRESENTATION

NOTE: Inform the students of the Enabling Learning Objective requirements.

A. ENABLING LEARNING OBJECTIVE

ACTION:	Describe the basic effects of a nuclear detonation.
CONDITIONS:	As a squad leader in a classroom environment, given class notes and access to FM 25-51.
STANDARDS:	Explained the five effects of nuclear detonation: • Psychological • Nuclear Radiation • Electromagnetic Pulse (EMP) • Blast • Thermal IAW FM 25-51.

1. Learning Step / Activity 1. Describe the basic effects of a nuclear detonation.
Method of Instruction: Conference/Discussion
Technique of Delivery: Small Group Instruction (SGI)
Instructor to Student Ratio: 1:16
Time of Instruction: 20 mins
Media: VGT-2 thru VGT-4

Nuclear Detonation

Popularized versions of the “Holocausts” at Hiroshima and Nagasaki in August 1945 usually distort perceptions of conventional-nuclear combat. Certainly, those two bombs demonstrated explosive combat power that was several orders of magnitude more potent than any other weapon then known. However, the incendiary bombing of Tokyo in March 1945 had created a holocaust that lasted for two days, took more lives, and destroyed a larger area than either of the first atomic bombs. Most of the current nuclear weapons used for battlefield nuclear fire support are smaller than the Hiroshima or Nagasaki bombs. Although many may have yields as small as 1/10th to 1/100th the size of the first nuclear weapons used, they are still many times more powerful than most conventional munitions. Nevertheless, their effects on the battlefield are finite and limited to tactical distances from a few hundred meters (m) to a few kilometers (km). The Army has classified the actual yields of nuclear weapons currently in the field. Consequently, there are only four hypothetical yields, namely 2 kilotons, 5 kilotons, 10 kilotons, and 20 kilotons.

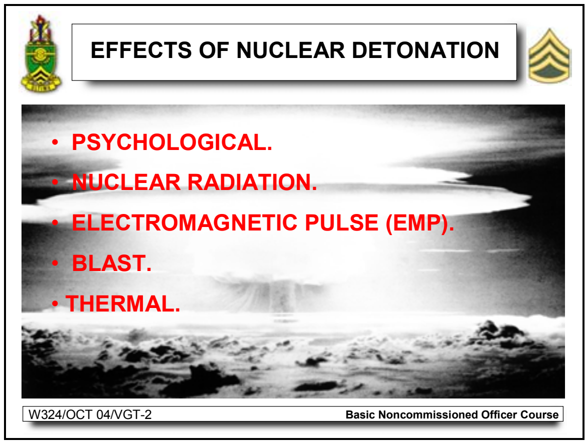
Effects

QUESTION: What are the five effects of a nuclear detonation?

NOTE: Allow the students to respond, and then provide the following answer.

ANSWER: See VGT-2.

SHOW VGT-2, EFFECTS OF NUCLEAR DETONATION



Ref: FM 25-51, page 2-1 (SH-4)

Effects produced by a nuclear blast are of the utmost concern. The degree of hazard from physical effects of nuclear radiation, electromagnetic pulse (EMP), blast, and thermal radiation depends on the type of weapon, the yield, the height of burst (HOB), and the distance between the point of detonation and the target. We also need to consider the environment in which the weapon detonates and the vulnerability of the target. Nuclear weapons may detonate in the air, on the surface, or beneath the surface. Each type of detonation produces a different result.

Psychological Effect

The most forgotten effect when talking about nuclear weapons is the psychological effect on soldiers. We call this effect "acute combat reaction" or "stress." In cases of severe stress, a psychological abnormality occurs. This abnormality occurs when an individual cannot cope with the danger presented by the environment. Fear develops and the soldier may become ineffective. You must understand that this is a natural reaction seen in various disastrous situations. Soldiers may display characteristic disturbances, such as stunned mute behavior, uncontrolled fright, tearful helplessness, apathetic depressed state, and increased tension.

These disturbances can last for minutes, hours, days, or sometimes weeks. Fortunately, most people have milder or shorter reactions of these types. The frequency and severity of the psychological disturbances vary with several factors. Some factors are intensity and severity of stress, degree of personal involvement, degree of training, degree of warning, presence or absence of leadership, and group identification. You as leaders must be aware of the psychological effects of nuclear battle, and take steps to reduce the effects on your soldiers.

Nuclear Radiation

We separate nuclear radiation into initial and residual radiation. Initial radiation occurs within the first minute after the detonation. Residual radiation occurs in the form of fallout or radioactive dirt and dust that falls back to the ground in a plume pattern. Nuclear radiation is difficult to defend against and has far-reaching effects. Nuclear radiation causes cell and tissue damage, which we know as radiation sickness. Symptoms of radiation sickness are headaches, nausea, vomiting, fever, fatigue, and diarrhea. Prolonged exposure may even cause death, depending on the concentration of radiation and proximity to the explosion. Residual contamination effects produce casualties in much the same way as initial radiation except that it may take longer to build up the required dosage. Radiological contamination occurs when dirt and debris drawn into the center of the explosion become radioactive. The radioactive debris, transported downwind as a cloud, gradually falls back to earth as fallout. Induced radiation occurs around ground zero. This area receives such a powerful dose of initial radiation that it remains a significant military hazard for 2 to 5 days after the blast. Some hazards remain for a longer period. It is dangerous to cross such an area or remain in it while it is radioactive. This may seriously alter the operational plans in the immediate battle area.

Electromagnetic Pulse

Electromagnetic pulse (EMP) adversely affects electronic equipment. Items like radios, generators, computerized firing systems, and aircraft and missile components may become inoperable. This cause’s unit performance degradation as a result of equipment failure or loss. Tests have shown that we will use radios twice as often and transmissions will be almost half again longer when operating in an NBC environment. Plan and prepare back up systems (i.e. wire and runners) for critical communications in advance.

Blast

The blast from a nuclear burst overturns and crushes equipment, collapses lungs, ruptures eardrums, throws debris and personnel, and collapses positions and structures.

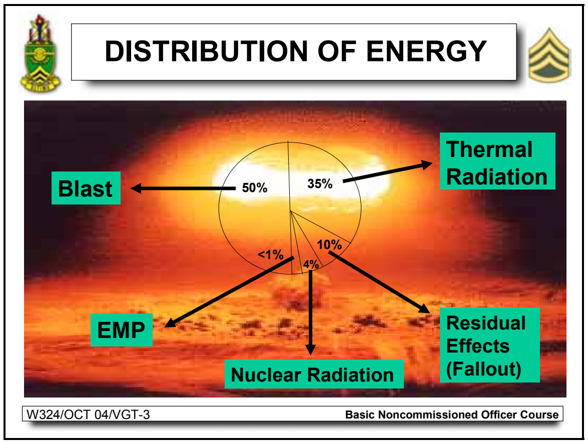
Thermal

Thermal radiation travels in a straight line at the speed of light, but has little penetrating power. The light can cause temporary blindness (dazzle) or permanent eye damage. The blinding effect is greater at night because your eyes adjust to the darkness. The heat can cause skin burns and start fires in wooded or built-up areas at considerable distances from the burst. Because thermal radiation travels at the speed of light, there is practically no time to seek protection. Generally, smoke or fog, thin clothing, terrain, vegetation, and shelter will protect the individual from thermal radiation.

REMOVE VGT-2

Distribution

SHOW VGT-3, DISTRIBUTION OF ENERGY



Ref: FM 25-51, page 2-2 (SH-4).

NOTE: Point out the effects or distribution of energy produced by a nuclear detonation, i.e., blast 50 percent, thermal radiation 35 percent, etc.

REMOVE VGT-3

Results

NOTE: Point out the effects of the different types of bursts. Ensure students understand that blast, thermal, nuclear radiation, and EMP are the results of an air, surface, or subsurface burst. Discuss which factor might have the greatest effect on a soldier.

SHOW VGT-4, RESULTS OF DETONATION TYPES

RESULTS OF DETONATION TYPES

TYPE BLAST	BLAST	THERMAL	NUCLEAR RADIATION	EMP
AIR	GREAT AND WIDESPREAD	GREAT AND WIDESPREAD	CONSIDERABLE PROMPT RADIATION. NO SIGNIFICANT RESIDUAL RADIATION EXCEPT FOR SMALL AREAS UNDER BLAST	EFFECTS 3 TO 9 MILES FROM GZ UP TO ALTITUDES OF 19 MILES. GREAT AND WIDESPREAD FOR BURST ABOVE 19 MILES
SURFACE	GREAT BUT RADIUS OF EFFECT SOMEWHAT REDUCED	GREAT BUT NOT WIDESPREAD	GREAT, PROMPT, BUT NOT WIDESPREAD. RESIDUAL RADIATION WILL APPEAR AS FALLOUT.	EXTENDS OUTWARD 3 TO 5 MILES FROM GZ
SUBSURFACE	GREAT BUT RADIUS OF EFFECTS GREATLY REDUCED	NEGLIGIBLE	LITTLE OR INSTANT RADIATION GREAT AMOUNT OF RESIDUAL FALLOUT	LIMITED TO AREA AROUND GZ

W324/OCT 04/VGT-4 Basic Noncommissioned Officer Course

Ref: FM 25-51, page 2-2 (SH-2-4)

Airburst

We can control the effects of a nuclear explosion to a great extent by varying the height of the burst. The detonation of a nuclear weapon at such a height that the fireball doesn't touch the surface of the earth is an airburst. An airburst increases blast, thermal radiation, and initial radiation effects. Fallout of radioactive material from an airburst is not significant unless rain or snow falls through the radioactive cloud and brings the material to earth. Except for very high airbursts, neutron-induced radiation in the area of ground zero will be of concern to both mounted and dismounted personnel required to go into or across the area.

Surface Burst

The detonation of a nuclear weapon at such a height that the fireball touches the surface of the earth or water is a surface burst. Blast, thermal radiation, and initial nuclear radiation are not as widespread as from an airburst. The fallout produced by a surface burst is, by far, it's most dangerous effect, in that it can cover thousands of square kilometers with high levels of radioactivity.

Subsurface Burst

The detonation of a nuclear weapon so that the center of the fireball is beneath the surface of the earth or water is a subsurface burst. If the fireball of this type of burst breaks through the surface, it produces fallout. Thermal radiation is not a significant hazard since the soil almost completely absorbs it. It also significantly reduces blast effects, but waves passing though the ground or water extend for a limited distance. The range of the initial nuclear radiation will be considerably less than from either of the other two types of bursts because the soil also absorbs, to a great extent, the radiation. However, extremely hazardous residual radiation occurs in and around any crater. Soldiers can survive nuclear attacks by taking cover to shield themselves against the initial effects of the nuclear explosion.

REMOVE VGT-4

With small-yield tactical nuclear weapons there will be comparatively large numbers of casualties due to initial radiation, possibly combined with the effects of blast. Burn injuries will become more common as the weapon yield increases. We normally limit first aid measures to those with burns caused by thermal radiation and injuries caused by the blast wave. There are no immediate life-saving measures for the treatment of radiation sickness or blindness caused by the intense light.

CHECK ON LEARNING:

QUESTION: What are the three types of nuclear blasts?

ANSWER: Air, surface, and subsurface.

Ref: FM 25-51, page 2-2 (SH-4)

QUESTION: What are the effects of a nuclear detonation?

ANSWER: Psychological, nuclear radiation, electromagnetic pulse (EMP) blast, and thermal.

Ref: FM 25-51, page 2-1 (SH-4)

QUESTION: What are the two types of nuclear radiation?

ANSWER: Initial and residual.

Ref: FM 25-51, page 2-4 (SH-4)

B. ENABLING LEARNING OBJECTIVE

ACTION:	Describe the categories of a biological weapon and avoidance procedures.
CONDITIONS:	As a squad leader in a classroom environment, given class notes and access to FM 25-51, FM 3-11.4, and FM 3-3.
STANDARDS:	Explained the categories of a biological weapon and avoidance procedures IAW FM 3-3, Chap 4 and FM 25-51, Chap 2. • Identified two categories of biological agents. • Identified three methods of disseminating biological agents. • Identified Aerosol, Vectors, and Covert avoidance procedures IAW FM 3-3, Chap 4 and FM 25-51, Chap 2.

1. Learning Step / Activity 1. Describe the categories of a biological weapon and avoidance procedures.

Method of Instruction: Conference/Discussion
Technique of Delivery: Small Group Instruction (SGI)
Instructor to Student Ratio: 1:16
Time of Instruction: 20 min
Media: VGT-5

Biological Weapons

Now let's discuss biological weapons and their effects. U.S. policy states that we will never use biological agents under any circumstances. All nations do not share this view. Some countries used biological agents in past wars, and their use changed the outcome of battles, wars, and even history. Because biological agents are easy and cheap to produce and can cause more casualties than chemical or nuclear weapons, we can expect countries to use biological agents in an all out conflict. To meet this threat, you must know the effects, characteristics, and most likely means of employment of biological agents so you can defend yourself and continue your mission.

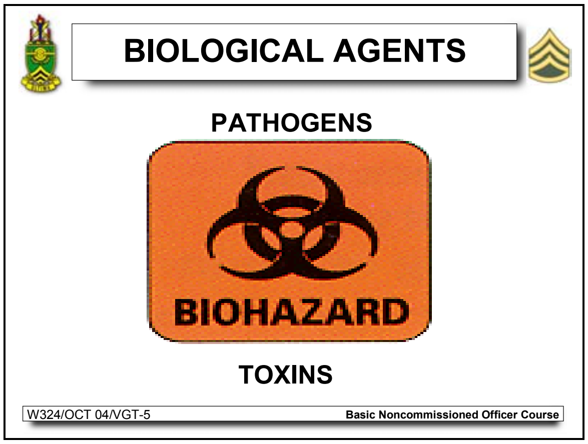
QUESTION: What are two broad categories of biological agents?

NOTE: Allow the students to discuss their answers and then provide the following answer.

ANSWER: See VGT-5.

Ref: FM 3-3, p 4-0 (SH-2)

SHOW VGT-5, BIOLOGICAL AGENTS



QUESTION: What are pathogens?

NOTE: Allow several students to respond.

ANSWER: Pathogens are infectious agents that cause disease in man, animals, or plants.

Ref: FM 3-3, page 4-0 (SH-2)

A pathogen is a germ that enters the body through the lungs, digestive tract, skin, and mucous membrane openings. Countries will most likely use pathogens (germs) as biological weapons. These germs are alive and enter the body to cause disease. Pathogens take time to enter the body and multiply in sufficient quantities to overcome the body's defenses, so symptoms may not appear for hours or even months. The fact that germs can cause some disease that may spread from one person to another to produce mass casualties, makes pathogen warfare extremely effective and very hard to defend against. The effects of germ infection may be different from person to person. Some soldiers may die quickly while others may become ill with vomiting, diarrhea, fever, and chills or go into a coma or have convulsions. Some may show no symptoms at all. Germs die in hours or days. Some decreasing effects are wind, rain, and dust. Sunlight rapidly destroys germs. The best defense against pathogens are strong body defenses and weather. The enemy will most likely employ biological agents in our support area. By infecting support personnel, the enemy severely lessens our ability to provide support to combat units.

REMOVE VGT-5

QUESTION: What are toxins?

NOTE: Allow several students to respond.

ANSWER: Toxins are poisonous substances produced as by-product of microorganisms (the pathogens), plants, and animals. These toxins exert their lethal or incapacitating effects.

Ref: FM 3-3, page 4-0 (SH-2)

The advantage of using toxins is that the enemy can control their spread and use them without fear of harming their own soldiers. Since there is no field monitoring device to detect toxins, the only way to recognize the use of toxins is by the method of delivery and the symptoms. Administering first aid for toxins is extremely difficult because the symptoms are similar to those of chemical agents and pathogen biological agents. The fact that toxins are difficult to detect or identify and are more deadly makes their employment on the battlefield a good possibility. There are two types of toxins which you may encounter on the battlefield.

QUESTION: What are the names of these two types of toxins?

NOTE: Allow several students to respond.

ANSWER: Neurotoxins and cytotoxins.

Ref: FM 3-3, page 4-0 (SH-2)

Neurotoxins disrupt nerve impulses, tend to be quick acting, and produce nerve agent-like symptoms in seconds to hours.

QUESTION: What are some symptoms of neurotoxin poisoning?

NOTE: Allow several students to respond.

ANSWER: Mental confusion, loss of balance, and vision problems, limp paralysis, or convulsive-type seizures.

Ref: FM 3-3, page 4-0 (SH-2)

Cytotoxins are slower acting than the neurotoxins and produce choking, blistering, or even radiation-like symptoms in a period of hours to days. These symptoms vary from skin lesions such as blisters, to vomiting, diarrhea, coughing, and choking. You may have heard the term “yellow rain.” Yellow rain was a cytotoxin used in Southeast Asia and Afghanistan in the 1970s and 1980s.

NOTE: Ask the students if there are any questions pertaining to the types of toxins; provide answers if necessary.

You as a leader must know the dissemination techniques and avoidance procedures to protect your soldiers and yourself from a biological agent hazard. The method used to disseminate biological agents directly affects the defensive measures you must take to protect yourself from these agents. Only after you identify the agent can you begin the specific defenses. There are three methods of disseminating biological agents.

QUESTION: What are the three methods of disseminating biological agents?

NOTE: Allow several students to respond.

ANSWER: Aerosol, vectors, and covert.

Ref: FM 3-3, page 4-5 (SH-2)

Attacks using aerosol methods include ground or airbursting munitions, aircraft spray tanks, or ground-level aerosol generators. The enemy may deliver some pathogens by use of arthropods and other vectors such as fleas, ticks, lice, and mosquitoes. The enemy may also use bulk container aircraft dissemination or small cage vector bomblets. The attack will most likely occur in a covert (hidden) manner. Covert dissemination produces greater effects, simply due to lack of warning. It can involve terrorist personnel targeting specific areas. The enemy could target large open areas, using aerosol generators, or enclosed areas such as command and control facilities, aircraft, billets, or other similar type areas. Biological agents could be in the form of liquids, powders, or sprays. Food harvests, processing, distribution, and preparation facilities are prime targets as well as water treatment facilities and reservoirs.

Aerosol Avoidance Procedures

Let's now look at the aerosol avoidance procedures for before, during, and after a biological agent attack.

NOTE: Refer the students to pages 4-7 and 4-8 in FM 3-3 (SH-2) and read one or two bullets from the before, during, and after section of the aerosol avoidance procedures.

Before the attack--

- Establish and enforce preventive medicine programs to include immunizations, area sanitation, personal hygiene standards, rest, and nutritional needs of the troops.
- Gain intelligence on threat capabilities and intentions. Seek out, intercept, and destroy enemy weapon systems, production facilities, and storage sites.
- Instruct troops on the threat, recognition of the attack, and protective measures.

- Train and drill on fitting and putting on protective mask and clothing.
- Set up collective protection systems for personnel, equipment, and supplies. (NOTE: Field expedient collective protection must be airtight.)
- Identify backup (alternate) food, water, and supply sources.
- Establish detection and sampling procedures.
- Conduct vulnerability analysis.

During the attack--

- Recognize the attack.
- Initiate personnel protective measures. Masking is the first priority, but since the attack may be chemical or toxin, initially it may require MOPP 4. For maximum protection and the lowest risk of incurring casualties, soldiers should wear protective clothing and mask for at least 4 hours after an attack on the unit, or you predict/know the agent cloud to have passed through your unit area. Make every effort to identify the exact agent, including its characteristics. Remove contamination from skin immediately with large amounts of warm soapy water (if available) and decontaminate the skin with the M258A1 kit or M291 kit.
- Repulse or eliminate delivery vehicle or weapons.
- Observe for distinguishing signs between biological and chemical agent attack and a mixture of conventional and biological attack.
- Report the attack utilizing the NBC Warning and Reporting System (NBCWRS). (If you cannot immediately identify a biological attack as an NBC 1, report it agent unknown, or Suspected Biological Report).

After the attack--

- Estimate the downwind hazard (significant casualties in unprotected personnel can be at least two times the maximum downwind hazard distance for a chemical agent).
- Begin sampling/collection procedures IAW unit SOP.
- Consume only sealed rations and properly contained water (decontaminate all outer container surfaces, if exposed). Call preventive medicine personnel when safety of unit level water supplies is questionable. Ensure veterinary personnel inspect food storage depots and supply points. Replenish water supplies from water purification units.
- Separate biological casualties. Use minimum number of personnel (to limit exposure) to provide supportive medical care until evacuation.

NOTE: Ask the students if there are any questions pertaining to aerosol avoidance procedures. Provide answers if necessary.

Vector Avoidance Procedures

Let’s now look at the vector avoidance procedures before, during, and after a biological agent attack.

NOTE: Refer the students to pages 4-8 and 4-9 in FM 3-3 (SH-2) and read one or two bullets from the before, during and after section of the vector avoidance procedures.

Before the attack--

- Apply insect repellent on exposed skin.
- Gain intelligence on threat capabilities and intentions.
- Seek out, intercept, and destroy enemy weapon systems and production and storage sites.
- Instruct troops on the threat, recognition of the attack, and protective measures.
- Establish and enforce preventive medicine programs to include immunizations, area sanitation, personal hygiene standards, rest, and nutritional needs of the troops.

During the attack--

- Recognize and report suspicious indications of the vector attack (the sudden appearance of large numbers or strange kinds of insects not previously encountered in an operational area or the finding of vector bomblet cages).
- Cover exposed skin. Balance between protection and degradation of performance. Protective over garments will not totally exclude the determined tick. Bloused trousers and rolled down and buttoned sleeves with insect repellent properly applied will probably afford as much protection with less degradation.
- Apply insect repellent liberally-especially to neck, face, ankle, and wrist areas.
- Report the attack.

After the attack--

- The nuclear, biological, and chemical center (NBCC) should coordinate with the supporting medical authority for preventive medicine assistance.
- Begin insecticide and other pest control measures as outlined by preventive medicine personnel. Logistical support for unit-size pest control procedures should be a coordinated effort between the NBCC and the supporting medical authority. Physically remove body lice, ticks, and fleas by self-aid and buddy aid as necessary.
- Make hazard estimates. Recon and medical reports may help the NBCC in assessing hazard areas.

NOTE: Ask the students if there are any questions pertaining to vector avoidance procedures, provide answers if necessary.

Covert Avoidance Procedures

Let's look at the covert avoidance procedures for before, during, and after a biological agent attack.

NOTE: Refer the students to pages 4-9 in FM 3-3 and read one or two bullets from the before, during, and after section of the covert avoidance procedures.

Before the attack--

- Maintain operational security (OPSEC).
- Identify covert/sabotage threat force capabilities and intentions through intelligence.
- Arrange to take security measures based upon threat assessment.
- Identify alternate supply sources for those high-risk items.
- Instruct troops to be alert to dissemination devices or signs of covert tampering as intelligence dictates.

- Establish and enforce preventive medicine programs to include immunizations, area sanitation, personal hygiene standards, and rest and nutrition needs of the troops.

NOTE: Based on intelligence, protection of food and water may prevent successful employment of a specific biological agent.

During the attack--

- Report the observation of an attack, the apprehension of enemy agent(s) engaged in such activity, or the finding of signs and indications of covert attacks.
- Initiate personnel and collective protection. For maximum protection and the lowest risk of incurring casualties, soldiers should maintain this protective posture for at least 4 hours.

After the attack--

- Warn personnel downstream, downwind, and/or down supply lines. The NBCC will do so based on at-hand medical and intelligence information and analysis of NBC 1 Reports.
- In conjunction with the veterinary and surgeon general, initiate disposal and replacement of food, water, and other supplies. The NBCC can coordinate inspections and medically approved replenishment sources. Actions involving disposal of major quantities of food must be coordinated with the supporting veterinary personnel. Actions involving disposal of major quantities of other non-medical supplies should be coordinated with the NBCC.
- Initiate sampling based on knowledge, consent, and special sampling requirements of the NBCC. If you suspect a biological weapon attack, wash surfaces with at least a 5 percent solution of bleach. Bleach is a very effective form of decontamination for most BW agents.

NOTE: Ask the students if there are any questions pertaining to convert avoidance procedures. Provide answers if necessary.

CHECK ON LEARNING:

QUESTION: What are the three method of disseminating biological agents?

ANSWER: Aerosol, vectors, and covert.

Ref: FM 3-3, page 4-5 (SH-2)

QUESTION: What are pathogens?

ANSWER: Pathogens are an infectious agents that cause disease in man, animals, or plants.

Ref: FM 3-3, page 4-0 (SH-2)

QUESTION: What are the names of the two types of toxins?

ANSWER: Neurotoxins and cytotoxins.

Ref: FM 3-3, page 4-0 (SH-2)

Break: 00:50 to 01:00

C. ENABLING LEARNING OBJECTIVE

ACTION:	Describe the categories of a chemical weapon.
CONDITIONS:	As a squad leader in a classroom environment, given class notes, and access to FM 25-51, FM 3-11.4, and FM 3-3.
STANDARDS:	Explained the categories of a chemical weapon IAW FM 3-3, chap 3.

1. Learning Step / Activity 1. Describe the categories of a chemical weapon.

Method of Instruction: Conference/Discussion
Technique of Delivery: Small Group Instruction (SGI)
Instructor to Student Ratio: 1:16
Time of Instruction: 20 mins
Media: VGT-6

Chemical Weapons

Now let's turn our attention to the types, characteristics, and effects of chemical agents. Numerous threat forces in the world today have the equipment, organization, and training to conduct chemical operations. You can expect them to use chemical agents as part of their conventional fighting capability. The biggest threat from chemical agents is on the unprotected soldier. Soldiers in mission-oriented protective posture (MOPP) gear have a reduced ability to function normally. Practically every human function becomes much more difficult in MOPP 4. Avoidance is the best protection from chemical agents. Your knowledge of chemical warfare will greatly enhance your ability to function and survive.

Chemical Agent Categories

The classification of chemical agents depends on their physical state, physiological actions, and use. There are three categories of chemical agents when talking about how long they tend to remain in an area after employment.

QUESTION: What are the names used to classify chemical agents?

NOTE: Allow several students to respond.

ANSWER: Persistent, nonpersistent, and dusty.

Ref: FM 3-3, pages 3-0 and 3-1 (SH-2)

We suspect that threat forces stockpile persistent and nonpersistent agents. Persistent agents have the ability to cause casualties in an area of operation for long periods of time. Persistent agents produce two types of casualties, immediate and delayed. Immediate casualties occur when the soldier inhales the vapor, and delayed casualties occur as the agent enters through the skin. Non-persistent agents use blood agents at a critical moment in battle to force troops into a higher MOPP level. Enemy forces will use persistent agents to impede the use of critical terrain, channelize the attacking force, or contaminate materiel. Nonpersistent agents create casualties through the respiratory system and skin absorption.

Dusty agents are primarily mustard (HD) and nerve agent sarin (GB) impregnated onto a solid sorbent (usually on silica) and dispensed as aerosols. Your M256 chemical agent detector kit, chemical agent monitor (CAM) may detect the vapors from the solid sorbent.

NOTE: Ask the students if they have any questions pertaining to the chemical agents' classification. Clarify any misunderstandings they may have.

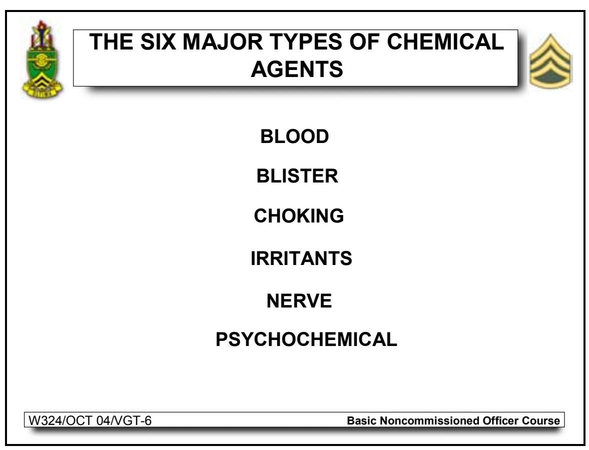
Chemical Agent Types

QUESTION: What are the six major types of chemical agents?

NOTE: Allow the students to discuss their answers and then show VGT-6.

ANSWER: See VGT-6.

SHOW VGT-6, THE SIX MAJOR TYPES OF CHEMICAL AGENTS



Ref: FM 3-3, pages 3-0 and 3-1 (SH-2)

We consider nerve, blood, and choking agents as the most lethal of the six. Blood agents can cause death within minutes. These agents are cyanide containing compounds that the body absorbs mainly by inhalation. Blood agents kill by preventing oxygen transfer from the blood to the body. Blood agents are nonpersistent, lasting from minutes to a few hours.

Blister agents cause skin irritations to severe blisters depending on the concentration and length of contact. Blister agents can damage the eyes and lungs if inhaled and can be lethal if ingested or inhaled in heavy concentrations. Blister agents are persistent and can last for days. Irritants, such as tear gas, and vomiting agents are generally not lethal, but, if used in closed-in spaces, they can produce death. These agents are nonpersistent and generally cause dysfunction by irritation.

Nerve agents can cause death within 1 to 15 minutes. These agents disrupt the function of nerves and muscles, especially the central nervous system. Nerve agents are both persistent and nonpersistent depending on the environment.

Psychochemical agents are incapacitating agents. Those agents usually cause no permanent damage. Psychochemical agents produce effects such as depression, sedation, and even morphine like effects. Some mimic schizophrenia. These agents are also nonpersistent.

REMOVE VGT-6

The detection of chemical agent contamination is the key to reduced casualties and survivability. Once units detect contamination, they can take appropriate protective measures and plan operations to minimize the effects of chemical agents.

CHECK ON LEARNING:

QUESTION: What are the three categories of chemical agents?

ANSWER: Persistent, nonpersistent, and dusty.

Ref: FM 3-3, page 3-0 (SH-2)

QUESTION: How do nonpersistent agents create casualties on the battlefield?

ANSWER: Through the respiratory system and skin absorption.

Ref: FM 3-3, page 3-0 (SH-2)

QUESTION: What are two types of casualties that persistent agents produce?

ANSWER: Immediate and delayed.

Ref: FM 3-3, page 3-0 (SH-2)

D. ENABLING LEARNING OBJECTIVE

ACTION:	Identify actions to take before, during, and after Nuclear, Biological, or Chemical (NBC) attacks.
CONDITIONS:	As a squad leader in a classroom environment, given class notes and access to FM 3-11.4.
STANDARDS:	Identified the actions and procedures taken before, during, and after NBC attacks IAW FM 3-11.4, chapter II.

1. Learning Step / Activity 1. Identify actions to take before, during, and after Nuclear, Biological, or Chemical (NBC) attacks.
Method of Instruction: Conference/Discussion
Technique of Delivery: Small Group Instruction (SGI)
Instructor to Student Ratio: 1:16
Time of Instruction: 25 mins
Media: VGT-7 and VGT-8

NBC Attacks

The next subject area we will discuss is actions to take before, during, and after an NBC attack. Enemy forces could employ NBC weapons anywhere, anytime, and on any battlefield. NBC defense applies just as much to the rear-area soldiers as it does to the soldiers on the forward lines. Preparation for an event is the key to success. There are many protective actions that units may take before, during and after an NBC attack. We will discuss some of them. You must ensure that your soldiers know how the terrain affects nuclear weapons. This will reduce the risk of your personnel becoming casualties. Slopes will deflect the nuclear effects above your personnel. Depressions and obstructions will give you some form of protection. However, if you don't know the actual point of impact, the best protection remains an area below ground with some overhead cover.

QUESTION: What is another way to attenuate (reduce) the thermal effects of a nuclear detonation?

ANSWER: Obscuration. (Fill the air with smoke)

Ref: FM 3-11.4, p II-7, para 3 (SH-3)

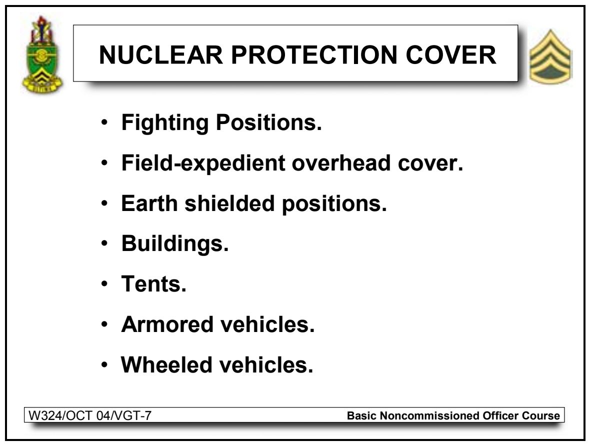
Preattack Actions

Preattack actions are critical because they will increase your unit's survivability to the greatest possible extent. You should select the right shelters, fortify those shelters, and protect vital equipment. Whenever the tactical situation permits, you must prepare defensive positions.

These will vary from individual fighting positions to improved defensive positions. These actions and good prior planning protect against nuclear effects. We will now discuss some of the objects your soldiers can use while in a nuclear protection posture.

NOTE: Select a student(s) to discuss each of the bullets on the next VGT. Allow for interaction. The students should not read the information. They should use their own explanation. Ask them how they would use each type of cover to protect them from nuclear effects.

SHOW VGT-7, NUCLEAR PROTECTION COVER



Ref: FM 3-11.4, p II-8 thru II-13 (SH-3)

REMOVE VGT-7

NBC Actions During a Nuclear Attack

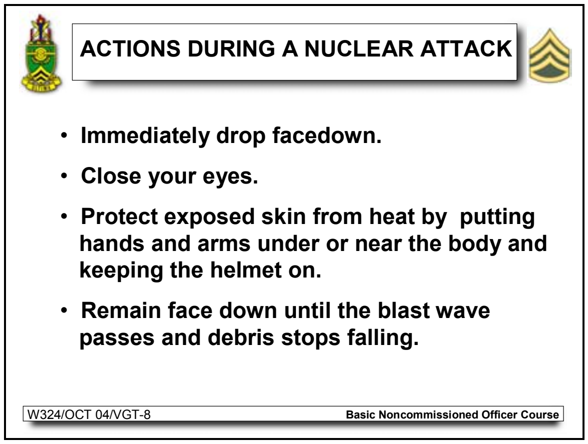
Now let's discuss what actions to take during a nuclear attack. The first indication of a nuclear attack will be a very intense light. Heat and initial radiation accompany the light and the blast follows within seconds. All of this takes place in a very short period of time, so your soldiers must automatically take required actions during a nuclear attack.

QUESTION: What immediate actions should you take during a nuclear attack to prevent as much exposure as possible/

NOTE: Allow the students to discuss their answers and then show VGT-8.

ANSWER: See VGT-8.

SHOW VGT-8*, *ACTIONS DURING A NUCLEAR ATTACK



REF: FM 3-11.4, p II-14, top of page (SH-3)

REMOVE VGT-8

You should remain calm and check for injury. Check your weapons and equipment for damage. Your soldiers can take addition precautions such as curling up on one side to protect the head and trunk. They can also seek other types of overhead protection. Try to store bulky equipment in other pits if they prevent personnel from keeping low in their positions.

If you are inside a shelter, lying facedown on the floor will offer additional protection from flying debris. Try to construct baffles or turns in shelter entrances to prevent overpressure buildups and the entry of dust and debris.

NBC Actions After a Nuclear Attack

Let's discuss what actions to take after a nuclear attack. Treat casualties caused by blast, thermal radiation, and nuclear radiation. Except for radiation casualties, treat nuclear casualties the same as conventional casualties. Wounds caused by the blast are similar to other combat wounds. Thermal burns are similar to other types of burns. First aid cannot help radiation casualties. Refer these casualties to medical facilities that can handle them.

Continue protection and resume the mission. Protection must not stop when the attack ends. Immediately after an attack, your soldiers must check for radioactive contamination, and if contaminated, they must reduce the hazard by using their basic decontamination skills. Decontamination techniques to reduce radioactive contamination are to brush, scrape, or flush radiological contamination from surfaces. As a minimum, unit personnel should seek cover in foxholes and shelters, and radiac operators should begin continuous monitoring. Covering the mouth with a handkerchief instead of wearing your protective mask reduces the contamination in the mask filter. Commanders and NBC personnel should monitor schedules for pieces of equipment having filters. Exchange the filters when possible.

NOTE: Ask the students if they have any questions pertaining to actions taken before, during, and after a nuclear attack. Clarify any misunderstandings they may have.

NBC Actions before a Biological Attack

We already discussed the biological agents. Now we will discuss what actions to take before a biological attack.

QUESTION: What are two ways to prepare before a biological attack?

NOTE: Allow the students to discuss their answers and then provide the following answer.

ANSWER: Personal health and realistic training.

Ref: FM 3-11.4, p II-16 para 4b (SH-3)

We talked about personal health maintenance earlier in this lesson. Your NBC training must be as realistic as possible to prepare your soldiers for a biological attack. You must integrate NBC training in all areas of squad/section training--individual and collective. Leaders are directly responsible for reinforcing NBC tasks through continuous training, which instills confidence in your soldiers. Things that you should ensure are--

- Up-to-date immunizations. Immunizations will reduce the chance of becoming a biological casualty.
- Good hygiene. Protect against the spread of disease by practicing good health habits.
- Area sanitation. Ensure the area is clean. Bury all empty ration packets and residue. Clean all latrine facilities. Control of rodents and insects is also important.
- Good physical conditioning.

Integrate training in an NBC environment into all areas of unit training--individual and collective. You as leaders are responsible for reinforcing these tasks through continuous training. This will instill individual confidence.

NBC Actions During a Biological Attack

If threat forces attack you with biological agents, there is usually no warning. Units automatically assume MOPP-4 to protect themselves against contamination when there are high-probability indicators of an attack.

NOTE: Select a student(s) to answer the question**.**

QUESTION: What are some biological-attack indicators?

ANSWER: Indicators are:

- Mysterious illness (many individuals sick for unknown reasons).
- Large numbers of vectors, such as insects or unusual insects.
- Large numbers of dead or strange-acting (wild and domestic) animals.
- Mass casualties with flu-like symptoms—fever, sore throat, skin rash, mental abnormalities, pneumonia, diarrhea, dysentery, hemorrhaging, or jaundice.
- Artillery shells with less powerful explosions than high-explosive (HE) rounds.
- Aerial bombs that pop rather than explode.
- Mist or fog sprayed by aircraft or aerosol generators.
- Unexploded bomblets found in the area.

Ref: FM 3-11.4, p II-17 and II-18, para 4-c (1)

Assuming MOPP provides protection against biological agents. However, an agent can still can entry through buttonholes, zipped areas, poor stitching, poor sealing at the ankles, wrists and neck. Even through the pores in the fabric.

NBC Actions after a Biological Attack

Actions to take after a biological attack include submitting NBC reports, beginning post attack recovery, and other actions. You must take samples, identify casualties by the symptoms they exhibit and treat those symptoms. Personnel should decontaminate immediately after an attack by using decontamination kits or washing with soap and water.

You must isolate individuals showing symptoms of contagious disease. This will prevent the spread to others.

NOTE: Ask the students if they have any questions pertaining to actions taken before, during, and after a biological attack. Clarify any misunderstandings they may have.

NBC Actions before a Chemical Attack

Protection against chemical agents begins before an attack. As you know, chemical agents can enter the body through the skin, eyes, ingestion, and respiratory tract. You as a leader must conduct defensive planning against chemical attacks by preparing unit SOPs that specify their chemical defense techniques and procedures. Solid and liquid agents could provide an operational hazard for hours, days, or months depending on the agent. There are some actions that unit personnel can take to alleviate these hazards.

NOTE: Select a student(s) to answer the question**.**

QUESTION: What are some preattack actions a unit may take before a chemical attack occurs?

ANSWER: They can:

- Assess chemical threat, potential risk, and likelihood of attack.
- Implement coordinated chemical defense plan.
- Prepare to provide first aid for unit personnel.
- Determine and implement appropriate MOPP levels.
- Minimize skin exposure.
- Continue good hygiene and sanitation methods.
- Deploy and activate detectors.
- Designate and prepare shelters.
- Watch for attack indicators (e.g., a chemical cloud, a distinctive odor, and release of an agent).
- Cover unprotected mission-essential equipment.

Ref: Fm 3-11.4, p II-21, para 5b (SH-3)

NBC Actions During a Chemical Attack

Once an attack begins, it is important to warn others of the hazard. You will warn other soldiers by giving an alarm or signal. The alarms or signals are audible alarms, automatic alarms, and visual signals. Your unit SOP should have a description of each of the alarms or signals. Once you hear or see an alarm or signal do the following:

- Give attack warnings.
- Take cover to protect against blast, shrapnel, heat, liquid, and particulate contamination. After you take cover, you and your personnel must don their masks an other protective gear.
- Use MOPP 4 in the absence of other information and remain in MOPP 4 until directed by higher headquarters.

NBC Actions After a Chemical Attack

Immediately after a chemical attack, personnel should avoid outside activities to the maximum extent possible depending on the mission. There are numerous actions that you must take after a chemical attack. Some of these actions are--

- Avoid potentially contaminated areas.
- Obtain and report observations or evidence of an attack.
- Adjust MOPP level to the lowest possible level consistent with identified hazards.
- Sample, monitor, and analyze for residual hazard.
- Conduct unmasking procedures (all clear).
- Conduct selective unmasking, a procedure that requires one or more individuals to unmask for brief periods while others observe them for agent effects.
- Use the M256-series Chemical Detector Kit to detect possible agents.
- Move to another area and retest for chemical agents. If the mission does not allow a move, retest after one hour.
- Assess the detector information and make a determination whether to unmask or not.
- Conduct filter exchange based on design, physical condition, climatic conditions and other possible threat agent employment.

Your commander will set the guidelines in the decontamination operations. It will be your job as a leader to ensure that your soldiers perform all decontamination procedures correctly.

CHECK ON LEARNING:

QUESTION: What are some of the nuclear protection covers you may use in case of a nuclear attack?

ANSWER: Fighting positions, field-expedient positions, earth-shielded positions, buildings, tents, armored vehicles, and wheeled vehicles.

Ref: FM 3-11.4, p II-8 thru II-13 (SH-3)

QUESTION: When should preattack preparations for a biological attack begin?

ANSWER: Long before the biological attack happens.

Ref: FM 3-11.4, p II-16, para 4b (SH-3)

NOTE: Ask the students if they have any questions pertaining to actions taken before, during, and after a chemical attack. Clarify any misunderstandings they may have.

SECTION IV. SUMMARY

Method of Instruction: Conference / Discussion
Technique of Delivery: Small Group Instruction (SGI)
Instructor to Student Ratio is: 1:16
Time of Instruction: 10 mins
Media: -None-

Check on Learning	The check on learning questions on ELO A, B, C, and D serve as a check on learning for this lesson.
Review / Summarize Lesson	Soldiers on the modern battlefield can expect to fight in nuclear, biological, or chemical environments for long periods of time. They must be able to fight and win under these conditions. As a leader, it is your responsibility to train your soldiers in all critical NBC technical and tactical skills. The survival of your soldiers on the battlefield is a direct reflection on how well you trained them in peacetime. Remember, well-trained soldiers, properly equipped and disciplined, can fight and win on the NBC contaminated battlefield.

SECTION V. STUDENT EVALUATION

Testing Requirements	**NOTE:** Describe how the student must demonstrate accomplishment of the TLO. Refer student to the Student Evaluation Plan. During this course, you will take a 50-question examination. The examination will include questions on the ELOs and TLO from this lesson. You must correctly answer at least 35 questions to receive a GO. A GO is a graduation requirement.
Feedback Requirements	**NOTE:** Feedback is essential to effective learning. Schedule and provide feedback on the evaluation and any information to help answer students' questions about the test. Provide remedial training as needed. You will receive feedback immediately following the written examination.

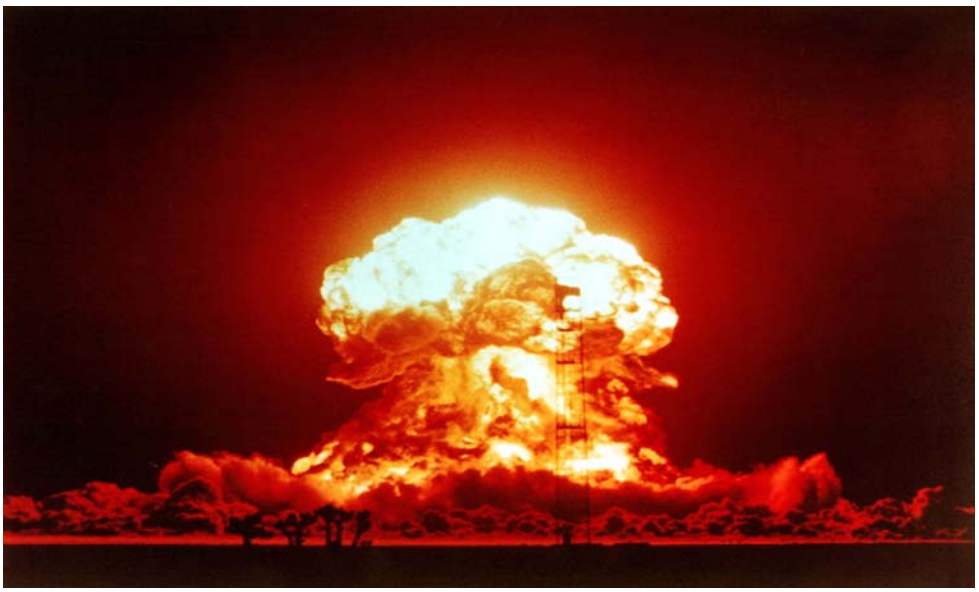
VIEWGRAPHS FOR LESSON 1: W324 version 1

Introduction

Motivator

VGT-1, NBC Operations

NBC OPERATIONS

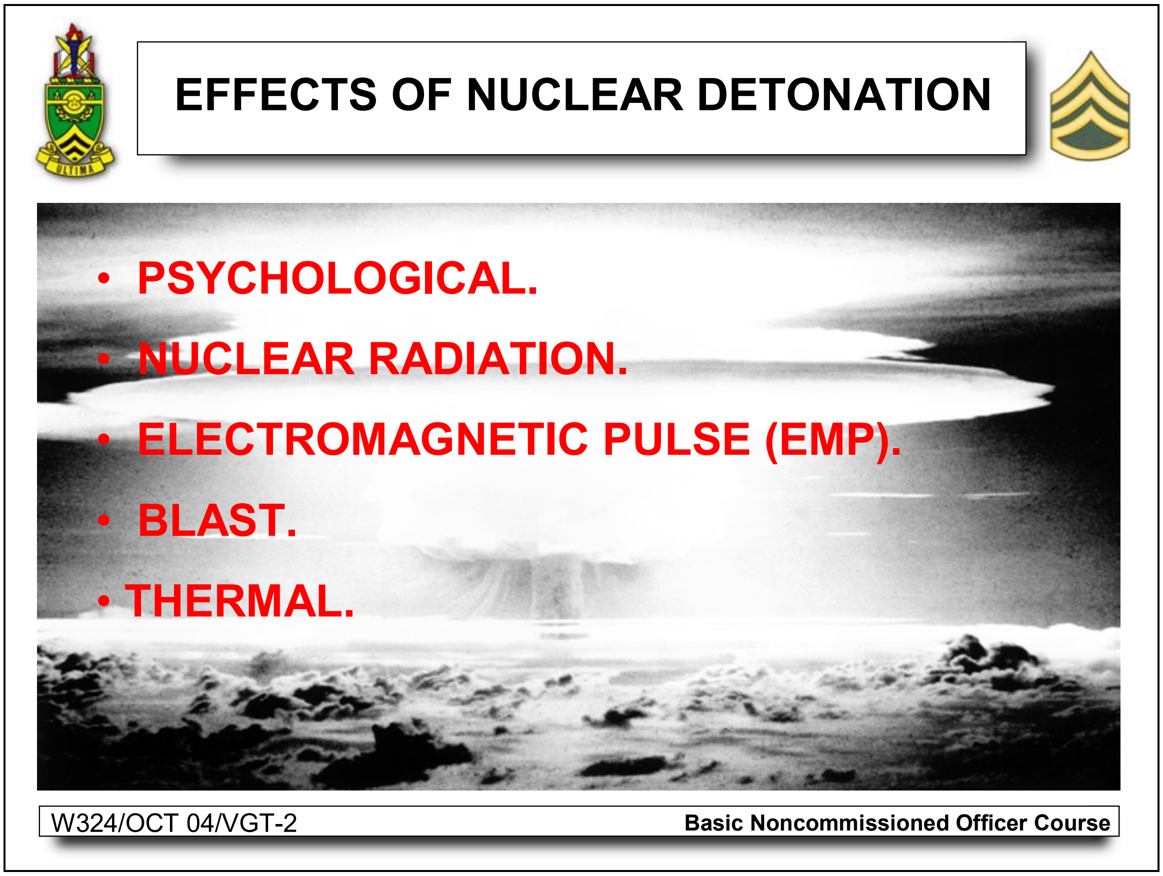


W324/OCT 04/VGT-1 **Basic Noncommissioned Officer Course**

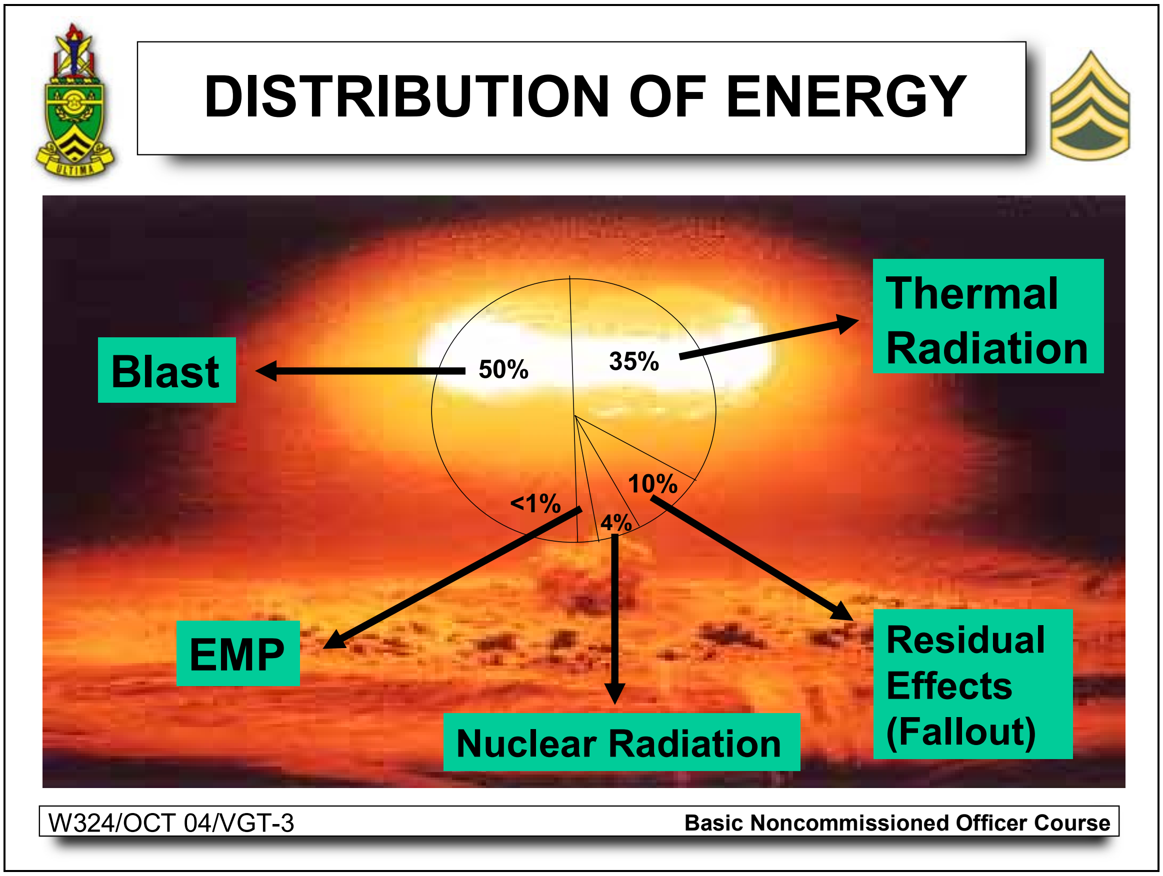
Enabling Learning Objective A

Learning Step 1

VGT-2, Effects of Nuclear Detonation



VGT-3, Distribution Of Energy



VGT-4, Results Of Detonation Types

RESULTS OF DETONATION TYPES

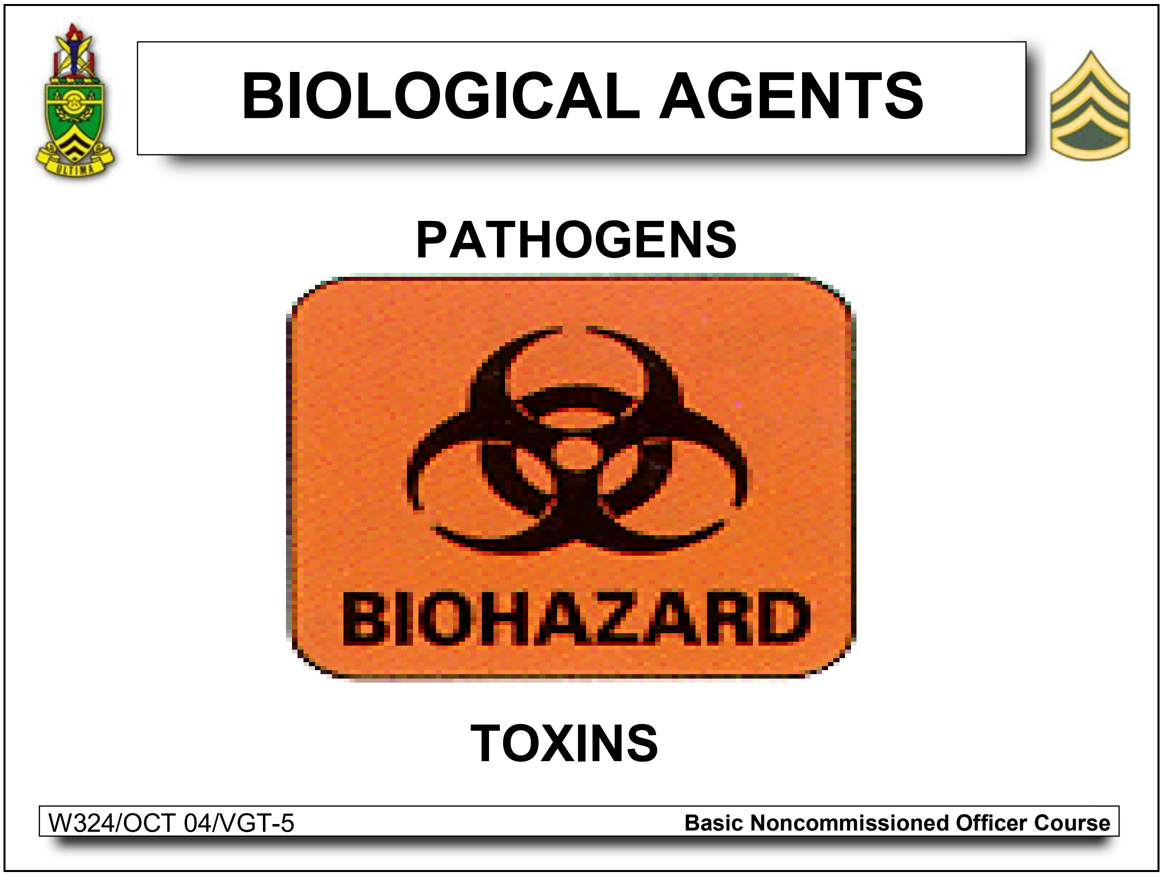
TYPE BLAST	BLAST	THERMAL	NUCLEAR RADIATION	EMP
AIR	GREAT AND WIDESPREAD	GREAT AND WIDESPREAD	CONSIDERABLE PROMPT RADIATION. NO SIGNIFICANT RESIDUAL RADIATION EXCEPT FOR SMALL AREAS UNDER BLAST	EFFECTS 3 TO 9 MILES FROM GZ UP TO ALTITUDES OF 19 MILES. GREAT AND WIDESPREAD FOR BURST ABOVE 19 MILES
SURFACE	GREAT BUT RADIUS OF EFFECT SOMEWHAT REDUCED	GREAT BUT NOT WIDESPREAD	GREAT, PROMPT, BUT NOT WIDESPREAD. RESIDUAL RADIATION WILL APPEAR AS FALLOUT.	EXTENDS OUTWARD 3 TO 5 MILES FROM GZ
SUBSURFACE	GREAT BUT RADIUS OF EFFECTS GREATLY REDUCED	NEGLIGIBLE	LITTLE OR INSTANT RADIATION GREAT AMOUNT OF RESIDUAL FALLOUT	LIMITED TO AREA AROUND GZ

W324/OCT 04/VGT-4 **Basic Noncommissioned Officer Course**

Enabling Learning Objective B

Learning Step 1

VGT-5, BIOLOGICAL AGENTS



Enabling Objective C

Learning Step 1

VGT-6, The Six Major Types Of Chemical Agents

THE SIX MAJOR TYPES OF CHEMICAL AGENTS

BLOOD

BLISTER

CHOKING

IRRITANTS

NERVE

PSYCHOCHEMICAL

W324/OCT 04/VGT-6 **Basic Noncommissioned Officer Course**

Enabling Objective D

Learning Step 1

VGT-7, Nuclear Protection Cover

NUCLEAR PROTECTION COVER

- **Fighting Positions.**
- **Field-expedient overhead cover.**
- **Earth shielded positions.**
- **Buildings.**
- **Tents.**
- **Armored vehicles.**
- **Wheeled vehicles.**

W324/OCT 04/VGT-7 **Basic Noncommissioned Officer Course**

VGT-8, Actions During A Nuclear Attack

ACTIONS DURING A NUCLEAR ATTACK

- **Immediately drop facedown.**
- **Close your eyes.**
- **Protect exposed skin from heat by putting hands and arms under or near the body and keeping the helmet on.**
- **Remain face down until the blast wave passes and debris stops falling.**

W324/OCT 04/VGT-8 **Basic Noncommissioned Officer Course**

Appendix B Test(s) and Test Solution(s) (N/A)

Appendix C Practical Exercises and Solutions (N/A)

HANDOUT FOR LESSON 1: W324 version 1

This Appendix Contains

This appendix contains the items listed in this table--

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Student Handout 1

Advance Sheet

Lesson Hours

This lesson consists of two hours of small group instruction.

Overview

You as a leader will have to prepare your soldiers for the threats of NBC attacks on the modern battlefield. This lesson will show you how to be successful in preparing your soldiers in identifying the basic characteristics, effects, and actions necessary to function in a Nuclear, Biological, and Chemical (NBC) environment.

Learning Objective

Terminal Learning Objective (TLO)

Action:	Direct the actions necessary to function in a Nuclear, Biological, and Chemical (NBC) environment on the battlefield.
Conditions:	As a small unit leader in a company or battalion level unit.
Standards:	Identified the basic characteristics, effects, and actions necessary to function in a Nuclear, Biological, and Chemical (NBC) environment on the battlefield IAW FM 25-51, FM 3-3, FM 3-11.4.

ELO A Describe the basic effects of a nuclear detonation.
ELO B Describe the categories of a biological weapon and avoidance procedures.
ELO C Describe the categories of a chemical weapon.
ELO D Identify actions to take before, during, and after Nuclear, Biological, or Chemical (NBC) attacks.

Assignments

The student assignments for this lesson are:

- Read Student Handout 1.
- Read FM 3-3, Chemical and Biological Contamination Avoidance, Chapter 3, pages 3-0 and 3-1 and Chapter 4, pages 4-0 thru 4-9 (SH-2).
- Read FM 3-11.4, Multiservice Tactics, Techniques, and Procedures for Nuclear, Biological, and Chemical (NBC) Protection, Chapter II (SH-3).
- Read FM 25-51, Battalion Task Force Nuclear Training, Chapter 2 (SH-4).

Additional Subject Area Resources

None.

Bring to Class

- All reference material received for this lesson.
- Pen or pencil and writing paper.

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HANDOUT FOR LESSON 1: W324 version 1

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- Read FM 25-51, Battalion Task Force Nuclear Training, Chapter 2 (SH-4).

Additional Subject Area Resources

None.

Bring to Class

- All reference material received for this lesson.
- Pen or pencil and writing paper.

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Student Handout 2

Extracted Material from FM 3-3

This student handout contains 12 pages of extracted material from the following publication:

FM 3-3, Chemical and Biological Contamination Avoidance, 16 Nov 1992, w/chg 1, 29 Sep 94.

Chapter 3 pages 3-0 and 3-1

Chapter 4 pages 4-0 thru 4-9

Disclaimer: The training developer downloaded the extracted material from the General Dennis J. Reimer Training and Doctrine Digital Library. The text may contain passive voice, misspellings, grammatical errors, etc., and may not be in compliance with the Army Writing Style Program.

Chapter 3
Chemical Agents

Avoidance of chemical agents requires a complete understanding of physical characteristics, employment, and weather and terrain conditions. Units can then estimate when and where specific type of chemical agents will be used, where the hazards are, and how best to avoid them.

Threat forces are equipped, structured, and trained to conduct chemical operations. We expect them to use chemical agents as part of their conventional fighting capability because so much of their training revolves around the use of such agents.

The basic threat principle is to use chemical agents on unprotected troops to create casualties. Against protected troops, the primary purpose is to make the use of equipment, terrain, and operations more difficult. The use of chemical weapons by the threat forces initially may require a decision at the same level as nuclear weapons. But they most likely will be used more freely once the initial use has been authorized. Threat forces consider chemical weapons as an extension of conventional warfare. If units understand the uses of chemical agents, they will be better able to avoid chemical hazards.

Types of Chemical Agents

Chemical agents may be classified persistent, nonpersistent and dusty. Threat forces classify chemical agents according to their effect on the body. They identify six major types—nerve, blood, blister, choking, psychochemical, and irritants.

Persistent

Threat forces are known to stockpile persistent and nonpersistent agents.

Persistent agents are used to impede the use of critical terrain, channelize the attacking force, or contaminate materiel. Persistent chemical agents are used to produce casualties (immediate or delayed). Immediate casualties occur when the soldier inhales the vapor. Delayed casualties occur and is absorbed through the skin demonstrating the need for protective equipment.

Persistent agents are used to—

- Contaminate rear area supply depots.
- Defend avenues of approach.
- Neutralize personnel defending a strong point.
- Protect flanks.
- Degrade unit efficiency,

To avoid persistent agents-

Avoid areas heavily splashed with liquid contamination which may be persistent for several days (depending on weather and type of agent). See FM 3-6 for more details.

- Cover personnel, equipment, and supplies whenever possible.
- Monitor for the chemical agent for 2 to 10 days (depending on weather and type of agent). See FM 3-6 for more details.
- Concentrate on finding clean areas and routes (recon units).
- Cross contaminated areas in MOPP 4.
- Mark contaminated areas.
- Avoid contact with unknown liquids.

Nonpersistent

Threat forces currently stockpile blood agents, choking agents, psychochemical agents and nerve agents such as Tabun (GA), Sarin (GB), and Soman (GD). Although G-series nerve agents (GA, GB, GD and GF) are classified as nonpersistent agents, some G agents may persist for hours to days. Refer to Table 1-2 in Chapter 1 of this Field Manual or FM 3-4 for persistency data. Nonpersistent agents should be expected along the forward line of troops (FLOT), and against units in contact with the attacking echelon. These agents are used to immobilize, injure, or hinder activities of the unit under attack. For example, threat may use a blood agent at a critical moment in battle to force troops into a higher MOPP level. Forcing troops into a higher MOPP level reduces morale and degrades performance. Another advantage is that the threat would not need to decontaminate the area before occupying it. Nonpersistent agents act through the respiratory system or through skin absorption.

Nonpersistent agents are used to—

- Create favorable fighting conditions.
- Produce casualties prior to an assault.
- Degrade and suppress troops by forcing them into a higher MOPP level.
- Allow occupation without decontamination.

To avoid nonpersistent agents-

- Avoid low areas and enclosed spaces where vapors lingers.
- Camouflage
- Maintain discipline

Dusty

Dusty agents, (toxic dust or dust-impregnated agents as they may be referred to) are not new. These agents have been subjected to extensive scientific research since the 1930's. These agents are primarily mustard (HD) and the nerve agent sarin (GB) impregnated onto a solid sorbent (usually on silica) and dispensed as aerosols. These agents generally have a lower vapor pressure and a dramatic increase in inhalation toxicity.

Vapors off gassing from the solid sorbent may be detected by the M256 Chemical Agent Detector Kit, Chemical Agent Monitor (CAM) or when mixed in water, by the M272 Water Test Kit.

Detection and Identification

Following OPSEC measures, the next most important step in chemical contamination avoidance is detecting and locating chemical agents. Once agents are detected units can be warned to take appropriate protective measures, and can plan operations to minimize the effects of chemical agents. Detection allows individuals to survive and units to accomplish their missions.

Chemical agents will be delivered either directly on unit positions (on-target attacks) or upwind to drift over the unit position (off-target attacks). Detection methods differ for each type of attack.

On-target attacks produce immediate casualties by contaminating troops and equipment. If the attack is intended to produce immediate casualties, a large amount of agent must be delivered in a very short time (within 30 seconds). The M8 series alarm does not detect all chemical agents; it takes several seconds to respond to those agents it does detect. Therefore, a large percentage of troops might be exposed to chemical agents before the alarm sounds. As an example the M8 Alarm will sound within 2-3 minutes when exposed to an nonpersistent nerve agent concentration of GB at 0.2 mg/m^3 and persistent nerve agent VX at 0.4 mg/m^3. The M8A1 alarm will sound within 1-2 minutes with an agent concentration of GB at 0.1 mg/m^3 and VX at 0.1 mg/m^3. This means that troops must recognize the delivery of the chemical agent, observe a color change in the detector paper, or recognize symptoms of chemical agent poisoning.

Off-target attacks are easier to protect against. Units use the M8 series alarm to alert the unit that a chemical agent is about to drift over their position. Detector paper also can alert units that they are moving into a contaminated area. Protective action can then be taken before troops are exposed to the agent. Table 3-1 shows the arrival time of chemical agents for various wind speeds. A distance of 150 meters was chosen for the table because it is the optimum distance that the detector can be placed upwind and a chemical agent cloud cannot slip behind the alarm and hit the unit.

Table 3-1. Wind speed effects on arrival time of chemical agents.

Wind Speed (kmph)	Time Before Agent Reaches Unit Location (seconds)	Distance Between Unit and Detectors (meters)
5	108	150
10	54	150
15	36	150
20	27	150
25	22	150

When using this chart, commanders must realize that if the concentration of chemical agents is low, the alarm may not respond for several seconds. Also the average time for individuals to mask (including reaction time) is about 15 seconds. Warning times for different distances and wind speeds can be determined using the following formula—

$$\text{Warning time (see)} = \frac{\text{Distance (m)} \times 36}{\text{Wind speed (kmph)} \times 10}$$

36 is the factor to convert hours to seconds

10 is the factor to convert kilometers to meters

This method can be used only to warn against agents drifting into the unit location. On-target attacks circumvent detectors placed at this maximum distance.

Automatic Chemical Agent Alarm

The automatic chemical agent alarm (ACAA) can be used in a stationary position. Keep the detector upwind at all times.

As soon as a unit arrives in an area it plans to occupy, it emplaces the alarms. The detectors are always placed upwind. Unless circumstances do not permit, they should be no more than 150 meters upwind from the farthest upwind position of the unit. This warns the soldiers upwind as well as the soldiers farther downwind. The detector units should never be placed more than 400 meters from the alarm unit. Otherwise the signal may not be strong enough to sound the alarm. The optimum spacing of 300 meters between detectors reduces the risk that a chemical agent cloud will drift between detectors without sounding the alarm. The number of alarms needed to protect a unit depends on the unit size. The larger the unit front, the more detectors are needed to warn the unit. In this case, front means the upwind direction. Front could be the left or right flank or the forward or rear edge of the unit. Table 3-2 gives an estimate of the number of detectors needed for fixed employment of the alarms.

Chapter 4
Biological Agents

The avoidance of biological agents requires an understanding of what biological agents are, how they may be used, and what happens to them once they are released. Units can then anticipate when and where biological agents will be used. They can estimate where the hazard is located so avoidance procedures can be initiated.

Biological agents are divided into two broad categories — pathogens and toxins.

Pathogens

Pathogens are infectious agents that cause disease in man, animals, or plants. Agents that constitute antipersonnel biological warfare (BW) threats include bacteria, viruses, and rickettsias (see Appendix B). These are commonly referred to as germs. While the vast majority of microorganisms are harmless or even helpful, there are about 100 naturally occurring pathogens that could be used as biological warfare (BW) agents. Pathogens cause disease (infection) by entering the body through the lungs, digestive tract, through the skin and mucous membranes of body openings.

Once they enter the body, pathogens multiply, overcoming the body's natural defenses, and produce disease. All bacteria do not require living cells for growth. Symptoms most commonly associated with pathogen infection include upper respiratory flu or cold like symptoms, vomiting, diarrhea, pneumonia or skin lesions (spots or rashes). Some pathogens, cause nervous systems damage (headache, paralysis, convulsions, or coma).

Bacteria

Bacteria are living microorganisms. Unlike viruses and rickettsias, they are capable of reproduction outside living cells. If they enter the body and if the victim is not properly treated, the microorganism will multiply and incapacitate the host. Bacteria can be found in almost any environment. Those few that are potential BW agents have the ability to rapidly cause illness after entering the body through the lungs or digestive tract. A typical bacterial cell is 1-2 microns in diameter and 2-10 microns in length (1,000,000 microns = 1 meter).

Viruses

Viruses constitute a large group of infectious organisms. Unlike bacteria, they must be inside a cell in order to multiply. Viruses multiply by taking over the cell, causing it to produce viruses instead of normal cell components. After producing hundreds or even thousands of virus particles, the cell is often destroyed as these particles are released. Viruses are much smaller than bacteria, ranging from 0.02 - 0.2 microns in size. Their small size means that a relatively small amount of agent can infect a large number of personnel across a wide area.

Rickettsiae

Rickettsiae are bacteria that are unable to multiply unless they are within a living cell. Most are spread from one person to another by means of an insect or tick that serves as a vector. The rickettsia will be picked up by the vector from one infected person or animal, which then transmits the rickettsia when it bites its next victim. Rickettsiae are smaller than most bacteria, but larger than viruses.

Toxins

Toxins are poisonous substances produced as by-products of microorganisms (the pathogens), plants, and animals. Some toxins can be chemically synthesized, and some can be artificially produced with genetic engineering techniques. Toxins exert their lethal or incapacitating effects by interfering with certain cell and tissue functions. Basically, there are toxins that disrupt nerve impulses (neurotoxins) and toxins that destroy cells by disrupting cell respiration and metabolism (cytotoxins). There is a vast range of signs and symptoms with both toxin types. These signs and symptoms can be confused with both chemical and pathogen poisoning.

The neurotoxins tend to be quick acting and produce nerve agent-like symptoms in seconds to hours. Symptoms of neurotoxin poisoning range from mental confusion, loss of balance, and vision problems to a limp paralysis or convulsive-type seizures leading to coma and death.

An example of a neurotoxin is palytoxin, produced by a bacterium in palython soft corals. This is a fast acting toxin causing muscle paralysis then death within 5 minutes.

Cytotoxins tend to be slower acting and produce choking, blistering, or even radiation-like symptoms in a period of hours to days. Symptoms range from skin lesions such as blisters, to vomiting, diarrhea, coughing, and choking (the latter three signs may be accompanied by bloody discharges) to marked weakness, coma, and death.

An example of a cytotoxin is trichothecenes (T-2 toxin) which is a group of about 40 delayed acting. fungal toxins (mycotoxins). These are produced from molds of infected grain and were reportedly used in Southeast Asia and Afghanistan in the 1970's and 1980's. T-2 toxin is often referred to as "yellow rain."

Characteristics of BW Agents

Delayed Effects

Both pathogens and some toxins - especially cytotoxins - can cause delayed effects. These effects may take hours to days before the onset of disease.

The effects of pathogens are delayed due to the required incubation period. This incubation period is the growth process of pathogens inside the body prior to disease production and differs among agents.

Toxins, unlike pathogens, are not living organisms The delayed effects are not caused by an incubation period. The delay is caused by the time required to kill or inactivate cells. Repeated exposures to small amounts (less than incapacitating or lethal effective doses) can add up to an incapacitating or lethal effective dose.

Large Area Coverage

Biological agents can be disseminated over large areas. They cart sail with the wind and travel extensive distances downwind. Pathogens can infect the target with as little as 1 to 20 microorganisms. Billions of pathogenic cells can be packed in 1 gram of agent. The light weight and small size allow these pathogens to spread easily to all areas that are not airtight. Similarly. toxins are very potent and are more toxic than nerve agents. They require very low doses to exert their effects. Toxins, like pathogens can cover large areas when disseminated.

Control

Somewhat more control can be achieved in employing toxins as compared to pathogens and they can cover larger areas than those covered by chemical aerosols. Compared to the pathogens, they are extremely toxic and lightweight, particularly if employed as art aerosol. However, being chemical by-products rather than living organisms, toxins are not infectious, contagious, nor capable of self- reproduction. Thus, area coverage and the results of the attack are much more predictable and reliable.

Pathogens, however, are difficult to control: especially if they are artifically disseminated. Because some pathogens cause contagious diseases, the victim himself becomes the sourse of agent. Both sick and dead soldiers, and their wastes, can become a hazard to those around them. The extent of this hazard will vary from agent to agent, but it is an important part of controlling and avoiding further casualties. Also, the coverage patterns of pathogen agent clouds are very sensitive to wind direction and speed. The enemy may decide to use pathogens in an attack located close to their own positions. In this case the enemy will be form-xl to use a pathogen for which their troops have immunization, or the enemy must be willing to accept some casualties.

In general, healthy skin provides an adequate barrier against most agents of biological origin. Skin (usually in a tropical environment) that has rashes, scratches, fungal infections, etc . . . is more susceptible to skin penetrants.

Skin Penetration

Some toxins, due to their small molecular weight, size, and solubility, may also penetrate the skin. MOPP gear protects the skin from the effects of such toxins and therefore must be used. For maximum protection and the lowest risk of incurring casualties, soldiers should wear the protective gear for 4 hours after the unit has been attacked or the agent cloud is predicted / known to have passed through the unit area. During this time every effort is made to identify the exact agent including its characteristics.

Weather Effects on Biological Agents

Sunlight

Most biological pathogens and some toxins are affected by ultraviolet rays in sunlight. Most attacks will likely occur at night, during extended twilight, or during overcast conditions. To overcome this problem, encapsulation (a natural or man made protective covering around the pathogen), or possibly genetic engineered pathogens, may produce agents that are resistant to direct sunlight. Thus. any agent delivered during conditions of direct sunlight, or after beginning morning nautical twilight (BMNT), should be considered as a sunlight resistant agent.

Humidity

The relative humidity that is the most favorable for the employment of a biological aerosol attack depends upon whether the agent is disseminated as a wet or dry aerosol. For a wet aersol, a high relative humidity slows the evaporation of the tiny droplets of agent. This lowers the rate of decay of the wet agent because drying may result in the death of pathogens. On the other hand, a low relative humidity favors the employment of dry agents. The extra moisture present in the air when humidity is high may increase the decay rate of pathogens in a dry aerosol. High humidity may also promote a clumping of particles causing them to fall out of the air more rapidly.

Wind

High wind speeds increase the area covered by biological agents, but lower the casualty percentages within an area due to dilution of the agent. Most BW attacks will occur under conditions of moderate windspeed, the most effective windspeeds for target coverage being 12-30 kmph. As the agent cloud travels downwind, it gradually loses its effectiveness due to dilution caused by agent fallout, dispersal, and death of the pathogen agent or neutralization of the toxin. However, because most biological agents are lighter and more potent (weight to effect basis) than chemical agents, the downwind hazard areas of biological weapons will be much larger than those of chemical weapons. If delivered directly on target, as with a bomblet attack, the wind direction and speed will have a more limited effect on coverage, however, downwind efforts must stall be considered. If dissemination occurs far upwind from the target area in a more elevated manner, downwind effects can be even more dramatic.

Temperature Gradient

Temperature gradients may exert some effects upon the behavior of a biological aerosol cloud. However, prediction of these effects require specific knowledge of the agent and its potential carriers. The effects of temperature gradient upon biological agents are similar to those upon chemical agents. However, because biological agents are effective in lower concentrations than chemical agents, the effects of temperature gradient are less upon a biological cloud than a chemical agent cloud. A stable atmosphere (inversion) results in the greatest effects. Under unstable (lapse) and neutral conditions, more atmospheric mixing occurs leading to a cloud of lower concentration, but still sufficient to inflict casualties. Temperature gradients for biological agents normally are listed in Pasquill Stability Classes. These classes are listed in Table 4-1. As stated previously, stable atmospheric conditions produce the best effects for biological agents. This means Stability Class E or F. The Simplified Biological Downwind Hazard Prediction (SBDWHP) procedures will be used for all temperature gradients.

Table 4-1. Pasquill Stability Classes

Class	Definition
A	Extremely unstable
B	Moderately Unstable
C	Slightly Unstable
D	Neutral
E	Slightly Stable
F	Moderately Stable

Conditions:

	Daytime			Nighttime	
Surface Wind Speed, M/Sec	Strong	Moderate	Slight	Cloudy	Clear
<2	A	A-B	B		
2-3	A-B	B	C	E	F
3-4	B	B-C	C	D	E
4-6	C	C-D	D	D	D
>6	C	D	D	D	D

Precipitation and Temperature

Precipitation will tend to wash biological agents out of the air more rapidly. This will slightly reduce the downwind hazard. Most pathogens are stable at normal temperatures, thus, the effects of temperature are expected to have little or no effect on hazard predictions. With the advent of toxins, bioengineering of pathogens and encapsulation, even arctic or desert conditions are much less restrictive to the user of BW. Most toxins are more stable than pathogens and are less susceptible to the influence of temperature, relative humidity, and radiation. As a general rule cool temperatures favor the employment of wet agents and warm temperatures favor the employment of dry agents.

Windows of Vulnerability

Coordinate with higher headquarters, intelligence sources, and medical personnel to determine what biological agent is most likely to be employed by the enemy. Determine, based on agent the optimum weather conditions and method of dissemination for greatest effect for each agent considered.

Coordinate with the Divisional Staff Weather Officer (SWO) to determine when these optimal weather conditions are projected to exist m the Area of Operaation (AO). These projected times that the optimal weather conditions exists is called "the wimdow of vulnerability". This "window" represents the best time, based on weather, for the enemy to employ biological agents. During this "window of vulnerability" if the unit is attacked with something that appears to be a chemical agent; yet no chemical alarm or detector kit responds to the agent, submit a Suspected Biological Report and obtain samples.

Persistence of Biological Agents/hazard

The persistency of a biological agent refers to the duration of effectiveness of the agent and varies greatly between agents.

The persistency of a biological agent will depend on many factors. Weather, terrain, ultra violet rays, method of dissemination, and type of agent are just a few of the factors that contribute to the persistency of a biological hazard. These factors must be considered when determining or initiating unmasking procedures. The persistence of microbes can be enhanced by encapsulating them with a microscopic protective coat. In addition, some microbes will produce a very resistant form called a spore. This is an essentially dormant state which can reactivate when the proper conditions exist. Spores will survive heat, drying and even some radiation for years. The spore can remain on the ground until conditions become appropriate for the organism to survive. In a process called reaerosolization, the organism will be returned to its aerosol form by some outside means. The most probable scenario is that heavy vehicle traffic or winds will cause many of the organisms to be suspended in the air. This particle suspension will cause a hazard area of military significance. The threat of casualties due to reaerosolization of the biological agent is agent specific, but in most cases it will be below 5 percent.

Due to the sheer magnatiude of potential agents, persistency data, or decay rates for biological agents is beyond the scope of this manual. Two biological agents with desirable weaponizing characteristics are Bacillus, Anthracis, and Botulinum Toxin. Decay rate or persistency rate graphs for these two agents are depicted in Appendix B, Figures B-1 through B-4.

Use of Biological Agents Against US Forces

It is possible that pathogens and toxins will be used against U.S. forces. The employment of pathogens and toxins throughout the entire battle area cannot be discounted. Possible targets of pathogens include:

- Rear area command centers and key facilities.
- Troop assembly areas.
- Ports of embarkation or supply points, airfields and industrial centers prior to the outbreak of hostilities.

Possible targets of toxins include —

- Forward combat areas and logistical areas.
- Any area that presents a likely target for a terroist or insurgent group.

The use of biological agents will complement the effects of other weapon systems. For example, threat forces could use pathogens with incubation periods that will cause the outbreak of disease, days or weeks after a nuclear attack. This would maximize the effects radiation has on reducing the body's immune system. They could also use pathogens before a planned offensive maneuver. The maneuver would be timed to coincide with the incubation period of the pathogen. Troops in a weakened state due to the onset of illness will be more susceptible to fatigue, have slower reaction time, and will have their ability to make decisions hampered. This further reduces our capability to wage war. Biological agents can be used singularly or in combination with other biological or chemical agents. This causes confusion in diagnosis, delays and compounds treatment, and magnifies incapacitating or lethal effects.

U.S. forces may also be exposed to immediate and residual biological hazards as a result of direct attack or by crossing biologically contaminated areas. Contamination avoidance is essential to reduce the impact of biological hazards. Our ability to survive, fight, and win on a biologically contaminated battlefield, requires the capability for warning and detecting an attack and identifying the agent. Detecting biological agent attacks are not easy. A detection/waming device for pathogens is under development. An improved version of the M256 Detector Kit will be able to detect T2 mycotoxin. Future developmental items may include the ability to detect biological agents with the on-board mass-spectrometer for the NBC Recon System (FOX). For those agents that cannot be identified, detection is accomplished by -

Recognizing a pattern of employment to predict an attack.

- Using the IPB process with specific PIRs for advance warning.
- Recognizing the signatory symptoms, signs and effects of biological agents.
- Sampling with air samplers may provide indication of an attack in progress.

The first two methods of detection are the only methods we have of warning troops of an attack before it occurs. The last method will alert the unit that an attack has occurred, and therefore allow the unit to take necessary protection and decon procedures to minimize the effects. Additionally, this method will help to establish a pattern of employment and, during future attacks, it will give notice (or at least high suspicion) that the enemy is employing biological agents. At this point, it should be added that when a unit is attacked, the unit can only suspect a biological attack. This suspicion is based on dissemination techniques, patterns of employment and the "window of vulnerability". Confirmation of a biological attack occurs only when a sample of the unknown agent is obtained and laboratory analysis confirms that the unknown substance is biological in origin.

Prior to this laboratory confirmation, the unit will not know if the attack was biological or chemical from an unknown source. Mission Oriented Protective Posture (MOPP) will protect the wearer against all known chemical or biological agents. Therefore, the unit must assume MOPP Level 4 (full protection) and apply those tactics, techniques and procedures (TTP) depicted in Appendix A for chemical or biological contamination avoidance.

Using Intelligence Sources

Intelligence can yield useful information for predicting biological attacks. Intelligence also can yield information that drives the scope and intensity of the biological defense program. Combat, technical, medical, and strategic intelligence sources must be used. Strategic intelligence gives the commander an estimate of the threat force's overall capabilities, limitations, and probable intentions for the employment of biological agents. Combat intelligence gives the commander an estimate of the threat force's battlefield readiness to employ biological agents. Technical intelligence enables evaluation of the effectiveness of enemy biological agents, possible dissemination systems and of protective equipment. Medical intelligence provides information about enemy preventive medicine, medical treatment, types of potential pathogens employed and preparations in medically related areas that could indicate a possible biological attack. See FM 8-10-8 for additional information on medical intelligence.

Recognizing a Pattern of Employment

Using the IPB process, windows of vulnerability based on weather, enemy activity, and movement of likely dissemination systems. help characterize the patterns of employment. The time of attack, method of dissemination, type of munition used, or the stage of the operation in which the agent is employed may be similar. Similar situations or patterns will not be definite proof that a biological agent attack is imminent but early warning should be given to all units in the potential hazard area.

Recognizing Distinguishing Symptoms, Signs, and Effects

Detecting a biological attack by this method is the least desirable way. But, due to the lack of detection devices, covert dissemination, and delayed effects of biological agents, this may be the first indication of a biological agent attack. With common diseases the number of personnel affected gradually increases. Natural food poisoning can be caused by a bacterial toxin. But in such a case, the casualties would be limited to those personnel that consumed the infected food. This can be verified by a medical analysis. When a biological agent has been used, large numbers of soldiers are exposed at or about the same time. This causes "explosive" epidemic numbers of casualties. Criteria (signs, symptoms, and effects) for suspecting a biological attack include:

- Epidemic number of casualties occurring within hours to three days of each other (most within 24 hours of each other).
- Higher death or infection rates than normally encountered with the disease.
- Diseases or increased outbreaks of a particular disease not normally encountered in a particular region or country (for example, yellow fever in Europe).
- An aerosol dissemination technique is indicated by high numbers of respiratory signs—particularly when in nature the disease affects the body through a different portal of entry (such as pulmonary or lung-infecting anthrax versus the much more common form of skin-infecting anthrax).
- Multiple outbreaks of zoonotic disease(s) (diseases that are communicable from small animals to man).
- Personnel working in a protected environment do not contract the disease (or vice versa could indicate a covert dissemination of a biological agent).
- Casualties occurring downwind, downstream, or within a supply line pattern.
- Large numbers of sick or dead animals are observed, especially if suffering the same symptoms of the disease which is affecting the human population.
- The sudden appearance of large numbers of strange insects or ticks that have not been encountered previously in an area of operations. This information may be obtained through preventive medicine sections.

Once suspected and reported, medical staff personnel can conduct epidemiological studies and determine if there could be other causes for the outbreak and thus prevent the perpetuation of false NBC reports.

Dissemination Techniques and Avoidance Procedures

To avoid a biological agent hazard, first; prevent the attack and second, combat (limit) the effects on personnel and supplies in the event of an attack.

The method of dissemination determines the extent and severity of contamination. However, some agent specific defenses can be administered before the agent is disseminated. These defenses may take the form of immunizations or prophylaxis, (taking medicine oraly).

There are three general methods of disseminating biological agents. Each helps the agent to get into the body.

- Aerosol dissemination is used when the respiratory system is targeted.
- Vectors (such as fleas, lice, ticks, and mosquitoes) and some toxins are used to attack through the skin.
- Covert (hidden) methods are employed to attack both the respiratory and digestive systems.

Aerosol Dissemination Procedures

Biological agents may be disseminated by ground or airbursting munitions, aircraft spray tanks, boat or truck mounted aerosol generators. The attack most likely will occur in a covert (or hidden) manner. Tactical level are those directed at specific units or elements on the battlefield. They are likely to occur at altitudes of 1,000 feet or less (100-foot optimum). Estimation of the hazard areas resulting from dissemination at altitudes greater than 1,000 feet above ground level requires extensive meteorological analysis. Toxins can be disseminated as a liquid (such as with "yellow rain"). This makes the toxin highly visible; but the hazard will generally be limited to the immediate area of the attack.

In a tactical aerosol attack, the aerosol cloud (after initial formation) will travel downwind at a rate determined by wind speed. The cloud will lengthen and widen as it travels downwind. The length of the agent cloud will equal about one-third of the distance traveled. Units near the release point will encounter a more concentrated agent cloud. However, units located farther downwind (even though exposed to a less concentrated agent cloud) will be exposed for a longer time, so unprotected personnel will inhale a higher total dose. Figure 4-1 shows the typical downwind movement and characteristics of a biological agent cloud. The peak danger area will be located in the area where the cloud stays in tact while at the same time is at its maximum width and length. This distance is approximately the maximum downwind hazard prediction for a chemical agent; therefore, it is vital to determine whether or not the attack is biological or chemical. The biological agent cloud can cause both immediate or delayed casualties. This is due to the fact that each individual will receive a different dose and the time until the onset of symptoms will be dependent on the amount of agent and each soldiers physiological makeup. The onset of illness will also be affected by the soldiers reaction time and any other forms of protection (i.e inoculation, masking time) that were available against the agent. Biological agent

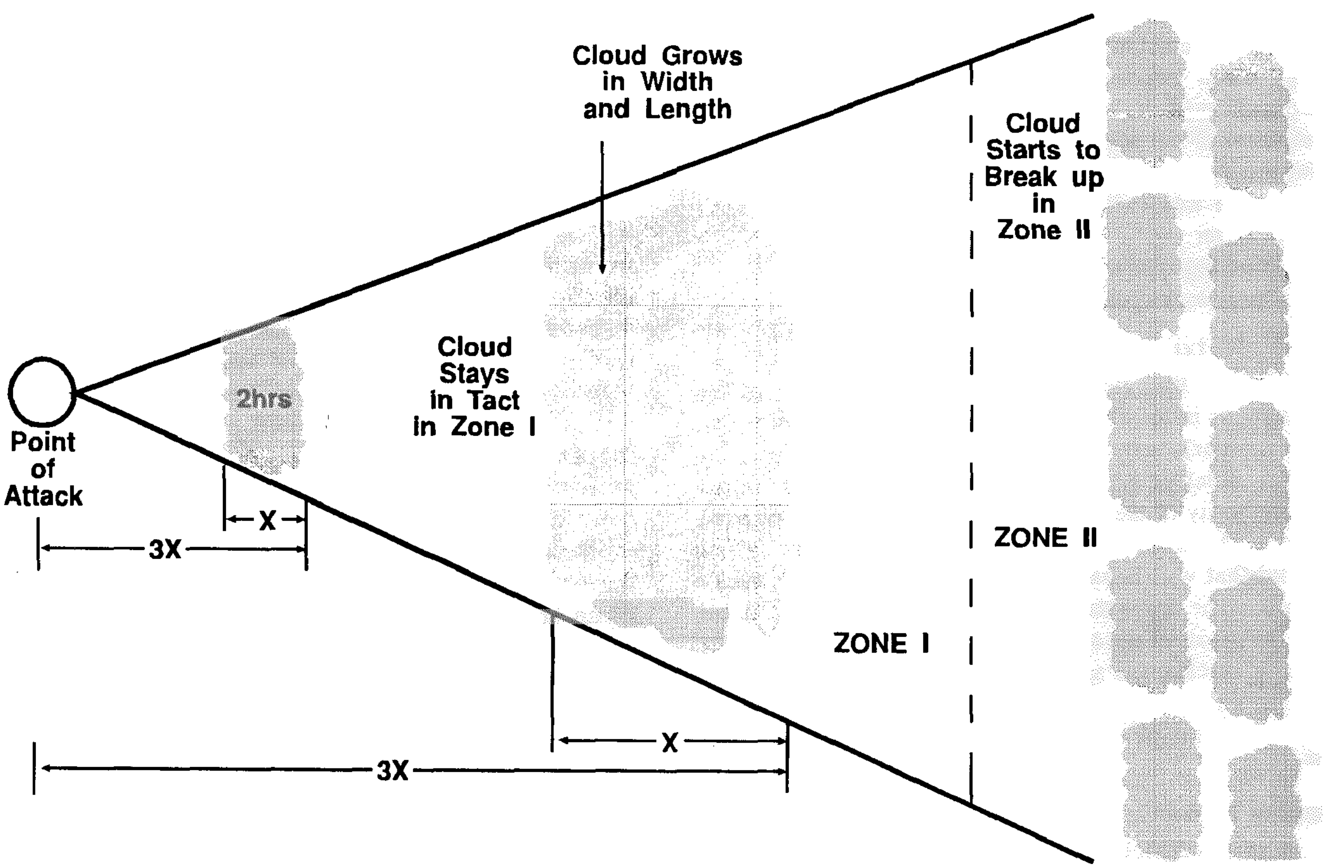

Figure 4-1. Downwind Movement and Characteristics of a Biological Agent Cloud.

casualties can occur in an area as much as two times the maximum downwind hazard distance for a chemical agent. Traveling farther downwind, the cloud is exposed to environmental elements. It is subjected to dispersal and settling and impaction on terrain features. The agent cloud will lose much of its concentration and the losses will be such that the majority of unprotected personnel will not receive an infective (pathogen) or effective (toxin) dose. However, dispersal will not be uniform and casualties may occur as far as four to five times the maximum downwind hazard distance of chemical agents. The following two examples illustrate biological aerosol strength:

- If the infective dose of a particular agent is one organism and there is a concentration of just one organism per 5 liters of air, the average soldier, breathing at a rate of 15 liters/minute, can breathe in three times the infective dose in one minute.
- It has been calculated that as little as 2 to 3 grams of tularemia bacteria Francisella tularensis (causative agent of rabbit fever) may be sufficient to create a bacterial aerosol 100 meters high and extending over an area 1 square kilometer. This can infect humans, breathing at a normal rate, with 100 minimum infective doses per minute.

Knowing biological cloud behavioral characteristics, units may calculate the approximate cloud arrival time and cloud exposure time. This provides both an estimation of the exposure period as well as the time of exposure if the point of attack has been identified. This information is presented later in this chapter.

There are two primary aerosol dissemination techniques:

- Bursting type munitions.
- Spray tanks/generators.

Bursting type munitions

When a biological projectile or bomb bursts on the ground or in the air, the filling (either a liquid slurry or dry powder), is initially dispersed in all directions.

An effective ground bursting munition, will project the majority of the filling into the air to form an aerosol cloud. Air bursting munitions may also form an aerosol cloud that will behave in a similar manner to a spray attack. The agent may however, also be designed to fall to the ground as a surface contaminant much like persistent chemical agents.

The dimensions of the aerosol cloud will be influenced by the means of delivery, the weather conditions, and the terrain.

Spray Tanks/Generators

Aircraft/vehicle spray tanks, or aerosol generators, may also be employed to form an aerosol cloud. This form of attack is likely to take place as covertly as possible. Tactical attacks (those directed at specific units or elements on the battlefield) with biological agents are likely to occur at altitudes of approximately 300 meters or less. Determining the hazard areas resulting from biological agent dissemination at altitudes of greater than 300 meters will require in-depth meteorological analysis and is therefore beyond the capabilities of most units. The simplified biological downwind hazard prediction (SBDWHP) pertains to aerosol disseminations that occur at or below 300 meters above ground level, Biological agents may also be disseminated as a liquid (such as "yellow rain") and the hazard generated by this means of delivery will be limited to the area of attack.

Zones of Contamination

After its initial formation, the aerosol cloud will travel downwind. The agent cloud will lengthen and widen. While it is highly concentrated, it will cause a high number of casualties (immediate or delayed) among unprotected personnel (approaching 100% with some agents). The area in which casualties among unprotected personnel will be high enough to cause significant disruption, disability, or elimination of unit operations or effectiveness is defined as Zone I. Priority medical treatment may be required for individuals exposed to the Zone I hazard. Units in this zone should increase their protective postures during the period of greatest hazard or upon alert if near the attack area. Units should be able to calculate this period using the equations for cloud arrival and cloud exposure times.

After traveling downwind, exposure to the elements will disperse the aerosol cloud to a degree at which the majority of unprotected personnel will not receive an infective (pathogen)/effective (toxin) dose. However, dispersal will not be uniform, and casualties may occur relatively far from the point of attack. This area of reduced, but definable hazard is Zone II. Personnel in this zone may assume a limited protective posture, including the protective mask, wearing work or protective gloves, buttoning up the uniform, rolling down uniform sleeves, and covering or bandaging any exposed cuts or scratches. Monitoring of personnel in Zone II for symptoms/effects of BW agents is required. Zone II includes all areas in which hazards to unprotected personnel are likely to exceed negligible risk levels under an aerosol disseminated attack. This zone may be very large; under some conditions encompassing thousands of square kilometers. Dividing the hazard areas into zones allows commanders to weigh the tactical considerations against performance degradation of MOPP with some knowledge of the relative risks. The end line for Zone I is the 20-30% casualty line and the end line for Zone II is the 1-3% casualty line. Figure 4-2 shows casualty probability curves for both Zone I and Zone II. It is important to note that the curves will be different for each agent and will depend greatly on the weather conditions that exist at the time of dissemimtion.

Aerosol Avoidance Procedures

Before the attack

- Establish and enforce preventive medicine programs to include immunizations, area sanitation and personal hygiene standards, and rest and nutritional needs of the troops.
- Gain intelligence on threat capabilities and intentions.
- Seek out, intercept, and destroy enemy weapon systems, production facilities and storage sites.
- Instruct troops on the threat and recognition of the attack and protective measures.
- Train and drill on fitting and putting on protective mask and clothing.
- Set up collective protection systems for personnel, equipment, and supplies. (NOTE: Field expedient

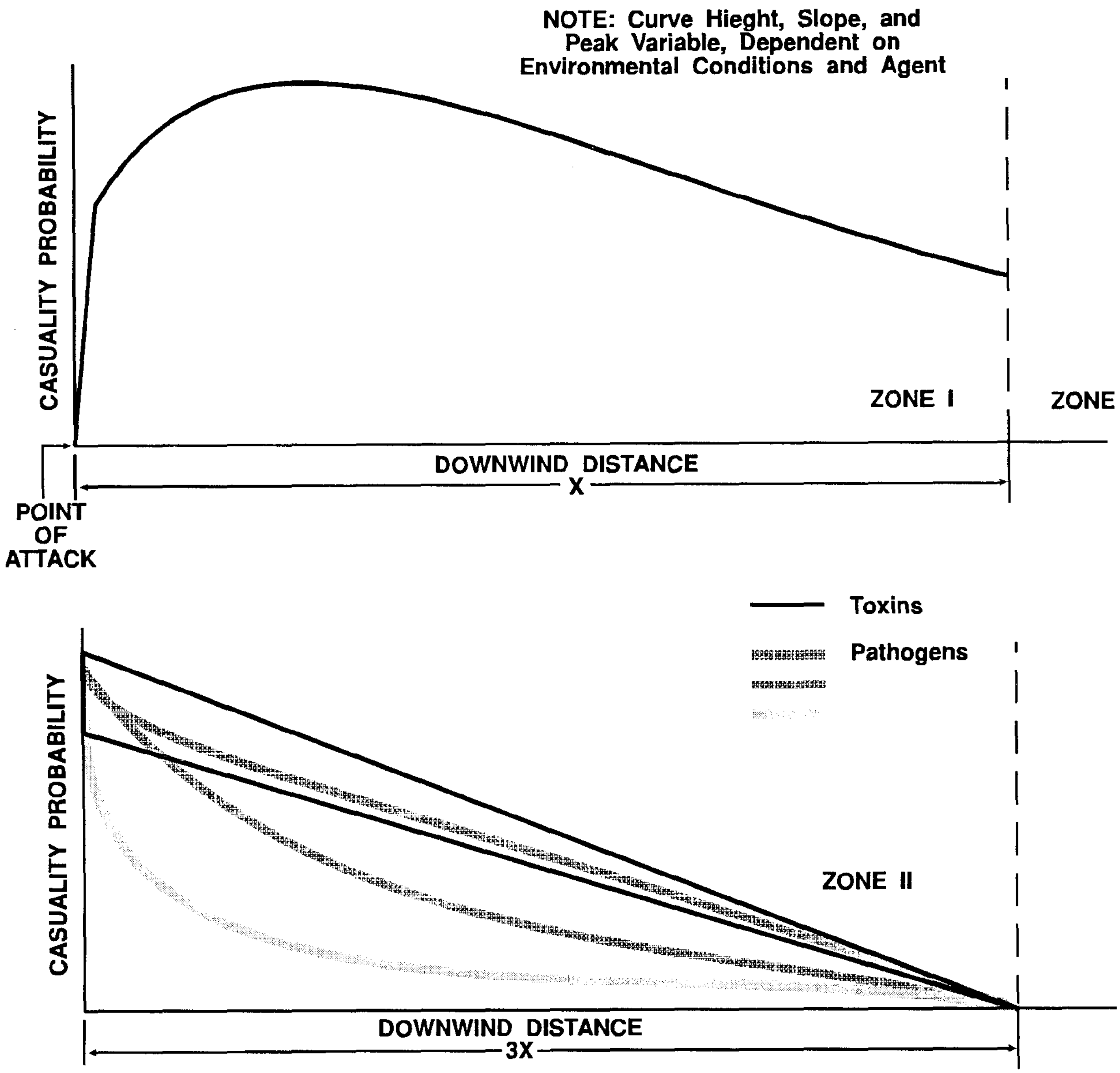

Figure 4-2. Biological Casualty Probability Curves for Zone I and II.

collective protection must be airtight.)

- Identify backup (alternate) food, water, and supply sources.
- Establish detection and sampling procedures.
- Conduct vulnerability analysis.

During the attack:

- Recognize the attack.
- Initiate personnel protective measures. Masking is the first priority, but since the attack may be chemical or toxin, MOPP 4 is required initially. For maximum protection and the lowest risk of incurring casualties, soldiers should wear protective clothing and mask for at least 4 hours after the unit has been attacked or the agent cloud is predicted/known to have passed through the unit area. Every effort must be made to identify the exact agent, including its characteristics. If the skin is contaminated, remove contamination immediately with large amounts of warm soapy water (if available) and decontaminate the skin with the M258A1 kit or M291 kit. (FM 3-5, Chapter 2, has detailed instructions on skin decon).
- Repulse or eliminate delivery vehicle or weapons.
- Observe for distinguishing signs between biological and chemical agent attack or a mixture of conventional and biological attack.
- Report the attack utilizing the NBC Warning and Reporting System (NBCWRS). (A biological attack that can not be immediately identified will be reported as an NBC 1, agent unknown or Suspected Biological Report).

After the attack:

- Estimate the downwind hazard (significant casualties in unprotected personnel can be at least two times the maximum downwind hazard distance for a chemical agent).
- Begin sampling/collection procedures IAW unit SOP.
- Consume only sealed rations and properly contained water (outer container surfaces, if exposed, must be properly decontaminated. See FM 3-5). Call preventive medicine personnel when safety of unit level water supplies are questionable. Ensure veterinary personnel inspect food storage depots and supply points. Replenish water supplies from water purification units.
- Separate biological casualties. Use minimum number of personnel (to limit exposure) to provide supportive medical care until evacuation.

Vector Dissemination Procedures

Some pathogens may be delivered by use of arthropods and other vectors such as fleas, ticks, lice, and mosquitoes. Bulk container aircraft dissemination or small cage vector bomblets can be used. The enemy may use vectors to circumvent the protective mask or MOPP gear. Any experienced field soldier or outdoorsman knows the the tick is capable of crawling under even the most constrictive clothing. Some flying insects can travel considerable distances against prevailing winds. This makes dissemination patterns hard to determine. Some pathogens can remain within the infected vector for the life of the vector, so biological hazards can be prolonged (one to two months for some mosquitoes and six to seven months for some fleas). If the enemy decides to use vectors, control is a limiting factor. Of course, frigid temperatures that may kill the vectors, will also have an effect. This dissemination method also limits the enemy because he has no way of controlling the vectors once they have been released. Logistical and production problems can arise in the delivery of a live pathogen inside a living vector in sufficient quantities to be an effective weapon. The prediction of hazard areas caused by vector dissemination is virtually impossible based on the unpredictability of the vectors.

Vector Avoidance Procedures

Before the attack:

- Apply insect repellant on exposed skin.
- Gain intelligence on threat capabilities and intentions.
- Seek out, intercept, and destroy enemy weapon systems and production and storage sites.
- Instruct troops on the threat, recognition of the attack, and protective measures.
- Establish and enforce preventive medicine programs to include immunizations, area sanitation, personal hygiene standards, rest and nutritional needs of the troops.

During the attack:

- Recognize and report suspicious indications of the vector attack (the sudden appearance of large numbers or strange kinds of insects not previously encountered in an operational area or the finding of vector bomblet cages).
- Cover exposed skin. Balance between protection and degradation of performance. Protective overgarments will not totally exclude the determined tick. Bloused trousers and rolled down and buttoned sleeves with insect repellant properly applied will probably afford as much protection with less degradation.
- Apply insect repellant liberally—especially to neck, face, ankle, and wrist areas.
- Report the attack.

After the attack :

- The NBCC should coordinate with the supporting medical authority for preventive medicine assistance.

- Begin insecticide and other pest control measures as outlined by preventive medicine personnel. Logistical support for unit-size pest control procedures should be a coordinated effort between the NBCC and the supporting medical authority. Physically remove body lice, ticks, and fleas by self aid and buddy aid as necessary.
- Make hazard estimates. Recon and medical reports may help the NBCC in assessing hazard areas.

Convert Dissemination and Avoidance Procedures

Sabotage and terrorist personnel may possess a variety of aerosol and contamination/poisoning techniques for various targets. Aerosol techniques can be fairly large operations, using aerosol generators (or foggers) that produce large open-air hazard areas. These techniques also can be more limited and selective, targeting the enclosed air space of key command and control facilities, aircraft, ships, troop billets, and other similar type areas. Biological agents in liquid, powders, or spray can be placed directly into food stuffs at harvest, processing, distribution, and preparation points. They can be placed into the water reservoir/distribution chain.

Before the attack:

- Maintain OPSEC.
- Identify covert/sabotage threat force capabilities and intentions through intelligence.
- Arrange for security measures to be taken based upon threat assessment.
- Identify alternate supply sources for those high-risk items.
- Instruct troops to be alert to dissemination devices or signs of covert tampering as intelligence dictates.
- Establish and enforce preventive medicine programs to include immunizations, area sanitation, personal hygiene standards, and rest and nutrition needs of the troops. (NOTE: Based on intelligence, protection of food and water may prevent successful employment of a specific biological agent.)

During the attack:

- Report the observation of an attack, the apprehension of enemy agent(s) engaged in such activity, or the finding of signs and indications of covert attacks.
- Initiate personnel and collective protection. For maximum protection and the lowest risk of incurring casualties, soldiers should maintain this protective posture for at least 4 hours.

After the attack :

- Warn personnel downstream, downwind, and/or down supply lines. The NBCC will do so based on at-hand medical and intelligence information and analysis of NBC 1 Reports.
- In conjunction with the veterinary and surgeon general initiate disposal and replacement of food, water, and other supplies. The NBCC can coordinate inspections and medically approved replenishment sources. Actions involving disposal of major quantities of food must be coordinated with the supporting veterinary personnel. Actions involving disposal of major quantities of other nonmedical supplies should be coordinated with the NBCC.
- Initiate sampling based on knowledge, consent, and special sampling requirements of the NBCC. If a BW attack is suspected, wash surfaces with at least a 5% solution of bleach. Bleach is a very effective form of decontamination for most BW agents.

Warning and Reporting

Determining that a biological attack has occurred will pose considerable difficulties for soldiers. There are the usual indicators of CB attack, such as low flying aircraft spraying mists or fogs, munitions with little or no explosive effect, or ground generators spraying a fog or mist, all during the “windows of vulnerability”. But even if fortunate enough to observe the attack, the field soldier will not be able to distinguish a biological attack from a chemical attack.

The NBCWRS is used to report biological attacks. However, the number of potential agents, the various dissemination methods and techniques, and the lack of automated detection and identification devices have thwarted an all-encompassing simplified biological hazard prediction. So, the use of the NBCWRS will be extremely limited. Until intelligence and prior experience come into play, it is unlikely that biological reports will go past the NBC 3 Report.

Observed attacks will be transmitted (most likely) by the NBCC as an NBC 1 Chemical Report, agent unknown or NBC 1 Suspected Biological Report. Upon receipt of the initial NBC 1 Report, the NBCC will send an NBC 3 Chemical Report.

Reports from units in the immediate attack area will help determine the nature of the attack. The observation of two events in the attack may indicate a biological rather than a chemical attack. An attack that has no apparent immediate effect on birds, animals, insects, or unprotected personnel could indicate a pathogen attack or delayed action toxin especially if the attack occurs during the “window of vulnerability”. Observation of immediate effects coupled with a lack of detection/identification of a chemical agent could indicate a rapid-acting toxin attack. This information should be transmitted on a follow-up NBC 1 Report.

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Student Handout 3

Extracted Material from FM 3-11.4

This student handout contains 19 pages of extracted material from the following publication:

- FM 3-11.4, Multiservice Tactics, Techniques, and Procedures for Nuclear, Biological, and Chemical (NBC) Protection, June 2003

  Chapter II pages II-7 thru II-25

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no warning of missile or artillery attacks. However, aircraft, cruise missile, and remotely piloted vehicle attack warning times (due to different flight profiles) may be long enough (tens of minutes) to allow extensive preplanned actions. Regardless of the warning times, commanders and their staffs must quickly analyze the available attack information, evaluate the effect on current operations, and decide on the most effective COAs within the time available.

(17) Monitoring status of NBC Equipment and Supplies. Units assess the logistics supportability of each COA and determine what equipment and supplies (see Appendix G) are needed.

(18) Preparing for Contingencies. Units prepare for unexpected situations. The preparation could include handling instructions for weapons of mass destruction (WMD) threats using postal mail or packages (see Appendix H).

b. Specific preattack, during-attack, and postattack actions (unique to NBC, COLPRO, and TIM) are discussed in the following paragraphs.

3. Nuclear Protection

This paragraph discusses preattack, during-attack, and postattack aspects of protection that can be accomplished in the event of a nuclear attack. Personnel must make defensive preparations to protect themselves; the effective use of terrain and shelter is also very important. Additionally, a nuclear attack can also create EMP effects.

- By knowing how terrain affects nuclear weapons, personnel can greatly reduce the risk of becoming casualties. With training and practice, they can learn to recognize defensive positions that will give them optimum protection against a nuclear blast.

- Hills and Mountains. Reverse slopes of hills and mountains give some nuclear protection. Heat and light from the fireball of a nuclear blast and the initial radiation tend to be absorbed by hills and mountains. What is not absorbed deflects above the personnel because of the slope.

- Depressions and Obstructions. The use of gullies, ravines, ditches, natural depressions, fallen trees, and caves can reduce nuclear casualties. However, predicting the actual point of a nuclear attack is almost impossible. The best protection remains an area below ground with some sort of overhead cover.

- Obscuration. When the threat of nuclear weapons use is high, smoke can be used to attenuate the thermal energy effects from nuclear detonations.

a. Preattack Actions. Preattack actions are critical because they will increase the unit's survivability to the greatest possible extent. These actions range from selecting the right shelters, fortifying those shelters, and protecting vital equipment to using equipment to increase survivability. Whenever the tactical situation permits, units prepare defensive positions. These will vary from individual fighting positions to improved defensive positions. These actions and good prior planning protect against nuclear effects. One primary concern should be protection from gamma and neutron radiation. Gamma radiation protection requires thick layers of dense or heavy shielding material, such as lead, iron, or stone. On the other hand, light, hydrogen-based material gives good neutron radiation protection. Some examples are water, paraffin, and oil.

Note: The balance of the information in paragraphs 2 through 4 applies to land forces. See NWP 3-20.31 (Revision A), *Surface Ship Survivability*, for TTP on maritime CBR defense measures.

Note: See Appendix D for more detailed information on radiological protection—such as operational exposure guide (OEG), low-level radiation (LLR) exposure, and depleted uranium (DU).

(1) Fighting Positions.

(a) Digging in provides improved defense, because earth is a good shielding material. A well-constructed fighting position gives excellent protection against initial nuclear effects. It can also reduce residual radiation (fallout). Personnel must harden their fighting positions against the blast wave as time permits. Lining or revetting fighting positions can significantly increase survivability and decrease the size of the opening into the position. Smaller openings allow entry of less initial and residual radiation. However, many metal surfaces are good thermal reflectors. Cover these surfaces to prevent an increased danger of burns from the heat of nuclear blasts.

(b) The smaller the fighting position opening, the better. Most of the gamma radiation in the bottom of a fighting position enters through the opening. The smaller opening of a one-person fighting position reduces gamma radiation two to four times below the amount that a two-person foxhole allows to enter.

(c) A deep fighting position gives more radiation protection than a shallow one. It places a greater thickness of shielding material or earth between the occupant and the nuclear detonation. Therefore, it prevents less initial radiation from entering. In a two-person fighting position, radiation reduces by a factor of 2 for each 16 inches of fighting position depth.

(d) Thermal radiation can reach personnel in fighting positions by line-of-sight (LOS) exposure or by reflection off the sides. Use dark, rough materials to cover potential reflecting surfaces and as protective covers. Examples are wool (such as blankets) and canvas. Remember that thermal exposure may still burn or char these materials. Avoid direct contact with them. Do not use rubber or plastic materials alone. These items might melt and cause burns. Simply covering a position with ordinary metal screening material blocks the thermal radiation by about 50 percent. Use this screening for thermal protection without entirely blocking the view through the ports. Personnel must cover exposed portions, and they must keep low. Keeping low reduces thermal exposure just as it reduces nuclear radiation exposure.

(2) Field-Expedient Overhead Cover.

(a) An overhead covering of earth or other material reduces exposure to thermal and initial nuclear radiation and fallout. Overhead covering helps prevent collapse. It also provides protection against debris, such as falling rocks.

(b) Beware of poorly constructed overhead covers. A cover must be strong enough to withstand the blast wave. Use U-shaped metal pickets, timbers, or certain fabrics; and overlay them with sandbags or earth. Ammunition boxes filled with earth also make good cover. In constructing an effective overhead cover, remember the following:

- Choose dense covering materials.
- Cover in depth.
- Provide strong supports.
- Cover as much of the opening as possible.

(c) A vehicle provides expedient overhead cover. A simple and fast method is to drive a vehicle over the top of a fighting position. A heavy armored vehicle is better than a wheeled vehicle. As with any type of overhead cover, initial radiation can still enter the fighting position through the earth sides or the openings in the sides of the vehicle (between treads, road wheels, and tires). If time allows, use sandbags to cover these openings. Remember, the vehicle is not a good neutron shield. Also, the blast wave may violently displace the vehicle and collapse a fighting position.

(3) Earth-Shielded Positions.

(a) Well-constructed fighting positions and bunkers can provide excellent protection against all effects of a nuclear detonation. Radiation is still an important concern, though, because of its great penetrating power. Radiation scatters in all directions after a blast.

(b) It is important that as much earth cover as possible be placed between the individual and the blast. The more earth cover, the better the shielding. Table II-3 (page II-10) illustrates the value of increasing amounts of earth shielding from a hypothetical, free-in-air dose. An open fighting position gives a protection factor of 8. It blocks most of the LOS radiation and allows only a fraction of scattered radiation to enter. Each added 6-inch thickness of overhead earth cover reduces the scattered radiation by a factor of 2.

Table II-3. Shielding Values of Each Cover for a 2,400-Centigray, Free-In-Air Dose

Personnel In	Radiation Protection Factor	Resultant Dose cGy
Open	None	2,400
Open Fighting Position (4” Earth Cover)	8	300
Open Fighting Position (6” Earth Cover)	12	200
Open Fighting Position (12” Earth Cover)	24	100
Open Fighting Position (18” Earth Cover)	48	50
Open Fighting Position (24” Earth Cover)	96	25

(c) The flat earth cover of an underground shelter protects much better than an equivalent thickness of cover on a similar aboveground structure. This is because the underground LOS thickness is greater.

(d) A second layer of sandbags gives more protection to fighting positions. Each layer of sandbags, if filled with sand or compacted clay, reduces the transmitted radiation by a factor of 2. Table II-4 shows the advantage of adding layers of sandbags for a hypothetical, free-in-air dose of 2,400 centigray (cGy).

Table II-4. Shielding Values of Each Cover for a 2,400-Centigray, Sand or Clay-Filled Sandbags, Free-In-Air Dose

Personnel In	Radiation Protection Factor	Resultant Dose cGy
Open	None	2,400
Open Fighting Position, 4’ Deep	8	300
Open Fighting Position, 4’ Deep, 1 Layer (4 Inches)	16	150
Open Fighting Position, 4’ Deep, 2 Layers (8 Inches)	32	75
Open Fighting Position, 18’ Deep, 3 Layers (12 Inches)	64	38

(e) Sand or compacted clay gives better radiation shielding than earth because it is denser. Each layer of sand- or clay-filled sandbags can give up to 66 percent more radiation protection than the same thickness of soil or soil-filled sandbags. Table II-4 shows that three layers of sand or clay-filled sandbags give a protection factor of 64 (38 cGy). Generally, heavy sandbags protect better than light ones.

(f) Neutron radiation can be stopped. Water delays and absorbs neutrons, but since some gamma radiation is given off in the process, dense shielding is still required. Damp earth or concrete protects from both forms of radiation. For example, only 12 inches of concrete or 24 inches of damp earth reduce neutron radiation exposure by a factor of 10. Wet sandbags achieve a reduction factor of 2 for every 4-inch layer. Other expedient neutron-shielding materials include containers of water, fuel, or oil. Remember that radiation scatters in all directions, and shielding must provide all-around protection.

(g) Protect sandbags from exposure to thermal radiation. Sandbags can burn and spill their contents, which can then be moved more easily by the blast wave. Cover sandbags with a small amount of earth and/or sod to eliminate this problem. Covering sandbags also enhances camouflage and provides valuable fragmentation protection.

(4) Buildings.

(a) Certain types of buildings offer excellent shelter from nuclear hazards and require minimum of time and effort to adapt for use. Choose buildings carefully. The stronger the structure, the better the protection against blast effects. The strongest are heavily framed buildings of steel and reinforced concrete. The worst choices are shed-type industrial buildings with light frames and long beam spans. Even well-constructed frame houses are stronger than the latter. Ammunition storage bunkers also give exceptional protection. These are usually large enough for most vehicles and equipment.

(b) Many European, rural and urban structures can provide good protection. Many types of pre-World War II European buildings provide good blast and radiation protection. Examples are farmhouses, churches, and municipal buildings. Characteristics to look for include the following:

- Pre-World War II buildings. These have thick, full-span floor and ceiling beams; heavy roofing tiles; dense, reinforced walls; and, in most cases, a full basement.

- Full basements constructed of concrete or stone. Make sure that there is an exit directly to the outside as well as through the upper floors in case of emergency.

- Thick-walled masonry structures.

- Buildings with very little glass. European windows are typically protected by roll-up or folding shutters. These coverings provide some additional blast and thermal protection.

(c) A shielded building is best. Exterior rows of buildings in closely arranged groups (towns) shield buildings in the interior. These shielded structures suffer less blast overpressure and structural damage than exposed structures. However, debris and rubble problems and fire hazards may increase toward the center of town. Commanders should consider using shelters located two or three building rows from the edge of town to avoid serious hindrance to postattack mobility.

(d) Personnel should move below ground level. The basement, because it is below ground, provides increased blast protection and much more LOS radiation protection than aboveground floors. This additional protection results from the surrounding earth fill. Add additional radiation protection by placing a layer of earth or sandbags on the floor above. This additional deadweight will be significant and may require shoring up the floor. Alternately, more protection can be gained by sandbagging a smaller shelter in the basement (such as a sturdy table) without increasing the possibility of the entire floor collapsing. Block windows with sandbags and enhance the radiation protection and structural strength of any aboveground exterior walls by piling dirt and sandbags against the walls. Generally speaking, personnel can reduce radiation by a factor of 10 in basements as compared to levels in aboveground floors.

(e) Positions inside the building can make a difference if sufficient time is available to properly prepare them. On floors aboveground, the center of the building offers the greatest protection from both initial and residual radiation. Belowground, the corners of the building give the greatest protection. In either case, the dose to prone personnel would be about one-half the dose to a standing individual. The lesson here is to seek shelter in an underground structure and lie in a corner. If an underground shelter is not available, lie in the center of a shelter under a sturdy table. Other options include lying inside a fireplace, under a stairway, or in a bathroom where the plumbing and relatively close spacing of walls might provide increased structural strength.

(5) Tents. Tents are not a preferred shelter against the effects of nuclear weapons. A tent does provide some protection from residual nuclear effects (e.g., particulate fallout).

(6) Armored Vehicles. Armored vehicles provide good nuclear protection. In most situations, tanks offer the best vehicular protection available. Lightly armored vehicles also offer good protection. These vehicles include infantry fighting vehicles (IFVs), self-propelled artillery, and some heavy engineer equipment. If time is available, this protection can be improved with any of the following actions:

(a) Keep as low as possible inside an armored vehicle. Crew members normally elevated in a tank turret should get on the floor of the armored vehicle. This applies to the tank commander, gunner, and loader. Assuming such a low position reduces the radiation received by a factor of 4.

(b) Keep all hatches shut. Obviously, an open hatch will expose the crew unnecessarily to explosion effects. It could subsequently allow the entry of fallout particles and scattered gamma radiation. Close any other openings, such as the main gun breech.

(c) Prevent injury while inside an armored vehicle. The blast wave will throw personnel violently about inside an armored vehicle. Wear a helmet with the chinstrap secured to help prevent head injuries.

(d) Secure all loose equipment inside the vehicle. The force of the blast can throw about unsecured, loose equipment (such as tools, weapons, and helmets) inside the vehicle and cause injury or death to personnel.

(e) Dig-in armored vehicles (hull defilade) or place them in trenches or cuts in roadways. This provides some limited LOS radiation protection and considerable blast protection. A hull defilade fighting position or a trench that allows half of the vehicle sides to be covered can reduce gamma radiation by as much as a factor of 2.

(f) Use sandbags as radiation shielding. A single layer of sandbags placed on top of a tank turret or an armored vehicle hull provides valuable overhead gamma shielding. Each layer of sandbags reduces the gamma radiation by a factor of 2. Wetting the sandbags enhances the neutron radiation shielding and protects the sandbags from thermal damage.

(7) Wheeled Vehicles.

(a) Avoid using wheeled vehicles as shelter. Generally, wheeled vehicles provide little or no protection from the effects of nuclear explosions. Worse still, they are particularly vulnerable to overturning. This exposes drivers and passengers to increased risks.

(b) Ensure that personnel protect themselves as much as possible inside the vehicles.

(c) Secure all loose equipment inside the vehicles.

(d) Plan for and prepare adequate field shelters immediately adjacent to facilities that require personnel to continue operations in wheeled vehicles. Parking the vehicle inside or under a shelter gives some protection to the personnel inside. Existing or natural structures—such as ammunition bunkers, underpasses, tunnels, and caves—are in this category.

(8) Aircraft Ground Operations.

(a) Revetments give little protection against blast overpressure. However, revetments and barricades protect aircraft from damage by dynamic wind. These also protect aircraft from other hazards—such as the impact of rocks, sand, and other aircraft or aircraft debris. The tactical situation may require revetting for protection from conventional weapons blast and fragmentation damage. Use overhead cover for aircraft if it is available. Close doors and windows against damaging overpressure.

(b) Tie-downs can reduce damage from tumbling of the aircraft. Generally, tie-downs do not produce excessive stress on tie-down points. Aircraft plexiglass windows shatter into fragments. This can happen at low-blast overpressure (1.5 pounds per square inch [psi]) when there is no other significant damage. Tape the edges and the centers of windows. This reduces the extent of fragmentation and the nuisance that fragments may cause to cockpit operations.

(9) Electromagnetic Equipment. When enough warning has been given, commanders must ensure that electronic equipment, such as radios and computers, are turned off and protected. EMP is the high-energy, short-duration pulse (similar in some respects to a bolt of lightning) generated by a nuclear detonation. It can induce a current in any electrical conductor and temporarily disrupt or overload and damage components of improperly protected or unprotected electronic equipment.

b. During-Attack Actions. Nuclear attack indicators are unmistakable. The bright flash, enormous explosion, high winds, and mushroom-shaped cloud clearly indicate a nuclear attack. An enemy attack would normally come without warning. Initial actions must, therefore, be automatic and instinctive.

(1) An attack occurring without warning is immediately noticeable. The first indication will be very intense light. Heat and initial radiation come with the light, and the blast follows within seconds. Time needed to take protective action will be minimal. If exposed when a detonation occurs, personnel should do the following:

- Drop facedown immediately with feet facing the blast. This will lessen the possibility of heat/blast injuries to the head, face, and neck. A log, a large rock, or any depression in the earth's surface provides some protection.

- Close eyes.

- Protect exposed skin from heat by putting hands and arms under or near the body and keeping the helmet on.

- Remain facedown until the blast wave passes and debris stops falling.

(2) Personnel should stay calm, check for injury, check weapons and equipment for damage, and prepare to continue the mission. Personnel in fighting positions can take additional precautions. The fighting position puts more earth between personnel and the potential source of radiation. They can curl up on one side, but the best position is on the back with knees drawn up to the chest. This position may seem vulnerable, but the arms and legs are more radiation-resistant and will protect the head and trunk. Personnel can also seek other forms of overhead protection (if available) within a fighting position/shelter in case the overhead cover/roof collapses. Store bulky equipment, such as packs or radios, in adjacent pits if they prevent personnel from keeping low in their positions, or place these items over the face and hands for additional radiation and blast protection.

(3) Personnel inside shelters should take protective actions. A blast wave can enter the shelter with great force, and the debris it carries can cause injuries. Lying facedown on the floor of the shelter offers protection. However, avoid the violent flow of air from doors or windows. Lying near a wall is safer than standing away from a wall. Constructing baffles or turns in shelter entrances can prevent overpressure buildups and the entry of dust and debris.

c. Postattack Actions. Protection must not stop when the attack ends. Immediately after an attack, postattack recovery begins.

(1) Personnel must check for radioactive contamination and, then, must reduce the hazard with basic decontamination. Decontamination techniques to reduce radioactive contamination are to brush, scrape, or flush radiological contamination from surfaces.

(2) As a minimum, unit personnel cover positions and shelters, and radiac meter operators begin continuous monitoring. IPE reduces the amount of contaminants that can enter the lungs and the potential for skin burns from beta and alpha particles.

(3) For the commander, poststrike actions include damage assessment and the restoration of combat power.

(4) Commanders and NBC personnel must also monitor schedules for pieces of NBC equipment having filters. Exchange is based on service equipment directives or when the following conditions are applicable:

- Physical damage occurs.
- Filters have become waterlogged or wet.
- High resistance to airflow is observed.
- Directed to exchange filters by higher HQ.
- Listed as unserviceable in applicable directives.

d. Nuclear Casualties. Blast, thermal radiation, and nuclear radiation all cause nuclear casualties. Except for radiation casualties, treat nuclear casualties the same as conventional casualties. Wounds caused by blast are similar to other combat wounds. Thermal burns are treated as any other type of burn. First aid cannot help radiation casualties. These casualties must be referred to medical facilities.

4. Biological Protection

This section discusses preattack, during-attack, and postattack aspects of protective actions that must be accomplished in the event of a biological attack. Protection against biological agents begins long before the actual attack happens. Biological agents can enter the body through the skin, respiratory tract, and digestive tract. Key preparations begin with personal health maintenance followed by NBC defensive training, which all personnel must master.

a. Biological Agents. Biological agents can be classified according to their biological type, operational effects, and physiological action. Operationally, biological agents are best thought of as either pathogens or toxins.

- Pathogens. Pathogens are living organisms. As such, they require certain conditions of temperature, humidity, protection from sunlight, and a susceptible host population. The biological agent must overcome a host's natural defenses (during a latent period) in order to cause illness. The duration period of this incubation could last from hours to days. Pathogens can be disseminated in wet or dry form or by vectors (e.g., mosquitoes). Additionally, some pathogens are contagious and can be spread from individual to individual; therefore, personnel not in the initial area of attack could become casualties. Following a large-scale dissemination of a biological agent, an initial disease outbreak of epidemic proportions might occur.

- Toxins. Toxins are poisons naturally produced through the activities of living organisms. Some toxins can now be artificially synthesized (e.g., powder form) and disseminated in liquid or dry form. Generally, toxins do not cause immediate casualty-producing effects, and any casualties will arise hours to days after exposure. Unlike pathogens, toxins are not contagious (e.g., one person cannot infect another).

(1) Duration of effectiveness. The effectiveness duration of a biological agent depends on the characteristics of the agent, environmental factors, and any residual hazards. Solar (ultraviolet) radiation, relative humidity, wind speed, and temperature gradient are some of the most important weather factors in determining the effectiveness duration. As previously mentioned, biological agents can be disseminated as aerosols, liquid droplets, or dry powders.

(2) Cause of Casualty-Producing Effects. The primary cause of biological-agent, casualty-producing effects is through inhalation of an aerosol containing particles. Additionally, casualties can also be caused by the percutaneous effects of agents such as mycotoxins. Weather conditions have a tremendous impact on the employment of biological agents. Pathogenic agents will generally dissipate and decay in the presence of ultraviolet radiation. Some of the agent-containing particles (e.g., spores) disseminated as an aerosol, may settle out of suspension onto the ground; however, the impact of any residual hazard from reaerosolization of spores, such as anthrax, may present a hazard for personnel operating in a contaminated area for extended periods of time.

(3) Protective Measures. Protective measures include the use of IPE (e.g., a well-fitted mask), good hygiene, proper sanitation, and up-to-date immunizations. An individual's IPE provides protection against BW agents; however, based on the delayed casualty-producing effects of BW agents, personnel will not likely know an attack has occurred. See applicable service publications for information on the prevention and treatment of biological-agent casualties.

b. Preattack Actions. Preparations before an attack can be accomplished long before a biological attack happens. Personal health maintenance and realistic training are just two ways in which commanders can minimize their biological casualties. All personnel and leaders must adhere to the basic principles of good health; this applies especially under NBC conditions.

(1) Up-to-Date Immunizations. Immunizations reduce the chances of becoming biological casualties. Proper immunizations protect against many known disease-producing biological agents. All personnel should receive basic immunizations. Medical personnel will periodically screen these records and keep them up to date. If units deploy to areas in which specific diseases are prevalent, readiness preparation may include providing additional immunizations for needed protection. This prophylactic inoculation should be part of the IPB process and should be brought to the commander's attention.

(2) Good Hygiene. Protect against the spread of disease by practicing good health habits. The best defense against biological agents is good personal hygiene, keeping the body as clean as possible. This means not only washing the face and hands, but all parts of the body—particularly the feet and exposed skin. Hands need to be cleaned before meals or anytime bare hands are used to help ingest food and liquid or when smoking. Shaving may seem unimportant in the field, but it is required to achieve a proper seal of the mask. This is important because biological agents are usually most effective when received via the respiratory system or the skin. Small nicks, scratches, and cuts are

unavoidable in a field situation. Pathogens, either naturally occurring or intentionally employed as biological agents, enter these breaks in the skin and will cause infections if left untreated. Personnel should clean any breaks in skin with soap and water followed by first aid treatment.

(3) Area Sanitation. Another way to stop the spread of disease is to keep the area clean. Bury all empty ration packets and residue. Locate, construct, and use field sanitation facilities properly. Latrine facilities should include soap and water for hand washing. Latrines need to be cleaned daily. Avoid leaving such facilities open, and make sure that they are properly filled and marked before moving to help prevent accidental digging in the areas. Control of insects and rodents is also essential in preventing the spread of disease. Additional information on field sanitation can be found in service preventive-medicine (PVNTMED) publications.

(4) Physical Conditioning. Good physical condition requires maintaining the body in a well-rested, well-fed, and healthy state. Personnel should get as much exercise and rest as the situation permits, and they must remember to eat properly. If they stay healthy, their bodies will be better able to fight off germs. A high level of physical fitness also reduces the likelihood of heat stress when MOPP gear is worn for extended periods. Continuous operations will require that personnel learn to sleep in short naps and in MOPP4. This is also part of the conditioning process. It may also become necessary to eat smaller portions and at more frequent intervals.

(5) DOD Insect Repellent System. Proper implementation of the DOD Insect Repellent System will provide protection from those insects and ticks that may be used as biological agent vectors.

(6) NBC Training. Training in an NBC environment is integrated into all areas of unit training—individual and collective. Personnel learn, practice, and train to perform individual NBC survival tasks. Leaders are directly responsible for reinforcing these tasks through continuous training, thereby instilling individual confidence.

c. During-Attack Actions. If threat forces attack with biological agents, there may be little or no warning. This will depend on the IPB assessment. Units automatically assume MOPP4 to protect themselves against contamination when there are high-probability indicators of an attack.

(1) Biological-Attack Indicators. Biological agents may be disseminated as aerosols, liquid droplets, or dry powder. Attacks with biological agents can be very subtle or direct, if favorable weather conditions prevail. In nearly all circumstances, an individual will not know a biological attack has occurred. Symptoms can appear from minutes to days after an attack has occurred. Indicators may include—

- Mysterious illness (many individuals sick for unknown reasons).
- Large numbers of vectors, such as insects or unusual insects.
- Large numbers of dead or strange-acting (wild and domestic) animals.

- Mass casualties with flu-like symptoms—fever, sore throat, skin rash, mental abnormalities, pneumonia, diarrhea, dysentery, hemorrhaging, or jaundice.

- Artillery shells with less powerful explosions than high-explosive (HE) rounds.

- Aerial bombs that pop rather than explode.

- Mist or fog sprayed by aircraft or aerosol generators.

- Unexploded bomblets found in the area.

(2) Immediate Actions. Assuming MOPP provides protection against biological agents. However, an agent can gain entry through openings such as buttonholes; zipped areas; stitching; poor sealing at ankles, wrists, and neck; or through minute pores in the clothing fabric. Some toxins, however, require the same amount of protection as chemical agents. Since no wide-scale immediate-warning, biological-agent detection device is fielded, consider any unknown agent cloud as a sign of a biological attack and take the same actions prescribed for a chemical attack. For COLPRO, personnel must be housed inside a shelter with an efficient air filter system. Many buildings may be converted into temporary shelters if cracks are carefully sealed and a CB filter system with a ventilating mechanism is installed.

d. Postattack Actions. Actions after a biological attack include submitting NBC reports, beginning post attack recovery, and other actions—such as taking samples, identifying casualties by the symptoms they exhibit, and treating those symptoms. Early recognition of symptoms and treatment is essential in trying to limit the effects. Additionally, personnel should decontaminate immediately after an attack by using decontamination kits or washing with soap and water.

Note: Postexposure chemoprophylaxis is essential for preventing anthrax. See FM 8-284, *Treatment of Biological Warfare Agent Casualties,* for details.

(1) Agent Exposure. It is necessary to isolate individuals showing symptoms of contagious disease. This isolation helps prevent possible spread to others if the disease is communicable. Treatment of biological-agent casualties requires medical assistance as soon as possible. Further, symptoms associated with some toxins mimic other illness or chemical-casualty symptoms. Agent symptoms may include—

- Dizziness, mental confusion, or double or blurred vision.

- Skin tingling, numbness, paralysis, or convulsions.

- Formation of rashes or blisters.

- Coughing.

- Fever, aching muscles, fatigue, and difficulty in swallowing.

- Nausea, vomiting, and/or diarrhea.

- Bleeding from body openings or blood in urine, stool, or sputum (spit).

- Shock (symptoms appear in minutes or hours after the toxin attack).

(2) Unmasking Procedures. Unless prior warning is received from higher HQ to mask in advance of the arrival of a biological attack, units will likely not be aware that they have been exposed to a biological agent. However, if a unit has received prior warning of an advancing cloud, there are procedures that can be implemented. For example, a biological agent point detector can indicate (through its air-monitoring capability) when an aerosol cloud has passed the point detector. Once that occurs, units use devices, such as hand-held assays, to conduct testing to determine if positive test results are received. The report information is passed to the NBC center (NBCC). The commander, with the advice from the intelligence officer/noncommissioned officer (NCO), NBC officer/NCO, and the command surgeon considers this data as well as data from other sources (e.g., weather, time of day, threat, etc). Based on the multiple sources of data, the commander considers whether to reduce protective levels.

(3) Filter Exchange. When assessing filter exchange criteria several factors must be considered. Exchange criteria for filters is based on service equipment directives or when the following conditions are applicable:

- Physical damage occurs.

- Filters have become waterlogged or wet.

- High resistance to airflow is observed.

- Directed to exchange filters by higher HQ.

5. Chemical Protection

This paragraph discusses preattack, during-attack, and postattack aspects of protection that must be accomplished in the event of a chemical attack. Protection against chemical agents begins before an attack. Chemical agents can enter the body through the skin, eyes, ingestion, and respiratory tract. Leaders conduct defensive planning against possible chemical-agent attack. Units prepare SOPs that specify their chemical defense techniques and procedures.

a. Background.

(1) Chemical agents having military significance are categorized as nerve, blister, blood, incapacitating, or choking agents. These chemical agents kill, seriously injure, or incapacitate unprotected personnel. Chemical agents are classified according to their physical states, physiological actions, and uses. The terms “persistent” and “nonpersistent” describe the duration of chemical agents remaining in a targeted area.

(2) Agents may exist as vapors, solids, liquids, or gases (depending on the temperature); and they may cause casualties in multiple physical states. For example, an agent may be disseminated as a liquid casualty hazard from a delivery vehicle, yet remain a

vapor hazard if the agent has high volatility or off-gases from a porous surface during high temperatures. To a certain extent, the state in which an agent exists determines its use, fate, and effects.

(3) Personnel can be exposed to chemical warfare (CW) agents through breathing (inhalation), the skin, and the eyes. The casualty-producing effects of chemical agents can occur within seconds, minutes, or hours. For example, nerve agents are quick-acting and can cause casualty-producing effects within minutes. Alternatively, blister agents can take hours to cause their casualty-producing effects. Drink and food contaminated by CW agents are also harmful. Other means of exposure are breaching of the full-protective ensemble (e.g., from a tear caused by a munitions fragment) and/or transfer from a contaminated surface during processing through a contamination control area (CCA).

(4) Personnel could potentially come into contact with casualty-producing liquid agents prior to the agents absorbing into a nonporous surface. Alternatively, once a liquid agent absorbs into a porous surface, such as concrete (e.g., during cool evening temperatures), the agent may off-gas as a vapor during higher daytime temperatures and also cause chemical-agent symptoms among exposed personnel. Furthermore, there are other possible situations wherein casualty-producing effects of chemical agents can be impacted by temperature and type of surface (for example, during cold weather, chemical agent droplets are absorbed by an individual's protective clothing, the agent off-gases during the person's entry into a shelter for warming, causing the individual to exhibit chemical agent signs and symptoms).

(5) Solid and liquid agents may provide an operational hazard for hours, days, or months depending on the agent, weather conditions, and other factors.

b. Preattack Actions.

(1) Assess chemical threat, potential risk, and likelihood of attack.

(2) Implement coordinated chemical defense plan.

(3) Prepare to provide first aid for unit personnel.

(4) Determine and implement appropriate MOPP levels.

(5) Minimize skin exposure.

(6) Continue good hygiene and sanitation methods.

(7) Deploy and activate detectors.

(8) Designate and prepare shelters.

(9) Watch for attack indicators (e.g., a chemical cloud, a distinctive odor, and release of an agent).

(10) Cover unprotected mission-essential equipment.

c. During-Attack Actions.

(1) Give Attack Warnings. Detection and warning of the attack are critical to the implementation of protective measures. The warning signal for the attack directs personnel to take cover and use protective measures.

(2) Take Cover. Taking cover protects personnel against blast, shrapnel, heat, liquid, and particulate contamination. After taking cover, personnel don their masks and other protective gear, as appropriate.

(3) Use MOPP4. All personnel should assume MOPP4 (full IPE) in the absence of any other information and remain in MOPP4 until directed to reduce their MOPP level. The use of the MOPP ensemble could also be supplemented by the use of protective clothing—such as wet-weather clothing; an air crewman's cape; or the suit, contamination avoidance, and liquid protective (SCALP). (See Appendix A for more information on these items of IPE.)

d. Postattack Actions.

(1) Begin post attack recovery. If an adversary uses an air-bursting chemical munition, mission permitting, personnel will avoid outside activities to the maximum extent possible after an attack during the chemical droplet fall phase. Additionally, the chemical droplet fall phase could last up to approximately 60 minutes. The length of time depends on factors such as meteorological data and the weapon's height of burst. Outside activities could result in erroneous initial reconnaissance results and unnecessarily contaminated personnel and equipment.

(2) Avoid potentially contaminated surfaces/areas. All personnel should minimize contact with potentially contaminated surfaces until there are indications that surface contamination is no longer a hazard.

(3) Obtain and report observations or evidence of an attack. Personnel provide reconnaissance and assessment information for all types of damage, hazards, and chemical agents.

(4) Survey, control, and mitigate health hazards (treat and evaluate casualties). The HSS provides treatment for casualties according to established medical protocols.

(5) Adjust MOPP. Commanders should adjust MOPP to the lowest possible level consistent with identified hazards.

(6) Document exposure. Medical staffs should clearly document exposure in the medical records of those personnel who have been exposed.

(7) Sample, monitor, and analyze for residual hazard. Once the situation permits, the detection efforts determine the extent and duration of the residual hazards.

(8) Plan and implement decontamination and contamination containment actions. These actions are planned and implemented to minimize the operational impacts of contamination.

(9) Conduct unmasking procedures (all-clear). Commanders should revert to an appropriate MOPP level based on the current threat in conjunction with the all-clear signal. Personnel engaged in passive-defense functions should repair and resupply defense equipment in preparation for follow-on attacks. All personnel should return their IPE to a ready status in anticipation of the next attack warning.

(a) Selective Unmasking. Selective unmasking is an operational precautionary procedure used to support mask removal decisions. The unmasking process acknowledges detector limitations and requires one or more individuals to unmask for brief periods while others observe them for agent effects. Do not perform selective unmasking if agent detectors continue to detect an agent within the area or structure. Also recognize that the recommended unmasking methodology should meet personnel safety requirements and that accomplishing unmasking procedures does not guarantee the absence of low-level exposure.

(b) Unmasking Procedures Using the M256-Series Chemical Detector Kit. An M256-series chemical detector kit does not detect all agents. Therefore, consider also using unmasking procedures listed below in subparagraph (c), even if the detector is available. These procedures take approximately 15 minutes. After all tests with the kit, including a check for liquid contamination, have been performed and the results are negative, the senior person should select one or two individuals to start the unmasking procedures. If possible, move to a shady place. Bright, direct sunlight can cause pupils in the eyes to constrict, giving false signs of nerve agent exposure. The selected individuals unmask for 5 minutes and then reseal and clear their masks. Observe them for 10 minutes. If no symptoms appear, the commander/leader considers issuing the all-clear signal for unmasking. Continue to watch the personnel for possible delayed symptoms. Always have first aid treatment immediately available in case it is needed.

(c) Unmasking Procedures Without the M256-Series Chemical Detector Kits. If an M256-series kit is not available, the unmasking procedures take at least 35 minutes. Find a shady area. Use M8/M9 paper to check the area for possible liquid contamination. When a reasonable amount of time has passed after the attack, the senior person should select one or two individuals. They take a deep breath, hold it, and break the seal for 15 seconds, keeping their eyes wide open. They then clear and reseal their masks and are observed for 10 minutes. If no symptoms appear, the selected individuals break the seal of their mask, take two or three breaths (keeping their eyes wide open), and clear and reseal their masks. Observe them for 10 minutes. If no symptoms appear, the selected individuals unmask for 5 minutes and then remask. If no symptoms appear in 10 minutes after remasking, the commander considers issuing a directive for an all-clear. This process takes a minimum of 35 minutes. Leaders continue to observe the selected personnel in case delayed symptoms develop.

(d) Personnel Displaying Symptoms. In both cases, if personnel display symptoms of agent poisoning, ensure that first aid procedures are available and provided. If an agent is still present, the senior person present must select one of the following options:

- If possible, move to a new area and retest.

- If the mission dictates that movement cannot be conducted, conduct a retest after 1 hour.

Note: Leaders remain aware that selected chemical agents (e.g., blister agents) may not result in the onset of symptoms for several hours.

(e) Assessing Detector Information. Detector capabilities necessitate that leaders analyze the situation to determine if it is safe to unmask after the detection instruments or devices indicate negative results. This need for analysis exists because of the potential presence of low-level vapors that, through their cumulative effect on the body, may cause eye damage or more severe effects within minutes or hours. Analysis is required even if the above-mentioned unmasking procedures are used. NBC personnel should utilize service directives and materials to assist in this process. The key is the use of risk assessment to balance force survivability and the mission and to acknowledge that different agents dissipate at various rates from different surfaces. For example, the hazard time lines associated with contaminated equipment may exceed those associated with soil and/or concrete surfaces.

(10) Chemical Filter Exchange. Filter exchange is another action that is based on design, physical condition, climatic conditions, and the possible threat agent that could be employed. Information in the following paragraphs addresses peacetime, transition-to-war, and wartime exchange criteria.

Note: The information in this section is not meant to supersede other guidance contained in service-specific TTP or technical publications.

(a) Peacetime Filter Exchange. When assessing filter exchange criteria, several factors must be considered. Commanders and NBC personnel must monitor replacement schedules for pieces of NBC equipment having filters. Peacetime exchange criteria for all filters must occur when the following conditions are applicable:

- Physical damage occurs.

- Filters have become waterlogged/wet.

- High resistance to airflow is observed.

- Directed to exchange filters by higher HQ.

- Filters are listed as unserviceable in applicable supply bulletins (SBs), technical orders (TOs), etc. Selected service directives, may indicate specific filter lot numbers are unserviceable; however, if those filters are not clogged or damaged, they should still be considered serviceable for peacetime applications.

(b) Transition to War Filter Exchange. Commanders will determine when their units should remove their training filters and replace them with filters from unit contingency stocks. This guidance should be reflected in an SOP or an order. Factors for filter exchange consideration are unit location, unit readiness/deployability alert status, last filter exchange, threat, time availability, and stocks available. For example, a forward deployed unit commander, based on an enemy chemical capability in the AO, directs (by SOP) that his unit install its contingency filter set. Alternatively, a CONUS-based unit commander determines that the basis for installing contingency filters would occur upon an increase in unit alert status for deployment to an area with an NBC threat. Before initiating filter exchange, leaders consider the implications for their units. Some considerations are—

- Mission. What is the unit mission?

- Enemy. What is the current NBC threat assessment? Is the unit likely to be attacked on arrival in the operational area?

- Terrain and weather. Where should filters be exchanged—at the home station, en route, or in the operational area?

- Time available. When should filters be exchanged? When will there be adequate time to exchange filters?

- Troops and support available. Are the right people available to conduct the exchange?

(c) Wartime Filter Exchange. The decision to change filters is driven by two considerations: the amount of chemical agent the filter has been exposed to and the time the filter has been exposed to the atmosphere. These separate considerations are based on the two mechanisms by which the filter provides protection from chemical agents. For all agents, the filter uses mechanical filtration and absorption as the protection mechanism. For blood agent cyanogen chloride (CK), the filter uses a chemical reaction. The chemical reaction mechanism is degraded by prolonged exposure to CK. The absorption capacity is degraded by exposure over time to air, particularly hot, humid air. Based on these factors, the following filter change criteria apply:

Note: In an AO with no chemical attacks confirmed and no CK threat, filters should be changed annually. In an AO with no chemical attacks confirmed but where a CK threat exists, the filters should be changed according to guidance provided in Table II-5.

Note: Information in this table is applicable to USA units; other services follow directives as prescribed in applicable TOs and TMs.

- Physical damage occurs.

- Filters have become waterlogged/wet.

- High resistance to airflow observed.

- When directed by higher authority.

- For units that have received chemical attacks, change all filters every 30 days.

Table II-5. Wartime Climatic Filter Exchange Intervals, Blood Agent Threat Is High (Given In Weeks)

Climate Category					
Filter	**Cold Humid**	**Warm Moderate**	**Hot Dry**	**Hot Humid**	**System**
C-2/M13A2	52	52	39	10	M40/M42/M43/MC-2AP-series protective mask.
M10A1	52	52	52	13	M24/M25 protective mask.
M18 Gas	52	39	26	4	Filter composition of M13 tank GPFU.
M12A1 Gas	52	39	26	4	Fixed site filter used in structures and buildings.
M48 Gas/Particulate	52	52	39	10	M1A1 tank overpressure system.
MCPE Gas/Particulate	52	39	26	4	MCPE.
M10 Gas	52	39	26	4	Fixed-site shelter.
C-22 R1 Gas	52	52	52	13	GPFU M46 fixed-site filter.

Climatic Definitions		
Category	Mean Temp (F)	Mean Relative Humidity (%)
Cold Humid	Less than 15 degrees	Less than 90 percent
Warm Moderate	Less than 80 degrees	Less than 70 percent
Hot Dry	Less than 98 degrees	Less than 27 percent
Hot Humid	Less than 96 degrees	Less than 76 percent

Note: The climactic intervals listed are applicable to USA units; other services follow directives as prescribed in applicable technical publications.

Student Handout 4

Extracted Material from FM 25-51

This student handout contains 13 pages of extracted material from the following publication:

FM 25-51, Battalion Task Force Nuclear Training, Jun 91

Chapter 2 pages 2-1 thru 2-13

Disclaimer: The training developer downloaded the extracted material from the General Dennis J. Reimer Training and Doctrine Digital Library. The text may contain passive voice, misspellings, grammatical errors, etc., and may not be in compliance with the Army Writing Style Program.

CHAPTER 2

NUCLEAR WEAPON EFFECTS

THIS CHAPTER IMPLEMENTS STANAGs 2083 AND 2111.

Perceptions of conventional-nuclear combat are usually distorted by the popularized versions of the "holocausts" at Hiroshima and Nagasaki in August 1945. Certainly, those two bombs demonstrated explosive combat power that was several orders of magnitude more potent than any other weapon then known. However, the incendiary bombing of Tokyo in March 1945 had created a holocaust that lasted for two days, took more lives, and destroyed a larger area than either of the first atomic bombs. Most current nuclear weapons that will be used for battlefield nuclear fire support are smaller than the Hiroshima or Nagasaki bombs. Although many may have yields as small as 1/10th to 1/100th the size of the first nuclear weapons used, they are still many times more powerful than most conventional munitions. Nevertheless, their effects on the battlefield are finite and limited to "tactical" distances from a few hundred meters (m) to a few kilometers (km). The actual yields of nuclear weapons currently in the field are classified. Consequently, this chapter will discuss only four hypothetical yields, namely 2 kilotons, 5 kilotons, 10 kilotons, and 20 kilotons. These four yields span most of the range of yields likely to be employed to provide nuclear battlefield support, and they are useful in portraying the effects of weapons in this yield range. The nuclear weapon effects data presented in this chapter are realistic.

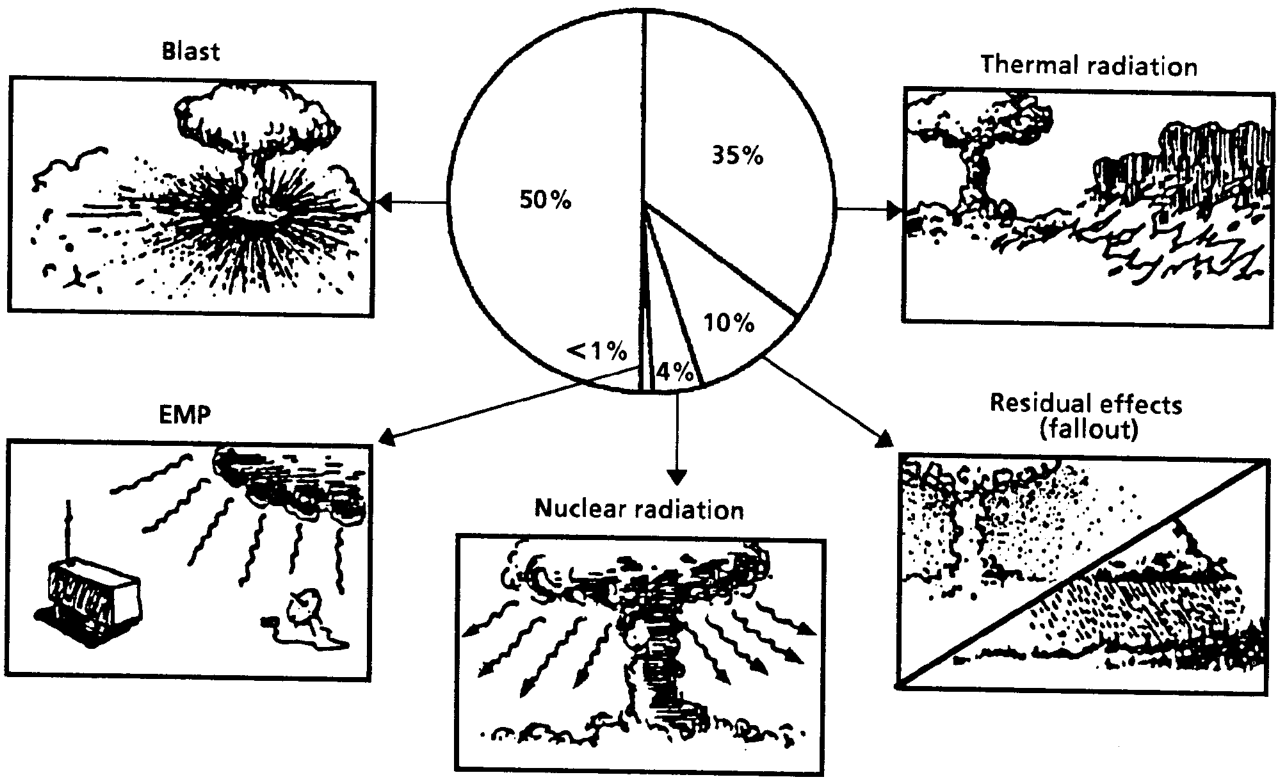
The effects of a nuclear detonation of concern to a commander and to his unit are:

- *Psychological.*
- *Nuclear radiation.*
- *Electromagnetic pulse (EMP).*
- *Blast.*
- *Thermal.*

The extent of each effect occurs in relationship to the yield of the nuclear blast. The dominant effect or the effect which extends furthest out from ground zero depends on the yield of the weapon and is important for a commander to know. This will be provided in the figures and graphs which follow. The figure on page 2-2 illustrates the type of energy, by percentage, that a nuclear weapon will produce. The degree of hazard from each effect depends on—

- *The type of weapon, the yield, the height of burst, and the distance between the point of detonation and the target.*
- *The environment in which the weapon is detonated.*
- *The vulnerability of the target. Nuclear weapons may be detonated in the air, on the surface, or beneath the surface. Each type of detonation produces a different result as shown in the figure on page 2-2.*

Distribution of energy



Results of detonation types

Type Burst	Blast	Thermal	Nuclear Radiation	EMP
Air	Great and widespread.	Great and widespread.	Considerable prompt radiation. No significant residual radiation except for small areas under blast.	Effect 3 to 9 miles from GZ up to altitudes of 19 miles. Great and widespread for burst above 19 miles.
Surface	Great but radius of effect somewhat reduced.	Great but not widespread.	Great, prompt, but not widespread. Residual radiation will appear as fallout.	Extends outward 3 to 5 miles from GZ.
Subsurface	Great but radius of effect greatly reduced.	Negligible.	Little or no instant radiation. Great amount of residual fallout.	Limited to area around GZ.

PSYCHOLOGICAL

An effect that is most often forgotten when talking about nuclear effects is the psychological effect it has on soldiers. It is often referred to as acute combat reaction or stress. Although it is possible to estimate roughly the number of injured and dead which would result from the thermal, blast, and radiation effects of a nuclear weapon used in combat, it is much more difficult to predict the numbers and types of psychiatric patients. It is generally felt that the acute psychological problems which would occur would be essentially the same as those seen in other combat situations, and that the treatment methods developed as a result of experience in past wars would be appropriate.

The primary psychological abnormality which develops in severe stress or disaster situations is a transient, fluid state of emotional disruption. This abnormality occurs when an individual cannot cope with the danger presented to him by his environment. Its major features are fear and the results therefrom. The fear develops largely from the individual's inability to make meaningful decisions or to initiate purposeful actions; and as a result, even minor decisions become difficult to make. A vicious circle of fear-inaction-fear may ensue, and the individual involved may become ineffective. This may vary in degree from very mild to complete helplessness.

Panic defined as frantic, irrational behavior associated with real or supposed trapping would probably be rare since it has been found to be rare in other disaster situations. Chronic mental disease, either psychotic or neurotic, also would probably be rare. This again reflects the finding that these reactions are not commonly seen in disaster situations.

Characteristic disturbances would include stunned mute behavior, uncontrolled flight, tearful helplessness, apathetic depressed states, inappropriate activity, increased tension, or preoccupation with somatic representations. These disturbances can last for minutes, hours, days, or sometimes weeks. Fortunately, people with the milder and shorter reactions are in the majority.

The frequency and severity of the psychological disturbances vary with several factors:

- Intensity and severity of stress. Stressful situations of brief duration are rather easily tolerated, and recovery of individuals with mild degrees of mental disruption under these circumstances is rapid. If stressful situations follow one another rapidly, or if any one of them is of long duration, more severe psychological reactions of longer duration may increase.
- Degree of personal involvement. If an individual has a "close call" or if he sees close friends or relatives severely injured, his reaction will be more severe than if he remains "relatively" remote from danger.
- Degree of training. This is the most important factor in that it is the one which is most easy to modify. A well-trained individual, who can react instinctively to dangerous situations and initiate appropriate actions, will develop a minimum of incapacitating fear. The fear he does develop will, if anything, help him. It will be an integral part of a reaction of increased awareness or alertness allowing more efficient fight or flight.
- Degree of warning. This is closely related to the above paragraph. Warning helps a trained person to prepare. He can initiate proper actions early. For an untrained person, the effect will be variable. If fear of incapacitating degree occurs, then the warning may well result in more harm or danger. If the fear is not incapacitating, then the untrained person who cannot react automatically to initiate proper actions may be able to use the time to improvise appropriate action. Whatever time he has to do this will help.
- Presence or absence of leadership. In a group in a disaster situation, a few individuals will emerge as leaders. These may not be the appointed leaders, although in a military unit this is usually not the case unless the appointed or regular leaders become ineffective or are lost. When effective leadership is available, the group will fare much better than when there is none.
- Group identification. This is a particularly important factor for the military. If group or unit integrity is preserved, the individuals in the unit will do much better. Also, those individuals with mild psychological disruptions will recover faster if they can remain with or close to their unit, thus retaining their personal relationship.

NUCLEAR RADIATION

Nuclear radiation is separated into initial and residual radiation. Initial radiation is emitted within the first minute after the detonation. Residual radiation occurs in the form of fallout or radioactive dirt and dust that falls back to the ground in a plume pattern. When CPT Anderson's operations NCO reported a reading of 15 cGys from his IM-93 dosimeter shortly after the detonation, it is highly possible that this was caused by initial radiation. However, CW2 Carlson's report of 150 cGy 30 minutes after the detonation included both the initial and residual effects. As shown in the figure on page 1-13, the battalion TOC is outside the plume of fallout, while CW2 Carlson and the attack helicopter company are within zone 1 of the fallout plume. Zone 1 has the probability of the highest residual radiation levels. It is essential that soldiers in this area take immediate actions to protect themselves because residual radiation causes damage to the body for an extended time. Chapter 3 discusses the best actions to take when in zone 1. Nuclear radiation consists of radioactive particles, too small to be seen by the naked eye. Radiation travels at the speed of light and interacts with the human body. It causes damage to tissues and cells.

Assessment of the Radiation Hazard

The figure below provides a guide for use by commanders as to the effects of nuclear radiation in terms of combat effectiveness. It is based on the reaction of groups to nuclear radiation and should normally apply to company-or platoon-sized units. It also outlines effects of tactical importance according to the fraction of a group affected at given range of dose.

Biological effects of nuclear radiation (STANAG 2083 Edition 5)

Estimated Dose Range (rad)	Initial Symptoms	Onset of Symptoms	Incapacitation	Hospitalization	Final Disposition
0-70	None to slight incidence of transient headache and nausea. Vomiting in up to 5% of exposed personnel in upper part of dose range.	Within 6 hours.	None.	None.	Duty.
70-150	Transient mild headache and nausea. Some vomiting in up to 50% of group.	Approx 3 to 6 hours after exposure.	None to slight decrease in ability to conduct normal duties in up to 25% of group. Up to 5% of group may become combat ineffective.	Eventual hospitalization (20 to 30 days in upper part of dose range) required for less than 5% in upper part of dose range.	Duty. No deaths.
150-450	Headaches, nausea, and fatigue. Slight incidence of diarrhea. More than 50% of group vomits.	Within 3 hours after exposure.	Can perform routine tasks; sustained combat task may be hampered. More than 5% of group expected to become combat ineffective, increasing with higher dose.	Hospitalization (30 to 90 days) indicated for those in the upper dose range following a latent period of 10 to 30 days.	Some deaths anticipated; probably less than 5% at lower part of dose range, increasing to 50% toward upper end. Return to duty questionable in upper dose range.

Biological effects of nuclear radiation (STANAG 2083 Edition 5)(continued)

Estimated Dose Range (rad)	Initial Symptoms	Onset of Symptoms	Incapacitation	Hospitalization	Final Disposition
450-800	Severe nausea and vomiting. Diarrhea. Fever early is upper part of dose range.	Within 1 hour after exposure.	Can perform simple tasks. Simple tasks. Significant reduction in combat effectiveness in upper part of dose range. Lasts more than 24 hours.	Hospitalization (90 to 120 days for those surviving) indicated for 100% of exposed personnel. Latent period 7 to 20 days.	Approx 50% deaths at lower part of dose range, increasing toward upper dose range. All deaths occuring within 45 days.
800-3,000	Severe and prolonged vomiting, diarrhea, and fever.	Approx 1/2 to 1 hour after exposure.	Significant reduction combat effectiveness. In the upper part of the dose range, some personnel will undergo a transient period of complete combat ineffectiveness followed by capability for some response until end of latent period.	Hospitalization indicated for 100% of exposed personnel; latent period of less than 1 day.	100% deaths occurring within 14 days.
3,000-8,000	Severe and prolonged vomiting, diarrhea, fever, and prostration. Convulsion may occur at higher doses.	Within 5 minutes after exposure.	Will become completely incapacitated within 5 minutes and will remain so for 30 to 45 minutes. Will then recover but will be functionally impaired until death.	Hospitalization indicated for 100% of exposed personnel. Latent period of 1 to 2 days.	100% deaths occurring within 5 days.
8,000-18,000	Severe and prolonged vomiting, diarrhea, fever, and prostration. Convulsions may occur at higher doses.	Within 5 minutes after exposure.	Will become completely and permanently incapacitated for performing physical tasks within 5 minutes.	Hospitalization indicated for 100% of exposed personnel. No latent period.	100% deaths occurring within 2 days.
Greater than 18,000	Convulsions and prostration within 15 hours.	Within 5 minutes after exposure.	Will become completely and permanently incapacitated for performing any tasks within 5 minutes.	Hospitalization indicated for 100% of exposed personnel. No latent period.	100% deaths occurring with 15 hours.

Radiation Exposure Status

The radiation exposure status (RES) is an estimate, indicated by a categorization symbol, which may be applied to a unit, subunit, or to an individual. It is based on total cumulative dose received from exposure to penetrating radiation.

The RES provides a convenient method of enabling information regarding nuclear radiation doses to be exchanged. Since it is directly related to effects of tactical interest, it can be used for estimating the effectiveness of groups and can be employed when planning future exposure.

The scenario for the infantry battalion (page 1-12) lists the RES of each of the companies in the battalion. The commander must use the figures below to make decisions for future radiation exposure of each of his units. Listed are "degree-of-risk" criteria which should be used by unit commanders for assessing the risk of employing their units to additional radiation based on the mission and the tactical situation.

Commanders' guide on nuclear exposure status

Total Cumulative Dose [1] [2]	RES Category	Probable Initial Tactical Effects (after exposure)
0 (no exposure)	0	None
Greater than 0, but not greater than 70	1	None to slight decrease in combat effectiveness in up to 5 percent of group.
Greater than 70, but not greater than 150	2	Decrease in combat effectiveness in up to 25 percent of group; up to 5 percent of group expected to become combat ineffective.[3]
Greater than 150	3	Groups probably not able to perform complex tasks; sustained effort hampered; more than 5 percent of group expected to become combat ineffective, increasing with increasing doses.[3]

NOTES:
1. Injury or exposure to chemical agents may effect response to nuclear radiation.
2. The figures in the dose column may be subject to change in the light of future medical knowledge.
3. Combat ineffectiveness is taken to be the onset of serious nuclear radiation sickness.

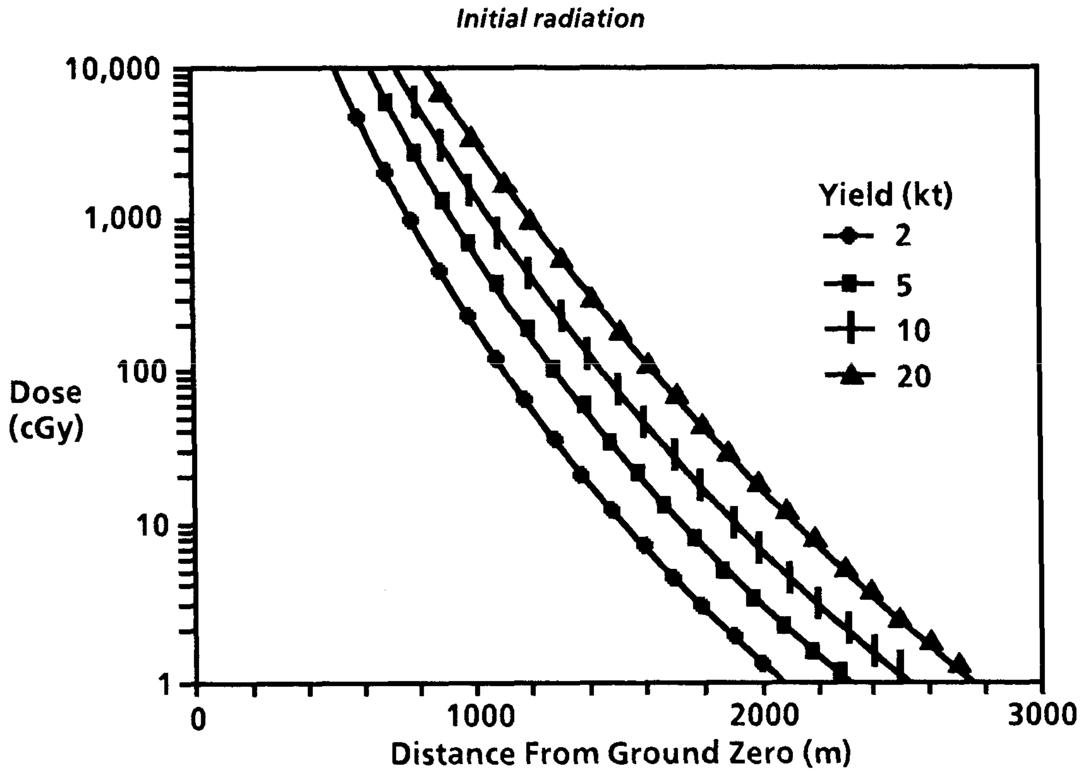
Nuclear radiation degree of risk exposure criteria

Total Cumulative Dose Before Exposure	RES Category[1]	Single Exposure Criteria[2]
No exposure	0	Negligible risk: Less than 50 cGy Moderate risk: Less than 70 cGy Emergency risk: Less than 150 cGy[2]
Greater than 0, but less than or equal to 70[3]	1	Negligible risk: Moderate risk: Emergency risk: That further dose which, when, added to the unit's dose, will not exceed the appropriate OEG risk criterion.
Greater than 70, but less or equal to 150[3]	2	Any further exposure is considered to exceed a moderate risk. Emergency risk: That dose which, when added to the unit's dose, will not exceed the OEG emergency risk criterion.
Greater than 150	3	All further exposure will exceed the emergency risk.

NOTES:
1. Risk levels are graduated within each status category to provide more stringent criteria as the total nuclear radiation dose accumulated becomes more serious.
2. Risk levels, as defined in FM 101-31-1 (see STANAG 2111), are:

Risk Level	Percent Incidence of Combat Ineffectiveness	Performance Degrading But Not Casualty Producing Effects
Negligible	1	2.5
Moderate	2.5	5
Emergency	5	No limit

NOTES:
3. If a unit's dose within category R1 or R2 is unknown, the unit's dose is assumed to be the midpoint of that category.



The extent to which initial nuclear radiation extends outward from ground zero depends on its yield and whether there are structures or barriers that block its path. The figure above compares the distances with different types of effects. The extent to which residual radiation will cause its effect is based on yield and upper-level wind patterns. Simplified predictions, as shown in the figure on page 1-13, can be used to determine possible hazards. However, detailed predictions and calculations must be performed at brigade and division level to determine actual hazard locations.

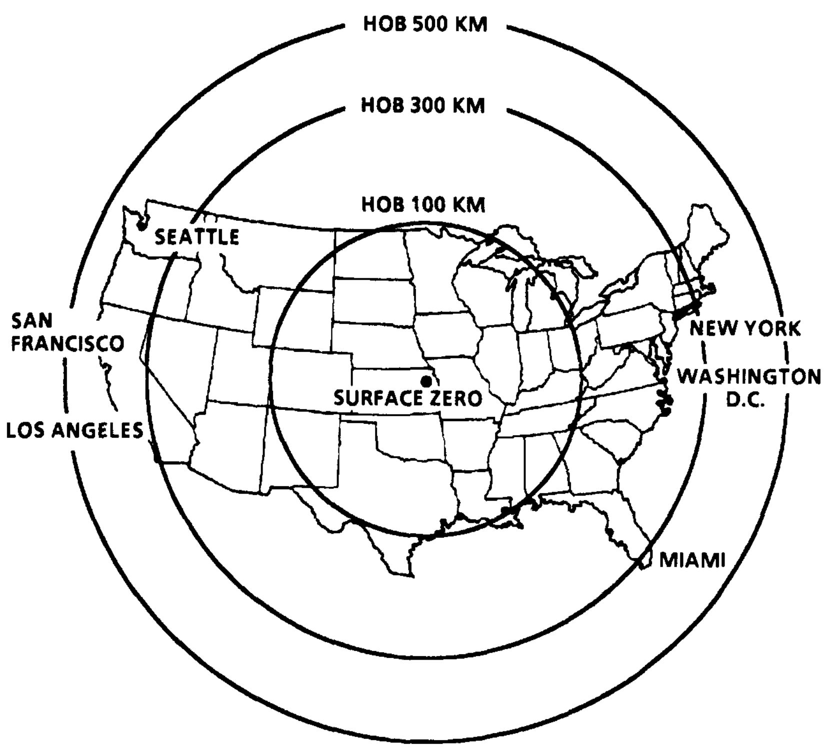
The Warsaw Pact armies have significant numbers of tactical nuclear weapons and assorted means to deliver them. Generally, we anticipate that low-yield weapons would be used against our forces near the forward line of own troops (FLOT) while larger yield weapons would be used against rear areas. Current information suggests that for every soldier receiving an acute incapacitating dose (greater than 3,000 cGy), another will receive a potentially lethal but not immediately incapacitating dose (from about 400 to 650 cGy). Two or more other soldiers would receive doses of radiation significant enough to cause them to be only marginally capable of performing their combat tasks. For yields of 5 to 10 kiloton (or less), initial nuclear radiation is the dominant casualty producer on the battlefield. Soldiers receiving an acute incapacitating dose (3,000 cGys) will become performance degraded almost immediately and combat ineffective within several hours. They will usually die within 5 to 6 days after exposure. Soldiers receiving less than a total of 150 cGy will remain combat effective. Between those two extremes, soldiers receiving doses greater than 150 cGy will become degraded; some will eventually die. A dose of 530 to 830 cGys is considered lethal but not immediately incapacitating. Personnel exposed to this amount of radiation will become performance degraded within 2 to 3 hours, depending on how physically demanding the tasks they must perform are. They will remain in this degraded state at least 2 days. However, at that point they will experience a recovery period and will be effective at performing nondemanding tasks for about 6 days. Then they will relapse into a degraded state of performance and remain so for about 4 weeks. At this time they will begin exhibiting radiation symptoms of sufficient severity to render them totally ineffective. Death may follow.

ELECTROMAGNETIC PULSE

One of the principal effects of nuclear weapons is their ability to produce adverse effects on electronic equipment. These effects are generally referred to as TREE (transient radiation effect on electronics) and EMP (electromagnetic pulse). Although these effects work in somewhat different ways, in both cases electronic equipment, such as field radios, generator controls, and aircraft and missile components, may become upset or inoperable. This will likely cause unit performance degradation as a result of equipment loss. Unique leadership challenges will require great flexibility on the part of soldiers and leaders as normal lines of communication are broken and new ones are established.

Electromagnetic pulse is an electromagnetic wave similar to radio waves which results from secondary reactions occurring when the nuclear gamma radiation is absorbed in the air or ground. It differs from the usual radio waves in two important ways. First, it creates much higher electric field strengths, Whereas a radio signal might produce a thousandth of a volt or less in a receiving antenna, an EMP might produce thousands of volts. Second, it is a single pulse of energy that disappears completely in a few seconds. In this sense, it is rather similar to the electrical signal from lightning, but the rise in voltage is typically a hundred times faster. Unlike lightning, EMP does not produce a flash in the sky nor a loud noise. Likewise, devices that protect equipment against lightning do not necessarily provide protection against EMP. EMP caused by tactical nuclear weapons will extend further than blast, thermal, or radiation. EMP which will have damaging effects on critical electronics equipment will range from 3,000 meters for the lower yield tactical nuclear weapons to about 12,000 meters for the higher yields.

High-altitude EMP coverage at various heights above the United States



Based on this information, the infantry battalion was totally encompassed by the effect of damaging EMP. Survivability of the electronics equipment in the battalion depends on how much of its equipment was designed with nuclear (HEMP) hardening, how well nuclear hardening was protected during maintenance, and how effective EMP mitigation techniques were implemented. The communications problems and equipment failure show that the battalion was not prepared. Proper EMP survivability and mitigation techniques are discussed in Chapter 3.

EMP also results from high altitude (above 31 kilometers or 19 miles) nuclear blast. Nuclear weapons detonated at these heights are strategic and cause more damage to electronics. They extend over a much greater area on the ground than low-altitude or ground-burst EMP.

Detonations that occur at these heights (especially greater than 100 kilometers) will not be seen, felt, or heard by soldiers on the ground. But, the EMP field could damage or destroy critical electronic components in communications systems and other materiel. The figure on page 2-8 shows the area covered from high-altitude nuclear detonation above the center of the United States. As shown, the entire continental United States is covered by the effects of EMP caused by a detonation at an altitude of 500 kilometers (inner ring). A detonation at 300 kilometers height of burst will cover over 80 percent of the continental United States. For a 100-kilometer height of burst, EMP's damaging effects extend out as far as 700 to 800 miles from the center of the burst.

There is no evidence that EMP is a physical threat to humans. However, electrical or electronic systems, particularly those connected to long wires, such as power lines or antennas, can undergo either of two kinds of damage. First, there can be actual physical damage to an electrical component, such as shorting of a capacitor or burnout of a transistor, which would require replacement or repair before the equipment can again be used. Second, at a lesser level, there can be a temporary operational upset, frequently requiring some effort to restore operation. For example, instabilities induced in power grids can cause the entire system to shut itself down, upsetting computers that must be started again. Base radio stations are vulnerable not only from the loss of commercial power but from direct damage to electronic components connected to the antenna. In general, portable radio transmitters and receivers with relatively short antennas are less susceptible to EMP. The vulnerability of the telephone system to EMP cannot be determined.

BLAST

A fraction of a second after a nuclear detonation, a high-pressure wave develops and moves outward from the fireball. This is the blast or shock wave and is the cause of most of the physical destruction accompanying a nuclear burst. The front of the blast wave travels rapidly away from the fireball, behaving like a moving wall of highly compressed air. This wave travels at approximately the speed of sound and consists of wind (dynamic overpressure) and crushing force (static overpressure).

Wind

The wind can range from a few miles per hour up to hundreds of miles per hour, depending on the yield of the weapon, height of burst, and distance from the point of detonation, The wind decreases with distance. For example, a 100-miles-per-hour wind will occur approximately 6 miles from a l-megaton detonation, 4 miles from a 300-kiloton detonation, or 1 mile from a 5-kiloton detonation. However, when a nuclear burst first detonates, the observer will not know the yield or ground zero. The winds have a positive and a negative phase. During the positive phase, the winds travel outward from the point of detonation. As the fireball rises, a slight vacuum is created that will cause the winds to reverse and blow back toward the detonation, The velocities of this reverse wind are mild compared to the positive phase. The reversal of the winds will keep debris in the air longer and possibly cause more damage. Because of the turmoil, ground troops may not even notice the negative phase. Aircrews may notice it more because wind reversal will create more air instability for them to overcome and will worsen any overcorrection effect.

The winds cause damage by drag forces. They overturn buildings, vehicles, or personnel; create missiles from debris, rocks, sticks, or glass fragments; hurl standing personnel against structures; and blow down trees. For nuclear weapons, the time from the initial blinding flash of light until the blast wave reaches the area can be several seconds or longer. For large-yield weapons at great distances, the time can be longer than 30 seconds. This means there will be some time to react before the blast wave hits.

Both wind and drag forces significantly affect the aerodynamics of both fixed and rotary-wing aircraft. As was seen in the scenario, CW2 Carlson was extremely lucky to be able to control his helicopter under such harsh conditions. Nuclear blast winds have the same effects on aerodynamic surfaces and airframes as any other type of high wind. The nuclear weapons can produce enormous wind velocities, extreme turbulence, and wind shear. The length of time that the winds persist is longer than that produced by conventional munitions. Wind effects on rotary-wing aircraft may result in yaw, pitch, roll, and lift changes. They can also cause blade flapping and bending, mast bumping, loss of tail rotor effectiveness, flameout, and airframe crushing.

Crushing Force

Blast also results in a crushing force (static overpressure) which can be hundreds of times greater than the ambient air pressure. As with winds, the crushing force decreases with the distance from the point of detonation. Normal outside ambient air pressure at sea level is about 15 pounds per square inch. Static overpressure decreases with greater height and increases at deeper levels under water. At increasingly deeper levels of water, the human body can feel a constant force on all parts of the body. This is no different than the crushing force caused by a nuclear blast, except that with a nuclear detonation the increase of crushing force occurs immediately, causing the effects to be even more detrimental. The figure below summarizes both wind and crushing force effects for a 2-kiloton, 5-kiloton, 10-kiloton, and 20-kiloton nuclear detonation.

In the figure, the distances given for each yield represent the point outward from ground zero where the effect as shown will occur. Thus, in the first example a 2-kiloton burst will cause a 1 pound per square inch crushing force, with 45 MPH winds at a distance of 2,670 meters from ground zero. Arrival time for the peak crushing force and winds described is shown in the crushing force figure on page 2-11. In the scenario for the infantry battalion, Carter's foxhole is 750 meters from ground zero for the 2-kiloton burst. He had just over 2 seconds to protect himself from a 4 pounds per square inch overpressure and 70 MPH blast wave. If he were not inside his foxhole or protected by some other sturdy structure, he might have been seriously injured.

Blast effects

Yield/Dist (m)	Crushing Force PSI	Wind Velocity MPH	Effect
2 kt - 2,670 5 kt - 3,600 10 kt - 4,569 20 kt - 5,750	1	45	Glass windows shatter; light damage to parked helicopters; soldiers endangered by flying debris.
2 kt - 1,620 5 kt - 2,200 10 kt - 2,700 20 kt - 3,500	2	70	Moderate damage to wood-frame buildings; light damage to some tactical wheeled vehicles; moderate damage to parked helicopters.
2 kt - 1,000 5 kt - 1,350 10 kt - 1,700 20 kt - 2,150	4	120	Sever damage to wood-frame buildings and helicopters; winds high enough to kill soldiers.

Blast effects (continued)

Yield/Dist (m)	Crushing Force PSI	Wind Velocity MPH	Effect
2 kt - 880 5 kt - 1,200 10 kt - 1,500 20 kt - 1,900	5	150	Severe damage to tactical wheeled vehicles; moderate damage to tanks and tracked vehicles; possible lung damage and eardrum rupture; 165-lb men lifted off the ground and thrown in a rolling, tumbling motion; 90 percent of trees blown down.
2 kt - 610 5 kt - 825 10 kt - 1,050 20 kt - 1,300	9	250	Severe damage to concrete buildings and multistory masonry buildings; 165-lb men lifted off the ground; attains a speed of 20 ft/second for a distance of about 15 ft.

Peak crushing force

Distance From Ground Zero	2 kt	5 kt	10 kt	20 kt
	Time in Seconds			
500 m (1/3 mile)	2.0	1.0	.2	0.0
1,600 m (1 mile)	4.2	4.0	3.6	2.8
3,200 m (2 miles)	10	9	8.1	7.4

THERMAL

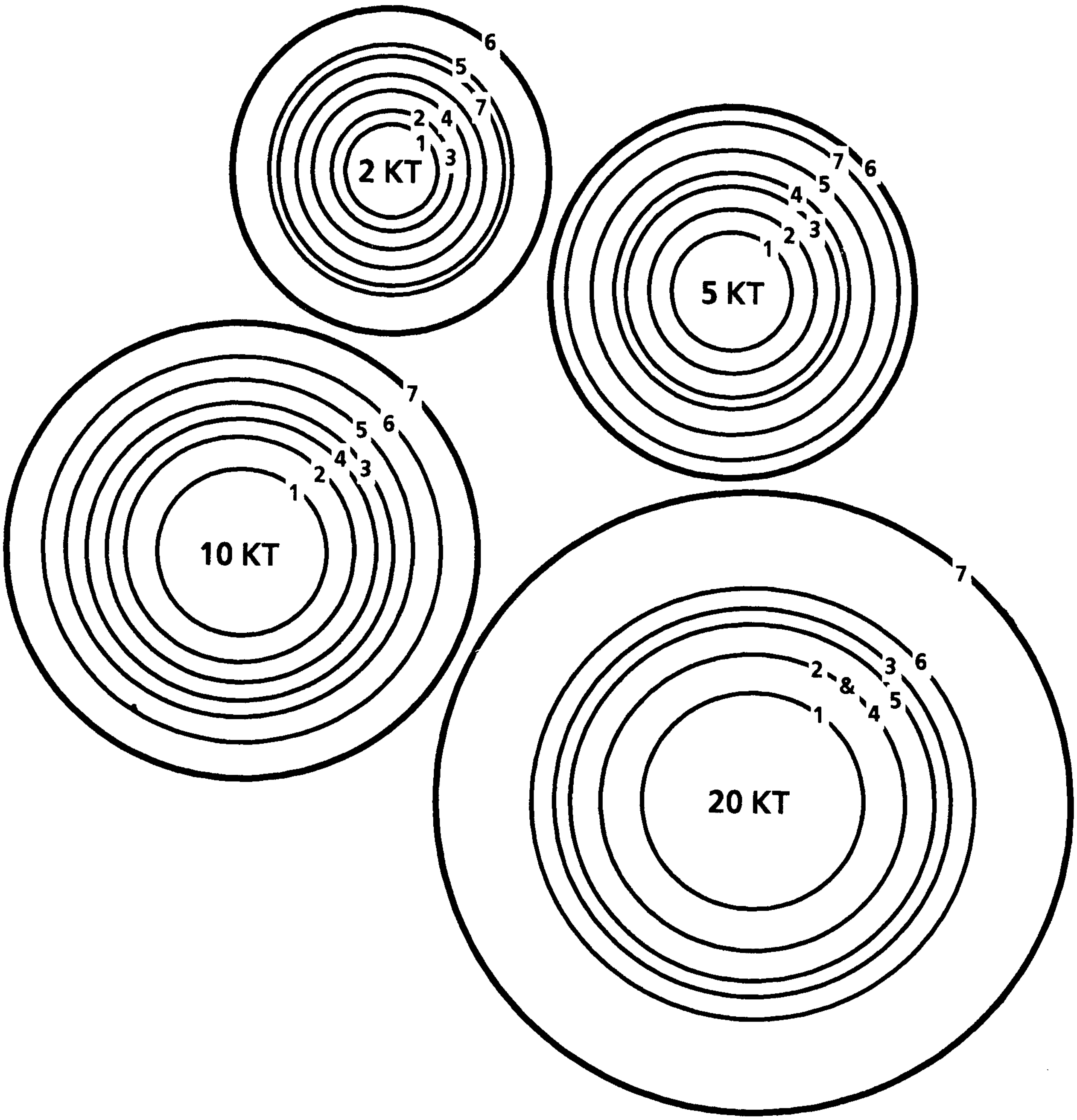
As was shown in the figure on energy on page 2-1, approximately 35 percent of the energy from a nuclear explosion is an intense burst of thermal radiation or heat. The effects are roughly the same as the effect of a 2-second flash from an enormous sunlamp. Since the thermal radiation travels at the speed of light, the flash of light and heat precedes the blast wave and occurs immediately, just as lightning is seen before thunder is heard. The visible light will cause "flashblindness" in soldiers who are looking in the direction of the explosion. Depending on the yield, flashblindness can occur even if not looking in the direction of the attack. In the scenario for the battalion TF, none of the observers received flashblindness; however, it is likely that in an actual situation numerous soldiers will be affected by the flash. Flashblindness increases significantly during nighttime burst.

The figure on page 2-13 compares safe separation distances to avoid flashblindness for both daytime and nighttime burst. As shown in the figure, the effects of flash extend further out than any other effect produced by a nuclear detonation. Flashblindness is normally only a temporary effect on soldiers, and full eyesight will return in a matter of minutes. However, under certain circumstances, serious eye damage leading to loss of sight can occur. This damage will vary with the height of burst, yield, location, and circumstances for each soldier at the time of the burst. Skin burns result from higher intensities of light and therefore take place closer to the point of explosion. The distance at which burns are dangerous depends heavily on weather conditions. Extensive moisture or a high concentration of particles in the air (smog) absorb thermal radiation. Thermal radiation behaves like sunlight, so objects create shadows behind which the thermal radiation is indirect (reflected) and less intense. Some conditions, such as ice on the ground or low white clouds over clean air, can increase the range of dangerous thermal radiation.

Thermal Effects

Nuclear Weapons Radii of Damages
Scale 1:50,000

1. Moderate damage, wheeled vehicles
2. 90% tree blow down - coniferous forest
3. 30% tree blow down - coniferous forest
4. 3000 cGy initial radiation - exposed personnel
5. 650 Gy initial radiation - exposed personnel
6. 150 cGy initial radiation - exposed personnel
7. Third-degree burns and fires



Safe separation distances from ground zero to avoid flashblindness

	Daytime (miles)	Nighttime (miles)
2 kt	1-2	50-60
5 kt	5	60-70
10 kt	8-9	80-85
20 kt	10-12	90-100

Thermal energy will also affect the battlefield by setting flammable items on fire. These items could include grass, trees, loose tinder, and possibly the paint and rubber tires on vehicles. In addition to flash burns to the skin, the thermal energy may be strong enough to ignite clothing, etcetera.

To make a comparable assessment of the different effects of a nuclear burst, the nuclear weapon radii of damages chart on page 2-12 can be used as a template on a 1:50,000 scale map. The 2-kiloton template can be used to compare damage radii to position of observers in the infantry battalion. Note that as the yield increases, thermal effects become the dominant effect which can cause injury to soldiers. For all yields shown, EMP would extend out the farthest.