NEW JERSEY HAZMAT EMERGENCY RESPONSE COURSE

STUDENT GUIDE **COURSE NUMBER: 06088**

LEVEL 1 - FIRST RESPONDER
DOMESTIC PREPAREDNESS
CBRNE OPERATIONS

PRESENTED THROUGH:
NEW JERSEY STATE POLICE-HOMELAND SECURITY BRANCH
SPECIAL OPERATIONS SECTION, TECHNCIAL RESPONSE BUREAU
HAZARDOUS MATERIALS RESPONSE UNIT (HMRU)

BENCHMARKED FROM THE DEPARTMENT OF DEFENSE
"DOMESTIC PREPAREDNESS TRAINING PROGRAM"

STUDENT MANUAL

4th Edition 0404

Domestic Preparedness; Operations

Training Goal:

At the conclusion of this course, students will be able to demonstrate a knowledge of the role of Level 2 trained responders in dealing with a Nuclear, Biological, Chemical agent attack.

Student Materials:

WMD Operations
No. 2 Pencil

Domestic Preparedness; Operations

Preface	12
Module 1 Introduction	14
Module 2 Responder Actions	17
Module 3 Chemical Downwind Hazard Analysis	25
Module 4 Personal Protection	30
Module 5 Introduction to Detection and Identification	36
Module 6 Emergency Decontamination Procedures	41
Module 7 Practical Exercise	47
Glossary	57
Appendix	62

Although the information set forth in this program is presented in good faith and believed to be correct, persons or agencies using this information must make their own determination as to its suitability for their purposes. In no event are the participating organizations and the developing Technical committee responsible for damages of any nature resulting from the use of this information.

This document may be reproduced in part or entirely, provided its use clearly indicates that it was prepared by the Hazardous Materials Emergency Response Planning Unit, New Jersey Office of Emergency Management, Division of State Police.

Preface

The Federal Bureau of Investigation (FBI) defines terrorism as: "The unlawful use of force against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in the furtherance of political or social objectives."

For years, we have viewed terrorism as something that happens in other countries. If Citizens of the United States were victims of terrorist attacks, they must have been overseas or on international flights or cruises in dangerous areas. The events at the World Trade Center in New York and Oklahoma City have shattered this view forever. The citizens and facilities that we are charged to protect can become the targets of international AND domestic terrorists at any time.

Terrorist attacks with conventional weapons such as firearms, explosives or incendiary devices seems the most likely scenario but we must also plan for the possibility of nuclear, chemical and biological.

While federal agencies will have primary responsibility for the investigation of terrorist attacks, local law enforcement and emergency management will have the vital role of first responder when their local setting becomes the target.

As an emergency responder in your community, you need to be aware of protocols for identifying that a problem exists, as well as how to isolate the problem, gather basic information, and report what you have found. Remember that if you are the "first on the scene" at an attack, your actions are critical in initiating a proper response.

Every county and municipality in New Jersey should have a viable plan for countering terrorism as part of the response roles outlined in its EOP. Hopefully, there will never be a need for it to be used.

The Domestic Preparedness Training Program only addresses Nuclear material, and Biological and Chemical (NBC) agents/devices. They can also be referred to as Weapons of Mass Destruction (WMD). The two terms are synonymous.

NBC weapons differ from other terrorist weapons in that they employ military chemical and biological warfare agents or radioactive materials as a primary ingredient. You will learn more about these in the next few modules, but for a brief definition:

Chemical agents are supertoxic chemicals used for the purpose of poisoning victims. They are similar to hazardous industrial chemicals, but hundreds of times more toxic. Contrast this with bombing an oil refinery to create a massive fire, which constitutes a terrorist attack, but not an NBC attack.

Biological agents are living germs that will cause disease in people. Some of these are deadly to animals as well, though they are not the primary targets. Toxins are a special type of poisonous chemicals categorized as biological agents because they were created by living organisms. They generally behave like chemical agents and serve the same function, to poison people.

Radiological materials can pose both an acute and long term hazard to humans. In many ways, they behave like some of the chemical agents in that they cause cell damage. A major difference is that the radiological agents do not necessarily have to be inhaled or come in contact with the skin to do damage. Some types of radiation, (like x-rays), can penetrate significant layers of protective material.

This course will build on the knowledge you already possess by comparing HAZMAT incidents with NBC Terrorism incidents.

Domestic Preparedness; Operations
Course Introduction

Module 1: Course Introduction (Operations Training - course #06088)

Training Objectives:

At the conclusion of this course, students will be able to demonstrate a knowledge of the role of Level 2 trained responders in dealing with a **N**uclear, **B**iological, **C**hemical agent attack.

Video: "Attack at Harford Mall"

NBC Operations Training

The scenes you have just seen from the Harford Mall attack begin to describe the public expectation of the Operations Level First Responder. We will revisit the response as it unfolds during this course and examine it.

Focus

The focus of the Domestic Preparedness Operations Program is on NBC agents/devices, and because these materials were invented primarily for military use, much of the terminology associated with them is military in nature. These agents were specifically designed to injure or kill, and as a result, will affect the procedures employed to address hazardous materials incidents. Today we will discuss those differences. Your mission is to bring order from confusion and defeat the terrorist by minimizing the effects of these weapons.

Course Goals

The purpose of this course is to train you to the Domestic Preparedness Operations Level. These classes are designed to increase the depth of knowledge of responders confronted with the challenges created when a terrorist incident involves the employment of chemical, biological, or radiological agents (all of which are hazardous materials), collectively known as NBC agents. Following its completion, you should be able to:

1. Identify the correct operations level defensive actions to be taken in the event a terrorist employs an NBC agent.

2. Identify appropriate personal protective equipment.

3. Select appropriate detection and identification equipment that might be employed in response to deployment of an NBC agent.

4. Understand emergency decontamination procedures that can be employed at the Operations Level.

Administrative Notes

1. Because of the origin, much of the material we shall cover is military in nature. This is mostly true because, until now, responding to the employment of these agents was only a military mission resulting from a military operation. Unfortunately, this is no longer the case, and now other individuals may also possess these weapons.

2. The modules that will be presented during this course are only designed to address those issues that are peculiar to a response to the employment of NBC weapons. As such, they will not, in most cases, dwell on material you have already been taught.

Overview

The course will concentrate on five blocks of instruction:

"Responder Actions" will focus on Operations Level defensive actions responders should take to minimize hazards, both to themselves and the general public.

"Chemical Downwind Hazard Prediction" will provide responders a quick and rapid method for predicting the boundaries of the downwind vapor hazard associated with a release of any of the chemical agents into the atmosphere.

"Protective Equipment" will provide an overview of personal protective equipment. It will also address the limitations of self protection when using Structural Fire Protective Clothing (SFPC) and Self Contained Breathing Apparatus (SCBA).

"Detection and Identification Equipment" will provide an overview of the various types of detection and identification equipment available.

"Emergency Decontamination Techniques" (strip, flush, cover) will address the differences between a normal HAZMAT decontamination operation and one involving a chemical agent, and briefly cover emergency decontamination techniques.

Domestic Preparedness; Operations
Responder Actions

Module 2: Responder Actions

Training Objectives:

At the conclusion of this module, students will be able to:

1. Describe actions appropriate to the operations level of training and equipment in response to an incident involving NBC agents/devices.

2. Identify the correct response based upon the considerations provided during the class.

Responder Actions

In the event a terrorist employs a chemical, biological, or radiological device, you, as a local responder, are going to be **"on your own"** for the initial critical portions of the response. Responder actions at all levels - awareness, operations, and technician - will determine whether the terrorist is successful in his or her objective of causing panic and casualties. In the case of our attack at the mall, we need to determine the correct response of responders at the scene, particularly those at the Operations Level.

In other words:

Ensure the safety of yourself and other responders

Initiate emergency decon

Initiate defensive control techniques

Ensure site management activities are initiated

Operations Level Responders

By definition, responders at the operations level are those individuals "who respond to releases or potential releases or hazardous substances as part of the initial response to the site for the purpose of protecting nearby persons, property, or the environment from the effects of the release. They are trained to respond in a defensive fashion without actually trying to stop the release. Their function is to contain the release from a safe distance, keep it from spreading, and prevent exposures." Responders at this level should have had sufficient training or experience to:

a. Understand basic hazard and risk assessment techniques.

b. Select and use proper personal protective clothing provided to the Operations Level first responder.

c. Understand basic hazardous materials terms.

d. Know how to perform basic control, containment, and/or confinement operations with the capabilities of the resources and personal protective equipment available within their unit.

The role of the First Responder at the Operations Level, described above, was drawn from 29 CFR 1910.120

Differences between NBC and HAZMAT incidents

Mass casualties. Expect to have lots of casualties.
Fast-reacting toxic chemical agents. All of these chemical agents are super toxic; in some cases 1,000 times more toxic than normal industrial HAZMATs. They are also fast-acting on the body, some able to knock a person down in a matter of seconds or minutes, given a sufficient concentration.
Decon. Because of their high toxicity and fast reaction, decon must be done rapidly to reduce exposure.
Crime Scene. You can't forget that the site of an NBC terrorist incident is a crime scene. At some point in time when the dust settles and the incident site is returned to normal, the perpetrators must be brought to justice.
Resources. The NBC terrorist incident will be a major drain on resources. Personnel, equipment, transportation, communication, medical and emergency services will quickly be maxed out in an incident involving a chemical agent release.
Vapor control. To minimize exposure to people downwind, vapors of the chemical agent must be controlled as soon as possible. The faster vapors can be controlled the smaller the agent cloud, the faster it will dissipate, and the less exposure potential is presented to personnel downwind.
Mass Media Coverage. Finally, an NBC terrorist will draw the attention of mass media representatives from around the world. You can expect to be front page news and the lead story on the nightly news. You can't usually say that about a routine HAZMAT spill.

Incident Phases
Response to an incident generally can be broken down into four fairly distinct, yet overlapping phases. Of the actions that occur during these phases, Operations Level Responders will only be involved with those that are defensive in nature.

1) The Notification Phase
The Notification Phase begins with the recognition that an incident has occurred and continues until the first emergency vehicle arrives at the incident site and site management begins. The notification may be made by anyone. It may not come from a responder at the awareness level, but rather from some untrained individual who notices the development of a mass casualty situation. The challenges presented by the notification phase include ensuring the safety of emergency responders (making sure that responders don't enter the area without proper protection) and that they approach the site from an upwind and upgrade direction; gathering information about the incident (e.g., wind direction, signs and symptoms of agent, number of victims); and that security is established around the site, where access is controlled into and out of the general area around the incident, and you begin to restrict movement into the downwind vapor hazard zone.

Operations Level Responder Actions
Operations Level responders observing a dissemination device or what appear to be the signs and symptoms that a device has functioned should immediately:

a. Ensure responders operate safely from a safe distance. Always move upwind of the attack. A reasonable upwind distance for a chemical attack is 300 feet; for an explosive, at least 1,000 feet.

b. Ensure all Awareness actions have been properly implemented:
   - Protect yourself and other responders. Are any Awareness responders in jeopardy?
   - Are any Awareness responders potentially contaminated.
   - Have proper authorities been notified?

NOTIFY THE DEP HOTLINE: 1-877-927-6337 (1-877 WARN DEP)

   - Are walking casualties being corralled upwind and upgrade and segregated?
   - Has the area been cordoned off to prevent people from entering or leaving the area, and are crowds being controlled?
   - Are specific verbal instructions being given? Are personnel being warned of the danger?
   - Has the presence of secondary devices and perpetrators in the area been considered?

c. Gather critical information about the incident and pass it on to those that need to know.
   - Number of casualties
   - Signs and symptoms
   - Weather

d. Ensure safe site management activities have been instituted.
   - Site security
   - Crowd control

2) The Response Phase

The Response Phase begins with the initiation of site management and concludes with the evacuation of the last living casualty away from the hazard. This phase focuses on saving lives. Challenges in the Response Phase include securing the site, rescuing victims, agent identification, emergency decontamination or neutralization of large concentrations of agent, evidence preservation, and searches for secondary devices and perpetrators.

a. The site and downwind vapor hazard area must be secured and entry into this area restricted, but many law enforcement personnel may have no personal protective equipment of any kind. Consequently, they must be prepared to evacuate quickly if notified of a change in wind direction.

b. Only responders wearing proper protection should attempt rescue of ambulatory victims; otherwise responders may become victims themselves.

c. Agent identification. The challenge is to identify the agent category as quickly as possible using available detection and identification equipment and the signs and symptoms of chemical agent poisoning exhibited by the victims.

d. Emergency decontamination of people. Challenges include the speed at which the decon operation must occur in order to save lives, the number of victims involved, and the limitations imposed by the availability of proper PPE to safely do the job.

e. Preserve evidence while at the same time neutralizing potentially large areas of contamination. This process may destroy evidence that could be used later in apprehending and prosecuting the perpetrators.

f. Be alert for secondary devices.

Operations Level Responder Actions

a. Position your equipment upwind, uphill and upstream from the incident site, if possible. Also be aware of ventilation exhaust ports from the incident site (e.g., from subways, buildings).

b. Isolate the area. Establish Hot, Warm and Cold zones.

c. Protect yourself. Wear appropriate personal protective equipment if you have to enter the contaminated area. **Bunker gear with SCBA is not equivalent to either OSHA Level A or Level B protection**, and may only provide minimal protection against chemical agents. This will be discussed in more detail in a later module of this course.

In no case should you, as an Operational Level responder come in contact with the victims and risk contamination.

Always stay alert to the signs and symptoms of agent exposure on yourself and fellow responders.

d. Corral casualties and victims. Using an amplified, authoritative voice, direct walking victims to a holding area to await decontamination. Within the limitations of your PPE, carry out non-ambulatory victims and conduct rescue operations. Consider keeping families together. Also the elderly and small children will require special attention because they are more susceptible to the toxic effects of chemical agents.

e. Set up Decon stations (usually under the supervision of HAZMAT technician level personnel). Emergency Decon stations should be located uphill of the contaminated area, as well as upwind, so that any contaminated runoff will flow into the already contaminated area.

Runoff may be contaminated and spill into sanitary sewage systems, rivers, streams and contaminate ground drinking water.

Expect modesty to be a serious issue. As time and resources permit, use tents and screens to provide separate decontamination sites for men and women.

f. If the appropriate PPE is available, execute emergency decontamination of victims that have evacuated the immediate area of the incident. You may also operate a decontamination corridor to support decontamination of ambulatory victims, if you have the proper PPE. Do NOT decontaminate equipment. Leave the equipment in the Hot zone for later disposition.

g. Assist in providing first aid to victims after they have been decontaminated. You may also assist in setting up a triage site for the triage, treatment and follow-on transport of victims away from the hazardous area.

h. Within the limitations of your PPE, establish and support a personnel decontamination capability that will support deployment of HAZMAT personnel upon their arrival. You may also begin to set up an equipment decontamination site, including the coordination, control and confinement of runoff resulting from equipment decontamination operations.

Within the limits of your PPE, operate a decontamination corridor to support HAZMAT personnel.

i. Initiate defensive contamination control operations in order to limit the spread of contamination. This includes assisting in diking water runoff, and beginning emergency decontamination operations.

j. **Be alert to the presence of secondary devices** and perpetrators in the area. The perpetrators may be the first victims.

k. Preserve evidence as much as possible, realizing that when you neutralize the source of the hazard, you may be destroying evidence that could be used later in apprehending and prosecuting the perpetrators. However, if the hazard is not neutralized quickly, the downwind hazard may continue to grow.

3) The Recovery Phase

The Recovery Phase begins when the incident has been stabilized and the last of the living victims has been delivered to a medical facility to receive definitive medical treatment. It concludes with the end of the survey of the area for agent contamination. During this time the focus is on re-establishing essential services that may have been interrupted by the attack. By this time, other, more qualified responders will have arrived to provide assistance. Other challenges will include the decontamination of essential equipment and establishment of an Equipment Decontamination Station. Evidence is collected for use in apprehending and prosecuting the perpetrators. This may be done by hazmat response teams.

4) The Restoration Phase

The last phase, the Restoration Phase, begins upon completion of the survey for contamination and continues until all contamination has been eliminated. Challenges include the restoration of the site to its original state with emphasis on site safety. Quite often, this is handled by a qualified site contractor or spill cleanup personnel.

Operations Level Responder Actions

The Recovery and Restoration Phases. Properly protected Operations Level responders:

a. Within the limitations of available personnel protective equipment, continue to support/operate a decontamination corridor to support HAZMAT personnel

b. Within the limitations of available personal protective equipment, complete operation of the decontamination corridor to support decontamination of non-ambulatory victims to be evacuated from the Hot Zone as well as ambulatory victims already evacuated.

c. Within the limitations of available personal protective equipment, operate the equipment decontamination site to support decontamination of the equipment necessary for the re-establishment of essential services. Ensure runoff resulting from decontamination operations is controlled and contained/confined as best as possible.

d. Continue to provide first aid to victims as they are evacuated and decontaminated.

e. Follow-up with medical assessments after the incident to ensure you don't exhibit symptoms of agent exposure. If so, get immediate treatment.

Table-Top Exercise/Review Questions

Q. Based on the video, what are the challenges you feel you may be faced with?

Q. Which are the challenges which you feel are most important?

Key Points

During the past 30 minutes we have addressed the Operations Level responder actions should a chemical, biological, or radiological attack occur. The key points to remember about this section are that:

a. Operations Level responders may be limited in their actions by their training and the available PPE.

b. The first priority of Operations Level responders is the safety of themselves and other responders. Otherwise, they may become a victim, and part of the problem instead of the solution.

c. Operations Level responders initiate emergency decontamination operations within the limits of their PPE. Emergency Decon will be discussed in greater detail in a later course module.

d. Operations Level responders initiate defensive contamination control techniques, such as controlling run-off and Emergency Decon of victims.

e. Finally Operations Level responders face multiple challenges when dealing with chemical agent terrorist incidents, including information gathering and communication, support of site security and evidence preservation.

Domestic Preparedness; Operations
Chemical Downwind Hazard Analysis

Module 3: Chemical Downwind Hazard Analysis

Training Objectives:

At the conclusion of this module the students will:

1. State the reasons for conducting a downwind hazard analysis.

2. Describe the factors which affect the downwind travel of a toxic plume, and the limitations of a prediction.

3. Be able to construct a simplified downwind hazard prediction.

This module will provide you with the knowledge and skill necessary to be able to construct a simplified downwind hazard analysis of a toxic cloud resulting from a terrorist use of a chemical agent.

As you know, a chemical device, when activated, will probably release a cloud of material, which will then move with the wind. Depending on the concentration of the agent in the cloud, people downwind of the release can become victims. Eventually, though, the cloud is diluted by the air to such an extent that it no longer poses a hazard.

So, as in conventional HAZMAT incidents, "dilution is the solution."
Your job may be to advise the Incident Commander on the downwind hazard, using the techniques learned today.

Chemical Downwind Hazard Predictions
Many factors affect the travel of a toxic cloud.

Weather is a major factor. Wind speed and direction, air stability (inversion, neutral, lapse), temperature, precipitation, and humidity are among the factors which determine where a cloud travels, and how long it poses a hazard. With wind speed under 6 mph, the cloud tends to disperse evenly in all directions (creating a circle around the release point). At wind speeds above 6 mph, the cloud tends to form a "pear shaped" plume as it travels downwind. Precipitation can "wash" agent out of the air, but now there may be a runoff problem.

Air stability is also important. During hot sunny days, ground-level air tends to rise, taking a toxic cloud with it. During evenings and overcast days, ground air tends to stay low; so will the cloud. Because biological agents are killed by the UV radiation in sunlight, a viable biological cloud will travel much farther downwind during darkness than during the day.

The type of **agent and quantity** is also a factor. Some liquid agents/devices (GB for example) evaporate quickly and create a dense, but short-lived hazard. Other agents (VX) evaporate very slowly and could create a low-density cloud of long duration. Naturally, the size and hazard of a cloud from 1-liter of a material is less than the hazard from a tank car of the same material.

The presence of **buildings and terrain features** (hills, valleys, trees, etc.) can have a major effect on the wind direction and degree of air turbulence. You probably have experienced this in a city with tall buildings, where the wind can be moving in a different direction within a few blocks.

Dissemination methods and parameters also affect the cloud formation. A vapor from a liquid puddle evaporating will form a less dense vapor cloud than one from a pressurized spray.

Problems
These factors cause problems with predicting where a toxic cloud will go, how far it will travel and how long it will remain a hazard.

You probably don't know the **micro-weather** (at ground level, where the incident is). Even if you know the micro-weather at the site of the attack, you are not likely to know what it is in the downwind area.

You probably don't know the **quantity** of the agent released. Even if the device has been recovered, and it can be estimated how much liquid could have been in it, the purity will probably not be known. Early on, you may not even know **which agent** (by name) you are dealing with. For example, nerve agent GA behaves much differently than nerve agent GD, but field tests will probably not distinguish between the two.

Generally, computer models (ALOHA, D2PC etc.) do not model the effects of **terrain and cities** well. They are based on certain assumptions and usually test data from flat, open plain disseminations.

Finally, by the time you arrive to make a prediction, the cloud may be gone, either carried downwind and diluted, or risen in the atmosphere above where it could harm people. This would be especially true in a small quantity "puff" event.

All predictions are based on many pieces of data, each of which may be a "best estimate." Don't be fooled by the sophistication of a computer model. Remember that the "garbage in - garbage out" principal applies. Any hazard prediction is only a prediction, not a fact.

What can we do?
So does that mean you can do nothing? No. You can make some assumptions, and using a method you are already familiar with, make a prediction.

If you have ALOHA (or other applicable computer program) hooked up and available on a computer, you can use it if you like. But if you don't, you can use the simplified method in the Emergency Response Guidebook and be accurate enough for the situation.

Other methods:
a. Track 9-1-1 calls by plotting on a map.
b. Track location of victims by plotting on a map.
c. ERG (Guidebook Method)

Guide Book Method - Step 1
To use this method you need to know the material involved. Look up its ID number from its name in the blue pages (if there). If you don't know the exact name of the agent, or its name is not there, use the agent class. For example, **for nerve agents, use ID 2810. For the blood agents use ID 1051. For the blister agents, use ID 2810.**

Q. How would you know the agent class if you did not have detection equipment?
A. By recognizing signs and symptoms of the agent that you learned in the Awareness course.

Guide Book Method - Step 2
Look up the ID number in the green pages, and read across to the initial **isolate** distance and **protect** distance. You will need to know if you are dealing with a **small** incident (less than 55 gallons), or a **large** one (larger than 55 gallons), and if it is **day** (between sunrise and sunset) or **night**.

Guide Book Method - Step 3
On a map of the incident area, draw (to scale) a circle with the radius of the initial **isolate** distance, with its center at the center of the incident site. Mark which way the wind is blowing at the site. Then, through the center of this circle, place the upwind edge of a square box which is the **protect** distance on each side. This edge is perpendicular to the wind direction. For practical purposes, you have defined the potential hazard area. The toxic plume should pass somewhere within this area. If you know the approximate wind speed, you can also have an idea of where the leading edge of the cloud might be (wind speed × time = distance).

Table Top Exercises:

Case 1:
A 5-pound cylinder of Hydrogen Cyanide was released at the intersection of Business Route 1 and Tollgate Road at 10 am. It is now 10:30 am. The wind is blowing to the north at about 5 mph (wet finger method!). Construct the Downwind Hazard Prediction. What would you advise the IC regarding evacuation of the mall?

Case 2:
A one quart device containing nerve agent was activated at the intersection of Rt 924 and Ring Factory Road at 10 am. It is now 10:10 am (you guys are fast!). The wind is blowing toward the northwest, at about 10 mph. Construct the Downwind Hazard Prediction. Will you need to warn the Wakefield Elementary School? Bel Air Middle School? Bel Air High School? When might the agent cloud reach the High School, if at all?

Action After Prediction
Once you have made this prediction, you have an *idea* of who downwind might need to be warned. This information will play into decisions regarding whether to evacuate or shelter in place. This has major implications in terms of resources, and tactical and political decisions.

For an *exact location* of the cloud plume, HAZMAT technicians will send in reconnaissance teams to approach from the crosswind edges until they get a detection. As they do this at several points, you can get a picture of the actual area of hazard. This

must be done in *at least* Level C protection. Also, remember that if the wind is blowing, the hazard is also moving and being diluted as time passes.

Other Considerations

a. For radiological and biological hazard predictions contact a technical source through the National Response Center (NRC).

b. For explosive secondary devices, follow your local protocol.

c. For unknowns, establish an isolate distance and contact a technical resource for guidance.

Key Points

Using a simplified hazard prediction method, you can get an idea of where the hazard area might be, but its actual position can only be determined through reconnaissance. Using your hazard prediction, you now have an idea of what areas to evacuate or shelter in place. A discussion of the evacuate/shelter-in-place issue is presented in the reference section of your book.

Domestic Preparedness; Operations
Personal Protection

Module 4: Personal Protection

Training Objectives:

At the conclusion of this module, students will be able to:

1. State protection offered by the various levels of protective clothing

2. Describe their response capability based on their assigned level of protective clothing and training

As in other hazardous material releases, specialized chemical protective clothing is required to ensure your safety in a situation involving NBC agents. We will talk about what each EPA level of protection will protect against in an NBC environment and why.

Level D Protection
These are examples of EPA Level D protection.
What do these suits protect you against? The weather.
Used when there is no respiratory or skin hazard.
Firefighter's turnout gear should be considered Level D protection.

Structural Firefighter Gear with SCBA
Structural Firefighter Gear includes helmet, hood, coat, pants, boots, gloves and SCBA.

Structural Firefighter Gear with a Self-Contained Breathing Apparatus (SCBA) is generally considered Level D (work uniform) protection. It will protect against inhalation exposure but it will not adequately protect you against skin absorption from agent vapors and it is permeable to many chemicals.

Level D is the normal work uniform and provides only minimal protection. It affords no real-time respiratory protection, only minimal skin protection, and basically only protects against dirt. OSHA Level D mandatory components include the wearing of:

a. Coveralls
b. Chemical-resistant boots or shoes
c. Optional equipment
(1) Escape mask
(2) Gloves
(3) Safety glasses or chemical splash goggles
(4) Hard hat
(5) Face shield

Level C Protection
This is an example of EPA Level C - industry workers in Tyvek™ and APRs.

a. Includes hooded chemical resistant clothing with an air purifying respirator.
b. Can only be used when:
   - The chemical agent presents no splash hazard.
   - The air respirator can remove all contamination.
   - Air purifying respirator criteria are met.
   - Concentration of agent are below IDLH.
c. Provides adequate protection against airborne biological agents and radiological materials.

Level C is normally *not* appropriate for work in the Hot Zone.

Level C protection requires:

a. Hooded chemical-resistant clothing (overalls; two-piece chemical splash suit; or disposable chemical-resistant overalls)
b. NIOSH-approved full-face or half-mask air purifying respirator
c. Both outer and inner chemical-resistant gloves
d. Chemical-resistant boots
e. Optional equipment
- **(1) Disposable chemical-resistant outer boot covers**
- **(2) Hard hat**
- **(3) Face shield**
- **(4) Coveralls**

Level B Protection

a. Level B includes a non-encapsulating chemical splash resistant suit with hood and SCBA.
b. It provides maximum respiratory protection with less skin protection, because it is not fully encapsulated. As you can see, the air tank is outside of the suit.
c. It protects against agent which presents no skin vapor hazard and when there is a low liquid splash potential.
d. It is also used in low oxygen environments.

Level B protection requires:

a. Hooded chemical-resistant clothing (overalls and long-sleeve jacket; coveralls; one or two-piece chemical splash suit; or disposable chemical-resistant overalls)
b. Positive pressure full-face piece SCBA or positive pressure supplied air respirator with escape SCBA
c. Both outer and inner chemical-resistant gloves
d. Chemical-resistant boots, with steel toe and shank
e. Optional equipment, as required for the situation
- **(1) Coveralls (for added internal protection)**
- **(2) Long underwear (to absorb perspiration)**
- **(3) Hard hat (to be worn under suit)**
- **(4) Disposable suit (to be worn over encapsulating suit)**
- **(5) Disposable boot covers (to protect chemical-resistant boots)**
- **(6) Communication equipment**

Level A Protection

a. Level A includes a totally encapsulated chemical resistant suit, with SCBA or supplied air with escape.
b. It provides maximum respiratory and skin protection.

c. It is used when there is a high level of liquid splash potential, a toxic respiration and skin vapor hazard, or where the chemical agent is unidentified.

Level A protection requires:

a. Completely encapsulating, gas/vapor-proof, chemical-resistant suit
b. Self-contained breathing apparatus (SCBA) or positive pressure supplied air respirator with escape SCBA
c. Both outer and inner chemical-resistant gloves
d. Chemical-resistant boots, with steel toe and shank
e. Optional equipment, as required for the situation
- **(1) Coveralls (for added internal protection)**
- **(2) Long underwear (to absorb perspiration)**
- **(3) Hard hat (to be worn under suit)**
- **(4) Disposable suit (to be worn over encapsulating suit)**
- **(5) Disposable boot covers (to protect chemical-resistant boots)**
- **(6) Communication equipment**

Initial Protection Levels

As an operations level first responder, you should not be in the Hot Zone without the appropriate level of protection. You always want to enter a suspected chemically contaminated area with the level of protection that will ensure your survival. At the same time, you don't want to over-burden yourself with protective equipment that is nice to have but may hinder your mission because of the heat or because of its weight or bulk. Therefore, you have to know what kind of chemical agent you're dealing with in order to make knowledgeable decisions as to the level of protection required to make sure you don't become a victim yourself - either as a result of the chemical agent or from exhaustion.

It is generally recommended that initial entry into the Hot Zone be in Level A by responders trained to properly wear and work in that gear, with a possibility of downgrading to a lower level of protection after the agent is identified, the concentration of the agent is determined to be below IDLH, and the Incident Commander authorizes a lower level of protection.

Materials that may be encountered in an NBC hot zone

Blister agents (e.g., mustard) are designed to injure body tissue, both internally and externally. Mustard agent vapors will destroy exposed skin tissue. Therefore, the hazard presented by blister agents is both dermal and respiratory, requiring maximum protection for each method of entry, i.e., Level A protection.

Nerve agents (e.g., sarin, soman, VX) present both a respiratory and a dermal hazard. In liquid form, nerve agent droplets will be absorbed into the skin. In their vapor state, they will enter the body through the lungs and destroy the body's ability to produce cholinesterase, the muscle-controlling enzyme. Consequently, initial entry into an area suspected of nerve agent contamination must be in Level A to ensure full protection of both the respiratory tract and the skin. With time, and an accurate determination of agent concentration in the atmosphere, a decision may be made to downgrade the protection to Level B, if it is determined that a vapor hazard no longer exists.

Choking agents (e.g., phosgene and chlorine) enter the body through the lungs and not through the skin. Consequently, respiratory protection is the primary concern to protecting against these agents. However, choking agents, in high enough concentrations, may also present a skin hazard. Therefore, initial entry in Level A is prudent. Choking agents are reasonably non-persistent, so that the level of protection may be downgraded to Level C as soon as the concentration in the affected area is determined to be below IDLH, assuming that the respirator to be used has been proven to protect against that particular agent.

Blood agents (e.g., Hydrogen Cyanide) also enter the body through the respiratory tract or through mucous membranes, not through the skin. However, in high enough concentrations, blood agent could mix with skin moisture to form acid and thereby cause skin irritation. Level A provides maximum protection for both the respiratory system and the skin. Since blood agents, by definition, are extremely volatile, they will dissipate quickly in the air, probably by the time measurements are taken to determine the concentration of the agent. If the agent vapor concentration is below IDLH, the level of protection required may be downgraded to Level B or C, but like choking agents, only if the respirator to be used is known to protect against that particular agent.

Biological Agents enter the body primarily through the respiratory tract, although they can also enter through broken skin, ingestion, or through other body openings. Respiratory protection is the key to protecting against these agents. An air purifying respirator (with High Efficiency Particulate Air or HEPA filter) provides this respiratory protection against airborne biological agents.

Radiologically contaminated materials also present a respiratory hazard. Radioactive dust particles can be inhaled. As with biological agents, an air purifying respirator with HEPA filter provides respiratory protection against the inhalation of radioactive dust particles.

If you are unsure of the agent employed, reduce any risk by only entering the area in Level A (Remember: only don level A gear after you have been trained to wear it safely and have practiced with it in a safe environment). If you see indications of nerve or

blister agent employment, **DO NOT ENTER THE HOT ZONE IN BUNKER GEAR!** - or you, too, will become a victim.

A response team requires maximum respiratory protection when entering atmospheres containing unknown substances, or entering atmospheres containing known substances in unknown concentrations.

In addition, unless you are certain you are not dealing with a blister or nerve agent, you need to protect your skin from chemical agent liquids and aerosols. Liquid chemical agent can be transferred to you in numerous ways, including:

a. Helping victims,
b. Helping other responders,
c. Walking through contaminants, and
d. Overspray from victim decontamination operations (e.g., hosing down of victims).

Key Points

a. Tests using agent simulants appear to indicate that your Structural Firefighter Gear with SCBA provides adequate respiratory protection, but little protection against chemical agent liquids and mustard agent vapors.

b. Without proper protective clothing and training, you are limited in the responder activities you can ***safely*** perform.

Domestic Preparedness; Operations
Detection and Identification

Module 5: Introduction to Detection and Identification

Training Objectives:

At the conclusion of this module, the students will be able to:

Describe the types of detection and identification equipment available to the first responder.

You have already seen that it is important to be able to quickly detect that a chemical, biological or radiological agent is present at a terrorist site, and to identify it to the degree possible. Remember that the first sign of an attack may well be the symptoms of the victims, but you also learned that for some agents, symptoms may not always be specific enough. Detection and identification equipment is used to confirm the agent, and thereby help determine the protection, first aid and decontamination measures necessary.

Why So Much Military Equipment?

You will note that there is reference to a number of military kits. That stands to reason since the military of all nations have been concerned for many years about these agents on the battlefield, and have been basically the only users of the equipment (until now). However, the military equipment should be available to you through federal sources, or in many cases, direct from the manufacturer. As a minimum, you will see this equipment in use by supporting military units.

Wherever appropriate, we will refer to commercial off-the shelf equipment.

System	Speed	Training Needed	Results
M8 paper	Seconds	Few minutes	Detects presence of liquid V-or-G nerve agents or blister agent, by type
M9 paper	Seconds	One minute	Detects presence of liquid chemical agents
CAM	Seconds	One hour	Detects presence of nerve or blister agent vapors, by type
M256 Kit	15 minutes	One hour or less	Identifies specific types of agent vapors (blood, nerve, blister)
Drager Kit	2-3 minute per tube	30 minutes	Detects, identifies and may quantify agent vapors
GC/MS	Minutes-hours	One-two weeks for trained technician	Identifies specific chemical (liquid or vapor)

Note: These are listed in the order of increasing sensitivity and resistance to interferents

The Detection and Identification Equipment (Chemicals)

Just as there is no single system which will detect all HAZMATs, there is no single system which will detect all chemical agents. You will need to use a number of items, each of which will serve a specific role during the response. This slide illustrates a number of kinds of systems, from the very simple papers (which work in seconds) to the very sophisticated laboratory instruments (which can take from minutes to hours to give results). In general, we can say that the more simple a system is to use, the less specific the result. On the other hand, the more complex the system, the more

information you will obtain. Also be aware that some devices only respond to liquids, while others respond to vapors. The key point is that the response team will need to use the information provided by several different systems.

The detection and identification items shown on this slide were designated as an integrated system to be used by soldiers in a military situation. As such, they have limitations in an urban environment.

The Biological Detection and Identification Equipment

System	Speed	Training Needed	Results
Detector Tickets	Minutes	Less than 1 hour	Identifies specific, selected BW agents
Biological Integrated Detection System (BIDS)	30 minutes - 1 hour	Weeks	Detects BW attack; can identify selected BW agents
Biological Laboratory	Days	Months-years	Can identify specific BW agent

Having concluded the discussion of chemical detection and identification, we turn now to the biological agents. Remember, because of the high likelihood that a biological agent attack may not be discovered until days after the actual event, there may be no "First Response" per se. All of the activity may be focused on the hospital providers.

As you can see from this slide, the "continuum" for biological agents is much smaller. The simple fact is that there are currently only a limited number of items which can be used to detect and identify biological agents in the field.

Detector tickets (term "SMART" tickets, for "Sensitive Membrane Antigen Rapid Tickets") have been developed for a limited number of potential agents (anthrax, staph enterotoxin, botulinum toxin, plague and Ricin) which work on an antibody-antigen principle and could be used on site to give a very quick response. Additionally, detector tickets for Cholera, Brucella and Tularemia are close to being developed. All are still in the research and development phase and are being validated by the developer.

The military has recently fielded what is essentially a mobile biological lab called the Biological Integrated Detection System. This unit might be deployed to pre-planned events, such as the Olympics. Stacks on the roof of the vehicle sample the air for microorganisms of a particular size. When detected, the system alerts the operator to begin on-board laboratory analysis of air samples.

The bulk of biological agent identification work will likely take place in a biological lab, such as found in hospitals, research universities, or the Centers for Disease Control.

Radiation Detection

The picture for detection of radioactive material is actually the best of all. Your agencies probably already have radiation detectors, and these are appropriate for use in a terrorist situation. In fact, if you suspect a terrorist incident, it is prudent to first have the site checked for possible radiation. Let's briefly review the types of detectors which may be useful.

Film badges: Used to provide a record of the ionizing radiation exposure for personnel working in a radiation area. These are sent away for development and reading and the results returned to your agency.

Individual dosimeters: A direct reading instrument which can be read on scene to determine the radiation exposure of the wearer.

Geiger-Mueller type instruments: Direct reading of the Beta and Gamma radiation dose rate. Some may also differentiate Beta radiation from Gamma. Remember, Beta radiation is stopped by such things as clothing, paper, thin metal (e.g., aluminum foil) and skin.

Alpha instruments: Direct reading instruments of alpha radiation. Because of the very low penetrating power of Alpha radiation, they are specially designed instruments generally operated by highly trained technicians.

System	Speed	Training	Results
Film Badge	Slow (requires processing)	None	Total Ionizing Radiation Dose
Individual Dosimeter	Immediate	Few Minutes	Total Ionizing Radiation Dose
Geiger Muller Instrument	Immediate	30 Minutes	Ionizing Radiation Dose Rate (Beta/Gamma)
Alpha Instrument	Immediate	Hours - Days	Alpha Dose Rate

Key Points

You have now seen the types of equipment which are available for use to detect and identify chemical, biological and radiological materials.

a. You need to have the proper PPE and the training and medical clearance to wear it before you can begin on-site detection.

b. You have seen that for the chemicals, a number of items will be required, ranging from simple papers to hand-held electronic devices, hand manipulated wet chemistry systems and sophisticated laboratory instruments. For chemical agent detection and

identification, you need to know signs and symptoms in conjunction with simple detection equipment in order to identify the agent you are dealing with.

c. Without the aid of chemical detection equipment, you can't verify the presence of an agent.

d. No one chemical agent kit detects all agents.

e. Because the detectors and identification methods for biological agent/devices are fewer, detection and identification will likely take place in local, state or federal laboratories.

f. The raditaion detection devices to which your agency has access will do the job for you in the event of a radiological hazard.

Domestic Preparedness; Operations
Emergency Decontamination Procedures

Module 6: Emergency Decontamination Procedures

Training Objectives:

At the conclusion of this module, students will be able to:

1. State differences in decontamination techniques presented by NBC agents vs. typical hazardous materials.
2. Describe decontamination levels
3. Describe emergency decontamination techniques
4. Describe several decontaminants

One of the first priorities after a nuclear, biological or chemical (NBC) incident is agent containment and decontamination. The speed and organization of the response team, the establishment of control around the Incident Site, and the timely application of decontaminant will be the keys to success. We will discuss how to accomplish such a response by focusing on the difference between conventional HAZMAT incidents and those involving NBC agents.

Decontamination Differences from a Typical Hazmat Incident

Large Number of Victims - is probably the first major delta between normal HAZMAT and NBC incidents. You may be required to control, triage, decontaminate and track hundreds if not thousands of people at the site.

Scene Control - may involve a larger area, a mass casualty situation, with numerous responders who all want to "help", and a huge press response seeking information on the incident.

Rapid Response - because of the speed at which some of the chemical agents work against the body, decontamination must be swift in order to avoid more casualties.

Major Resource Intensive - a response of this magnitude will require more personnel and material than is normally on hand. This requires you to do contingency planning, before you are ever faced with the situation.

Run-off Control - an active effort to confine run-off from decontamination operations reduces the spread of the hazard. Because of its potential toxicity, decontamination run-off should be kept away from sewer drains, ground water, streams, and watershed areas.

Crime Scene/Evidence Preservation - your normal HAZMAT incident site is not a crime scene. In addition to decontaminating the area, evidence must be preserved for eventual use in apprehending and prosecuting the perpetrators.

Decontamination Levels

There are two levels of decontamination; *Emergency* and *Technical.* They combine to cover the rapid decontamination of victims on site and the more deliberate decontamination of the responders.

Emergency Decontamination - is employed to save lives by neutralizing agent from the skin.

Technical Decontamination is that which is performed to remove contamination from personnel protective equipment of responders, equipment, and facilities.
At the Operations Level, we will concentratte on emergency decontamination procedures.

Emergency Decon Considerations

a. All personnel who come in contact with or have the potential to come in contact with the exposed casualties must wear protective clothing and respiratory protection.
    (1) Structural firefighting clothing and positive pressure self contained breathing apparatus; or EPA Level B chemical protective clothing may be used **based on the incident.**
    (2) If available, wear rubber gloves.
    (3) Minimize contact with the casualties.
    (4) Ensure all responders are aware of the signs and symptoms of exposure.
    (5) Consider yourself contaminated following exposure to victims.

b. Isolate victims / casualties
    (1) You must communicate the need for assistance and what these people must do.
        - Loudspeaker/PA system
        - Must communicate "authority" with concern
    (2) Casualties need to be away from the hazard, but still controllable.
    (3) Isolate Upwind, Upgrade, Upstream.
    (4) Segregate symptomatic from asymptomatic; or male from female.
        - Take into consideration families, small children, the elderly, handicapped persons (blind, persons in wheelchairs, speech impaired, etc.)
        - Isolate any refusals from the rest to prevent further contamination
    (5) Collect personal items.
        - Use plastic bags and a method of identification
    (6) Have victims strip down to their undergarments.
        - Approximately 80% of the contamination should be removed with the clothing. Pantyhose should be removed because they can hold a large amount of liquid/vapor close to the skin and cover a significant amount of skin.
        - Use bags (large trash bags, biohazard bags, or other suitable bags of size and strength) to collect the individual clothing.
        - Bagged clothing should be placed into drums at a later time.
        - Wet people down before stripping if dealing with a known biological or radiological hazard to prevent re-aerosolizing the agent.

c. Set up Emergency Decon
    (1) Time is critical!
    (2) Need large area.
        - Close to the scene but out of the hazard (Hot) zone
        - Able to handle one or more lanes of people
    (3) Need to consider water run-off.
        - Getting the casualties decontaminated is the number one priority, especially when dealing with chemical agents

- It is not necessary to control the run-off but know where it is going and that it will not flow into clean areas
- If possible and time and available resources allow, try to confine the water run-off to an isolated area
- Confinement may be critical when dealing with radiological agents/devices
- If run-off is not confined, notify the proper authorities downstream

For chemical agents, it is expected that the agents will be hydrolyzed to some extent and diluted by the large amounts of water and not present a major problem downstream.

For radiation, expect water to spread the contamination downstream.

For biological agents, downstream contamination will vary, depending on the type of agent and how it survives in that environment.

If run-off goes into the storm drainage system, you must notify locations downstream as a precaution.

If run-off goes into the sanitary sewer system, you must notify the receiving waste water treatment facility as a precaution.

(4) Establish segregated lanes for symptomatic from asymptomatic; or male from female.
(5) Take into account modesty and the public eye (and media). Modesty covers can be quickly established using ladder trucks with salvage covers hung from the base ladder section extended or by using pike poles, ground ladders, or ropes strung between fire engines and covered with salvage covers. (Don't forget the "eye in the sky", media)
(6) Consider weather conditions.
    - May need to move the operation indoors (e.g., school gym with showers, car wash, etc.)
(7) Use hose lines and elevated master streams.
    - Use fog nozzles with low pressure to rain the water down on the people (i.e., "shower").
(8) When capabilities and resources allow:

Soap and water is the next best decontaminant of choice, with a solution of dilute household bleach (0.5%) being the preferred decon solution.

Do not wait for the soap or beach to be available - **Use Copious Amounts of Water Immediately!**

d. Perform Decon

(1) You must communicate the need for assistance and what these people must do.
(2) Arms out/legs spread.
(3) Wash from top down.
(4) If suspected liquid mustard agent (a persistent agent) is on a victim:
    - Blot the agent off (using a pinching motion) first to remove the liquid
    - Do Not Rub! Blot - Blot - Blot
(5) If suspected biological or radiological agent:
    - Start rinsing the people off first as they remove their clothes. This will entrain the agent on the clothes and reduce the tendency for the agent to stick to their bodies due to static charge.

e. Provide cover
    - Use whatever is available from the local area
        — Get blankets, large towels, sheets from local stores, hospitals, and hotels; or even table cloths from local restaurants
        — Carry disposable ponchos or TYVECK coveralls
        — Cut up salvage covers
    - *What about initiating life saving activities (ABC)?*

f. Establish Triage, Treatment, and Transport (T^3) Area

Establish T^3 in a clean area
- Large enough to hold all casualties
- Can be secured

Ensure all responders are aware of the signs and symptoms of exposure

Maintain ABCs minimizing exposure to the casualty
- Assume victims may still have some contamination on them
- Wear PPE and use mechanical ventilation
- Use of pharmaceuticals is required for stabilizing casualties exposed to chemical agents

Interface with local hospitals receiving casualties
Use mass transit to assist in transporting casualties

g. Do Self-decon
    - If exposed or after emergency Decon and Technical Decon is not available
    - Consider yourself contaminated - take appropriate precautions and go through decontamination yourself

h. Considerations for Non-Ambulatory (Litter) Emergency Decon

- Minimize exposure to responders
- Structural firefighting clothing and positive pressure self contained breathing apparatus
- EPA Level B chemical protective clothing
- Rubber gloves
- Limit the number of responders in contact with the victims
- Use supports to hold stretchers and backboards off the ground (e.g., milk crates, saw horses, etc.)
- Keep clothing away from victim's face during removal (to keep casualty from breathing the agent)
- Remove/cut clothing from head to toe, front to back, keeping away from face

Decontaminants of Choice

The premise remains the same (blot, strip, flush and cover), but the availability of various decontaminants can enhance the effectiveness of the decontamination process.

Personnel can be flushed of agent using just water, or soap and water as the soap will help lift the contaminant. Remember that any covering can trap contamination, so washing must be complete. If available, a 1:10 solution of household bleach is most effective in removing and neutralizing contamination (one quart per 2.5 gallons of water, or 5 gal to 55 gal drum). Wounds which are more than superficial should not be decontaminated using bleach.

Radioactive contamination does not require the use of a Hypochlorite solution. Soap and water is best.

Key Points

a. The key points to remember are that the safety of emergency responders is paramount over all other considerations.

b. Emergency decontamination must be accomplished quickly because of the speed at which the chemical agents react with the body.

c. Expect a large number of people to undergo emergency decontamination.

Domestic Preparedness; Operations
Operations: Practical Exercise

Module 7: Operations: Practical Exercise

Training Objectives:

At the conclusion of the exercise, students will

1. Develop a list of available resources and assets to respond to an NBC incident
2. Develop a site management plan for the NBC incident scene
3. Describe response to specific challenges.

Throughout this course, we have discussed what the different responder activities will be and where you, at the operations level, will fit into this process. This exercise will challenge you to discuss and decide how all of the resources will come together in a response to an NBC event.

The situations in this module are designed to stimulate discussion about response procedures and allow you to address how you would handle each of these using your local SOP. We can discuss a few of these in the class, but you should review all of them on your own.

Review the exercise key points.

a. There are many resources available to you and many assets you can use when responding to an NBC incident. When you get them and who controls them can, in some cases, be pre-planned, as part of your local protocols and SOP. Other resources may only be available on a case-by-case basis. Planning for alternative methods to accomplish your tasks is imperative.

b. Your ability to assist in the various roles, both on and off the site, will be critical to the incident commander in managing the overall response efforts and to the technicians who have specific tasks to accomplish. Your understanding of the overall response plans and where you fit in to these plans helps to put your roles into perspective within the emergency response to an NBC incident.

c. The situations in this exercise are offered as study of the Harford Mall incident and are only representative of the types of challenges you may get in an NBC incident. Some of the situations may not materialize; others may take on such proportion as to dictate the allocation of resources differently than you planned.

During this exercise, you will describe the resources available to emergency responders and discuss how you would employ them in a response to an NBC incident. Your objectives are shown on the slide.

a. First, you will be presented the general scenario, which was depicted in the video "Terror at Harford Mall." From this scenario, each team will develop a list of resources (things) and assets (people) available within your agency and outline their tactical objectives. We will compare these and develop a single list for the rest of the exercise.

b. Then, you will develop the site management plan, bringing together all of the emergency response assets to assist in the example NBC incident. Each group will develop its portion of a site safety diagram, showing on the overhead projector where each resource and activity will be located and what they will be doing.

c. Finally, time permitting, your teams will be challenged with several situations, each focusing on some specific response actions. Each team will discuss the situation,

recommend appropriate actions for the responders to take, and either brief or show what those actions are on the overhead diagram of the scene.

The situation is the terrorist NBC attack at the Harford Mall. Recall all of the information which you know up to the point at which the second 9-1-1 call was received and the fire and police were dispatched to the Mall. This will be the starting situation as shown in the Mall diagram:

a. At 12:00 on a Saturday, an unknown man left a package in the food court of the Harford Mall before departing from a typically crowded shopping day. The package contained a broken jar, from which liquid was leaking out of the bottom. Moments later, an elderly man noticed the liquid coming from the bag and summoned a cleaning person, who scooped up the bag and placed it on top of the trash receptacle. While the cleaning person began sweeping up around the immediate area, the man clutched his chest and collapsed near the trash bin. Other shoppers rushed over to help the man. A security guard observed the scene on the mall security camera and called 9-1-1. His call stated that the man appeared to be having a heart attack and the guard requested an ambulance.

b. In the few minutes it took for the ambulance to arrive, several other bystanders began to convulse and collapse around the man, including the people who were helping the man, the cleaning person, and two people who were filming a commercial nearby in the food court. The cameraman filmed the first victim, then left his camera running on the floor as he collapsed next to the group of people.

c. The medical team arrived to find several prone victims near the package and the camera. As they began to assist the victims, they were rapidly overcome and collapsed next to the victims. The security guard, still observing the scene on the mall security camera, called 9-1-1 a second time. His report was that several people had "caught whatever the first guy had" and they were lying on the floor in the food court.

Knowing what you know about the rest of the situation, take a few minutes to discuss what you think may be happening, what resources you would need, what assets your responder group has available, and when they would be expected to respond. Also consider how you might have done any response actions better than those shown in the video, especially where your local SOP differs from their actions. Fill in the blank forms depicted in this slide and in the next. Then we will discuss your results. A representative team of each group will brief the class on the capabilities of your responder group, while the other teams fill in the rest of their forms. In this way, we can all see what each responder group can do and what resources it needs to do the job.

Use student handouts 7-1 and 7.2.

Site management. At this point, you have listed the resources and assets which would be available to assist your actions in an NBC incident. Take the next 5 minutes to discuss among your team how and where you would place the assets on site and develop and overall site safety plan. Then one of you will outline this on the diagram for the rest of the class. Your plans should address the following:

a. Establish the control zones, what goes on in the zones, and who is in charge of them. Determine what the boundaries should be and where activities such as the medical triage or treatment and the decontamination areas will be with respect to the buildings and parking areas surrounding the site.

b. Decide where to place the assets which will be responding to the incident. As the response progresses and other assets are called in, discuss how and where to bring them in to be readily available without hindering the others already on site.

c. Assess the situation. Identify the hazard, consider the effects of weather and terrain on it. Determine who and what is at risk, to include the risk to the responders. Decide also what actions are needed to mitigate the hazard itself and any associated hazards, such as the runoff from decontamination. Discuss the procedure for monitoring the hazard and reporting any increased risk.

d. Address the safety factors which may affect the response effort. Include the level of protection for the responders, the requirements for decontamination, the needs of the responders and victims for medical treatment, and whether to evacuate or shelter the population in the surrounding area.

e. Consider which organizations are able to provide help, what they can do for you, and when to call them in.

STUDENT HANDOUT 7-1

Team _____ Resources Available

Time to Mobilize	Resources	Available?

Notes:
List resources according to what time they are available on site - first 10 minutes, first half hour, first two hours, or not until later.
State if resources are not immediately available or require special coordination.

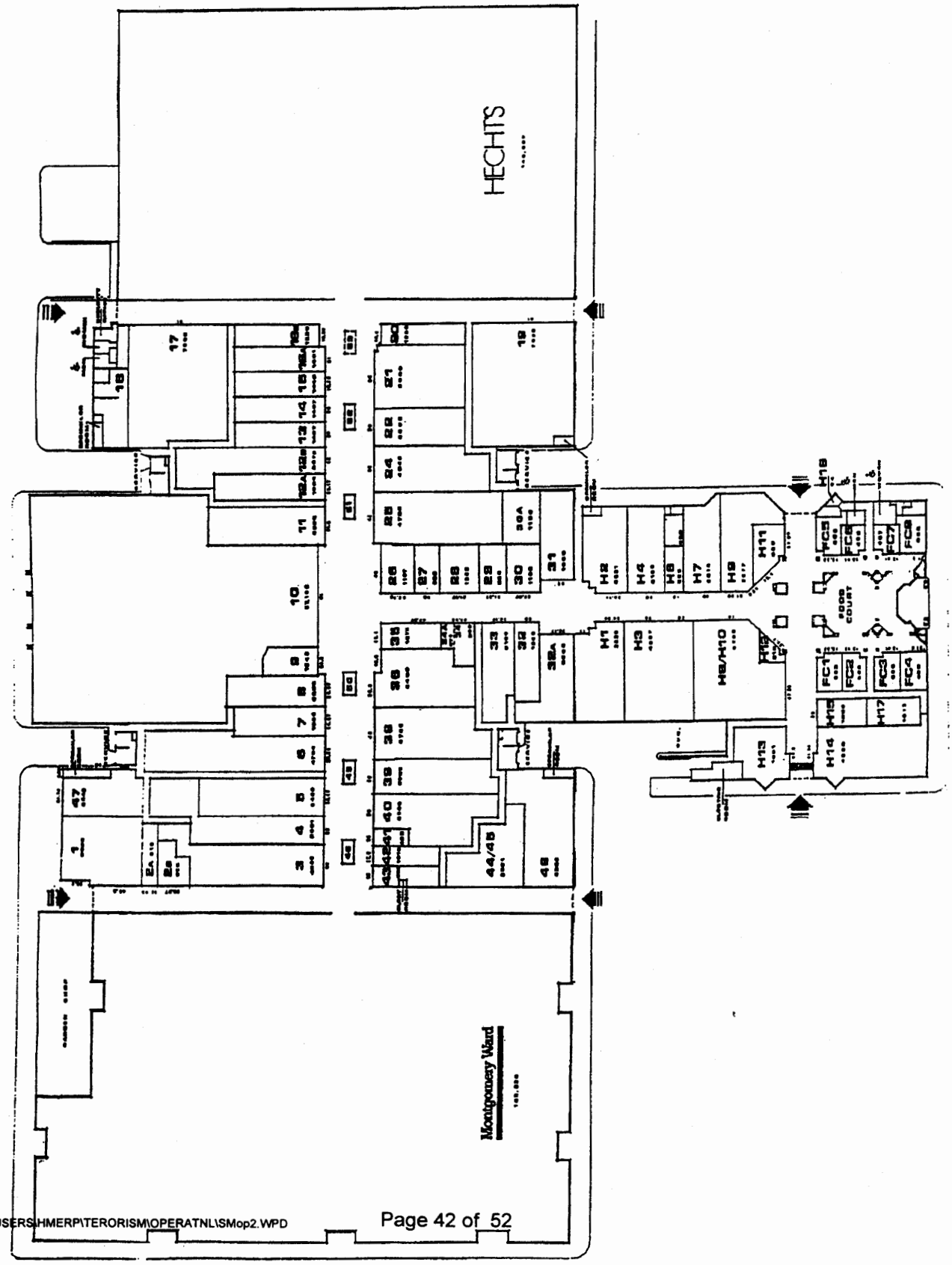
STUDENT HANDOUT 7-2

Team _____ Resources Available

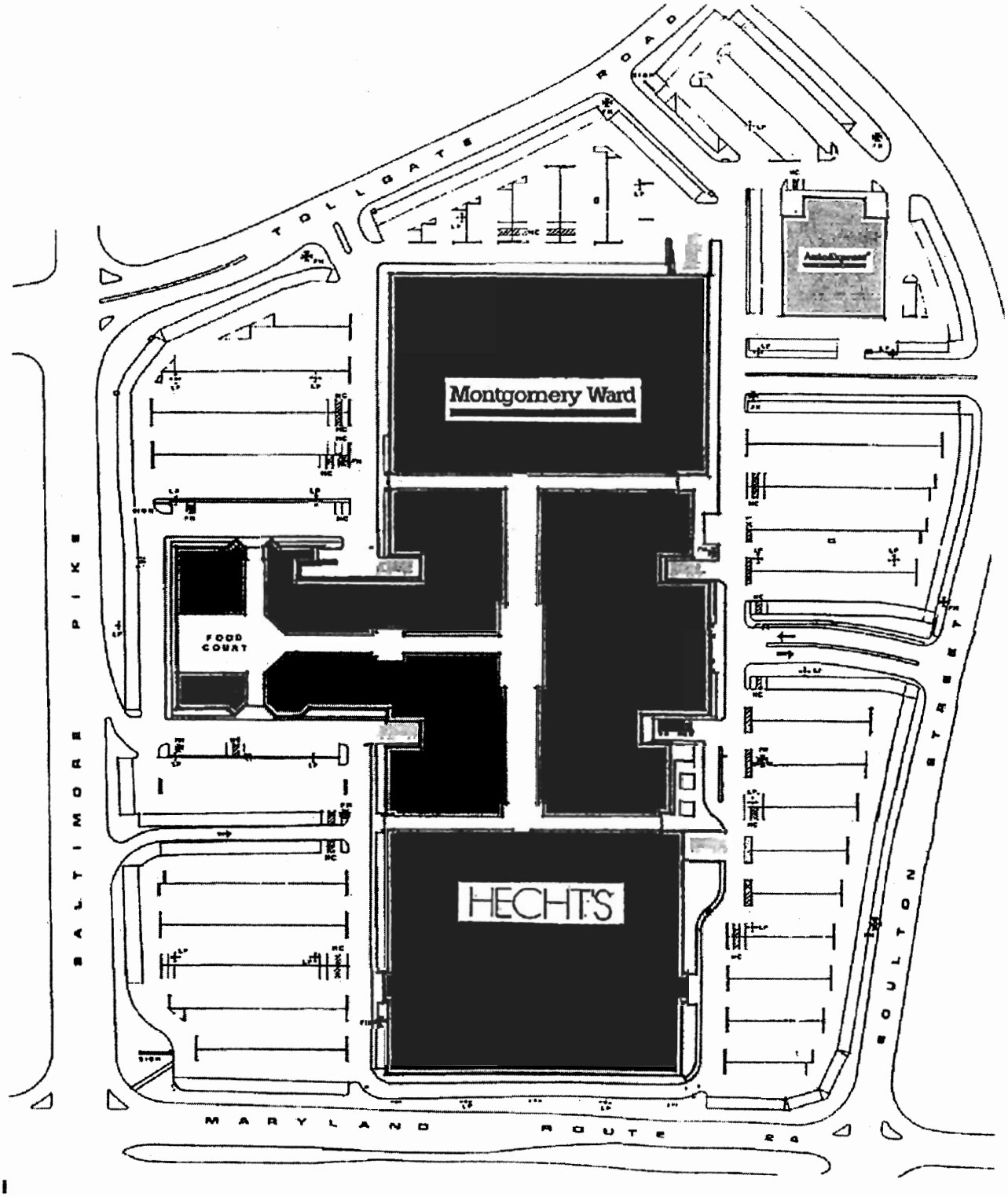
Agency	When Responding	Tactical Objectives	Protection Available	Other Equipment

Notes:
List activities according to responsible agency - Fire, Police, EMS, or Other.
State the objectives and level of protection (or special equipment) available to each activity.

STUDENT HANDOUT 7-3



STUDENT HANDOUT 7-4



Converting Concentration Units:

For a gas at 25°C and at 1 atmosphere pressure:

$$\text{Concentration (in mg/m}^3\text{)} = \frac{\text{Concentration (in ppm) x Molecular Weight (in g)}}{24.45} \quad (1)$$

The detection limits listed on this wall chart are given in "parts per million" by volume (ppm) at 25°C and 1 atmosphere pressure. These values can be converted into the concentration unit "mg/m³" by using the equation (1) given in the box above.

To Calculate the Molecular Weight of a Substance

The Molecular weight of a substance is the sum of tis atomics weights. The following example illustrates how to calculate the molecular weight of 1,1-Dichloro-1-nitroethane.

Find the name of the substance on this wall chart. Listed alongside the name of each substance you will find its chemical formula - for example 1,1-Dichloro-1-nitroethane:

Its chemical formula is: $C_2H_3Cl_2NO_2$

Molecular weight = Sum of the atomic weights

Refer to the "Periodic Table of the Elements" on this chart to find the atomic weights of each of the elements carbon, hydrogen, chlorine, nitrogen and oxygen. These values have been "rounded-up" to the nearest first decimal place to simplify the calculation. The molecular weight of 1,1-Dichloro-1-1nitroethane is calculated below:

Molecular weight = 2 x C + 3 x Cl + 1 x N + 2 x O
= 2 x 12.0 + 3 x 1.0 +2 x 35.4 + 1 x 14.0 + 2 x 16.0
= 24.0 + 3.0 + 70.8 + 14.0 + 32.0
= 143.8

Thus its molecular weight (in g) = 143.8

To Convert ppm (at 25oC) to mg/m3

Reading from the chart - the detection limit of 1,1-Dichloro-1-nitroethane is 0.2 ppm at 25°C and 1 atmosphere pressure. Using equation (1) shown in the box above, the detection limit can be calculated in mg/m³:

$$\text{Detection Limit} = \frac{0.2 \times 143.8}{24.45} = 1.18 \text{ mg/m}^3$$

To Convert Measured Gas Concentrations from mg/m3 to ppm (at ToC and Patm.)

Equation (1) can only be used to convert concentration units of a gas measured at a pressure of 12 atmosphere and at a temperature of 25°C. If the gas is at a pressure of P atmospheres and its temperature is To kelvin then the conversion equation becomes:

$$\text{Measured conc. (in mg/m}^3\text{)} = \frac{\text{Calculated Conc. (in ppm) x Mol.Wt.(in g)}}{\text{Molar Volume}}$$

Where: Mol.Wt. = molecular weight of the substance (an explanation is given earlier)
Measured conc. = measured concentration of the gas (in mg/m³)
"Molar Volume" = is the volume occupied by the molecular weight (in g) of any gas at a specified temperature and pressure. Table 1.lists the molar volume of gases at various temperatures and 1 atmosphere pressure. Its value at at temperature of T°K and a pressure of P atm. can be calculated from the following equation:

$$\text{"Molar Volume"} = \frac{RT}{P}$$

Where: T = temperature of the gas in °K
R = Gas Constant
= 8.2054 x 10^{-2} litre atm K^{-1} $mole^{-1}$
P = pressure of the gas in atmospheres

Temperature (°C)	-20	-15	-10	-5	0	+5	+10	+15	+20	+25	+30	+35	+40	+45	+50
Molar Volume (dm³)	20.76	21.17	21.56	21.99	22.40	22.81	23.22	23.63	24.04	24.45	24.86	25.27	25.68	26.07	26.50

Table 1. Molar Volume of a gas at 1 atmosphere pressure at different temperatures

DPT 7.0

	Level of Protection			
Protective Equipment	**A**	**B**	**C**	**D**
Fully Encapsulating, gas-tight, liquid and vapor protection	**M**			
Non-encapsulating with hood, liquid splash protection		**M**		
Positive pressure, self-contained breathing apparatus or supplied air respirator w/ escape	**M**	**M**		
Air purifying respirator			**M**	
Escape breathing apparatus				**O**
Chemical resistant clothing			**M**	
Apron		**O**	**M**	
Gloves	**M**	**M**	**M**	**O**
Boots	**M**	**M**	**M**	**M**
Work Clothing	**O**	**O**	**O**	**M**
Safety glasses	**O**	**O**	**O**	**O**
Hard hat	**O**	**O**	**O**	**O**
Face shield		**O**	**O**	**O**

M - Mandatory
O - Optional

OSHA Levels of Protection Summary

DPT 7.0

GLOSSARY

Acetylcholine a chemical neurotransmitter produced by nerve cells predominantly outside the central nervous system. It is a chemical "messenger"; stimulating the heart, skeletal muscles, and numerous secretory glands.

Acetylcholinesterase an enzyme that normally hydrolyzes acetylcholine, thereby stopping its activity. This enzyme is inhibited by nerve agents.

Aerobe a microorganism which can live and grow in the presence of oxygen.

Aerosol a liquid or solid, composed of finely divided particles, suspended in a gaseous medium. Aerosols are not necessarily visible.

Anaerobe a microorganism that can live without air or oxygen. In some cases, oxygen is toxic to these organisms.

Arsenical a chemical compound containing arsenic.

Atropine an alkaloid obtained from *Atropa belladonna*. It is used as an antidote for nerve agent poisoning. It inhibits the action of acetylcholine at the muscle junction by binding to acetylcholine receptors.

Autonomic Nervous System that part of the nervous system that governs involuntary functions, such as heart rate, reflexes, and breathing. It consists of the sympathetic and parasympathetic nervous system.

Bacteria a one-celled microorganism which has no chlorophyll and reproduces by dividing in one, two, or three directions of space.

Binary Chemical Agent a highly toxic agent produced when two or more chemical substances, which individually have relatively little toxicity, react due to being mixed or combined.

Biological Agent a microorganism, or toxin from a living creature, that causes either disease in man, plants, or animals or deterioration of material.

Blister Agent is an agent which causes inflammation, blisters and general destruction of bodily tissue. In addition, the vapor also attacks the respiratory tract with the most severe impacts on the upper tract. Eyes are very susceptible to this class of agents.

Blood Agent is an agent which affect bodily functions through action on the oxygen-carrying properties of the blood and interfere with normal transfer of oxygen to bodily tissue.

Carrier is an individual who harbors specific disease organisms, without showing clinical symptoms, and serves as a means of conveying infection.

Central Nervous System consists of the brain and spinal cord.

Chemical Agent a solid, liquid, or gas which, through its chemical properties, produces lethal or damaging effects on man, animals, plants or material, or produces screening or signaling smoke.

Chemical Agent Symbol is the U.S. code designation of any chemical agent. This is a combination of one to three letters or letter-number combinations. It's not the same as, and should not be confused with, the chemical formula.

Choking Agent is an agent which causes irritation and inflammation of bronchial tubes and lungs. Their primary physiological action is limited to the respiratory tract with injury extending to the deepest part of the lungs.

Contagious Disease an infectious disease capable of being directly transmitted from one individual to another. Many infectious diseases are not contagious but require some special method of transmission or inoculation.

Cumulative Effect the building up, within the body, of small ineffective doses of certain chemical agents to a point where eventual effect is similar to a large dose.

Cutaneous pertaining to the skin.

Cyanosis blueness of the skin due to insufficient oxygen in the blood.

Cytotoxin toxin that directly damages and kills the cell with which it makes contact.

Disease is the deviation from the normal state or function of a cell, an organ, or an individual.

Endemic native to, or prevalent in, a particular district or region. An endemic disease has a low incidence but is constantly present in a given community.

Endotoxin a toxin produced in an organism and liberated only when the organism disintegrates.

Enterotoxin a toxin of bacterial origin that affect the intestines, causing diarrhea.

Enzyme organic substance capable of causing chemical changes to take place quickly at body temperature by catabolic action. A biological catalyst.

Epidemic an outbreak of a contagious, infectious disease. The disease can be transmitted from an infected individual to a non-infected individual by direct contact, droplet inhalation, or vector.

Epiphytotic an outbreak of disease among plants. It is analogous to an epidemic in man.

Epizootic an outbreak of disease among animals. It is analogous to an epidemic in man.

Exotoxin a toxin excreted by a microorganism into the surrounding medium.

Fungus any one of a group of thallophytic plants, including molds, mildews, rusts, smuts, and mushrooms. These plants do not contain chlorophyll, and reproduce mainly by sporulation.

Germs are disease-producing microorganisms, microbes, or pathogenic bacterium. The term includes bacteria rickettsiae, viruses, and fungi.

Hydrolysis is the interaction of a chemical agent with water to yield a less toxic product or products.

IDLH Immediately Dangerous to Life or Health; is the maximum concentration from which one could escape - without any respiratory protection - within 30 minutes without experiencing any escape-impairing (e.g. severe eye irritation) or irreversible health effects.

Incapacitating Agent is an agent that produces temporary physiological or mental effects, or both, which will render individuals incapable of concerted effort.

Choking Agent is an agent which causes irritation and inflammation of bronchial tubes and lungs. Their primary physiological action is limited to the respiratory tract with injury extending to the deepest part of the lungs.

Contagious Disease an infectious disease capable of being directly transmitted from one individual to another. Many infectious diseases are not contagious but require some special method of transmission or inoculation.

Cumulative Effect the building up, within the body, of small ineffective doses of certain chemical agents to a point where eventual effect is similar to a large dose.

Cutaneous pertaining to the skin.

Cyanosis blueness of the skin due to insufficient oxygen in the blood.

Cytotoxin toxin that directly damages and kills the cell with which it makes contact.

Disease is the deviation from the normal state or function of a cell, an organ, or an individual.

Endemic native to, or prevalent in, a particular district or region. An endemic disease has a low incidence but is constantly present in a given community.

Endotoxin a toxin produced in an organism and liberated only when the organism disintegrates.

Enterotoxin a toxin of bacterial origin that affect the intestines, causing diarrhea.

Enzyme organic substance capable of causing chemical changes to take place quickly at body temperature by catabolic action. A biological catalyst.

Epidemic an outbreak of a contagious, infectious disease. The disease can be transmitted from an infected individual to a non-infected individual by direct contact, droplet inhalation, or vector.

Epiphytotic an outbreak of disease among plants. It is analogous to an epidemic in man.

Epizootic an outbreak of disease among animals. It is analogous to an epidemic in man.

Exotoxin a toxin excreted by a microorganism into the surrounding medium.

Fungus any one of a group of thallophytic plants, including molds, mildews, rusts, smuts, and mushrooms. These plants do not contain chlorophyll, and reproduce mainly by sporulation.

Germs are disease-producing microorganisms, microbes, or pathogenic bacterium. The term includes bacteria rickettsiae, viruses, and fungi.

Hydrolysis is the interaction of a chemical agent with water to yield a less toxic product or products.

IDLH Immediately Dangerous to Life or Health; is the maximum concentration from which one could escape - without any respiratory protection - within 30 minutes without experiencing any escape-impairing (e.g. severe eye irritation) or irreversible health effects.

Incapacitating Agent is an agent that produces temporary physiological or mental effects, or both, which will render individuals incapable of concerted effort.

Incendiary Agent is a compound that generates sufficient heat to cause destructive thermal degradation or destructive combustion.

Incubation Period is the time interval between the introduction into the body of an infectious agent and the appearance of the first symptoms of disease.

Latent Period a period of seeming inactivity. An example would be the 10-20 year period between exposure to a cancer causing agent and the development of cancer.

Malaise a feeling of bodily discomfort.

Melting Point is the temperature at which a solid changes to a liquid. The melting point is the same as the freezing point.

Miosis excessive contraction of the pupil.

Mortality Rate the ratio of the number of deaths from a given disease to the total number of cases of that disease.

Necrosis death of a cell or group of cells.

Neurotoxin a poison affecting nerve tissue.

Nerve Agent is an agent which affects bodily functions by reacting in an irreversible reaction involving tissue fluids, permitting accumulation of acetylcholine and continual stimulation of the parasympathetic nervous system, as well as affecting other parts of the autonomic nervous system.

Parasympathetic Nervous System the part of the autonomic nervous system that decreases pupil size, heart rate, and blood pressure, and increases functions, such as secretion of saliva, tears, and perspiration.

Pathogen a disease-producing microorganism.

PEL Permissible Exposure Limit; is a time weighted average concentration that must not be exceeded during any 8-hour work shift of a 40-hour work week. PELs are established by the Occupational, Safety and Health Administration (OSHA) and are designed to protect workers exposed to industrial chemicals on a daily basis as part of their professions.

Percutaneous effected or performed through the skin.

Persistency is an expression off the duration of effectiveness of a chemical agent. This is dependent on the physical and chemical properties of the agent, weather, methods of dissemination, and conditions of the terrain. Non-persistent agents, in general, lose their effectiveness as a military weapon approximately 10-15 minutes after deployment.

Phytotoxin a toxin derived from a plant. An example is ricin from the castor bean.

Pulmonary pertaining to the lungs.

Residual Contamination that amount of hazardous material that remains after decontamination.

Rickettsia gram-negative, nonmotile, intracellular, parasitic microorganism which is intermediate in size between bacteria and viruses.

Riot Control Agent is an agent that produces only temporary irritating or incapacitating effect. This class of agents includes both tear and vomiting agents.

Spores resistant, dormant cells of some bacteria; primitive reproductive bodies of fungi.

Sympathetic Nervous System a network of nerves that trigger certain involuntary and automatic bodily functions, such as constricting blood vessels, widening the pupils, and speeding up the heartbeat.

Symptoms the functional evidence of disease; a change in condition indicative of some mental or bodily state.

Synapse site at which neurons make functional contacts with other neurons or cells.

Synergistic working together, having combined cooperative action that increases the effectiveness of one or more of the components' properties.

Systemic relating to the entire organism instead of a part.

Tear Agent is an agent that causes a copious flow of tears and intense (although temporary) eye pain. In high concentrations, they are irritating to the skin and cause a temporary burning and itching sensation. High concentration can cause burns.

Toxin any poisonous substance of microorganic, vegetable, or animal origin.

Toxicity is the classification of toxic agents. There are various systems for identifying relative toxicity of poisons.

LC_{50} / LD_{50} The LC_{50} is the concentration of a vapor or aerosol which would prove lethal to 50% of the individuals exposed. The LD_{50} is the amount of liquid or solid which would prove lethal to 50% of the individuals exposed. The LD_{50} is used to identify the hazard posed by injection, ingestion or contact with liquids or solids, whereas the LC_{50} is used to identify the hazard posed by inhalation or contact with vapor.

Poisoning Potential:

6 (supertoxic) 5 mg/kg body weight
5 (extremely toxic) 5-50 mg/kg body weight
4 (very toxic) 50-500 mg/kg body weight
3 (moderately toxic) 500-5,000 mg/kg body weight
2 (slightly toxic) 5,000-15,000 mg/kg body weight
1 (almost non-toxic) 15,000 mg/kg body weight

TWA Time-Weighted Average; is the average concentration of a chemical that a normal worker can be exposed to during a normal 8-hour work day and a 40-hour week without showing any toxic effects. TWAs are calculated by averaging each exposure, taking into account the concentration of exposure as weighted by the duration of the exposure.

Ultraviolet Light is light waves shorter (and therefore with higher energy) than the visible blue-violet waves, but longer (and therefore with less energy) than X-rays. Ultraviolet light is very effective in killing microorganisms.

Vapor Density is the ratio of the density of any vapor to the density of air (assigned a value of 1). If the vapor density of the vapor is greater than 1, it will tend to settle to the lowest point and hug the earth. If the vapor density of the vapor is less than 1, the vapor will tend to disperse.

Vapor Pressure is the pressure exerted by vapor against the atmosphere and is dependent on temperature. The greater the vapor pressure, the faster a material will evaporate.

Vector a carrier; especially the animal or intermediate host that carries a pathogen from one host to another. Examples of carriers are mosquitoes, fleas, ticks, and lice.

Vegetative Cells are nonspore-forming bacteria or spore-forming bacteria in their nonsporing state.

Venom poisonous mixture of toxins and other natural chemical produced by animals. Examples include snakes, spiders, and scorpions.

Virulence is the degree of pathogenicity of a microorganism as indicated by its ability to invade the tissue of a host. It is the capacity of a microorganism to produce disease.

Virus is an infectious agent, smaller than bacteria and rickettsiae, capable of living and replicating only within a living susceptible host cell. Viruses cannot survive or be grown on artificial media.

Volatility is the tendency of a chemical to vaporize or give off fumes. It is expressed as the weight of vapor present in a given volume of air. The volatility depends on vapor pressure and temperature.

Vomiting Agent is an agent that causes vomiting and may produce coughing, sneezing, nasal discharge, tears, and pain in the nose and throat. Headaches often follow exposure to this class of agent.

Zoonosis a disease of animals that may be transmitted to man.

Zootoxin a toxin or poison of animal origin such as the venom of snakes, spiders and scorpions.

APPENDIX

COMMON CHEMICAL WARFARE AGENTS

EMERGENCY RESPONSE GUIDEBOOK ID AND GUIDE NUMBERS, & NFPA HAZARD CLASSIFICATIONS OF COMMON CHEMICAL WARFARE AGENTS

Substance:	DOT ID #	DOT Guide #	Health Hazard:	Flammability:	Reactivity:
Chlorine	1017	124	3	0	0
Phosgene (CG)	1076	125	4	0	0
Chloropicrin	1580	154	4	0	3
Cyanogen chloride (CK)	1589	125	4	4	2
Hydrocyanic acid (AC)	1051	117	4	4	2
Lewisite (L)	2810	153	4	1	1
Mustard gas (H, HD)	2810	153	4	1	1
Sarin (GB)	2810	153	4	1	1
Soman (GD)	2810	153	4	1	1
Tabun (GA)	2810	153	4	2	1
VX	2810	153	4	1	1