NEW JERSEY HAZMAT EMERGENCY RESPONSE COURSE

LEVEL 3 HAZARDOUS MATERIALS

COURSE NUMBER: 06089

WMD TECHNICIAN

PRESENTED THROUGH:

NEW JERSEY STATE POLICE

Homeland Security Branch, Special Operations Section
Technical Response Bureau, Hazardous Materials Response Unit

1st Edition

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

Module 1: Course Introduction (Technician Training)

NBC HAZMAT Technician Training

Welcome to the HAZMAT Technician Course. It will be presented as lecture, table-top and practical exercise. I will present the instruction, and at the conclusion of each module, review key points.

Before we begin the formal instruction, I would like to provide a brief overview of the Domestic Preparedness HAZMAT Technician Course.

Course Goals

The purpose of this course is to train you to provide Domestic Preparedness HAZMAT Technician Level capability. The classes that follow are designed to increase the depth of knowledge of responders who may be confronted with the challenges created if a terrorist incident were to involve the employment of nuclear, biological, chemical (NBC) agents. Following its completion, you should be able to provide:

a. Advice regarding the correct technician level offensive response actions to be taken in the event a terrorist were to employ an NBC weapon. These actions include agent detection procedures, identification procedures, PPE selection, downwind hazard prediction and decontamination.

b. An evaluation of your ability to respond to an incident involving the employment of an NBC agent through a practical exercise.

Focus

The focus of the Domestic Preparedness Training Program is on the response to an incident involving NBC agents. These agents are significant as they were designed and optimized specifically to kill or injure, and as a result will affect the response procedures normally employed at hazardous material incidents. We will discuss these changes in response procedures, the NBC Delta (or difference).

Additionally, because many of these agents were invented for military use, the terminology associated with them is military in nature, and thus different from that normally encountered with respect to hazardous materials. Your mission, to bring order from confusion and defeat the terrorist by minimizing the effects of these weapons, will rely heavily on an understanding of these differences.

Let us look at how an everyday HAZMAT incident differs from an NBC terrorism incident and explore the challenges and consequences presented by those differences.

a. NBC agents are more toxic than the hazardous material normally encountered by responders, and are referred to as "supertoxic" substances. Only milligrams of radiological material or chemical or biological agents can cause injury or death to thousands if disseminated correctly.

b. Early identification of the hazard is critical to ensure the safety and health of both responders and victims. Victim signs and symptoms must be reported early to the Incident Commander and/or the EMS officer in charge; however, only advanced detection and identification equipment such as a portable gas chromatograph can detect the lowest toxic threshold concentrations for chemical agents.

c. As a general rule, HAZMAT incidents do not produce mass casualties, but they will almost certainly produce large numbers of psychological casualties. This was demonstrated on a small scale by the Tokyo attack, which produced 5,500 casualties (4,700) of which were psychological.

d. While the normal HAZMAT response requires the decontamination of only a few people, an incident involving an NBC agent will require mass decontamination of hundreds, or even thousands of individuals. As a result, some of the initially arriving responders will have to be assigned this task, with another part of the HAZMAT team committed to establishing a separate decontamination corridor to provide technical decontamination for responders.

e. Most NBC agents are supertoxic, are heavier than air, and fall in the range of semi-persistent or persistent agents. As a result, they pose a greater threat than most hazardous materials to responders for a longer period of time in the area where the responders must execute their mission. Additionally, because of their higher toxicity, NBC agents will tend to pose a greater threat to individuals down wind of the site of the incident than conventional hazardous materials.

f. While a normal HAZMAT incident may or may not be labeled an environmental crime scene, an act of terrorism involving NBC agents is a Federal crime. As a result, the incident site will be designated a crime scene, and evidence preservation will be a key component of the response so that the perpetrator can be identified, apprehended, and brought to trial.

g. Interagency coordination at the municipal, state and Federal levels <u>may</u> be needed at the site of a hazardous material release. This same interagency coordination will be <u>required</u> in the event of an NBC terrorism attack, both as a result of the complexity of the response required, and due to public concern. The employment of liaison officers and staging area managers will be requisite to the timely and efficient application of resources. As a result, the Incident Commander at these types of incidents must be experienced in executing the Incident Command System and have the requisite experience to assign areas of responsibility to responding agencies and their personnel.

h. Because of the number of agencies and responders involved in the response to an NBC incident, communications systems will quickly become overloaded, and even the use of cellular phones may be inadequate as the sole auxiliary system.

i. Because of the public's concern about the consequences of exposure to nuclear, biological, and chemical material, mass panic and hysteria should be anticipated. This reaction on the part of the public will be many times greater than seen at a standard hazardous material scene. It will rapidly exceed the management capability and resources of fire companies and hazardous material teams alone. As a result, the importance of proper and immediate employment of local law enforcement personnel cannot be over emphasized.

j. At the scene of a standard hazardous material release, intervention can be methodical and deliberate; however, because of the expected number of victims, the catastrophic nature of injuries, and the speed with which the agents can kill, it is expected that the normally deployed forces will be quickly overwhelmed.

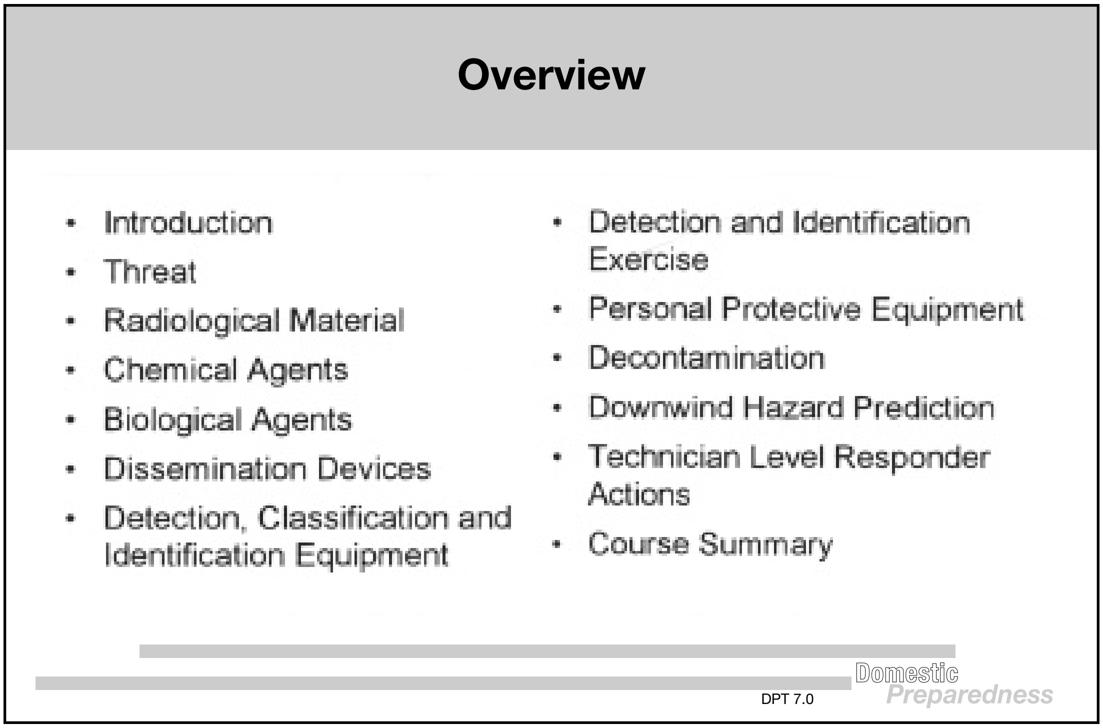
k. All responders must be aware that there is a possibility secondary devices might be present at or near the incident site. These devices may be of conventional high explosive fill, or may be constructed to deliver additional NBC material. When responding to a terrorist incident, always expect a secondary device to be present.

l. Indications that might alert responders to the impending attack may be present before a terrorist incident occurs. These indicators may take the form of phone calls to authorities describing the event or stating the reason for the attack, or might be the discovery of the dissemination device before it releases the agent into the atmosphere.

Administrative Notes

a. There will be approximately 10 hours of classroom instruction, composed of lecture and tabletop exercises, with an additional 6 hour practical exercise in detection and identification of an unknown agent.

b. As we teach the course, you may note that the emphasis is on chemical agents, rather than biological agents or radioactive material. This is because it is unlikely that there will be a true “first response” for a biological agent (as you will learn), and you already have training about the proper response procedures for incidents involving radioactive materials.



Overview

The next 16 hours are organized into thirteen blocks of instruction:

a. The Threat will address the potential danger posed by terrorists who have access to nuclear, biological, or chemical material.

b. Radiological Material will present technical information about nuclear material that a terrorist might employ.

c. Biological Agents will present technical information about selected biological agents that a terrorist might employ.

d. Chemical Agents will present technical information about selected chemical agents that a terrorist might employ.

e. Dissemination Devices will discuss the types of devices one might see used by a terrorist for the employment of weapons of mass destruction.

f. Detection, Classification, and Identification Equipment will provide instruction about the operation of selected items of equipment and the employment of simulants in training. One hour of lecture will be followed by a three hour practical exercise.

g. Personal Protective Equipment (PPE) will describe different types of equipment and present illustrative scenarios asking student to choose the correct PPE.

h. Decontamination will address the types of decontamination, which decontaminants are best for specific chemical agents, the decontaminants to be used on victims and those only for use on equipment, and the risks associated with decontamination.

i. Simplified Downwind Hazard Prediction which will address the purpose, preparation, and application of simplified downwind hazard prediction (with two practical exercises).

j. Technician Level Responder Actions will focus on the offensive actions technician level responders should execute to minimize hazards, rescue casualties, identify hazardous materials, and collect evidence.

k. Course Summary is designed to review key points of the course and solicit responder comments.

Module 2: The NBC Terrorism Threat (Technician Training)

Training Objectives: At the conclusion of this lesson, students will be able to describe:

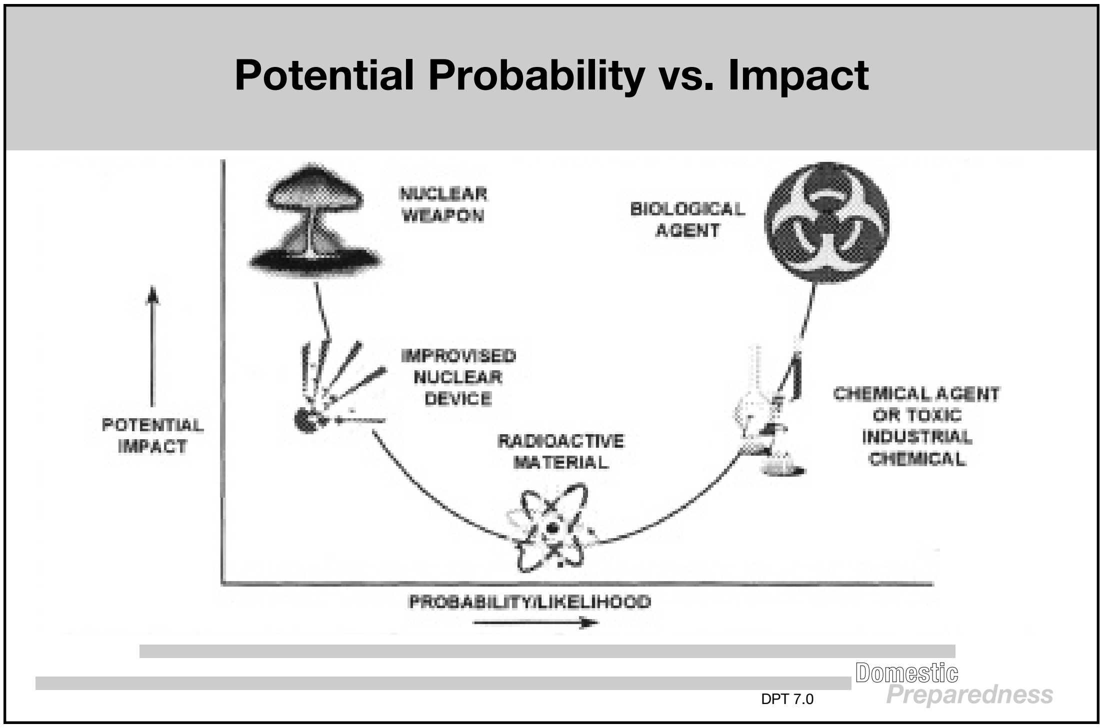
1. Recent terrorist incidents involving NBC material.
2. Some reasons terrorists might consider using NBC materials.
3. The sources and hazards of NBC weapons.
4. The likely targets and indicators of a terrorist NBC attack.
5. The potential outcomes of a terrorist NBC attack.

References:

1. *Hearing on Global Proliferation of WMD*, U.S. Senate Subcommittee on Investigations, October—November, 1995.
2. *The Threat of Nuclear Terrorism*, The Christian Broadcasting Network, 1996.
3. *Chemical and Biological Terrorism: The Threat According to the Open Literature*, Canadian Security Intelligence Service, June 1995.
4. AP, UPI and other open press sources.
5. *Politics and the Life Sciences*, Volume 15, Number 2, September 1996, pp. 167-240.

The Threat of NBC Terrorism

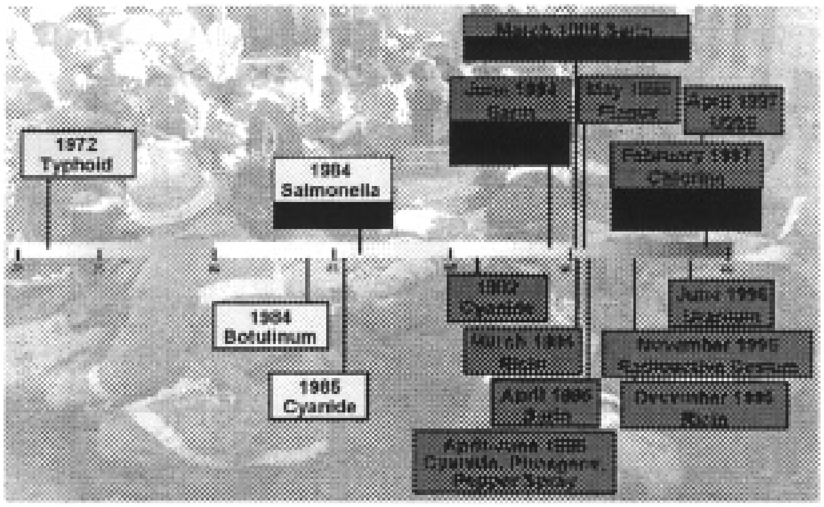
The March 1995 nerve agent attack by terrorists in the Tokyo subway system has heightened concern among government and public safety officials regarding the potential for similar attacks in the United States. Until the March 1995 attack, most of the effort towards preventing or responding to terrorist activity within transportation facilities or other areas where crowds gather was focused on hostage taking, bombing, the use of firearms, and sabotage. The Tokyo incident raised the specter and demonstrated the potential of a new and insidious form of terrorism, with which few in the government and public safety organizations were prepared to cope.



Probability of NBC Weapons vs. Potential Impact

The terrorist NBC threat includes nuclear weapons, radiological material, and chemical and biological agents. This slide contrasts the likelihood of the materials being used by terrorists with their potential impact. The conventional wisdom is that a nuclear weapon will be very difficult for a terrorist group to acquire; however, radioactive material, chemical agents, and biological agents are relatively easy to obtain, and thus pose a greater threat. Note that both the availability and the impact of chemical and biological threat materials are high, with a potentially devastating impact. This course will address neither nuclear weapons nor improvised nuclear devices. We will, rather, focus on the most likely terrorist weapons: radioactive material, chemical agents, and biological agents.

CB Terrorist Incidents Since 1970



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Domestic Preparedness

NBC Terrorist Incidents Since 1970

This time line, crafted from unclassified sources, shows the increase of actual terrorist activity involving NBC agents. This slide does not cite hoaxes, such as the letter which was alleged to contain anthrax, sent in April 1997 to B'nai B'rith headquarters in Washington, D.C. (While not addressed on this chart, these hoaxes are of concern because municipalities must initially respond to hoaxes as HAZMAT incidents). As you can see on the chart, there was only one reported NBC event in the 70s, with three more in the 80s, and an exponential increase of events in the 90s. Some highlights include:

a. In 1972, members of a U.S. Fascist group called Order of the Rising Sun were found in possession of 30-40 kilograms of typhoid bacteria cultures, with which they planned to contaminate water supplies in Chicago, St. Louis, and other large Midwestern cities.

b. In 1984, two members of an Oregon cult headed by Bhagwan Shree Rajneesh cultivated Salmonella (food poisoning) bacteria and used it to contaminate restaurant salad bars in an attempt to affect the outcome of a local election. Although some 751 people became ill and 45 were hospitalized, there were no fatalities.

c. In March 1995, four members of the Minnesota Patriots Council, a right wing militia organization advocating the violent overthrow of the U.S. Government, were convicted of conspiracy charges under the Biological Weapons Anti-terrorism Act for planning to use ricin, a lethal biological toxin. The four men, Douglas Baker, Richard Oerlich, Dennis Henderson, and Leroy Wheeler allegedly conspired to assassinate federal agents who had served papers on one of them for tax violations.

d. In May 1995, Larry Wayne Harris, a member of the neo-Nazi organization Aryan Nations, was arrested in Ohio on charges of mail fraud and fraud by wire. He allegedly misrepresented himself when ordering three vials of freeze-dried Yersinia Pestis, the bacteria which causes bubonic plague, from a Maryland biological laboratory.

e. In December 1995, Thomas Lewis Lavy from Arkansas was charged with possession of the toxin ricin in violation of the Biological Weapons Anti-terrorism Act of 1989. In 1993, Canadian customs officials had intercepted Lavy carrying a stack of currency with a white powder interspersed between the bills. Suspecting cocaine, customs eventually had the material analyzed, and discovered that it was not cocaine but ricin. Lavy was then arrested, and the next day hanged himself in his jail cell.

f. In November 1995, a Chechan separatist organization left a 30 pound package of radioactive Cesium and explosives in a Moscow park. The organization informed Russian Independent Television that this was one of 4 such packages smuggled into Russia. Since the location of the first package was disclosed before it detonated, it is thought that the attempt was to establish credibility for a possible future extortion attempt.

g. In June 1996, German authorities arrested a Slovak engineer on suspicion of smuggling 6.1 pounds of uranium into Germany. The material was seized from a safety deposit box in Ulm, a city in southern Germany.

h. In April 1997, Russian police arrested a group that tried to sell 11 pounds of uranium-235 stolen from a production plant in Kazakstan. (It only takes a few pounds of enriched uranium to make a nuclear weapon.)

Groups that Threaten

For this discussion, there are six basic types of terrorists or terrorist groups capable of using NBC weapons.

a. The lone individual, such as the "Unabomber," is by far the most difficult to detect. This type of terrorist is a wild card, striking without a predictable motive or pattern, copying a previous event for the publicity, or just acting on a whim. Fortunately, individual terrorists have been the least successful. Lacking the funding, organization, and sophistication of larger groups, they account for many of the recently failed attempts and hoaxes.

b. Local terrorist groups and non-aligned groups from the larger threat of domestic NBC terrorism, as they can have the funding, organization, and ability to build or purchase NBC weapons. The primary difference between them are the cause, the home base, and the source of their funding. Local terrorist groups have one distinct advantage over foreign organizations: the members fit into the local society and are often unnoticed until they strike.

c. On the other hand, internationally sponsored groups will have access to technologies, facilities and technical support not available to non-aligned groups. State sponsors, however, risk severe repercussions should their involvement be determined.

d. Doomsday cults, such as the Aum Shinrikyo, the group that conducted the sarin attack in Tokyo, obviously pose a major threat stemming from the fanaticism of their members, if such organizations embrace terrorism as means to an end.

e. The current threat from rebels/insurgents within the U.S. is held to be low.

Why NBC Terrorism?

Terrorist groups perceive several advantages of using NBC weapons in populated areas:

a. <u>Small quantities of chemical or biological agents are relatively easy to manufacture.</u> Although not quite “high school” science, chemical and biological weapons can be made from readily available components by individuals with knowledge gained at the college level. During most processing stages, only simple handling precautions are required. Even when the final products are made, readily available environmental protection (HAZMAT) gear is all that is required for handling the most toxic chemicals. Biological agents pose even less of a manufacturing safety problem than chemical agents.

b. <u>They are available.</u> Radiological materials are found in many facilities, such as research labs and in industry. In fact, almost every home has radioactive material (in smoke detectors). Toxic chemicals, and the materials to make chemical warfare agents, are readily available in school laboratories, are legitimately used in industry, and are employed in various research facilities. Libraries contain the “recipes” required. Biological pathogens can be obtained from nature, hospital labs, and university research facilities, among other places.

c. <u>They are cheap.</u> NBC weapons are called “the poor man’s atomic bomb.” A program to produce a fissionable device would probably cost hundreds of millions of dollars; obtaining material from black market sources would cost less, but still in the millions. One of the reports quotes testimony before a UN panel that, “for a large-scale operation against a civilian population, (manufacturing enough agent to cause) casualties might cost about...$600 per square kilometer with nerve gas and $1 per square kilometer with biological weapons.”

d. Small quantities can have a tremendous effect. An often quoted example is that "one small vial holds enough biological agent to kill every person on the earth." In practice, however, dissemination methods are not nearly so efficient.

For comparison purposes, a fragmentation hand grenade has an effective casualty radius of 15 meters. The same quantity of chemical agent (about 1.7 pounds), disseminated in a practical way, could fill a 600 long foot subway platform with a concentration which would injure or kill every person who remained on the platform for two minutes. It would take much less than an ounce of biological material to produce the same casualty effects. A radiological agent, spread in the same location, would likely not cause immediate injury, but would have the potential to shut down the facility until thoroughly removed.

e. They are not detected by methods used for explosives and firearms. Terrorists actions to date have resulted in the use of metal detectors and x-ray devices in transportation facilities and other areas where crowds gather. NBC weapons can be transported in glass or plastic containers configured to look like ordinary items. The fact that some of the devices in the Tokyo incident were carried in what appeared to be lunch boxes is indicative of the problem with detection.

f. They can be used covertly with little signature over periods of hours or even days. A clever person can easily devise methods to disseminate a chemical, biological or radiological weapon which results in little, if any, signature. The first indication of a chemical attack may be when people start to collapse, as was the case with the Tokyo incident. The first indication of a biological attack may be when people begin to develop symptoms of disease hours or days after an infectious dose is ingested. There may never be an obvious indication of a radiological attack.

g. They can be spread throughout large areas by natural convection or air-currents. NBC agents, such as dust or vapors, move with air currents. Ventilation systems in buildings or transportation facilities may actually become part of the dissemination system, carrying NBC agents far from the initial source. One author reported a test in which harmless biological organisms introduced into the Seventh and Eighth Avenue subways in New York City were detected at the extremities of the system within minutes.

h. Contaminated facilities require decontamination, tying up of resources and increasing media attention. Once disseminated, NBC agents can remain in the air as vapors or aerosols, or settle on surfaces. In each case a hazard can remain for hours to days or weeks if untreated, or for years in the case of some biological or radiological materials. This persistency of the hazard requires that facilities be monitored and decontaminated before being returned to service. Decontamination is a tedious, time-consuming and resource intensive process, which requires that personnel doing the work be fully protected from the effects of the agent.

i. The psychological impact of the agents will extend far beyond their actual effect. The mere thought of imminent exposure to a chemical or biological agent, or radiation, causes a terror reaction in many people. The pictures of Israeli civilians boarded up in their houses, fearful of Iraqi chemical attacks during the Gulf War is an example of the kind of fear these weapons can arouse.

j. It is difficult for civil government agencies to prepare for NBC terrorist incidents. Most civil agencies now have some kind of HAZMAT response team available, but while these teams and their equipment can form the core of an element that responds to a terrorist NBC incident, they are likely to be challenged beyond their current capability in terms of knowledge, manpower, and equipment. The number of potential casualties and the extent of the area involved can very quickly overwhelm the capabilities of any response organization. All responders (police, medical, fire, environmental management, transit, etc.) will need to be fully trained, equipped and integrated in the handling of such incidents, with these courses as your starting point.

k. NBC Terrorism provides the next level of escalation. As counterterrorism actions by government and law enforcement authorities are implemented, it becomes increasingly more difficult for terrorists to act with impunity. Furthermore, the populace is becoming somewhat used to conventional terrorist activity. There is frequently a flurry of media and government attention for a time, and then the coverage quickly ends. Terrorists seek to take actions which generate greater fear and attention. Because of the mass casualty potential (in the thousands, not hundreds), and the sometimes inordinate fear by the public regarding chemical and biological weapons and radiation, use of these materials by terrorists will enhance the impact of an attack. Such an event can move a group from relative obscurity to the center stage, which in many instances is their primary objective.

Limitations of the Use of NBC Materials

Despite the advantages, there are also limitations and disadvantages to the use of NBC weapons from a terrorist's perspective. It is important to understand these as well, because they can impact the development of response plans.

a. <u>Chemical weapons must be used in relatively large quantities.</u> When used in open areas, NBC agents are subject to dispersion by the wind. For chemicals, which are pound for pound a thousand times less toxic than biological agents, this requires quantities measured in pounds and gallons for a massive effect. This requirement creates manufacturing and handling problems, and increases the risk of detection—but many potential NBC agents, such as chlorine and phosgene, are shipped by the rail car or tanker truck load.

b. <u>Delayed effects can detract from the intended impact.</u> Terrorist activities occur for the purpose of making a public political statement. Determining whether an outbreak of disease or illness is the result of natural causes or terrorism is difficult and time consuming. This uncertainty as to the cause, and the time delay in seeing any effect, can detract from the potency of the political statement or the credibility of the claim. This may, however, be outweighed by the fear that is created; even a hoax instills considerable fear.

c. <u>The use of CB weapons may be counterproductive.</u> To a certain degree, there is a balance between the magnitude of the terrorist act and the support or attention it generates. Terrorism by the Irish Republican Army (IRA) brought attention to their complaints and allowed them to gain sympathy and support from a number of sources. The use of weapons abhorred by the public may isolate a terrorist organization from its potential support. So far, this has not deterred those who have already attempted to use chemical or biological weapons.

d. <u>Production of NBC agents and devices is inherently hazardous to the terrorist.</u> Production of chemical or biological agents, or use of radioactive material, is not without risk to the potential terrorist. Radiation is difficult to shield, biological agents may infect the grower, and chemical agents may kill or injure the producer. The technically proficient terrorist, however, will recognize the hazards and take steps to insure his or her safety.

e. <u>Development of effective NBC weapons requires numerous difficult steps.</u> One report listed 16 steps required to plan and execute a biological terrorist attack which would kill millions, each step of which would pose difficulty for the terrorist group. Problems cited included lack of knowledge, difficulty in obtaining equipment and materials, safety, risk of detection, and difficulty in preservation and dissemination. The bad news: the information, equipment and skills to accomplish these processes are readily available.

NBC Agent Sources

a. A likely source of chemical and biological agents is the home lab. This can mean low concentration, impure, inexpensive materials or fairly potent agents, depending on the process used to produce and purify them. In some cases, that process is as simple as an improperly processed canned good (botulinum toxin) or very complex (nerve gas).

b. Many terrorists rely on a real laboratory to produce the agent, and simply attempt to either buy it on the open market or steal it.

c. Stealing NBC agents is easier from industries that use poisonous chemicals in bulk and ship or store the chemicals in relatively accessible areas.

d. Terrorists are less likely to obtain NBC agents from military authorities, although foreign military equipment can be obtained for use as dissemination devices. With the breakup of the Soviet Union, there are many establishments in the NBC business looking for a new market among the unscrupulous.

e. Medical and university research facilities are possible sources for small quantities of hard to obtain chemical or biological materials, and these are often poorly protected from theft. The man in Ohio who obtained bubonic plague bacteria bought it from a biological research supplier.

Indicators of NBC Attack (Primary)

As stated earlier, you may respond to an incident such as a fire or explosion long before you know it is also an NBC incident.

a. The first indication that an attack may include NBC agents will be the observed symptoms of the agent in the victims. Chemical agents have unique symptoms that differentiate them from other illnesses; we will elaborate on this later. Keep in mind that most biological agents and a few chemical agents will not exhibit symptoms until several hours after the initial exposure. Radiological agents may not produce symptoms for days, and possibly years.

b. Another strong indication that a terrorist attack may have taken place is the massive number of casualties produced, with all having severe cases of the same apparent disorder.

c. Casualties downwind of a specific point or area, or limited to specific enclosed areas, also indicate a wind-borne hazard.

d. Someone may find the actual dissemination device if it did not function, or may view the device disseminating agent. Any unusual spraying or low-order explosion surrounded by a cloud is a tell-tale sign of an NBC release.

e. A warning of impending attack or a proclamation of credit may indicate the attack included an NBC agent, even if there were no immediate symptoms observed.

Indicators of NBC Attack (Secondary)

These are other indicators of an NBC attack.

a. Animals fall victim to the same effects of the attack as humans, and they are more likely to die of untreated injuries where they were exposed.

b. The casualties who are close enough to become ill may have observed the attack as it occurred. For example, people in the Tokyo subway who were exposed to the nerve gas reported that suddenly everything became dark. This is one of the symptoms of nerve agent poisoning. Even a consensus that "nothing" unusual happened might attest to the delayed effects of an NBC agent.

c. You may see something that appears to be out of place in the immediate area, such as agent residue left behind (resulting in unusual smells or unexplained liquid spills). Concentrated liquid chemical agent poses a grave risk to first responders who have not yet established the nature (NBC) of the attack.

Outcomes of a Terrorist NBC Event

a. A well planned and executed terrorist NBC attack may result in thousands of casualties, many of whom can carry residual contamination on their clothing into the ambulances. A similar event using biological agents could result in the infection of tens of thousands.

b. The presence of NBC agents in a terrorist act will overwhelm all factions of the emergency response system; medical, fire, police, HAZMAT teams, communications, support, and clean-up operations will be most heavily burdened.

c. The immediate area will have to be evacuated, tying up traffic and shutting down facilities for prolonged periods of time. Some contaminated facilities may not be certified as safe to reoccupy for weeks, if ever.

d. In a large event, mass fear can lead to panic extending throughout the city or state.

e. Fear leads to widespread panic, which can result in the public losing faith in the ability of the government to protect their safety and welfare.

f. You as first responders may bear the brunt of the reaction by the angry crowds as to why you did not protect them better. In the long term, this may stall or reverse your initiatives to increase the funding, equipment or manpower necessary to provide that protection. Finally, there will be a flood of news reporters to the scene.

Fallacies

There are three common perceptions about NBC weapons that we can now debunk:

a. It can't happen to us: Yes, it can happen. It already has in many states and in foreign nations, and it will continue to happen as it is easy for terrorists to do. Your preparedness will mitigate many adverse effects of the NBC attack when it does happen.

b. NBC agents are so deadly, the victims will die anyway: NBC weapons are not a doomsday machine. The vast majority of people within the area affected by an NBC event are not going to be seriously injured. Many won't show any symptoms at all. This does not lessen the severity of the injuries for those unlucky enough to become casualties; however, most of the survivors should eventually recover with proper medical treatment.

c. There is nothing we can do: Yes, there is something you can do, starting with all you already know as responders. Dealing with NBC agents as a part of the terrorist attack will certainly make that job harder, but not impossible.

Key Points

The preceding Module was designed to give you a basic familiarization with the reasons terrorists might choose NBC weapons: their limitations, impacts, sources; the types of targets they might attack; and the indicators and potential outcomes of a terrorist NBC attack. The key points are:

a. Terrorist groups today have the organization, funds, motivation and zeal to use NBC weapons. That civil authorities are ill prepared to address this threat will not diminish the threat. Since we cannot wish away the capabilities of the terrorists, we must prepare, with these courses to help you.

b. The specter of NBC weapons being used in our cities instills a fear and a perception of ineptitude in the government (including you as its representatives), that will far outlast the consequences of an actual attack and far exceed the boundaries of the affected area. Though the immediate effects will be devastating, the half-life of legal, safety, chronic health, and environmental implications will rival that of the strongest contaminant.

c. Small, home-made chemical and biological agent devices are the easiest to build and could be used by terrorists most effectively in confined spaces such as enclosed stadiums, buildings and subways.

d. The key to early recognition of an NBC attack is your familiarity with the symptoms of the chemical and biological agents and radiological material terrorists are likely to use. These you will learn in the next several hours.

e. NBC attacks have killed or injured thousands in a single stroke. The ability of the emergency response system to cope with mass casualties may make all the difference in providing the timely care needed to revive them.

f. Responders must prepare to meet this challenge by preparing now. These courses are designed to help you respond to the threat and knowledge is the first step to preparedness.

Review Questions

Q: Have terrorists attacks in the U.S. ever involved NBC agents?

A: Domestic NBC attacks by terrorists include the 1984 salad bar poisoning using salmonella, several other attempts with chemical and biological agents, and attempts to smuggle or disseminate radioactive material.

Q: What types of terrorist would use NBC weapons: individuals, hate groups, or internationally sponsored groups?

A: Any type of terrorists, i.e., individuals, domestic hate groups, or internationally sponsored organizations, might use NBC weapons.

Q: What are the immediate effects of NBC agents? Far reaching effects?

A: Immediate effects of NBC agents are fear and acute poisoning, with immediate or delayed symptoms, ranging from mild injury to death. Far reaching effects include fear and panic, and environmental, safety, and chronic health concerns.

Q: What are the most likely sources of NBC agents for a terrorist?

A: The most likely sources for a terrorist to acquire chemical or biological agents are a home laboratory using simple production methods or to buy them from a commercial source.

Q: What are the most likely targets of an NBC attack?

A: The most likely targets for a terrorist NBC attack are large crowds, enclosed areas, and high profile events. Other targets include critical facilities and infrastructure, large accessible NBC storage facilities, transportation vehicles, or any other potential facility of interest to the terrorist cause.

Q: What are the primary indicators of a terrorist NBC attack?

A: The primary indicators of a terrorist NBC attack are the NBC agent symptoms, mass casualties, casualty patterns, a dissemination device, and the warning given or credit taken by the terrorist.

Q: What are the potential outcomes of a well executed NBC attack?

A: The potential outcomes of a terrorist NBC attack may include mass casualties; an overwhelming of the response system; a disruption and shutting down of whole areas and facilities; panic; loss of faith in the government; and concern with the adequacy of the emergency response system.

Module 3: Biological Agents (Technician Training)

Training Objectives:

1. Know how to protect yourself.

2. Recognize the hazards and indicators of a biological attack.

References:

1. U.S. Army Medical Research Institute of Infectious Diseases, *Medical Management of Biological Casualties*, August 1996.

2. Biological Warfare, A Historical Perspective, *Journal of the American Medical Association*, Vol. 278, Number 5, August 6, 1997.

3. Clinical Recognition and Management of Patients Exposed to Biological Warfare Agents, *Journal of the American Medical Association*, Vol. 278, Number 5, August 6, 1997.

Biological Agents

The time was April, 1979. The place Sverdlovsk, USSR. Sverdlovsk (now Ekaterinburg) was located about two and one-half miles from a then Soviet military facility. On this particular day, the wind was blowing such that Sverdlovsk was downwind from the military facility when an explosion occurred. It was probably just another day in the lives of the people of Sverdlovsk, or so they thought.

A few days later, some of the townsfolk started developing fevers, chills and generally not feeling well; some were complaining about chest pains. As time passed, more individuals started displaying these same symptoms and some of the earlier victims died.

What happened? Attending medical personnel diagnosed this occurrence as an outbreak of anthrax. The initial news releases coming from the Soviets said the anthrax outbreak was the result of ingesting contaminated meat purchased on the black market.

Eventually 77 cases of anthrax were reported, with 66 deaths resulting. The autopsies listed the cause of death as anthrax.

In 1992, President Boris Yeltsin admitted that the nearby military installation had been part of an offensive biological weapons program and that an epidemic had been caused by a non-intentional release of 1 to 2 kilograms of anthrax spores during the process of uploading artillery shells.

This is a classic example of what a biological agent can do.

Learning Objectives

a. Know the protection needed and available to responders against biological agents.

b. Recognize the indicators and hazards of a biological incident.

Characteristics

a. As we look at biological agents, you will see some similarities to chemical agents, but you will also note some significant differences.

b. From a responder's point of view, the biggest difference is time. Unlike chemical agents, most of which have an immediate effect, most biological agents all have a delayed effect ranging from several hours to days, and in some cases weeks. When you respond to a biological incident, there may be no immediate casualties or anything significant unless you or someone else witness the actual release or a suspected dissemination device has been located.

c. As a responder, you need to understand some of the basic characteristics of potential biological agents and how to protect yourself.

Biological agents:

a. Are not dermally active: Unlike some of the chemical agents (nerve and blister agents), biological agents cannot penetrate healthy unbroken skin. (An exception is T-2 Mycotoxin, which causes skin damage). To cause disease, most biological agents must be inhaled or ingested. Our skin provides a good barrier to most agents, in contrast to some chemical agents which can cause toxic reactions and symptoms if placed on the skin.

b. Are non-volatile: Biological agents will be disseminated as either liquid or solid aerosols, with the biological material being subjected to the environment. Many biological agents are living organisms and adverse temperature and humidity will affect them. Sunlight, in particular ultraviolet rays, will kill many of them. In this environment, most will only last a few hours or days. Because of this, use of biological agents is more likely at night or in enclosed areas.

c. By weight are generally more toxic than chemical agents. For example, ricin, one of the toxins I'll mention, is 2 to 3 times more toxic than VX, the most toxic nerve agent and botulinium, another toxin, is 5,000 to 10,000 times more toxic than VX.

d. Are invisible to our senses. We cannot see, taste, hear, feel or smell them.

e. Have a range of effects. Biological agents have a variety of effects depending on the organism and how it affects us, the dose we receive, and the route of entry. This range can run from skin irritation to death.

f. Are obtained from nature: Each of the biological agents has a natural host. In some instances, with little training or equipment, a small amount of culture or material can be "grown" into larger quantities which are then placed in a dissemination device.

g. Are relatively easy to produce: This ties to the last characteristic. The key term here is relatively. As I said, if you can obtain a culture of one of the organisms and know how to "grow" or culture it, (provide a suitable environment, provide nutrients, allow it to reproduce, etc.) you can increase the quantity using basic procedures with easily obtainable equipment.

h. Have delayed effects. All living biological agents have a definite time period between when a victim is subjected to the agent and when the symptoms begin to appear. This is referred to as the incubation period, the time when the agent is reproducing in the body and defeating its natural defense systems. This incubation period can be as short as a few hours to days and in some cases weeks. Even toxins, which do not grow and reproduce, may take hours to produce symptoms.

Bacteria and Viruses

Both bacteria and viruses are living organisms and as such, require an environment in which to live and reproduce.

a. They can enter the body through inhalation or ingestion, through a break in the skin, or through other body openings or orifices. In a deliberate use, inhalation through the lungs is usually the targeted route of entry.

b. As I mentioned earlier, once the organisms invade the body, they begin to grow and reproduce. They can also produce toxins which may poison the body. Your body has built-in defense mechanisms, but if they were overwhelmed or not-effective, then the specific symptoms associated with the particular organism or disease begin to appear. Fever, vomiting, and diarrhea are frequently early symptoms. Depending on the particular disease, effects will continue to develop and can in many cases completely disrupt normal body functions and cause death.

c. Some bacteria and viruses can cause epidemics by being transmitted from one infected individual to another. This is true of only a few of the agents such as pneumonic plague (bacteria), smallpox, and viral hemorrhagic fevers (viruses).

Toxins

Toxins are poisonous substances produced as a by-product of pathogens, plants, and even some animals. Snake venom is a good example of a toxin.

Toxins:

a. Are not living organisms, but in fact chemical compounds, often proteins or protein-like materials.

b. Can enter the body the same way pathogens can.

c. Are not contagious.

Potential Biological Agents

- Anthrax (bacteria)
- Plague (bacteria)
- Q fever (rickettsia)
- Small pox (virus)
- Ebola (virus)
- Venezuelan Equine Encephalitis (VEE) (virus)
- Staphylococcal Enterotoxin B (toxin)
- Botulinum (toxin)
- Ricin (toxin)

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Domestic Preparedness

Anthrax

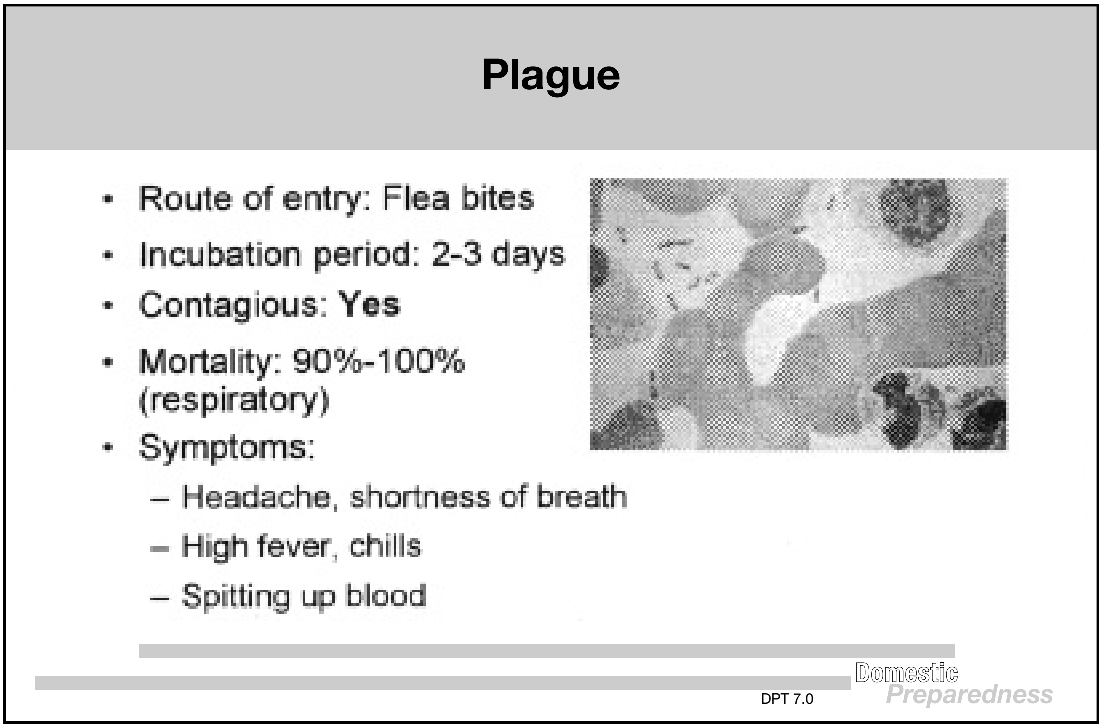
- Route of entry: Respiratory, cuts in skin
- Incubation period: 1-7 days
- Contagious: No
- Mortality: 80%-90% (respiratory)
- Symptoms:
  - Nausea
  - Fever, chills
  - Swelling of lymph nodes

DPT 7.0

Domestic Preparedness

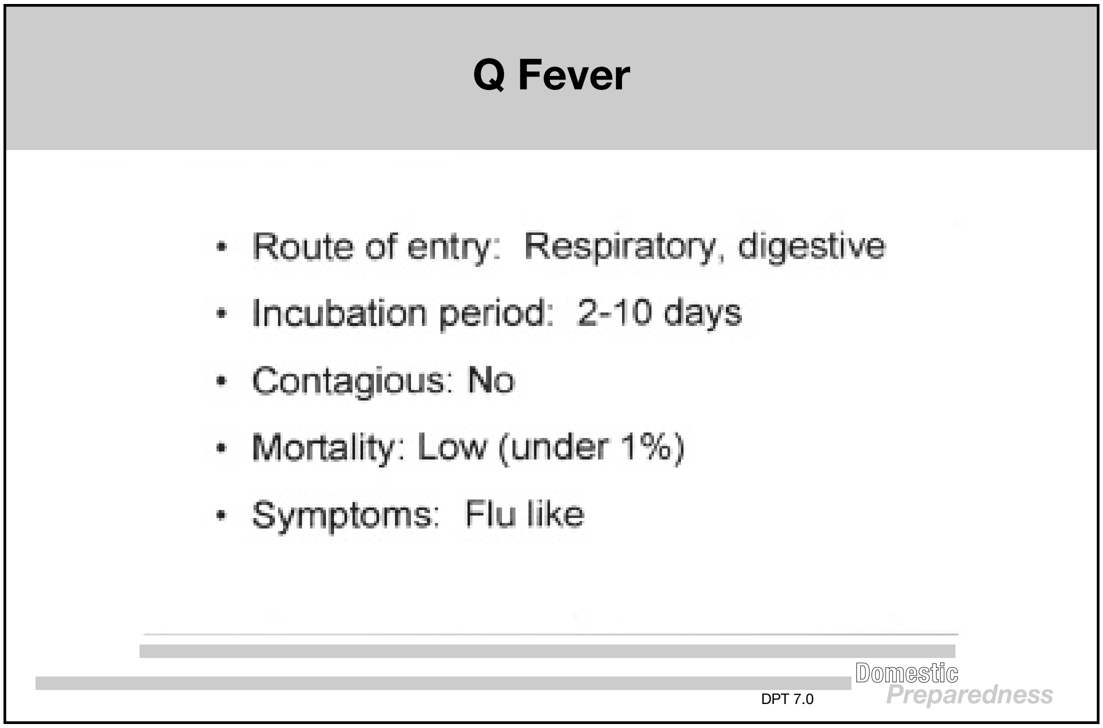
Anthrax (bacteria)

Anthrax is a bacteria. It occurs naturally in cattle, sheep, and other hoofed animals. It is normally transmitted to man through cuts or abrasions in the arms and hands. Anthrax can form spores which make the organism more resilient. In spore form, it can be transmitted to man through the respiratory tract, where it is a much greater threat (mortality can reach 80-90%). The incubation period is 1-7 days and the early symptoms are chills, fever, nausea, and swelling of lymph nodes. Treatment involves the use of antibiotics and treating the specific symptoms.



Plague (bacteria)

Plague or “black death” is another bacteria normally transmitted to man from rats through the bite of infected fleas. It can also be aerosolized and be transmitted to man through the respiratory tract causing pneumonic plague. Untreated pneumonic plague has a mortality rate of 90-100%. The incubation period is 2-3 days and early symptoms are high fever, chills, headache, spitting up of blood and shortness of breath. Treatment involves using antibiotics treating specific symptoms.

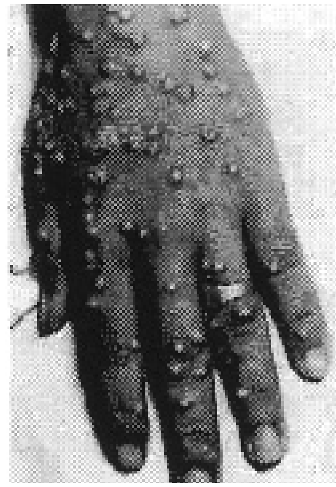


Q-Fever (rickettsia)

Q-Fever is a rickettsia, an organism which has some characteristics of bacteria and some of viruses. The organism can be found in nature in cows, sheep and goats and is transmitted to man through his inhalation of dust contaminated with animal tissue or feces through contaminated milk from infected cows or other animals. The incubation period is 2-10 days with symptoms similar to the flu. The mortality is low (under 1%). A vaccine is currently being evaluated. Recovery occurs in most cases without treatment after 2 days to 2 weeks. Tetracycline has been proven to shorten the duration of the illness.

Small Pox

- Route of entry: Respiratory
- Incubation period: 10-12 days
- Contagious: **Yes**
- Mortality: 30%
- Symptoms:
  - Fever, rigors, vomiting
  - Headache, backache
  - Lesions (after 2-3 days)



DPT 7.0

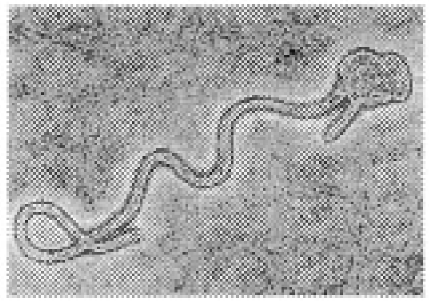
Domestic Preparedness

Smallpox

Smallpox is a virus. There is an effective vaccine, however, without this protection the aerosolized virus presents a respiratory threat. The incubation period is 10-12 days after which a victim will begin to feel ill with fever, rigors, vomiting, headache and backaches. Two to three days later lesions begin to appear. The mortality rate can reach 30%. Treatment involves supportive therapy.

Ebola

- Route of entry: Direct contact
- Incubation period: 3-21 days
- Contagious: **Yes**
- Mortality: 90%
- Symptoms:
  - Fever, vomiting, diarrhea
  - Blotches on skin
  - Bleeding



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Ebola

Ebola is one of the hemorrhagic fevers. This particular virus has received a lot of attention in the press and recent movies. It is transmitted to man by direct contact. The incubation period is 3-21 days with a mortality rate as high as 90%. Symptoms include fever, vomiting, and diarrhea, followed by blotches on the skin from subcutaneous bleeding. Treatment includes using Ribavirin and treating individual symptoms.

Venezuelan Equine Encephalomyelitis

- Route of entry: Mosquito bites, respiratory
- Incubation period: 1-5 days
- Contagious: No
- Mortality: 1%
- Symptoms:
  - Flu like

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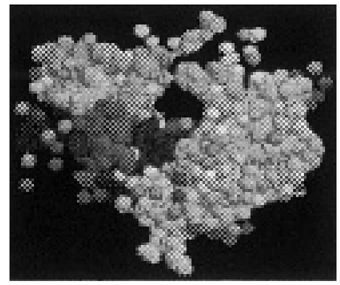
Venezuelan Equine Encephalitis

VEE is another virus. It occurs in nature in mules, donkeys and horses. Transmission is normally through mosquito bites but transmission as an aerosol has been proven, so inhalation through the respiratory tract is possible. The incubation period is 1-5 days. Symptoms are influenza like and last 3-5 days. Mortality is low, under 1%, and recovery occurs without intervention. Treatment is supportive.

Staphylococcus Enterotoxin B

- Route of entry: Digestive, respiratory
- Incubation period: 4-6 hours
- Contagious: No
- Mortality: Low
- Symptoms:
  —Vomiting, abdominal cramps, explosive water diarrhea (ingestion)
  —High fever, cough chills, prostration (respiratory)



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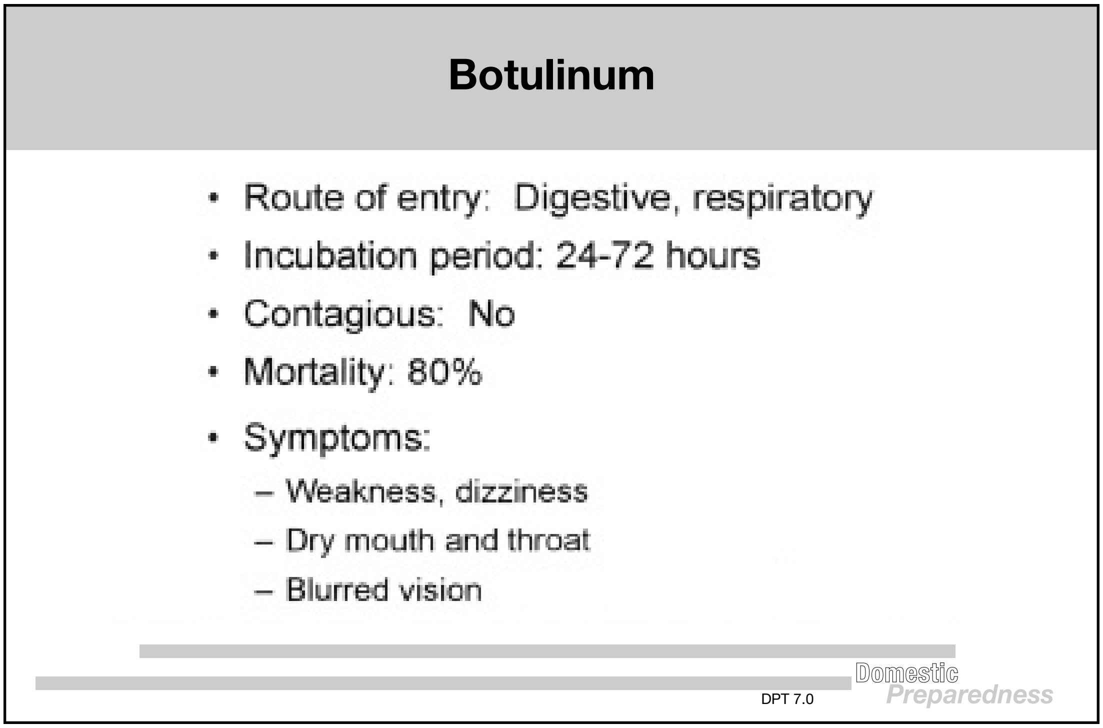
Domestic Preparedness

Staphylococcus Enterotoxin B (Cytotoxin)

SEB is a toxin. It is normally ingested, causing food poisoning. The incubation period is short, 4-6 hours, with symptoms including vomiting, abdominal cramps, and explosive watery diarrhea. Recovery is spontaneous after 6-8 hours. Inhalation of aerosolized toxin is possible, and in this case the symptoms are entirely different: high fever, cough, chills and prostration which usually lasts 1-2 weeks. Treatment is supportive and an antitoxin is available.

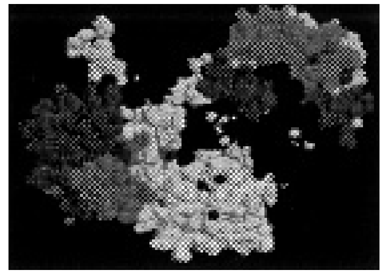


Botulinum (neurotoxin)

Botulinum is another of the toxins. It normally affects victims after the ingestion of improperly canned food. The toxin can be aerosolized and presents an inhalation threat. Symptoms begin 24-72 hours after ingestion or breathing in the toxin; weakness, dizziness, dry mouth and throat, and blurred vision begin to appear. Mortality can reach 60%. Treatment includes antitoxin and supportive measures.

Ricin

- Route of entry: Digestive, respiratory
- Incubation period: 24-72 hours
- Contagious: No
- Mortality: High
- Symptoms:
  - —Nausea, vomiting
  - —Abdominal cramps, bloody diarrhea
  - —Difficulty breathing



DPT 7.0

Domestic Preparedness

Ricin

Ricin is another toxin, with its origin as the castor bean plant. It is therefore readily available. Ricin normally enters the body through ingestion but can be aerosolized. It can also be induced through injection. The incubation period is 24-72 hours after which symptoms appear, including nausea, vomiting, bloody diarrhea, abdominal cramps and breathing difficulty. The untreated mortality rate is high, with death occurring after 36-72 hours. Ricin is 2-3 times more toxic than the nerve agent VX.

Treatment includes respiratory therapy, and other supportive measures.

Detection of Biological Agents

Detection of a biological attack:

a. Because of the incubation period, recognizing a biological agent attack or incident will be more difficult. It is more subtle than a chemical attack. As a first responder, you are not likely to arrive on a scene and see people lying around and exhibiting symptoms.

b. The first indications of a biological agent attack will probably originate with 9-1-1 operators, EMS personnel, or the medical community, especially the emergency departments in local hospitals. For example, if a series of calls to 9-1-1 for assistance reflects multiple individuals with high fever, and vomiting, etc., a trained 9-1-1 operator may realize he or she is receiving multiple calls with patients displaying similar symptoms. Or suddenly all over town, individuals begin arriving at “prompt care” facilities, emergency rooms, etc., again showing the same basic symptoms. These are both instances when response personnel should become suspicious.

Protection Against Biological Agents

If you know you are responding to a potential biological incident:

a. An SCBA or protective mask with High Efficiency Particulate Absorbing [HEPA] filters, combined with clothing and unbroken skin, are the first line of defense from biological agents.

b. Employ effective sanitation measures, i.e., do not eat or drink in the immediate area of the incident, touch nothing that can be avoided, and wash hands with soap and water if something is touched.

c. Decontaminate immediately upon exiting the Hot Zone, i.e., wet, strip, flush, cover.

(1) Wetting down exposed skin and clothing will prevent re-aerosolizing of the organisms.

(2) Remove potentially contaminated clothing.

(3) Flush with water, soapy water (if available) is better, or with 0.5% hypochlorite, if available.

(4) Cover to prevent exposure.

d. Any potentially contaminated equipment which may have been in contact with the agent will require decontamination.

e. If, after responding to an incident, you demonstrate flu-like or other symptoms of illness, seek medical attention immediately.

f. Blood-borne pathogen universal precautions will be your first line of protection when treating victims.

Decontamination

a. Wet—wetting down will cause biological material to adhere to clothing and skin, rather than re-aerosolizing and being ingested.

b. Strip—remove contaminated clothing.

c. Flush—remove any contamination from exposed skin and hair.

d. Cover—for protection.

Sample HEPA Filters

DPT 7.0

Domestic Preparedness

Sample HEPA Filters

Shown here are a few examples of High Efficiency Particulate Absorbing (HEPA) filters. There are numerous manufacturers.

Because of the ease of protecting from biological, our main concern is inhalation or ingestion in the form of dust or contaminated food or water.

Any good dust respirator or mask will protect you from the inhalation risk.

Key Points

We have taken a brief look at biological agents, their characteristics, and behavior.

I have explained how a biological incident is different from a chemical incident due to the effects of incubation periods.

We addressed both pathogens and toxins, and examined some of the potential diseases. We concluded with a review of some of the procedures that can be taken to protect yourself.

A biological agent incident or terrorist attack will rapidly become a medical management problem, but it is manageable and can be controlled.

Module 4: Nuclear Materials (Technician Training)

Training Objectives:

1. Understand the terms associated with Nuclear radiation.
2. Know how to protect yourself from radiation.
3. Know the types of radiation and their hazards.

Radiological Materials

The first of the agent types I want to discuss are the radiological materials. Of the three (chemical, biological or radiological), this is considered the least likely of the threats; however, the potential exists and you need to understand the terms, the types of radiation, and how to protect yourself.

Learning Objectives

a. Know how to protect yourself

b. Know the types of radiation and their hazards

c. Understand the terms associated with radiation

Introduction

As we pointed out in the earlier threat presentation, the potential for a terrorist to obtain an actual nuclear device and then transport it totally undetected is unlikely.

Despite what you see on the “internet”, producing a functional nuclear device is also highly improbable; therefore, we are not going to go into the ramifications of a true nuclear detonation occurring here in New Jersey.

What we will look at is the possible use of radioactive material by a terrorist and the implications of this.

To begin with, we need to understand some basic terms.

Definitions

To begin our discussion of radiological material and its potential use by terrorists, several terms must be defined and understood:

a. Atom: The smallest particle of an element that can exist either alone or in combination with another element; may be the source of vast potential energy.

b. Nuclear: Of, relating to, or utilizing the positively charged central portion of an atom.

c. Radiation: Energy emitted as a result of the disintegration of the nucleus of an atom; this disintegration is also known as *radioactive decay*.

d. Radiological: Of, or relating to, nuclear radiation.

e. Radioactive: Capable of emitting nuclear radiation.

Definitions

Radiation: In its simplest definition, radiation can be defined as either electromagnetic or particulate emissions of energy from the disintegration of the nucleus of an atom. This energy, when impacting on or passing through material, including us, can cause some form of reaction. This radiation is also referred to as ionizing radiation.

Radioactive material: Again, this is simply any material which is giving off some form of radiation.

Location of Radiological Material

Radiological material is used, transported, and stored in many locations around the United States. Among the locations where radiological material may be found are:

a. Nuclear weapons storage facilities.

b. Nuclear power plants.

c. Government facilities (DOD, DOE).

d. Hospitals and other medical facilities.

e. Research and educational laboratories.

f. Industrial manufacturing facilities.

g. In transit.

In all cases, systems are required to be in place to ensure the safety of this material, such as special packaging requirements, special security, and special handling. These safeguards generally prove adequate; however, as radiological material is so widely used and transported, it is vulnerable to terrorist activity.

Atomic Structure

There are three basic components of an atom.

a. Protons reside in the nucleus of the atom, with the number of protons present determining the specific element (one proton present means that the atom is hydrogen, two protons present means the atom is helium, etc.). As the number of protons changes, the element changes. All protons have a positive (+) charge.

b. Electrons orbit the nucleus of the atom and have almost no weight. All electrons have a negative (-) charge, equal in magnitude to the proton.

c. Neutrons reside in the nucleus of the atom and have a weight similar to that of the proton and no electrical charge. While atoms of the same element must have the same number of protons, they may have different numbers of neutrons. Atoms of the same element, but with different numbers of neutrons, are called *isotopes*.

Ionizing Radiation

When ionizing radiation is absorbed by our bodies, it can cause changes to our cells. Small amounts can be tolerated; larger amounts can be harmful.

For our purposes, this ionizing radiation can be classified as emissions of:

a. Alpha particles which:

    (1) Quickly lose energy and travel only one or two inches through air. They can be stopped by clothing or a piece of paper; and therefore, alpha emitters present only an inhalation or ingestion hazard.

    (2) After intake, can be absorbed and retained by many organs, causing damage, in particular, to the kidneys, liver, lungs, and bones. Based on the chemical properties of the radioactive element involved, specific body organs may be targeted (radium targets bone structure, iodine targets the thyroid gland, etc.).

    (3) Are characteristically emitted by elements such as plutonium, a nuclear weapon material and reactor fuel, and radium.

b. Beta particles which:

   (1) Lose energy more slowly than alpha particles, and thus, travel farther in air (about ten feet).

   (2) Can be stopped by material such as aluminum and other metals, plastics, and glass.

   (3) Are more penetrating than alpha particles and, therefore, are considered a hazard to the eyes and bare skin (skin burns may result from high doses of beta radiation exposure).

   (4) Beta emitters may be inhaled or ingested causing damage to internal body organs.

c. Gamma radiation which:

   (1) Can easily travel several hundred feet through air.

   (2) Can readily penetrate most materials (gamma is sometimes called *penetrating radiation*).

   (3) Can be decreased or stopped by very dense material such as lead, concrete, or steel.

   (4) Are external radiation exposure hazards, traveling through the body and damaging tissues in their path.

   (5) Are employed in commercial applications.

d. Neutrons which:

   (1) Can travel several hundred feet through air.

   (2) Can be moderated by materials such as water, paraffin, or plastic.

   (3) Are an external exposure hazard.

   (4) Can be absorbed by stable atoms, causing them to become radioactive.

   (5) Are employed in commercial applications.

Again, for our purposes, we’re not so concerned with the mechanism of radiation action as we are with the hazard, the detection of it, and protection from it.

Exposure and Contamination

Exposure of an object to radiation occurs when the object is subjected to the effects of radioactive particles without complete protection.

Radioactive contamination of an object occurs when radioactive particles are located on the object or cause the object to become radioactive.

Exposure to radiation does not indicate that radioactive contamination has necessarily occurred.

ESTIMATED DOSE RATES IN THE UNITED STATES (1970)	
SOURCE	AVERAGE DOSE RATE (mrem/year)
Environmental	
natural	102
fallout	4
nuclear power	0.003
Medical	
diagnostic	72
radiopharmaceuticals	1
Occupational	0.8
Miscellaneous	2
TOTAL	**182 mrem**

Routinely Occurring Radiation Exposure

Radiation exposure occurs routinely from the following:

a. External terrestrial objects such as rocks containing radium and thorium.

b. External cosmic sources such as the sun.

c. Naturally occurring radionuclides into the body (K-40, C-14, etc.)

d. Radionuclides that are inhaled such as radon.

e. Medical diagnostic procedures such as X-rays and nuclear medicine scans.

f. Consumer products such as smoke detectors.

Basic Radiation Units of Measurement

To quantify amounts of radiation exposure in terms of biological effect, the term rem (or millirem) is used. It has a specific definition, but we will be more concerned with the level of exposure rather than a definition.

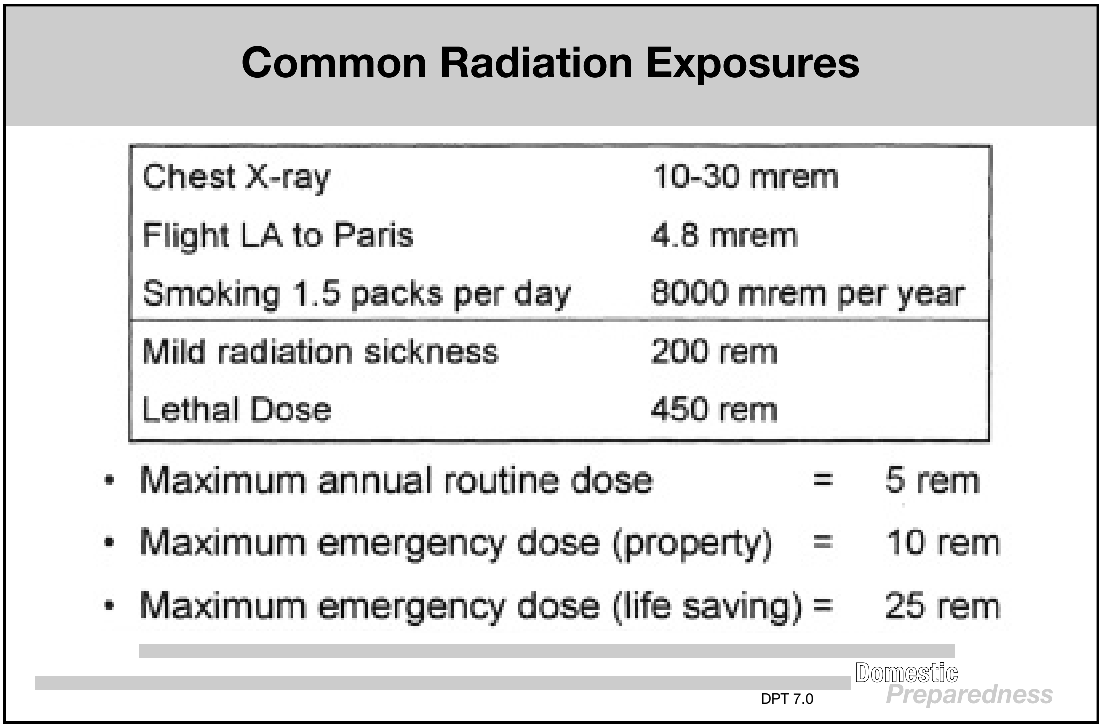
Rad—Units for absorbed doses of all radiation

Roentgen—Units of exposure to gamma radiation

Rem (mrem)—Unit of exposure related to biological risk (likelihood of organic tissue damage)

Ram

$$\text{mrem} = \frac{1}{1000}\ \text{rem}$$



Common Radiation Exposures

This chart reflects naturally occurring radiation doses (and doses received during normal activities) to provide a point of reference and for comparison. The threshold for any real consequences begins around 200 rem. The LD_{50} is around 450 rem.

The average annual radiation exposure has been calculated as:

Naturally occurring	295 mrem
Medical	52 mrem
Consumer products	10 mrem
Other	3 mrem
Total	360 mrem

Per 10 CFR 835, “Occupational Radiation Protection, Final Rule,” the DOE regulatory limit for routine radiation exposure has been established as 5 rem (5,000 mrem) per year for radiation workers. In cases of emergency, up to 10 rem may be permitted to protect against property loss, and 25 rem to save lives and ensure the public health.

Health Risks During an Incident

The three radiation concerns at an incident involve whole body exposure, intake of radioactive material (through the respiratory and digestive tracts), and contamination by radioactive material. Incidents involving either an explosion or fire will elevate the potential for intake or contamination due to the spreading of the radioactive material in the form of small fragments (dust) or smoke.

Health Risks

Risk depends upon several factors:

a. The dose (total amount of radiation received). The larger the dose received, the greater the health risk becomes.

b. The dose rate (the length of time over which the dose is received). Dose rate exposures are categorized as follows:

   (1) Acute—a large dose occurring over a short period of time. Acute exposures normally pose a high health risk with symptoms occurring within hours or days. Symptoms of acute radiation exposure are burns of the skin, vomiting, and indigestion.

   (2) Chronic—small doses occurring over a long period of time. Chronic exposures normally pose a smaller health risk with symptoms (tumors, etc.) delayed for years.

c. As previously discussed, alpha and beta emitters generally pose only internal exposure hazards. Gamma radiation, however, poses an external hazard for a distance of hundreds of feet.

Identification of Radioactive Materials

Under normal circumstances, all radioactive materials above specified quantities, as well as locations where radioactive materials are present, are identified with the standard radiation symbol (colored magenta on a black or yellow background). Yellow plastic wrapping or a labeled container may also be used to package radioactive material.

Detection

Radiation cannot be detected by our senses, but can be detected and identified with instrumentation. Most of the radiation detection instruments measure radiation in dose rates (the amount of radiation absorbed per unit of time, i.e., 50 mrem/hr). Some instruments, however, will measure the total exposure dose (the total amount of exposure occurring, i.e., 50 mrem). Because the possibility exists, checking for the presence of radiation as part of a HAZMAT response is always recommended.

Protection

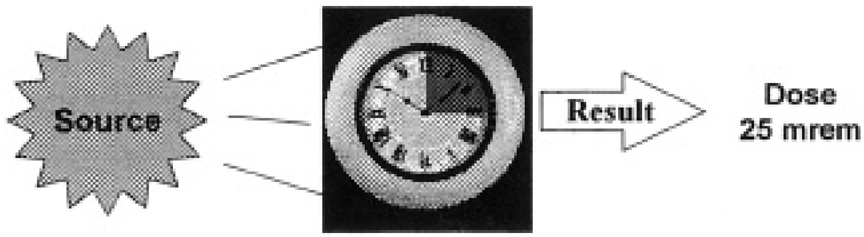
The radiation exposure received will depend on the type and strength of the radiation source. This exposure can be mitigated by the effective use of:

a. Time

b. Distance

c. Shielding

Time



100 mrem per hour x 15 minutes (.25 hour) = 25 mrem

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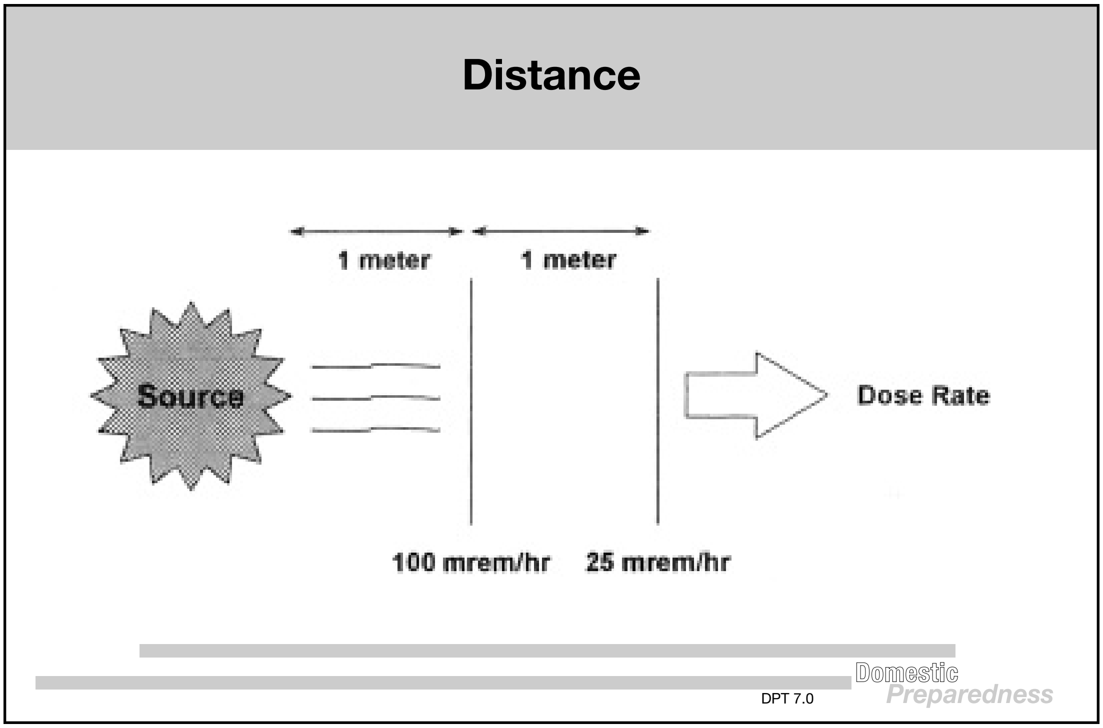
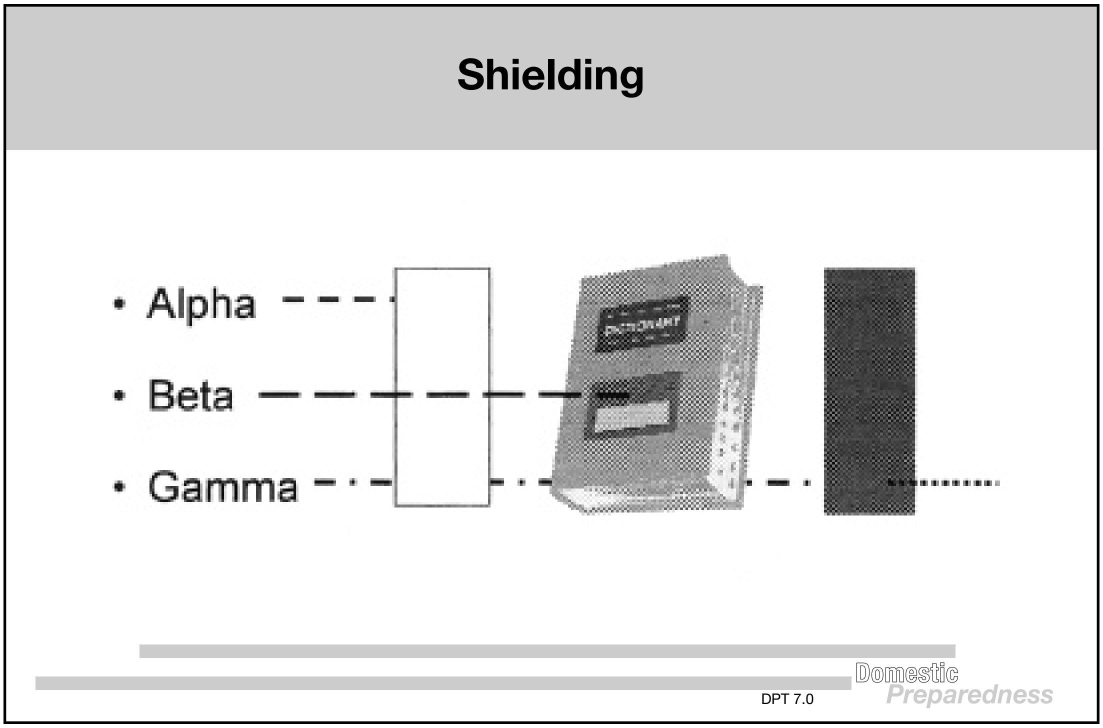
Time

The radiation dose is reduced in proportion to reduction of exposure time.



Distance

Distance is also critical for reducing radiation exposure dose. While alpha particles only travel a little over an inch in air, and beta particles will travel only a few yards in air, gamma rays will travel extensive distances. As a result, gamma rays pose the greatest threat of exposure; but responders will receive a smaller dose of radiation the farther away they are from the source. In the case of gamma rays, the intensity decreases in proportion to the square of the distance. DOE recommends personnel not required for response be kept 2,000 feet from the radioactive source.



Shielding

Radiation can also be mitigated, or partially mitigated, by various materials. Alpha radiation is stopped by a sheet of paper, beta radiation is stopped by aluminum foil or clothing, and gamma rays are only reduced by dense materials such as lead or earth.

Sample HEPA Filters

Because alpha and beta radiation have little penetrating potential, their main threat results from the possibility of inhalation or ingestion in the form of dust or contaminated food or water. The respiratory threat can be eliminated by employing High Efficiency Particulate Absorbing (HEPA) filters. There are numerous manufacturers.

It is more difficult to protect responders and potential casualties from gamma rays; therefore, the employment of time, distance, and shielding to reduce exposure are critical.

Decontamination

Personnel decontamination of radioactive material is accomplished in four steps:

a. Wet down the individual to be decontaminated to cause the radioactive material (contamination) to adhere to clothing and skin, thus reducing re-aerosolization and the potential for ingestion.

b. Strip contaminated clothing from the responders or victims.

c. Flush with large amount of water (and soap if available) to remove any remaining contamination from skin and hair.

d. Cover for protection and modesty.

e. Control run-off.

Key Points

There are three types of radiation to address. Alpha and beta radiation pose internal threats to body organs. Gamma rays pose an external threat to body organs.

Because the primary route of entry for alpha and beta radiation is the respiratory tract, a HEPA filter will provide suitable protection. Time, distance, and shielding provide the best immediate methods for protecting responders and casualties from the effects of gamma radiation exposure.

From a responder's point of view, survey every incident scene with one of the available detectors, otherwise it will be difficult to determine if a radiation hazard is present, unless there is a warning provided by a terrorist.

Once aware of the presence of radioactive material, protect yourself.

Module 5: Chemical Agents (Technician Training)

Training Objectives:

1. Understand Chemical agent terms, symbols, definitions, and characteristics.

2. Know the signs and symptoms.

3. Know how to protect yourself.

References:

1. FM 3-9, Potential Military Chemical/Biological Agents and Compounds, dated 12 December, 1990.

2. MRICD Casualty Care Office, Medical Management of Chemical Casualties Handbook, September 1995.

1. During the next module, we will examine detailed information about the military chemical agents that a potential terrorist would find most attractive to use in a domestic attack. As we discussed these agents, I want you to keep two things in mind:

    a. The response to an incident caused by a terrorist employing a chemical agent is in many ways similar to a “standard” HAZMAT response, but with the addition of some very significant considerations:

        (1) The toxicity of chemical agents greatly exceeds the more “routine” hazardous materials.

        (2) There is an elevated potential for casualties.

        (3) It is a crime scene.

    b. All of these add to the complexity of the incident, and make it less forgiving.

2. We will be using military terms frequently during our discussion, because they are the terms used with many of the detection instruments (most of which are military in origin). Additionally, many of the supporting federal response teams also use these terms.

3. With this as an introduction, let’s look at the objectives of this block of instruction.

Learning Objectives

a. Understand the terms, symbols, definitions and characteristics of chemical agents.

b. Know the agent signs and symptoms, required protection when working in an agent environment, immediate first aid for each of the chemical agents, and emergency decontamination procedures.

Characteristics of Chemical Agents

Each of the chemical agents we are going to discuss is a chemical compound, and, therefore, has characteristics and behaves in ways that are understandable and predictable. The more we know about these agents and their characteristics, the better equipped we will be to mitigate their effects.

I will be explaining a series of definitions (one at a time). Later, when we discuss the individual agents, these terms will be used to describe the characteristics of each agent.

Physical Properties

a. Freezing Point and Boiling Point: Depending on temperature and pressure, chemical compounds can exist as solids, liquids, or gases. If we know the agent and the temperature conditions that exist, then we know the physical state of the agent. For example, mustard agent freezes at approximately 57°F; therefore, its use in a colder climate should not be anticipated (or if used, a significant vapor hazard would not be expected). Likewise, many agents have very low boiling points, so they would be expected to be in a gaseous state, presenting an inhalation threat, but not lingering in the area for any significant length of time.

b. Vapor Density: Vapor Density is the ratio of the density of an agent gas or vapor to that of air at a given temperature and pressure. If the vapor density is greater than 1.0, the agent is heavier than air and will settle or sink. If the vapor density is less than 1.0, it will rise.

c. Vapor Pressure: Vapor Pressure is related to the evaporation rate. For our purposes, substances with high vapor pressures will evaporate more rapidly than those with low vapor pressures.

d. Volatility/Persistency: Volatility and Persistency are directly related to vapor pressure, and used to express how rapidly an agent will evaporate, and thus dissipate.

(1) The more volatile an agent, the more rapidly it will evaporate. Most agents are initially disseminated as liquids. In many cases, the liquid itself is a threat by absorption through the skin. After dissemination, most agents begin to evaporate, creating a vapor hazard.

(2) For Comparison with chemical agents:

Vapor Pressure of H_2O at 25°C = 23.7mm Hg

Volatility of H_20 at 25°C = 22,933 mg/m^3

(3) If an agent evaporates quickly (minutes), it is defined as non-persistent. If it evaporates somewhat more slowly (hours), it is defined as semi-persistent. If the agent takes a relatively long time to evaporate (days), it is defined as persistent. All volatility numbers cited for the agents that follow are calculated for a temperature of 20°C, unless otherwise stated.

Chemical Properties

a. Hydrolysis/Rate of Hydrolysis:

(1) Hydrolysis is the term used to indicate the reaction of a substance with water and the associated decomposition that occurs. Hydrolysis is important for understanding how some agents affect us biologically and is also important with respect to decontamination.

(2) The rate of hydrolysis indicates how fast the decomposition process occurs.

b. Hyrdolysis Products: Following a reaction between the agent and water, other compounds will be produced. These products are the hydrolysis products.

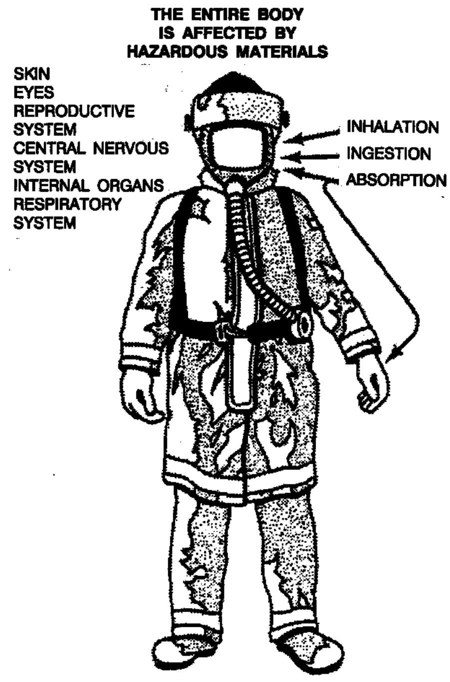
c. Reaction with Metals: Many chemical agents will react with metals causing corrosion or damage.

Physiological Properties

a. Rate of detoxification: The rate of detoxification refers to the speed with which the body is able to counteract the effects of a poisonous substance. Many chemical agents are essentially cumulative in their effects and will cause recurring effects throughout the remainder of an individual's life because the human body detoxifies them very slowly or not at all.

b. Rate of action: The rate of action of a chemical agent is the rate at which the body reacts to, or is affected by, that agent.

c. Toxicity: Toxicity is related to the dose required per unit of weight to cause effects on the body. Toxicity is usually expressed in terms of "incapacitating dosage" or "lethal dosage".



Routes of Entry

Routes (or portals) of entry describe how an agent gets into the body.

a. Most agents are disseminated as aerosols or gases and enter the body through the respiratory tract; however, some liquid agents enter via skin contact. In some instances, if the vapor concentration is high enough or the vapor exposure long enough, vapors can penetrate the skin and cause the same effects as skin contact with liquid agent.

b. The eyes are of particular concern, because they are especially sensitive to a number of agents.

c. Some agents may enter the body by ingestion of contaminated food or liquid.

d. In two instances assassins have injected chemical agents into their victims.

Nomenclature, Military Designation and CAS#

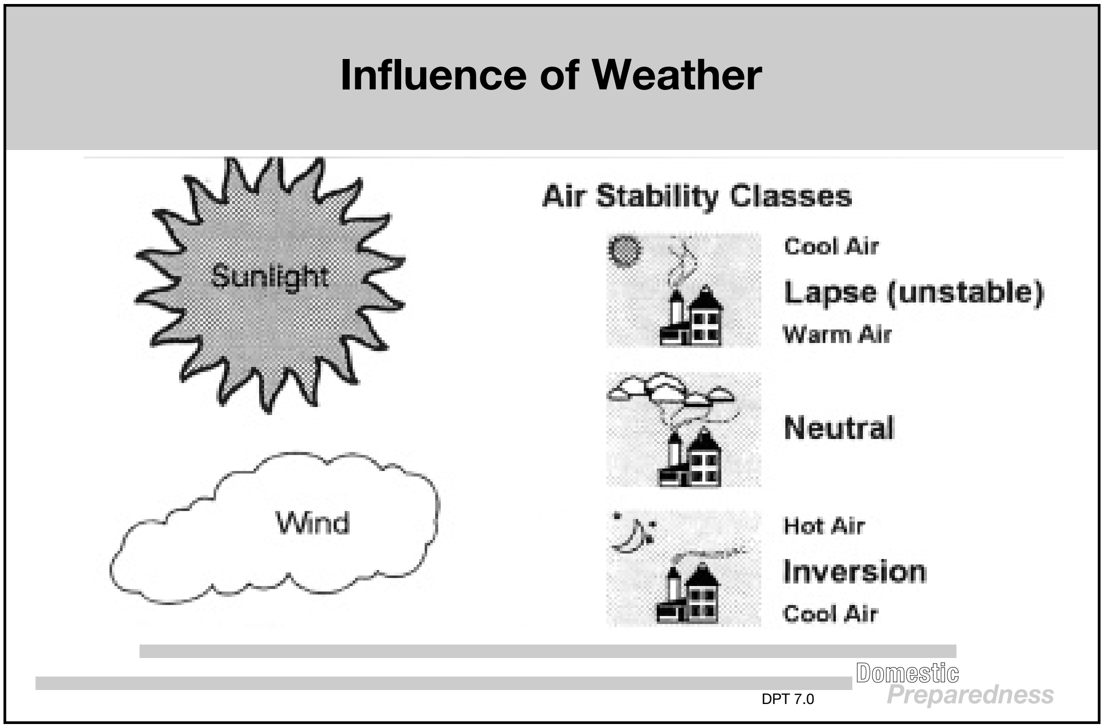
Each chemical agent is a chemical compound made of specific elements. All have scientific names and formulas which describe their chemical composition, but of interest to us are the common names they have been given, and the shorthand designations. These are important for three reasons:

a. Many of the military detectors (some of which you will be using during the detection and identification practical exercise) refer to these shorthand designations.

b. Many of your fellow HAZMAT technicians and other technical personnel, especially military response teams, will be using these symbols.

c. They are much easier to remember.

As we look at the specific individual agents, I'll point out both the common name and symbol. Additionally, the agents have all been assigned CAS numbers (Chemical Abstract Service). By using the CAS numbers you can acquire additional HAZMAT reference data.



Weather

Weather conditions have a significant effect on the behavior of chemical agents. Temperature, wind speed and direction, humidity, and air stability all influence how long an agent will remain in an area. To a degree, the weather conditions also influence how vulnerable individuals are, because they affect persistency (and the longer an agent remains in an area, the longer an unprotected individual is exposed to its effects). Some specific conditions are as follows:

a. A lapse or unstable air stability condition provides the least effective area coverage, as the agent cloud rises above people.

b. The inversion air stability condition is optimal, as it keeps the agent near the ground.

c. The most effective wind speed to provide the largest area coverage is 6-10 miles per hour.

Toxicity

Each of the agents we shall discuss were designated as militarily significant because of their toxicity. Through extrapolation from animal tests, toxicities for each of the agents have been determined. While toxicity is a relative figure and will vary, it will provide us an idea of how much agent it takes to kill or incapacitate.

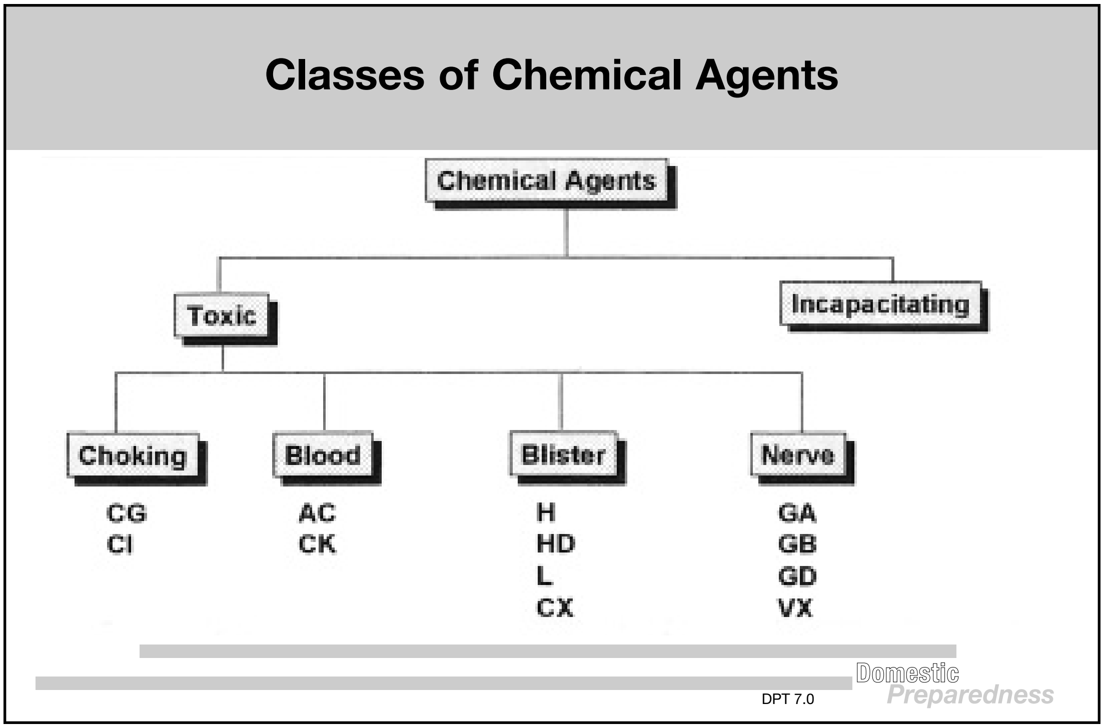
Toxicity is normally expressed as a concentration of agent in parts per million (ppm), or milligrams (mg) of agent per cubic meter (m^3). This toxicity is also expressed based on what effect we are describing: LC_{50} would mean the lethal concentration that would kill 50 percent of the exposed population; IC_{50} would mean the incapacitating concentration that would incapacitate 50 percent of the exposed population.

When toxicity is expressed considering time, then the expression would be LCt_{50} or ICt_{50} and expressed as mg-min/m^3, or parts per million (ppm) based on a specific time of exposure (e.g., 1 minute, 30 minutes, etc.).

Toxicity and Safety

As part of your previous HAZMAT training, you should be aware of exposure levels defined by OSHA and NIOSH, such as Permissible Exposure Limit (PEL) and exposures that are defined as Immediately Dangerous to Life and Health (IDLH). Both of these are expressed in either mg/m^3 or ppm.

A term you may not be familiar with is Airborne Exposure Limit (AEL). This is a Department of Defense term which you might see on some of the agent Material Safety Data Sheets (MSDS's). AEL is defined as: "Personnel working without protection from the inhalation of agent vapors in areas where agent may be present, will not be exposed to concentrations exceeding the AEL as listed in AR385-61, Table 2-3. It equals the PEL..."



Classes of Chemical Agents

The military has classified chemical agents according to how they affect individuals, initially as either toxic or incapacitating, and then further by their specific actions on the individual.

You will note on this chart that there are four categories of toxic agents:

a. Choking

b. Blister

c. Blood

d. Nerve

Under each category are the individual symbols for the agents we are going to discuss. There are many more agents than the ones we will address, but these are considered the most likely ones a terrorist might employ.

Although there may be specific incapacitating agents in various national inventories, we are not covering them in this course because their use by a terrorist is improbable.

Choking Agents

Common name, Military symbol	Phosgene (CG)	Chlorine (Cl)
Volatility/persistency	Non-Persistent	
Rate of action	Rapid	
Route of entry	Respiratory	
Odor	Newly mown hay	Bleach
Symptoms	• Coughing • Choking • Tightness in chest	
Protection	• Respiratory (Skin)	
First aid	Carry from area	
Decontamination	Aeration	

DPT 7.0 Domestic Preparedness

Choking Agents

Choking agents were first used during World War I with notable effectiveness. There are two choking agents I will mention: Phosgene (CG) and Chlorine (Cl). Both of these agents have various industrial uses and they are shipped as liquids daily throughout the U.S. Upon release, they evaporate rapidly becoming non-persistent gases, and, therefore, inhalation threats.

Both have recognizable odors: phosgene smells like newly mown hay and chlorine smells like a swimming pool. The rate of action in high concentrations is rapid; but in lower concentrations, other than the irritating smell, the symptoms might be delayed for several hours.

Symptoms include coughing, choking or gagging, and tightness in the chest. As the agent is inhaled, it irritates the respiratory tract, starting with the trachea and continuing down into the lungs.

The agent hydrolyzes with mucous secretions, forming hydrochloric acid which then burns tissue of the respiratory tract. This irritation causes the mucous membranes in the trachea and the lining of the lungs to secrete additional fluid. Eventually this fluid buildup is such that it interferes with the oxygen flow. The lungs literally fill with fluid (Dry Land Drowning).

There is little detoxification, so this action is cumulative. Although these agents are gases, both respiratory and skin protection are required as there may be some skin irritation.

Proper first aid is to mask the victims and then remove them from the area of hazard. Victims should be carried, because walking will only increase their need for oxygen. Decontamination is aeration. Responders who come into physical contact with phosgene should flush the affected area with water.

Choking Agents have a lethal toxicity (LCt_{50}) of 791 ppm (one minute exposure) for phosgene and 6551 ppm (one minute exposure) for chlorine.

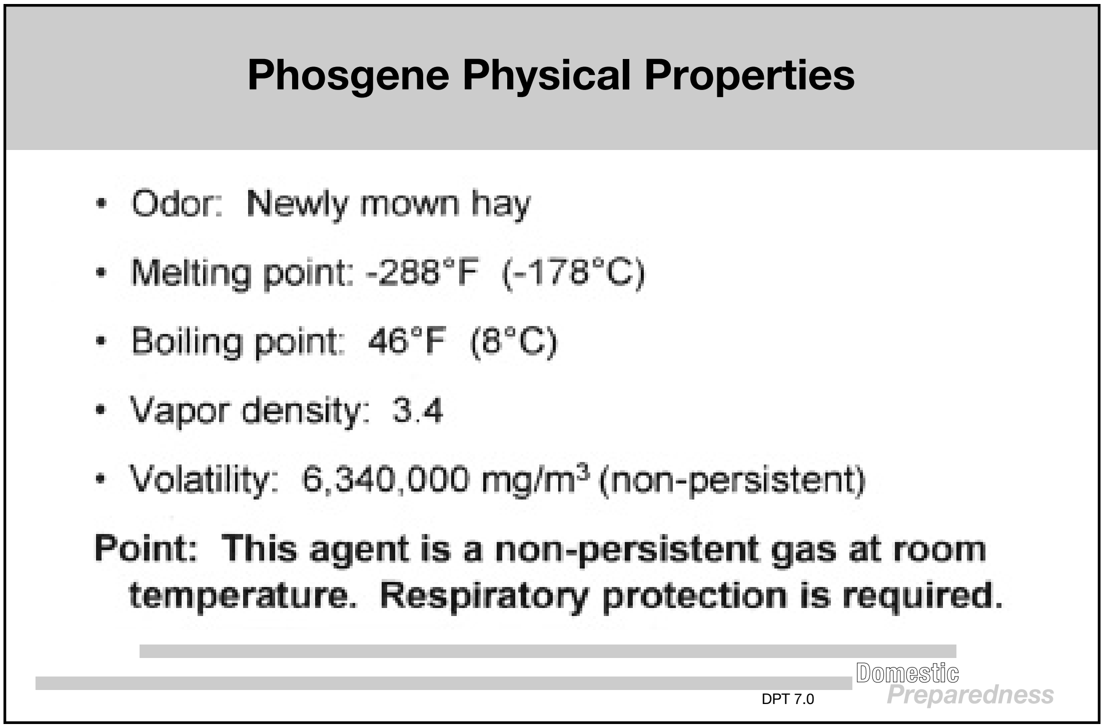
Phosgene was first developed in 1810.

Phosgene Chemical Properties

- Military designation: CG
- Chemical name: Carbonyl chloride
- Empirical formula: $COCl_2$
- CAS #: 75-44-5
- Rate of hydrolysis: Rapid, destroyed by rain
- Hydrolysis products: $HCl + CO_2$
- Reaction with metals: None when dry, acidic and corrosive when moist

DPT 7.0

Domestic Preparedness



Phosgene Physical Properties

Note the vapor density (3.4). As I mentioned, this means that Phosgene is going to settle in low areas. This is one of the reasons it was so effective in World War I.

Phosgene Physiological Properties

- Rate of action: Immediate to 3 hours
- Rate of detoxification: Not detoxified
- Method of Injury: Damaging of lung cell (edema)

PEL = 0.099 ppm IDLH = 2 ppm
ICt_{50} = 395 ppm LCt_{50} = 791 ppm

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Domestic Preparedness

Chlorine Chemical Properties

- Military designation: None
- Chemical name: Chlorine
- Empirical formula: Cl_2
- CAS #: 7782-50-5
- Rate of hydrolysis: Slow
- Hydrolysis products: HCl + ($HClO_3$)
- Reaction with metals: Vigorous if moist

DPT 7.0

Domestic Preparedness

Chlorine Physical Properties

- Odor: Bleach
- Melting point: -150°F (-101°C)
- Boiling point: -29°F (-34°C)
- Vapor density: 2.48
- Volatility: 19,369,000 mg/m^3 (non-persistent)

POINT: This agent is a non-persistent gas at room temperature. Respiratory protection is required.

DPT 7.0

Domestic Preparedness

Chlorine Physiological Properties

- Rate of action: Immediate in high concentrations, otherwise delayed
- Rate of detoxification: Rapid
- Method of injury: Damaging of lung cells

PEL = 1.0 ppm
IDLH = 30 ppm
ICt_{50} = 620 ppm
LCt_{50} = 6551 ppm

Domestic Preparedness

DPT 7.0

Blood Agents

Common Name Military Symbol	Hydrogen Cyanide (AC)*	Cyanogen Chloride (CK)
Volatility/Persistency	Non-Persistent	
Rate of Action	Rapid	
Route of Entry	Respiratory	
Odor	Bitter almonds or peach kernels	
Symptoms	Gulping or gasping for air Reddish skin & lips (purple lips for dark-complexioned) Unconsciousness, death	
Protection	• Respiratory (Skin)	
First Aid	• Mask • Antidote available to medical personnel • Remove from area	
Decontamination	Aeration	

DPT 7.0 Domestic Preparedness

Blood Agents

Blood agents were another type of agent used in World War I. We will discuss two: Hydrogen Cyanide (AC) and Cyanogen Chloride (CK).

Like the choking agents, CG and Cl, these agents have a variety of commercial uses and are therefore readily available. Both are very volatile and therefore non-persistent. As they are gases their route of entry is the respiratory tract.

Hydrogen Cyanide has a vapor density of 0.93 (lighter than air) and will rise. It also has a flow flash point (64°F) so it may well ignite if released using an explosive device.

Blood agents smell like bitter almonds or peach kernels. Their rate of action is very rapid, with symptoms appearing very quickly. When exposed to a high concentration, individuals will gulp for air, have reddish skin, red lips, (purple in dark-complexioned), and vomit, with unconsciousness, frothing and death occurring within minutes.

The agents are absorbed by the blood stream and carried throughout the body. Under normal conditions, the blood releases the oxygen it carries from the lungs to the individual body cells. Blood agents bond to the enzyme cytochrome oxidase, and prevent this oxygen transfer. An abundance of oxygen in the venous system is why the skin appears red.

Hydrogen Cyanide Chemical Properties

- Military designation: AC
- Chemical name: Hydrogen cyanide
- Empirical formula: HCN
- CAS #: 74-90-8
- Rate of hydrolysis: Slow in acids, rapid in 5% NaOH
- Hydrolysis products: Ammonia, formic acid, amorphous brown solids
- Reaction with metals: None

DPT 7.0 Domestic Preparedness

Blood Agents (continued)

The body has the ability to detoxify hydrogen cyanide more rapidly than the other agents, so exposure to low concentrations is not as deadly or cumulative. Both agents hydrolyze fairly rapidly; however, cyanogens chloride hydrolyzes more slowly than hydrogen cyanide.

Because blood agents are inhalation threats, only a protective mask is required. (When handling liquid cyanides (e.g., sodium cyanide) gloves and protective clothing should be worn).

First aid involves getting the victim out of the contaminated area and administration of an antidote (amyl nitrate) by medical personnel. Decontamination is accomplished by aeration.

Toxicity: The toxicities for blood agents vary as does the ability of the body to detoxify them. In a high concentration, the toxicity for hydrogen cyanide is 3600 ppm (one minute exposure).

Hydrogen Cyanide Physical Properties

- Odor: Bitter almonds or peach kernels
- Melting point: -8.2°F (-13°C)
- Boiling point: 78°F (26°C)
- Vapor density: 0.93
- Volatility: 1,080,000 mg/m^3 (non-persistent)

POINT: This agent is a very non-persistent liquid at room temperature. Respiratory protection is required.

DPT 7.0

Domestic Preparedness

Hydrogen Cyanide Physiological Properties

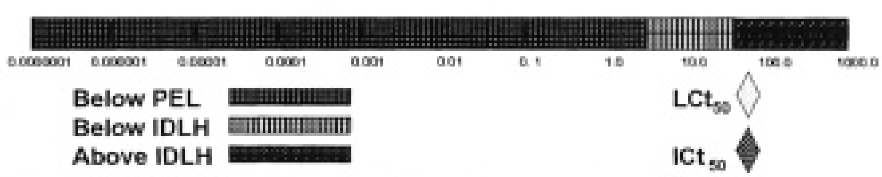
- Rate of action: Immediate
- Rate of detoxification: Very fast
- Method of injury: Stops cell respiration

PEL = 9.9 ppm

ICt_{50} = <LCt_{50} ppm

IDLH = 45 ppm

LCt_{50} = 3,600 ppm



DPT 7.0

Domestic Preparedness

Cyanogen Chloride Chemical Properties

- Military designation: CK
- Chemical name: Cyanogen chloride
- Empirical formula: CNCl
- CAS#: 506-77-4
- Rate of hydrolysis: Very slow
- Hydrolysis products: HCl and CNOH
- Reaction with metals: None

DPT 7.0 Domestic Preparedness

Cyanogen Chloride Physical Properties

- Odor: Faint bitter almonds, peach kernels
- Melting point: -21°F (-6°C)
- Boiling point: 55°F (14°C)
- Vapor density: 2.1
- Volatility: 6,132,000 mg/m^3 (non-persistent)

POINT: This agent is a very non-persistent gas at room temperature. Respiratory protection Is required.

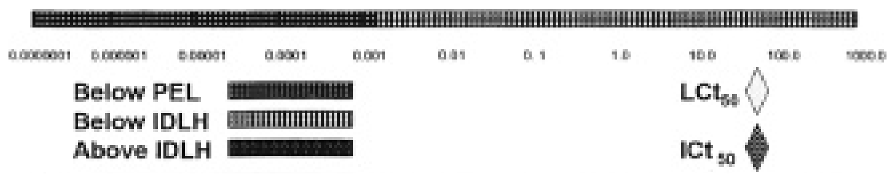
DPT 7.0 Domestic Preparedness

Cyanogen Chloride Physiological Properties

- Rate of action: Immediate
- Rate of detoxification: Very fast
- Method of injury: Stops cell respiration

PEL = 0.2 ppm
ICt_{50} = 2784 ppm

IDLH = unk
LCt_{50} = 4375 ppm



DPT 7.0

Domestic Preparedness

Blister Agents

Common Name Military Symbol	Mustard (H)	Lewisite (L)	Phosgene Oxime (CX)
Volatility/Persistency	Persistent		
Rate of Action	Delayed	Rapid	
Route of Entry	• Skin • Inhalation • Eyes		
Odor	Garlic	Geraniums	Irritating
Symptoms	Eyes: burning Inhalation: coughing Skin: blistering after 4-24 hours, pain		
Protection	• Respiratory • Skin		
First Aid	• Decontaminate • Ensure air passages are open		
Decontamination	• Immediate removal • Flush with water • Dilute bleach		

DPT 7.0 Domestic Preparedness

Blister Agents

Like the choking agents, blister agents were also used in World War I, because once all of the combatants had protective masks, choking agents were not as effective. Another agent was required. Blister agents filled the void because they had two primary routes of entry: inhalation and absorption through the skin.

There are three blister agent types: the Mustard family (H, HD, HN, and HT), Lewisite (L) and Phosgene Oxime (CX).

The Mustards and Lewisite are liquids, while Phosgene Oxime is a solid (prismatic crystalline powder) (melting point 40°C). They all present a vapor hazard, and Mustard and Lewisite also present liquid hazards. Mustard freezes (becomes a solid) at 57°F, so it would not be present as a liquid in the colder times of year.

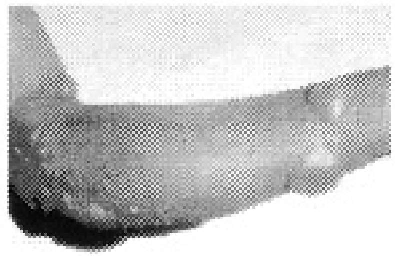
Mustard has the odor of garlic, while Lewisite smells like Geraniums.

The rate of action for skin contact is fast with all the blister agents. Mustard is a very insidious agent as it causes no pain nor is there any other indication of its presence for a period of 4-24 hours. It is also carcinogenic (as is Lewisite). With Lewisite and Phosgene Oxime there is immediate pain at the site of contact. The vapor effects of all three of these agents take longer to cause casualties, both on the eyes and through inhalation.

Symptoms vary according to concentration. Vapor or liquid in the eyes will cause some tearing, burning and a gritty feeling. Inhalation effects can cause coughing and perhaps a raspy or hoarse voice.

Liquid vapor skin contact will cause blistering. The area contaminated will start turning red, followed by blister formation. The blisters are deep, similar to second-degree burns, and occur anywhere that contact is made. Moist areas of the body are more susceptible, even when covered with clothing. As a result, these agents must be removed from the skin immediately.

Blister Agent Poisoning

DPT 7.0 Domestic Preparedness

Blister Agent Poisoning

The physiological action of blister agent produces extreme irritation, whether the eye, respiratory tract, or skin. Reports from Iran and Iraq during their war in the 1980's are of horrible, painful deaths due to lung damage. Skin blisters break, leaving large open wounds; however, additional blisters are not created from the fluid of broken blisters. There is some hydrolysis, but very little detoxification.

Blister agents require both respiratory protection and protective clothing. The mask will protect not only the respiratory tract, but also the eyes and face, and protective clothing the remainder of the body. These agents are absorbed, by most clothing, which will then "off-gas".

First aid involves removing all liquid agent from the skin immediately. Decontamination requires pinching or blotting agent off the skin rather than rubbing or wiping. After agent removal, flush with water or dilute bleach.

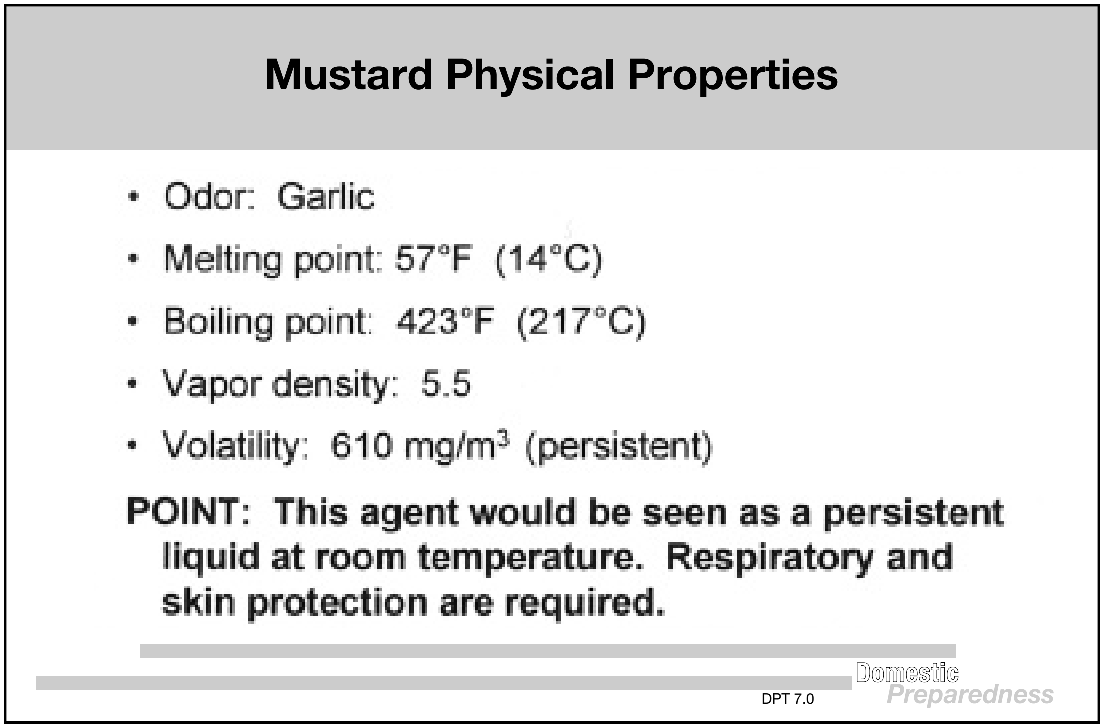
The lethal inhalation toxicity for Mustard is 231 ppm (one minute exposure). Blister formation on the skin from liquid, however, will occur at a much lower concentration; in fact, the LD_{50} for skin contact is only 7 grams per person.

Mustard Chemical Properties

- Military designation: H, HD
- Chemical name: Bis (2-chloroethyl) sulfide
- Empirical formula: $(ClCH_2CH_2)_2S$ or $C_4H_8Cl_2S$
- CAS #: 505-60-2
- Rate of hydrolysis: Slow
- Hydrolysis products: HCl and thiodiglycol
- Reaction with Metals: Very little

DPT 7.0 Domestic Preparedness

Mustard was described in the 1850’s but it was not used during the war between the States as use of chemicals was considered “unsporting.”



Mustard Physical Properties

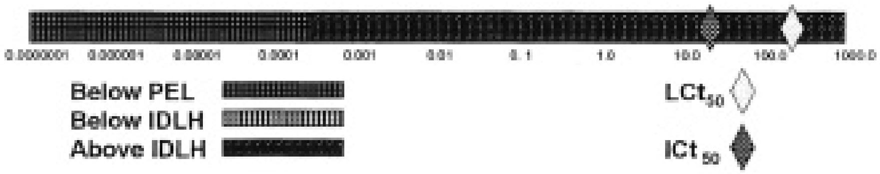
Note that Mustard is frozen (solid) below 57°F. Unless it's mixed with something to lower the freezing point, it probably will not be used in cooler weather conditions.

Mustard Physiological Properties

- Rate of action: May be delayed 6-24 hours
- Rate of detoxification: Cumulative
- Method of injury: Blistering

PEL = 0.0005 ppm
ICt_{50} = 23 ppm

IDLH = 0.0005 ppm
LCt_{50} = 231 ppm



DPT 7.0

Domestic Preparedness

Lewisite Chemical Properties

- Military designation: L
- Chemical name: Dichloro-(2-chlorovinyl) arsine
- Empirical formula: $ClCHCHAsCl_2$
- CAS #: 541-25-3
- Rate of hydrolysis: Rapid
- Hydrolysis products: HCl and chlorovinyl arsenious compounds
- Reaction with metals: None

DPT 7.0

Domestic Preparedness

Lewisite Physical Properties

- Odor: Geraniums
- Melting point: -64°F (-18°C)
- Boiling point: 374°F (190°C)
- Vapor density: 7.2
- Volatility: 4,480 mg/m^3 (persistent)

POINT: This agent is a persistent liquid at room temperature. Respiratory and skin protection are required.

DPT 7.0

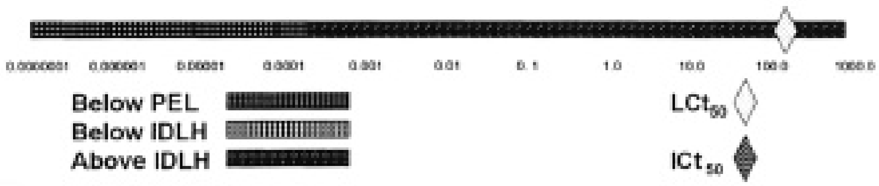
Domestic Preparedness

Lewisite Physiological Properties

- Rate of action: Rapid
- Rate of detoxification: None
- Method of injury: Blistering

PEL = 0.0004 ppm
ICt_{50} = unk

IDLH = 0.0004 ppm
LCt_{50} = 165 ppm



DPT 7.0

Domestic Preparedness

Phosgene Oxime Chemical Properties

- Military designation: CX
- Chemical name: Dichloroformoxime
- Empirical formula: $CHCl_2NO$
- CAS #: 35274-08-9
- Rate of hydrolysis: Slow
- Hydrolysis products: CO_2, HCl and hydroxylamine
- Reaction with metals: Corrosive

DPT 7.0 Domestic Preparedness

Phosgene Oxime Physical Properties

- Odor: Disagreeable, penetrating
- Melting point: 104°F (40°C)
- Boiling point: 264°F (129°C)
- Vapor density: 3.9
- Volatility: 1,800 mg/m^3 (persistent)

POINT: This agent is a colorless prismatic crystal at room temperature. Respiratory and skin protection are required.

DPT 7.0 Domestic Preparedness

Phosgene Oxime Physiological Properties

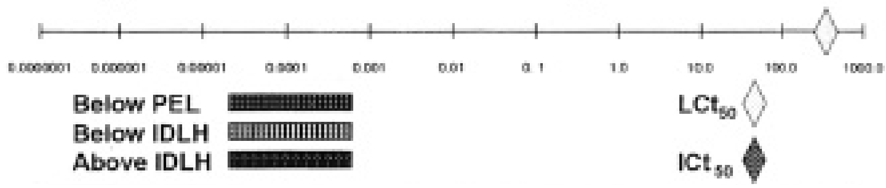
- Rate of action: Rapid
- Rate of detoxification: None
- Method of injury: Blistering

PEL = Unk

ICt_{50} = 0.6 ppm

IDLH = Unk

LCt_{50} = 687 ppm (est)



DPT 7.0

Domestic Preparedness

Nerve Agents

Common Name Military Symbol	Tabun (GA)	Sarin (GB)	Soman (GD)	VX
Volatility/Persistence	Semi-Persistent			Persistent
Rate of Action	Extremely rapid			
Route of Entry	• Respiratory • Skin			
Odor	Fruity		Camphor	Sulfur
Symptoms	• Pinpointing of Pupils • Salivation • Vomiting/Diarrhea • Twitching • Difficulty in Breathing			
Protection	Respiratory and Skin			
First Aid	• Atropine • 2-Pam chloride			
Decontamination	• Remove Agent • Flush With Water or Dilute Bleach			

DPT 7.0 Domestic Preparedness

Nerve Agents

Of all the agents, the nerve agents are of the greatest concern because of their toxicity, rate of action, and ability to enter the body by multiple routes of entry.

Nerve agents were discovered in the mid-1930's when German scientists were looking for better pesticides. Because there were many rat-infested ships docking in German ports, the scientists needed to find a better way to fumigate the ships. The story goes that the scientists pumped this new pesticide into the holds of a ship and then went down inside to see if it had been effective in killing the rats. The test was a success because not only did all the rats die, but so did the individuals conducting the test.

Most of you are familiar with insecticides, many of which are organophosphorous compounds similar to nerve agents. As a result, nerve agents have been referred to as "insecticides for people."

There are four agents that we will discuss: Tabun (GA), Sarin (GB), Soman (GD), and VX. Of those, GA and GB are our greatest concern because they are the easiest to produce.

All nerve agents are extremely fast acting. The G- agents are generally volatile and will evaporate fairly quickly. They are considered semi-persistent, and are both an inhalation hazard and a skin contact threat (liquid on skin). VX has a low volatility and is primarily a liquid hazard unless aerosolized. It evaporates about as quickly as motor oil, so it is primarily a skin contact hazard, but if in aerosol form will also be an inhalation threat.

When pure, the G- agents are both colorless and odorless, however there may be a slight fruity odor, if impure. VX is also odorless but may have a slight yellow color, and a sulfur smell, if impure. As the name implies, these agents affect the nervous system.

Nerve agents attack or interfere with the normal chemistry at the nerve muscle junction. Muscles work by contracting and relaxing. To stimulate contraction the nerve endings activate a chemical called acetylcholine, which acts as an electrical conductor to bridge the gap between the nerve ending and the muscle or gland. Following the contraction, the muscle secretes an enzyme called acetylcholinsesterase which neutralizes the acetylcholine, breaking the electrical contact, and allowing the muscle to relax. Nerve agents inhibit acetylcholinesterase production, and, therefore, the neutralization of acetylcholine. Thus the muscle receives constant stimulation, causing it to twitch, and tire quickly. As this occurs, fluids build up in the trachea and bronchioconstriction occurs making it more difficult to breath. Death usually results from cardiopulmonary failure.

The symptoms of nerve agent poisoning are fairly recognizable: dimness of vision (pinpointing of pupils), runny nose, drooling, difficulty breathing/tightness of the chest, nausea, vomiting and diarrhea, muscle jerking or twitching, involuntary urination/defecation, coma and death. Depending on where the agent contacts the body, pinpointing of the pupils is not always seen.

Depending on the concentration and exposure time, effects can all occur in very few minutes.

Remember the mnemonic SLUDGE:

S Salivation
L Lacrimation (Tearing)
U Urination
D Defecation
G Gastrointestinal (increase in secretions in tract) effects
E Emesis (vomiting)

Tabun Chemical Properties

- Military Designation: GA
- Chemical Name: O-Ethyl N,N-dimethylphosphoramidocyanidate
- Empirical Formula: $C_5H_{11}N_2O_2P$
- CAS #: 77-81-6
- Rate of Hydrolysis: Slowly with water; fairly rapidly with strong acids and alkalis. May be catalyzed by phosphate
- Hydrolysis products: HCN + others
- Reaction with metals: Slight; corrosive to steel

DPT 7.0 Domestic Preparedness

Tabun Physical Properties

- Odor: None when pure (fruity)
- Melting Point: -58°F (-50°C)
- Boiling Point: 475°F (246°C)
- Vapor Density: 5.63
- Volatility: 328 mg/m^3 (20°C), 610 mg/m^3 (25°C) (semi-persistent)

POINT: This agent is a semi-persistent vapor at room temperature. Both respiratory and skin protection are required.

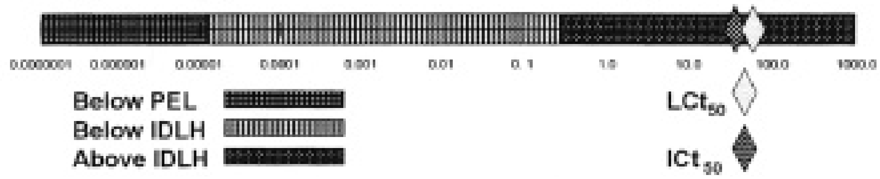
DPT 7.0 Domestic Preparedness

Tabun Physiological Properties

- Rate of Action: Immediate
- Rate of Detoxification: Slow
- Method of Injury: Overstimulation of muscles and secretory cells

PEL = 0.000015 ppm IDLH = 0.03 ppm

ICt_{50} = 45 ppm LCt_{50} = 60 ppm



DPT 7.0

Domestic Preparedness

Sarin Chemical Properties

- Military designation: GB
- Chemical name: Isopropyl methylphosphonofluoridate
- Empirical formula: $C_4H_{10}FO_2P$
- CAS #: 107-44-8
- Rate of hydrolysis: Hours to days - acid dependent
- Hydrolysis products: Acidic = HF and organophosphorus acids; Alkaline = Isopropyl alcohol and polymers
- Reaction with metals: None

DPT 7.0

Domestic Preparedness

Sarin Physical Properties

- Odor: None when pure (fruity if impure)
- Melting Point: -70°F (-56°C)
- Boiling Point: 316°F (158°C)
- Vapor Density: 4.86
- Volatility: 16,090 mg/m^3 (20°C) (semi-persistent)

POINT: This agent is a non-persistent vapor at room temperature. Both respiratory and skin protection are required.

DPT 7.0

Domestic Preparedness

Sarin Physiological Properties

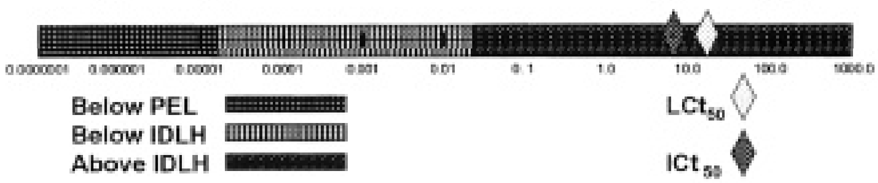
- Rate of action: Immediate
- Rate of detoxification: Very slow
- Method of injury: Overstimulation of muscles and secretory cells

PEL = 0.000017 ppm

ICt_{50} = 8 ppm

IDLH = 0.03 ppm

LCt_{50} = 12 ppm



DPT 7.0

Domestic Preparedness

Soman Chemical Properties

- Military designation: GD
- Chemical name: Pinacolyl methylphosphonofluoridate
- Empirical formula: $(CH_3)(C_6H_{13}O)POF$
- CAS #: 96-64-0
- Rate of hydrolysis: Hours to two days - acid dependent; 5 min in 5% NaOH
- Hydrolysis products: HF and organophosphorus acids
- Reaction with metals: Slightly corrosive

DPT 7.0 Domestic Preparedness

Soman Physical Properties

- Odor: None when pure (camphor if impure)
- Melting point: -44°F (-42°C)
- Boiling point: 388°F (198°C)
- Vapor density: 6.33
- Volatility: 3,900 mg/m^3 (25°C) (semi-persistent)

POINT: This agent is semi-persistent vapor at room temperature. Both respiratory and skin protection are required.

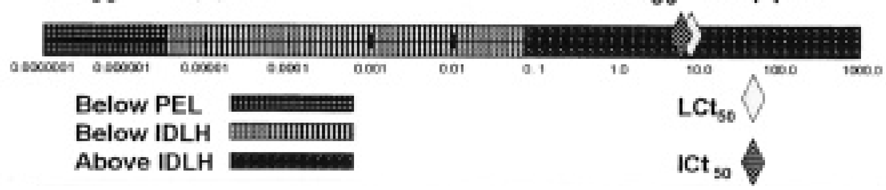
DPT 7.0 Domestic Preparedness

Soman Physiological Properties

- Rate of action: Immediate
- Rate of detoxification: Very slow
- Method of Injury: Overstimulation of muscles and secretory cells

PEL = 0.000004 ppm
ICt_{50} = 4 ppm

IDLH = 0.008 ppm
LCt_{50} = 9 ppm



DPT 7.0 Domestic Preparedness

VX Chemical Properties

- Military designation: VX
- Chemical name: O-ethyl S-(2-diisopropylamino)ethyl methylphosphonothiolate
- Empirical formula: $C_{11}H_{26}NO_2PS$
- CAS #: 50782-69-9
- Rate of hydrolysis: Minutes in alkaline solutions; days in acidic solutions
- Hydrolysis products: Toxic at pH 7-10
- Reaction with metals: None noted

DPT 7.0 Domestic Preparedness

VX Physical Properties

- Odor: None when pure (sulfur)
- Melting point: -38°F (-39°C)
- Boiling point: 568°F (298°C)
- Vapor density: 9.2
- Volatility: 10.5 mg/m^3 (persistent) at 25°C

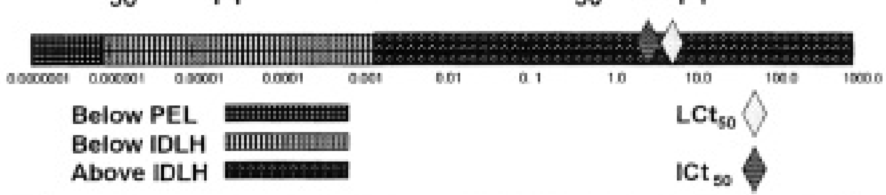
POINT: This agent is a persistent liquid at room temperature. Aerosols are very toxic when inhaled. Both respiratory and skin protection are required.

DPT 7.0 Domestic Preparedness

VX Physiological Properties

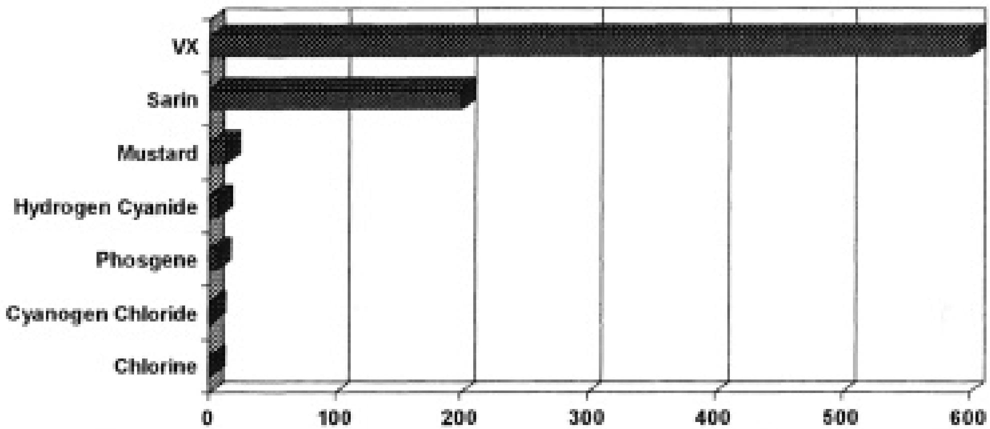
- Rate of action: Immediate
- Rate of detoxification: Very slow
- Method of injury: Overstimulation of muscles and secretory cells

PEL = 0.0000009 ppm IDLH = 0.0018 ppm
ICt_{50} = 2 ppm LCt_{50} = 3 ppm



DPT 7.0 Domestic Preparedness

Comparative Toxicities



DPT 7.0

Domestic Preparedness

Comparative Toxicities

This is a graphic comparison of the approximate lethalities of the agents we have discussed. They are based relative to chlorine in terms of respiration.

If we use Chlorine as a baseline:

a. Cyanogen chloride (CK) is twice as toxic

b. Phosgene (CG) is 6 times more toxic

c. Hydrogen cyanide (AC) is 7 times more toxic

d. Mustard (H) is 13 times more toxic

e. Sarin (GB) is 200 times more toxic

f. VX is 600 times more toxic

For skin toxicity, 10 milligrams of VX equals 1 to 2 grams of Mustard or Sarin. Less than a pinhead of Mustard is required to achieve a small blister.

Summary

During this lesson, we have examined the chemical agents of primary concern, their characteristics and behavior, and terms associated with them. We have also cited the symptoms, physiological action, protection required, first aid needed, and decontamination methods.

In this student guide, there is an additional summary chart at the end of this segment. It can serve as a quick guide for you to quickly associate the chemical agent, symbol, CAS number, classification, symptoms, toxicity, and other important data.

Closing Statement: The final point I would like to leave you with is this:

Although these agents were deliberately developed to cause injury or death to individuals and are extremely toxic, they are not the end of the world. They can be detected, protected against, treated, and decontaminated.

CHEMICAL AGENT SUMMARY REFERENCE

Type	Symbol/ Common Name	Volatility Persistency	CAS Number	LCT_{50}● (mg-min/m^3)	ICT_{50} (mg-min/m^3)	LCT_{50}★ ppm	ICT_{50}★ ppm
Choking	CG / Phosgene	Non-persistent	75-44-5	3200[1,2,6]	1600[1,2,6]	791	395
	Cl / Chlorine	Non-persistent	7782-50-5	19,000	1800	6551	620
Nerve	GA / Tabun	Semi-persistent	77-81-6	135-200[5,6] 400[3] 200[1]	300●[2]	60 20[5]	45
	GB / Sarin	Non-persistent	107-44-8	70-100[1,2] 70[5,6]	35-75●[1,2] 35[5]	12	8
	GD / Soman	Semi-persistent	94-64-0	70[1,2,5,6]	50-300● 35[5,6]	9	4
	VX	Persistent	50782-69-9	30-100[1,2] 30[5,6]	24-50●[1,2] 25[6]	3	2
Blister	H/HD	Persistent	505-60-2	1500[1,2,6]	150†[2] 200[1,5] (eyes)	231	21.5 30[5]
	HN-1	Persistent	538-07-08	1500[2,6]	200†[2,6]	(216)	(29)
	HN-2	Persistent	51-75-2	3000[2,6]	100†[2,6]	(470)	(16)
	HN-3	Persistent	555-77-1	1500[2,6]	200†[2,6]	(179)	(24)
	HT	Persistent	505-60-2 693-07-2	1500 (approx. same as H)[1,2]	200† (approx. same as H)[1,2]	Approx. same as H	Approx. same as H
	CX	Persistent	35274-08-9	3200[1,2,6]	>3†[2,6]	687	0.6
	L	Persistent	541-25-3	1200-1500[1,5,6] 1400[2]	<300†[2,5,6]	165[2] 141-177[1]	Unknown <35[2,6]
Blood	AC	Non-persistent	74-99-8	2000-4000[1,2]	Varies●[2]	3600	Varies
	CK	Non-persistent	506-77-4	11000[1,2,6]	7000●[1,2,6]	4375	2784

★ - Assuming 1 minute exposure, breathing 10 l/min
● - Respiratory
† - Ocular
NS - no standard

References:
1 - Chemical Agent Data Sheets, V.1, Dec. 1974, EO-SR-74001
2 - FM 3-9, 12 Dec 90
3 - Merck Index, 12th Ed., 1996
4 - CRC Handbook, 69th Ed., 1998
5 - MSDS from CBDCOM Safety
6 - CHPPM Detailed Facts Sheet

CHEMICAL AGENT SUMMARY REFERENCE

Symbol/ Common Name	IDLH ppm	PEL ppm	Hazard	Symptom	Physical Characteristics
CG / Phosgene	2	0.1[5,6]	Respiratory	Coughing, Choking	Gas odor: New-Mown Hay
Cl / Chlorine	30	1.0[4,5]	Respiratory	Coughing, Choking	Gas odor: Swimming pool
GA / Tabun	0.3[5,6]	0.000015[6]	Respiratory, skin, eyes	Pinpointing of the pupils; Dimness of vision; Runny nose / salivation	Colorless to lightly colored liquid at normal temperature; G-agents slightly less volatile than water; V-agents about as volatile as motor oil.★
GB / Sarin	0.03[5]	0.000017[6]	Respiratory, skin, eyes	Tightness of chest; Difficulty breathing; Twitching or paralysis; Tachycardia	
GD / Soman	0.008[5]	0.000004[6]	Respiratory, skin, eyes	Vomiting; Loss of consciousness; Convulsions	
VX	0.0018[5]	0.0000009[6]	Respiratory, skin, eyes		
H/HD	0.0005[5]	0.0005[6]	Respiratory, skin, eyes	Reddening of skin; Blisters	Oily light yellow to brown liquids with a strong odor of garlic; Fishy odor for HN-series; H and HD freeze at 57°F; All are volatile at room temperature
HN-1	.0004	0.0004[6]	Respiratory, skin, eyes	Eye pain and reddening; Eye damage	
HN-2	NS	NS	Respiratory, skin, eyes	Coughing; Airway irritation and damage; Eye effects may appear in a few hours	
HN-3	NS	NS	Respiratory, skin, eyes	Respiratory effects and blisters in 4-24 hours; Can be lethal in large doses	
HT	0.0005[6]	0.0005[6]	Respiratory, skin, eyes		
CX	Unknown	Unknown	Respiratory, skin, eyes	Immediate burning; Weal-like skin lesions; Eye and airway irritation and damage	A solid below 95°F, but vapor can result
L	0.0004 0.00035[5]	0.00035[6]	Respiratory, skin, eyes	Immediate pain or irritation of skin; Other symptoms similar to the H-agents	Oily colorless liquid with the odor of geraniums; More volatile than H
AC	45	10[5] 9.9[6]	Respiratory	Cherry red skin or lips; Rapid breathing; Dizziness; Nausea, vomiting	Rapid evaporating liquids
CK	Unknown	0.2[6]	Respiratory	Headache; Convulsions; Death	

★ - Assuming 1 minute exposure, breathing 10 l/min
● - Respiratory
† - Ocular
NS - no standard

References:
1 - Chemical Agent Data Sheets, V.1, Dec. 1974, EO-SR-74001
2 - FM 3-9, 12 Dec. 90
3 - Merck Index, 12th Ed., 1996
4 - CRC Handbook, 69th Ed., 1988
5 - MSDS from CBDCOM Safety
6 - CHPPM Detailed Facts Sheets

Module 6: Recognizing Dissemination Devices (Technician Training)

Training Objectives: At the conclusion of the module, students should be able to:

1. Recognize a potential NBC agent dissemination device.
2. Categorize a dissemination device as to type and potential impact.
3. Identify potential targets against which a terrorist might consider employing NBC agents.

References:

1. A Higher Form of Killing, Robert Harris and Jeremy Paxman; Wang and Hill, 1982.
2. “Hearing before the Senate Permanent Sub-Committee on Investigations on Global Proliferation of Weapons of Mass Destruction,” 31 October 1995
3. “Hearing before the Senate Permanent Sub-Committee on Investigations on Global Proliferation of Weapons of Mass Destruction,” 1 November 1995

Introduction

While knowledge of the capabilities and characteristics of chemical, biological, and radiological agents is useful in the remediation effort after an incident, the ability to recognize both the potential for an event and the tools of an NBC terrorist may enable responders to anticipate and prevent or mitigate the effects of the attack. This class will address the devices a terrorist might construct to disseminate NBC material.

Objectives

At the conclusion of this class, students should be able to:

a. Recognize a potential NBC dissemination device.

b. Categorize a dissemination device as to type and potential impact.

c. Identify potential targets against which a terrorist might consider employing NBC agents.

Dissemination Devices

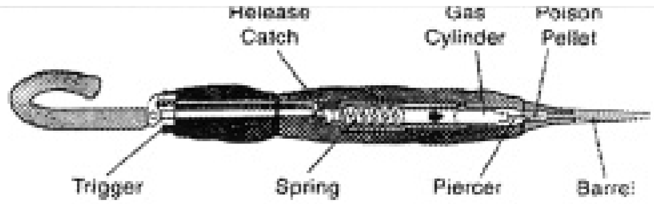
Type Disseminator	Type Dissemination	Function Type
• Direct Deposit	Point	Mechanical
• Breaking Devices	Point	Mechanical
• Bursting/Exploding Devices	Point	Mechanical
• Spraying Devices	Point or Line	Mechanical
• Vector	Area (Biological Only)	Biological

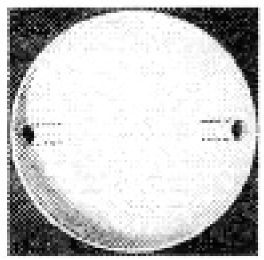
DPT 7.0 Domestic Preparedness

Dissemination Devices

Dissemination devices can be categorized by how they disseminate the agent or material.

Direct Deposit Device





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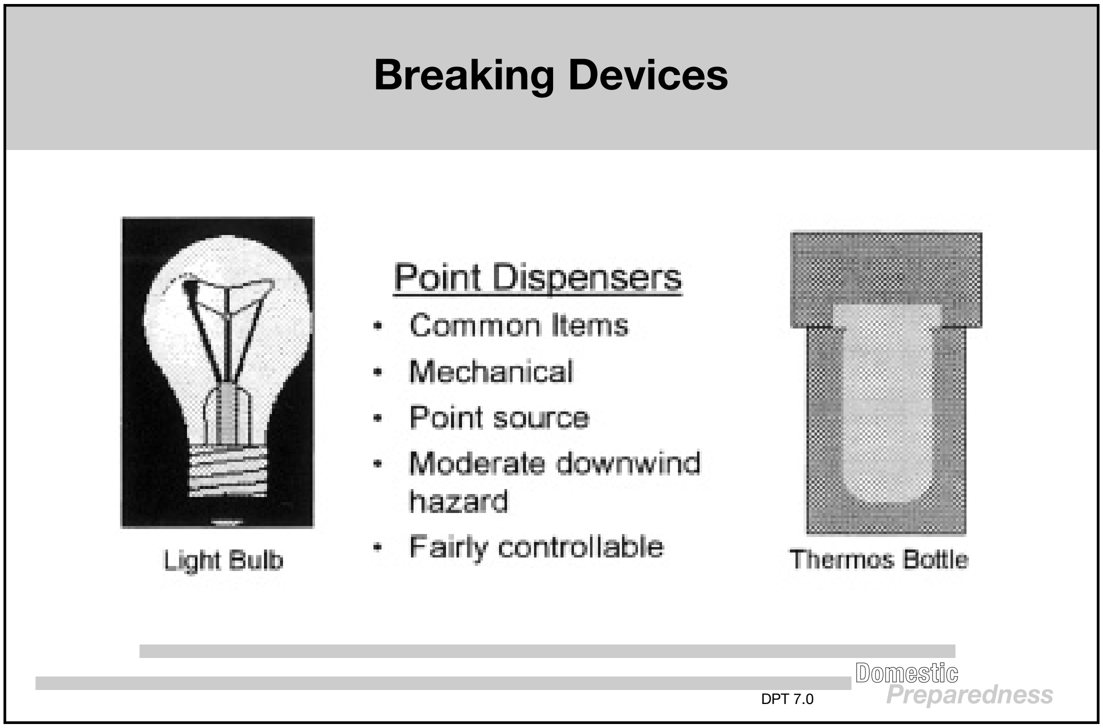
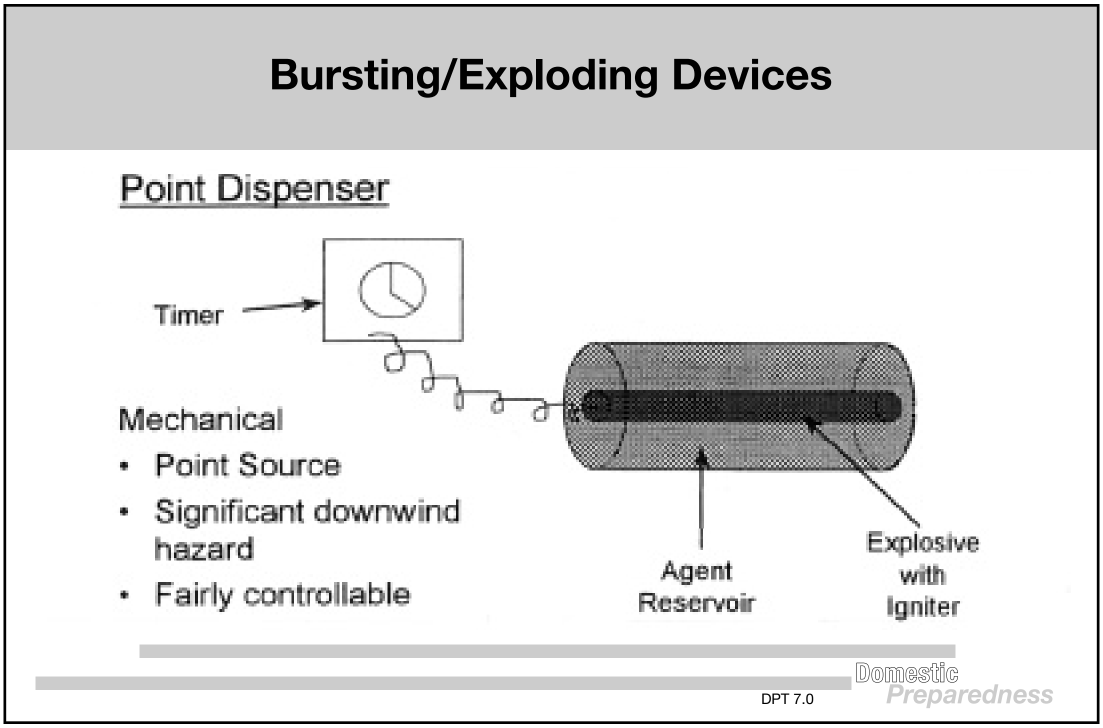
Direct Deposit

Direct deposit devices are mechanical and employed to execute an attack on a specific target with minimal collateral damage. These devices are normally constructed to inject the agent directly into the target and can be built into items as common as canes, pens, or umbrellas. These weapons pose no downwind collateral hazard. The effects of these devices are the most easily controlled.



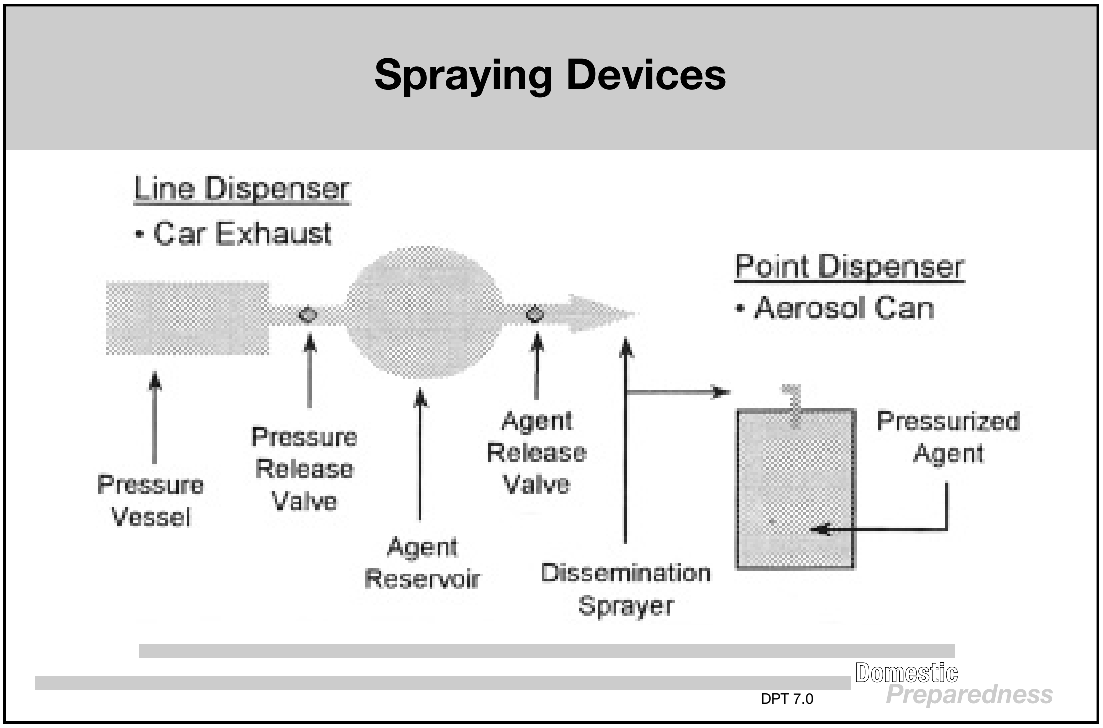
Breaking Devices

Breaking devices are those mechanical weapons which encapsulate the agent and release it when broken. They are optimally constructed from common items such as light bulbs, balloons, or thermos bottles and loaded by inserting the agent and sealing the device. The “loading process” is dangerous and as risky to the terrorist as to the target. The devices are employed simply by throwing them at the intended victims. Breaking devices cause point dissemination of the agent and create some downwind hazard to unprotected individuals. The effects of these devices are moderately controllable.



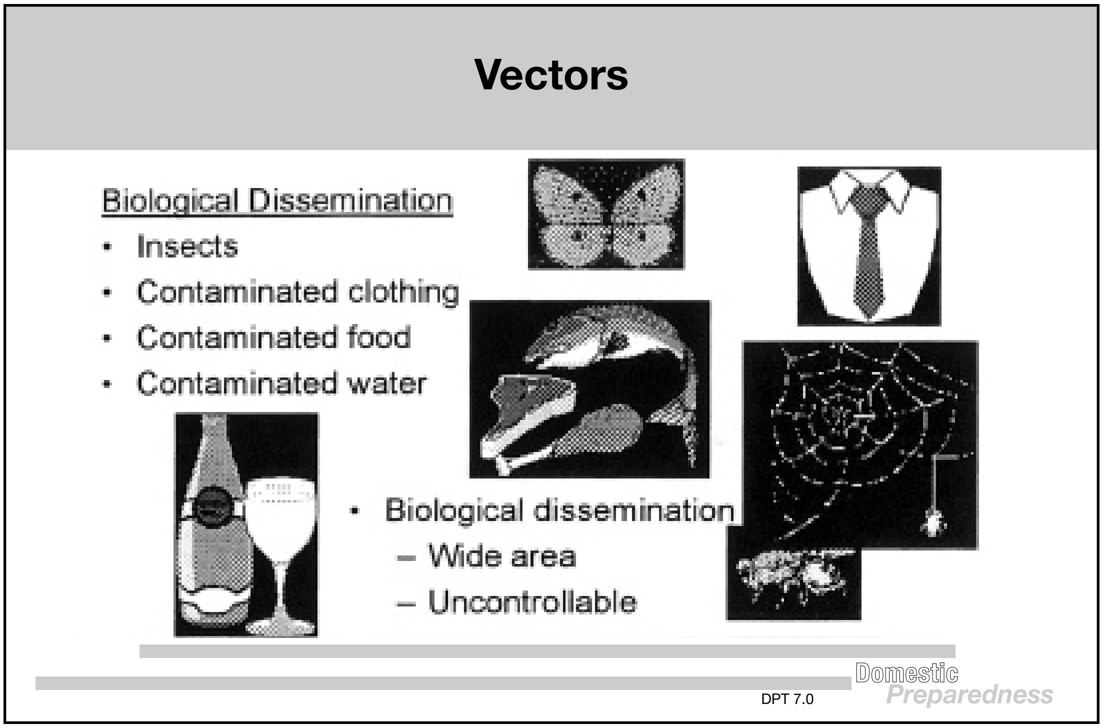
Bursting/Exploding Devices

Bursting or exploding mechanical devices are those which employ an explosive to break the agent container and disseminate the agent. These devices are usually configured with the explosive at one end of a tube, with the explosion forcing the agent out the other end; or with the explosive surrounded by the agent. Bursting devices always have an agent reservoir, a chamber for the explosive, and usually employ either a timer or a command detonation switch. These devices pose a wider area hazard than either the direct deposit or breaking devices due to the increased amount of agent involved and the explosive nature of the dissemination. Terrorists should be careful, however, to ensure that the blast and resulting heat do not consume the agent. The effects of these devices are predictable, but may deviate from the expected.



Spraying Devices

Mechanical spraying devices also contain an agent reservoir, but rather than an explosive charge, they employ pressure to disseminate the agent. The pressure may be either supplied independently of, or applied directly to, the agent reservoir. They can be employed either as point dissemination weapons, as with an aerosol can, or as line source generating weapons, as might be accomplished with a device incorporated into an automobile exhaust system. Of the mechanical employment devices, the effects of these weapons are the least controllable and pose the largest area hazard.



Vectors

Vectors usually disseminate only living biological agents. A vector is a carrier of the bacteria, and may be an insect or a contaminated item such as clothing, food, or water. As vectors are not weather dependent, this type dissemination is the least predictable and controllable. The vectors, if airborne, can range up to 40 miles within a day's time.

Potential Terrorist Targets

a. In order to increase the potency of an NBC agent, the best place for a terrorist to release it is within an enclosed space (indoors). Outside, the winds will rapidly dissipate vapors until they are too thinly concentrated to have a noticeable effect on passers-by. The ultra-violet rays of sunlight will also kill most biological agents within hours, a factor that further encourages terrorists to attack enclosed areas.

b. Wherever the agent is released, large crowds ensure more casualties, more panic, and more media attention. High profile events will guarantee instant media coverage, fame, and recognition for the group that caused the incident. The payoffs of a successful strike at an event such as the Olympics counterbalance the difficulty of breaching the increased security.

c. Critical facilities and infrastructure of the government may also be the target of terrorism, such as the Federal Building in Oklahoma City or the Lincoln Tunnel in New York City.

d. The same industries that produce or use poisonous chemicals usually store large quantities nearby, also making them a potential target for attack. Security is often low and the sites are usually easily accessible from main thoroughfares.

e. At particular risk are the vehicles used to transport potential NBC agents; placarded trains and trucks move regularly through populated areas in most cities.

f. Particular buildings, such as city halls, federal office buildings (i.e., IRS, FBI offices), and military installations are considered likely targets. In brief, almost any facility that is of interest to the terrorist’s cause can become the target of an NBC attack.

Responder Actions

If you recognize a dissemination device before it functions:

a. Do not touch, cover, or move the device. If the device is inside a facility, do not remove it. Taking the device outside could create a greater hazard.

b. Isolate the area. Closing doors and windows in the immediate area of the device could contain the release.

c. If feasible, move upwind, upgrade, and/or upstream.

d. Notify the proper personnel, according to local SOP.

After an attack:

a. Stay upwind, upgrade, and/or upstream of the site, if possible.

b. Notify the proper personnel, according to local SOP.

Key Points

- Dissemination devices can take many forms
  - Sometimes difficult to recognize
- Potential targets
  - Enclosed spaces
  - Critical facilities
  - Facilities of interest to terrorists
- Responder actions
  - Don't touch, cover or move device
  - Make proper notification

Module 7: Classification Detection and Identification (HAZMAT Technician)

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

1. Operate selected detection and identification equipment.
2. State the general capabilities and uses of selected detection and identification equipment.
3. List potential interferents and understand their impact.
4. Use the equipment as part of a detection and identification system.

References:

1. *FM 3-3, Chemical and Biological Contamination Avoidance*, Headquarters, Department of the Army, January 1992.
2. Equipment manuals.

INTRODUCTION

Classification, Detection and Identification

Detection and identification equipment is used to confirm the presence of NBC agents, indicate the probable concentration level of chemical agents, and indicate the specific agent that might be present to help determine the protection, first aid, and decontamination measures necessary.

Operation of available detection equipment and interpretation of the results for the Incident Commander are the responsibility of the HAZMAT technician.

Objectives

The purpose of this module is to provide the opportunity to view fielded (off-the-shelf) detection and identification equipment which might prove to be useful in response to an incident involving NBC materials. We shall examine the general capabilities and uses of various NBC detection and identification systems and the substances which might interfere with the use of the equipment. I shall also provide some ideas about how the systems are used together to provide the maximum amount of information and reliability.

The Detection and Identification Continuum (Chemicals)

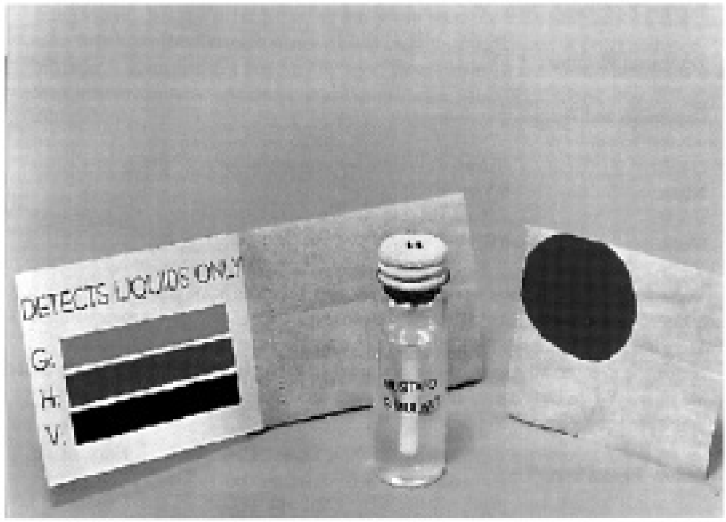
System	Response time	Training Needed	Results
M8 paper	Seconds	Few minutes	Detects presence of liquid V-or-G nerve agents or blister agent, by type
M9 paper	Seconds	One minute	Detects presence of liquid chemical agents
M8A1 alarm	Seconds	One-two hours	Alarms for nerve agent vapor
CAM	Seconds	Two hours	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)
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 Continuum (Chemicals)

Just as there is no single system which will detect all HAZMATs, there is no single system which will detect all chemical agents. A number of items are required, each of which will serve a specific role during the response. This chart lists a number of systems arrayed from the very simple items like papers (which work in seconds) to the very sophisticated laboratory instruments cited on the bottom of the chart (which can take from minutes to hours to give results). In general, we can say that the simpler a system is to use, the less specific the result. On the other hand, the more complex the system, the more information may be obtained. 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.

M8 Chemical Agent Detector Paper



M8 Chemical Agent Detector Paper

One of the first items which might be used is chemical detector paper. M8 paper provides a qualitative detection (color change) in the presence of liquid nerve or blister agents. It will not detect vapors. The color change is compared to the color printed on the inside cover to presumptively identify the agent; however, the paper will respond to a number of other chemicals, mainly organic solvents.

M8 paper is best used during initial reconnaissance of the incident site, to screen suspicious liquids. If no color change is indicated, nerve and blister agents can probably be eliminated. A positive response should be combined with other information before a conclusion that agent is actually present is reached.

M9 Chemical Agent Detector Paper

M9 Chemical Agent Detector Paper

M9 paper will change color to red in the presence of liquid chemical agent droplets. It has a sticky back so that it can be fastened to protective garments and equipment to disclose contamination. It has the ability to “wick” very small droplets to make visible spots where none would appear on M8 paper.

M9 paper is also less sensitive to other chemicals than the M8 paper, but does not differentiate between nerve and blister agent.

The key point with the papers is that they are for liquids only.

Other Chemical Agent Detector Papers

One good source of information regarding detection and identification equipment is the publication “Jane’s NBC Protection Equipment” which is published semi-annually. It provides information on a myriad of equipment from all nations. Many countries manufacture chemical agent detection paper. Some examples are shown on this slide, and others may be seen in “Janes’;” therefore, if the paper is not available from a U.S. source, an equivalent may be found elsewhere in the world.

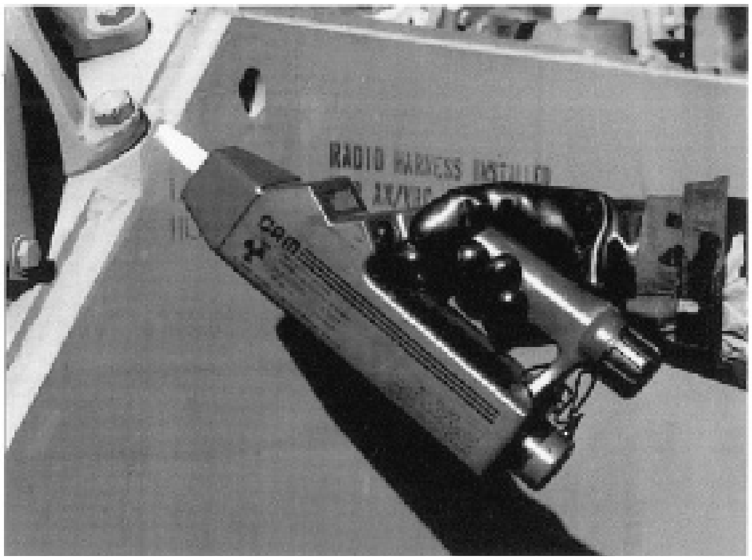
One very useful section of “Janes” listed commercial manufacturers and contact numbers for both U.S. and foreign equipment.

Chemical Agent Detector (ICAD)

The ICAD is a gross-level detector of nerve, blood, blister and choking agents. It provides a visible and audible warning of agent doses, but only when the concentration is above the initial effects dose.

It would best be used as a warning device.

Chemical Agent Monitor



Chemical Agent Monitor

The Chemical Agent Monitor, or CAM, is a hand-held, battery-operated, post attack device for monitoring chemical agent contamination on personnel or equipment. It detects vapors of chemical agents and discriminates between nerve (G-, VX) and mustard agents (H, HD, HN). It is designed for use by individuals in full protection, and is used to sort contaminated personnel and equipment from clean. The ICAM (Improved Chemical Agent Detector) is a newer model which simplifies maintenance.

A semi-quantitative indication of the amount of agent present is provided by the number of bars which appear on the LCD screen (0-8 bars).

One limitation of the CAM is that certain organic solvents can produce a false positive response, so the operator needs to be trained to determine what may be in the area that could cause a false response.

French AP2C

The French AP2C is a device similar to the CAM. Like the CAM, it detects and differentiates between nerve and blister agents. It can detect both simultaneously and is slightly more sensitive for nerve agents. It also recovers more quickly than the CAM/ICAM; however, it costs nearly twice as much.

SAW MINICAD

SAW MINICAD

The SAW-MINICAD is capable of detecting concentrations of G and H-agents in vapor form. It is not as sensitive as the CAM/ICAM. The device uses surface acoustic wave technology for detection. It weighs slightly over a pound.

It has not been fully tested nor has it been approved for use by the U.S. Armed Forces.

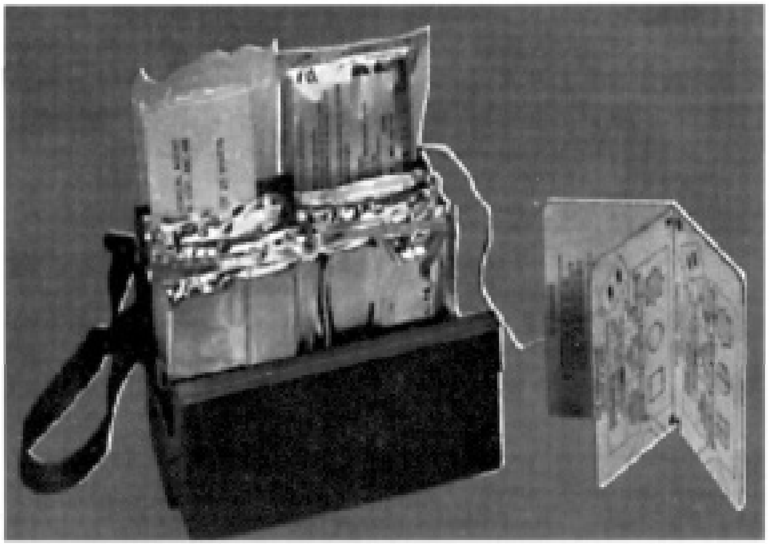
M8A1 Automatic Chemical Agent Alarm

The M8A1 alarm provides continuous automatic point detection and warning of nerve agent (only) concentrations below IDLH levels. It will produce a false positive reading in the presence of some organic vapors, including diesel exhaust, so it must be used by a trained operator who understands its sensitivities. It uses the same technology as the CAM, and requires an NRC license. The M8A1 Automatic Chemical Agent Alarm would be best used at the boundaries of the cold zone at a known nerve agent incident.

M21 Remote Sensing Chemical Agent Alarm

The M21 can remotely detect the presence of nerve (G-series) and blister agent (HD and L) vapor clouds at a distance of up to 3 miles. It needs to “see” fairly dense clouds of agent. It might be best employed facing into the wind covering an area where large crowds in the open are expected.

M256A1 Detector Kit



M256A1 Chemical Agent Detector Kit

This kit has the capability to detect nerve, blood, and blister agents. It will detect nerve and blood agents below IDLH level, and mustard agents below the incapacitating dose. It will also detect CX. It does not detect choking agents.

While designed for use in full protective clothing, the M256A1 Chemical Agent Detection Kit does require some practice to manipulate. It is the most widely used military detection kit, and is best used during the initial recon of a site to determine the class of agent involved. It takes about 15 minutes from start to finish to complete the whole series of tests.

Training kits are also available (M28/M29).

M18A2 Chemical Agent Detector Kit

The M18A2 is the Granddaddy of the M256A1. It uses technology similar to that of the Dräger tubes (with which you may be familiar), but is specifically designed to detect the chemical warfare agents. It can also take a sample for laboratory analysis.

While about 20 times less sensitive than the M256a kit for nerve agents, it is about twice as sensitive for the mustard agents. It will detect the choking agents, which the M256A1 will not. To complete a series of tests takes about 24 minutes.

It does require the manipulation of the tubes, detector tickets, an aspirator bulb and small bottles of chemical reagents.

We recommend that the M18A1 kit, if available, be used to supplement information obtained from the M256A1.

Dräger Detection Tubes

The Dräger Kits contain a series of tubes which can be used to detect the chemical warfare agents as well as toxic industrial chemicals. In fact, for the commercial chemicals (phosgene, chlorine, and the blood agents (hydrogen cyanide and cyanogen chloride)), the Dräger tubes are the most sensitive, detecting concentrations below the TWA level (with the exception of Lewisite).

Dräger tubes used for potential sampling include those specific for thioethers (mustard), phosphoric acid esters (nerve agents), organic arsenic (Lewisite), organic alkaline nitrogen compounds (HN, GA), specific cyanide tubes (blood agents), specific cyanogen chloride tubes (CK), specific chlorine tubes (Cl), or specific phosgene tubes (CG).

MINICAMS

(Transition)

The final types of instruments of the chemical detection and identification continuum are the gas chromatographs. These are laboratory-type instruments which require skilled lab technicians to operate and interpret results. A few have been hardened for use in vans and in the field.

An example of this type instrument is the MINICAMS. It is a hardened GC (gas chromatograph) used by the Department of Defense in depot operations where toxic chemical agents might be present. These instruments can provide automatic quantitative identification of chemicals. They can be set to read only one agent at a time, and must be calibrated daily. This kind of instrument would be best used by your local or state laboratory to precisely identify an agent and its concentration. It is capable of determining that agent concentrations are below TWA/AEL, which is important in terms of downgrading protection and verifying that decontamination is complete.

Gas Chromatograph/Mass Spectrometer GC/MS

Gas Chromatograph/Mass Spectrometer GC/MS

Another field deployable instrument is this (gas chromatograph/mass spectrometer) GC/MS. It is packaged in a suitcase-sized box, and can be used by trained personnel at field location to quantitatively identify chemical agents in soil, vapor or liquid samples. It can detect chemical agents below TWA/AEL levels.

Relative Lethality and Detection Thresholds

Because each item of detection or identification equipment has specific capabilities and limitations, use information from a number of systems. Combine this with external information, such as symptoms of the victims, intelligence information, etc.

This chart summarizes the sensitivities of a number of items of equipment for the various agents. Note that some items are better at detecting some agents than others. This is one reason why we have to use a number of kits and devices are used to arrive at a conclusion.

(Much of the data for CX is unknown).

Chemical Detection Process

- Level A
- Conventional instrumentation (LEL, O_2, radiation, pH paper, etc.)
- PID
- M8 Paper
- CAM/ICAM
- M256A1/M18A2
- Dräger
- Sample GC or GC/MS

Chemical Detection Process

Assume you are a member of a team making the initial entry into a suspected chemical terrorist event.

You enter the incident area in Level A, first performing a safety assessment (oxygen level, LEL, Carbon Monoxide level, etc. If you suspect radioactive material is present, you would also check with a radiac meter). You would then look for liquids and test with pH paper. Pure CW agents will be neutral, but a terrorist-produced agent is likely to be impure and would test acidic.

If these instruments provide no indication of danger, you can continue the survey.

If you have a PID instrument, you can check for volatile organic compounds. Chemical warfare agents are all thought to have ionization potentials below 10.6 eV.

Next, test any liquids with the M8 paper (or M9 paper).

You can use the CAM/ICAM to test for vapor above the liquid. These indicate/ differentiate nerve and mustard agents.

Next you would test with the M256A1. This is the most sensitive kit for the chemical warfare agents and tells you the class of agent (nerve, blood, blister). You might want to confirm your results with the M18A2 (can indicate agent by name, e.g., GA, GB, H, HN, etc.).

If you suspect an industrial chemical (also AC, CK, CG, Cl) use the Dräger tubes. You can also use the Dräger tubes to confirm nerve and blister agents (although not as sensitive as the M256A1).

Finally, you want to obtain solid, liquid and vapor samples. Solid and liquid samples do not have to be large. One gram or less is more than enough. Use the same protocols and procedures as for any HAZMAT sample collection. For vapor samples, use standard HAZMAT procedures, the sample collection tube in the M18A2, or any other sorbent tube. Samples will be analyzed by trained lab technicians using GC or GC/MS.

The Biological Detection and Identification Continuum

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. Because a biological agent attack may not be discovered until days after the actual event, there may be no “First Response” per se and all activity may be focused on the hospital providers.

The “continuum” for biological agents is much smaller and there are currently only a limited number of items which can be used to detect and identify biological agents in the field.

How Radiation Is Detected

- Radiation cannot be detected by human senses. Unlike hazardous substances that alert us by their color, the irritation they cause, or their taste, radiation has no such warning properties.

- A variety of instruments are available for detecting and measuring radiation.

- Radiation detection and measurement instruments are used routinely to monitor personnel working around or with radiation sources and to check for any leakage of radiation from containers used in the storage or transport of radioactive materials.

  [Turn in the booklet, "Transport of Radioactive Materials: Q&A about Incident Response," to page 4 to see examples of two of these meters.]

Radiation Surveys

As mentioned earlier, radiation cannot be detected by human senses; therefore, radiation surveys are conducted using a variety of instruments in order to determine:

- Radiation levels in a given area.

- Locating lost or hidden sources.

- Surveying facilities for radiation hazards.

- Predicting the possible exposure in an area and determining the necessity of wearing personnel monitoring devices.

- Monitoring contamination levels on equipment and personnel.

- Evaluating the need for posting warning signs.

Radiation Survey Instruments

Radiation survey instruments are used to measure both exposure to radiation fields and amounts of radioactive material present.

Radiation Survey Instruments

Instruments are chosen for use according to a number of properties of the radiation source being investigated. These properties include:

- Radiation type,
- Energy spectrum, and
- Intensity of the radiation.

Survey Instrument Operation

Calibration

Ordinarily a survey instrument is first calibrated in a known radiation field and then used to measure a radiation field of interest. The extent to which this calibration is valid is the fundamental factor which determines the accuracy of subsequent radiation measurements. Therefore, any instrument used for a radiation survey should have been calibrated recently and adjusted for a given calibration source and exposure conditions. Survey conditions may, and usually do, differ from calibration conditions, so that measurement accuracy is usually no better than several percent.

Verification of Operation

Before using an instrument in any survey, you should verify its proper operation.

- First, turn the instrument to “Battery Check” to see if the batteries and circuitry respond correctly.
- Next, set the instrument on its most sensitive scale and position the probe near a radiation check source.
- The meter should respond, and the meter reading should increase as you get closer to the source.

Radiological Survey Meters

Radiation Detection

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

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 me briefly review the types of detectors which may be useful.

Basic Portable Radiation Survey Instruments

- There are various types of portable radiation survey instrumentation, radiation detection devices, and monitoring systems.
- The first category, portable survey instrumentation, consists of four basic types: ionization chambers, Geiger-Mueller (GM) detectors, proportional counters, and scintillation detectors.

Types of Portable Radiation Survey Instruments

- The first three types (ionization chambers, G-M detectors, and proportional counters) are generally categorized as gas-filled detectors since they all employ a fill gas of some type for proper operation.
- The fourth type the scintillation detector utilizes a solid medium for the detection of ionizing radiation. Examples of each of these types will be described along with some of their uses and characteristics.

Gas-Filled Detectors

Ionization chambers

- Are primarily designed to measure gamma ray and x-ray radiations.
- Can detect/measure alpha and beta radiations with appropriate calibration factors and instrument design.
- Are fairly rugged devices.
- Do not only detect, but also measure dose and dose equivalent.
- Tend to be “finicky” (i.e., more attention to maintenance is required).
- Are susceptible to environmental conditions (e.g., heat & humidity).

Geiger-Mueller (GM) detectors

- Are widely used instruments for the detection of ionizing radiation.
- Are prepared in a wide variety of shapes and sizes (e.g., end window, side wall, and pancake).
- Detect a wide variety of radiation types including alpha, beta, gamma, and x-ray.
- Are excellent for low-level counting rate surveys including personnel and equipment monitoring and as a quick screening method in accident situations.
- Are principally detection, not measurement, devices.

Proportional counters

- Are produced in a variety of shapes and sizes available.
- Can detect (directly or indirectly) a variety of radiation types including alpha, beta, gamma, x-ray, and neutrons.

Solid-State Detectors

Scintillation detectors

Sodium Iodide

- Can detect/measure gamma radiation
- Energy-dependent devices (should typically be calibrated to the energy of interest)
- Fragile (sensitive to thermal and mechanical shocks)

Zinc Sulfide (ZnS)

- Can detect alpha radiation

Micro R Meter

- Can detect low-level gamma radiation

External Dosimetry

- The preferred method of external dosimetry is the use of a personnel dosimeter.
- Doses from external sources can also be evaluated by calculating the length of time spent in the radiation field of known intensity as determined through radiation monitoring.

Personnel Monitoring

Personnel monitoring devices can be defined as devices designed to be worn or carried by an individual for the purpose of measuring the dose received. For the measurement of external radiation hazards, these devices include, but are not limited to, thermoluminescent dosimeters (TLD), pocket chambers, and film badges. Personnel monitoring devices should always be worn when the worker is being (or likely to be) exposed to radiation.

Thermoluminescent dosimeter (TLD)

- Typically used to detect beta, gamma, or neutron radiation

Direct-reading personal dosimeter (pocket chamber)

- Responds to gamma and high-energy beta radiation, as well as neutrons if properly modified

Film badge

- Used to detect x-rays, gamma rays, high-energy beta radiation, and neutrons

Internal Dosimetry

- An individual can receive a dose from either an internal or external source of radiation.

- Doses from internal sources can be evaluated by performing bioassay procedures, whole-body counting, or calculating an uptake based on known air concentrations.

Key Points

During this module we addressed several types of fielded (off-the-shelf) detection and identification equipment which might prove to be useful as you respond to an incident involving chemical, biological, or radiological material. We also covered the general capabilities and uses of each system, and the substances which might interfere with the use of the equipment. We also noted that for chemical agents, several systems are used together to provide the maximum amount of information and reliability.

Are there any questions?

Chemical Agent Detectability Limits

Agent	LCT50 (ppm)*	Edmin (ppm)*	TWA/AEL (ppm)*	ASE (ppm)*	IDLH (ppm)*
GA	60	0.3-0.5	.000015	.0005	0.03
GB	12-17	0.5	.000017	.0005	0.03
GD	9	0.3-0.4	.000004	.00001	0.008
GF	10-16	0.3-0.4	ns	ns	ns
VX	3-9	2.2-4.5	.0000009	.00003	.0018
H, HD	231	23	.0005	.005	.0005
HN	179-470	14-29	.0004	.004	.0004
L	141-177	<36	.00035	.004	.0004
CX	687	0.6	Unknown	ns	Unknown
AC	3600	Varies with Conc.	9.9	136	45
CK	4375	2784	0.2	0.2	Unknown
CG	791	395	0.1	3	2
CL	6561		1.0		30

***All exposures are in parts per million based on a one minute exposure**

LCT50 — Dose which results in death for 50% of unprotected personnel.

EDmin — Dose which results in minimal observable effects in 50% of unprotected personnel (generally eye effects, except * = respiratory effect).

TWA — Time Weighted Average; average concentration which should not be exceeded during an 8 hour day/40 hour week.

AEL — Allowable Exposure Limit; allowable concentration in the air for occupational and general population exposures.

IDLH — Immediate Danger to Life of Health; that concentration from which one could escape within 30 minutes without a respirator and not experience escape – imparing (e.g., severe eye irritation) or irreversible health effects.

ASE — Allowable Stack Emission: ns – no standard, Q – qualitative only, ppm – parts per million, nt – not tested.

Chemical Agent Detectability Limts

Agent	M8/M9 Paper*	ICAM (ppm)*	M8A1 Alarm (ppm)*	M256A1 Kit (ppm)*	M18A2 Kit (ppm)*	Draeger Kit (ppm)*	GC/MS/ FPD/FID (ppm)*
GA	Q	0.05	0.015	0.0008	0.015	.025 (3)	0.000015
GB	Q	0.05	0.017	0.0008	0.017	.025 (3)	0.000017
GD	Q	0.04	0.013	0.0007	0.013	.025 (3)	0.000004
GF	Q	yes	yes	yes	yes	.025 (3)	yes
VX	Q	0.009	0.009	0.0018	0.009	.025 (3)	0.0000009
H, HD	Q	0.015		0.15-0.5	0.08	1mg/m ^{3} (1)	0.005
HN	Q	0.014				1mg/m ^{3} (7)	nt
L	Q	0.02		2	1	0.1 (2)	0.0004
CX	Q			1			
AC				10	7	1.0 (4)	
CK				4		0.1 (4)	
CG					3	0.2 (5)	
CL						0.2 (6)	

(1) Thioether Tube
(2) Organic Arsenic Tube
(3) Phosphoric Acid Esters Tube
(4) Cyanide Tube
(5) Phosgene Tube
(6) Chlorine Tube
(7) Organic Alkaline Nitrogen Tube

Module 8: Practical Exercise

Training Objectives: At the conclusion of the exercise, students will:

1. Understand how to operate selected chemical detection equipment.

2. Use the equipment to detect and identify simulated chemical agents in a training environment.

References:

1. Previous lessons

2. Equipment manuals

The Incident Commander must quickly determine the nature of all unknown hazards, especially if a chemical agent is believed to be present.

a. This information will affect several decisions and actions:
   - Risk assessment for the responders.
   - The signs and symptoms of agent poisoning to look for in yourselves and in other responders.
   - The level of protection to be employed initially, and whether it will be safe to downgrade from Level A PPE in the hot zone.
   - Medical treatment for the care of victims on site and those already transported to the hospitals.
   - Decontamination efforts and the choice of decontaminants that will be most effective.
   - The associated hazards that runoff from the decontamination efforts will pose to the area.

b. Your task as technicians is to detect the hazard and, if a chemical agent, to identify the specific agent if possible, or at least the family of agents involved (i.e., nerve agents versus nerve agent Tabun).

Objectives

Understand how to operate selected chemical detection equipment.

Use detection equipment to identify simulated chemical agents.

Key Points

a. The chemical detection kits, whether they are detector paper, electronic instruments like the CAM, or field detection kits such as the M256A1 kit and Draeger kit, all work by a different process to analyze a part of the suspected chemical. They each are sensitive to a specific group of chemicals and they are each affected by a different set of interferents.

b. During the exercise you learned how to combine several chemical detection methods in order to confirm the identity of a chemical agent, or in some cases, to confirm that there is no chemical agent present. When successive detection efforts consistently identify the unknown liquid as a specific chemical agent, then you have a higher level of confidence that this is actually the agent identified. Likewise, when several detection kits all indicate that the unknown material is not a chemical agent, you can more confidently eliminate that possibility.

Module 9: Protective Equipment (Technician Training)

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

1. Select the appropriate level of PPE for the chemical agent categories encountered in a given scenario.

2. List typical criteria for selection of protective equipment against NBC agents.

3. Given a scenario involving terrorist use of chemical warfare agent, students will be able to select appropriate level of PPE for the chemical agent category encountered.

References: Previous Lessons

Protective Equipment

The key to survival when responding to a terrorist incident involving nuclear, chemical, or biological agents is selection of the proper protective equipment for the mission. Responders must ensure that they are adequately protected from a potential hazard, but not overly protected to the extent that the protective equipment adversely affects mission execution.

Objective

The purpose of this module is to provide familiarization with what must be considered before selecting personal protective equipment. We will review the types and levels of PPE, then work through a series of four short scenarios which will provide the opportunity to make decisions regarding PPE selection, given only limited information.

PPE Selection Considerations

- Chemical agent
- Solid, liquid, vapor, aerosol
- Type of contamination
- Agent concentration
- Equipment protection factor
- Weather
- Zone
- Topography/Construction
- Protection level available
- Certified filter canisters
- Duration of mission
- Others?

Commercial PPE

The quality of commercial PPE varies by manufacturer. Before procuring PPE, first determine the mission to be performed and then define the physical protection needed. Based on these requirements determine which suits provide the requisite protection and conform to established standards (NFPA 1991 (ed. 1994), ASTM F739, MIL STD 282). Ensure the manufacturer certifies the suit you buy will provide adequate protection for your use profile.

Of the chemical warfare agents we have discussed, Level A suits have been tested against only four.

EPA Level A Protection

DPT 7.0

Domestic Preparedness

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

EPA Level B Protection

DPT 7.0 Domestic Preparedness

Level B Protection

a. Level B protection 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 encapsulating. 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.

EPA Level C Protection

DPT 7.0

Domestic Preparedness

Level C Protection

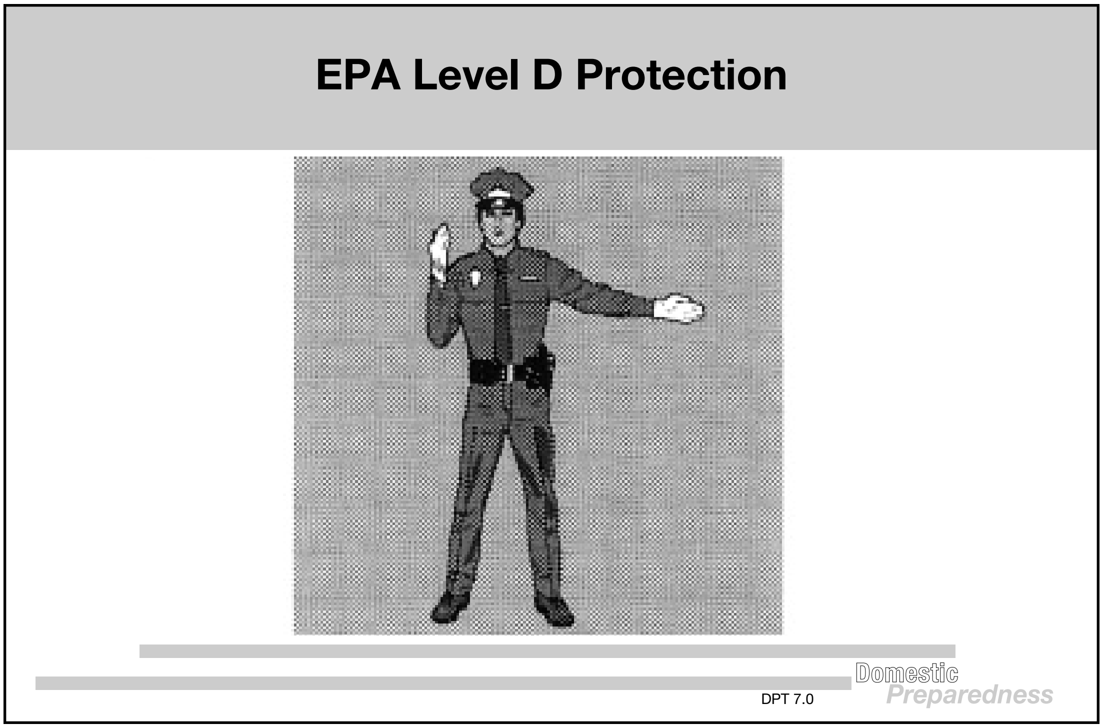
This is an example of EPA Level C—the military's battle dress overgarment.

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.
- Concentrations of agent are below IDLH

c. Provides adequate protection against airborne biological agents and radiological materials.

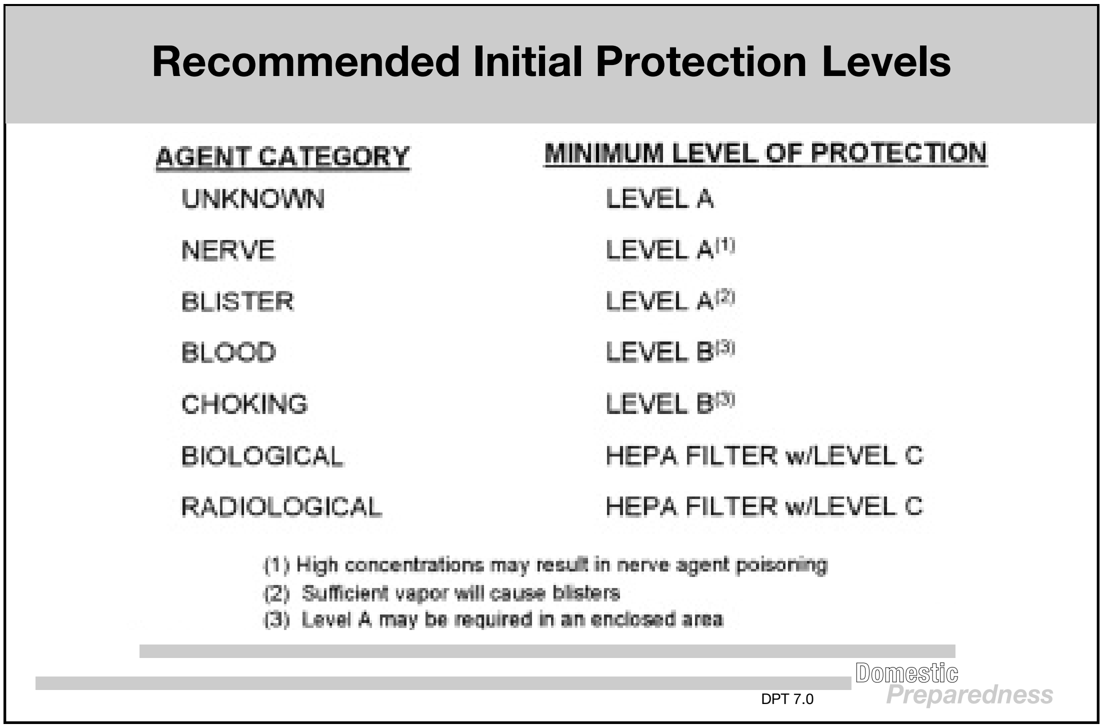


Level D Protection

This is an example of EPA Level D protection.

What does this uniform protect you against? The weather.

Used when there is no respiratory or skin hazard.



Recommended Initial Protection Levels

AGENT CATEGORY	MINIMUM LEVEL OF PROTECTION
UNKNOWN	LEVEL A
NERVE	LEVEL A(1)
BLISTER	LEVEL A(2)
BLOOD	LEVEL B(3)
CHOKING	LEVEL B(3)
BIOLOGICAL	HEPA FILTER w/LEVEL C
RADIOLOGICAL	HEPA FILTER w/LEVEL C

(1) High concentrations may result in nerve agent poisoning
(2) Sufficient vapor will cause blisters
(3) Level A may be required in an enclosed area

Recommended Initial Protection Levels

Technician level responders should not be in the Hot Zone without the appropriate level of protection; and while survival is the first priority, the PPE selected should not over-burden responders with “nice to have” capabilities that hinder mission execution due to excessive heat stress, weight, or bulk. As a result, responders must know the type of agent, and for chemical agents at least the class, to make knowledgeable decisions as to the level of protection required.

This graphic shows the minimum level of protection required for each of the major categories of NBC agents.

a. **Nerve agents** (e.g., tabun, sarin, soman, VX) present both a respiratory and a dermal hazard. In liquid form, droplets may be absorbed by the skin; in a vapor state, they may enter the body through the lungs. 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.

b. **Blister agents** (e.g., mustard) are designed to cause injury, both internally and externally. With both a dermal and respiratory threat, maximum protection is required for each route of entry, i.e., Level A protection.

c. **Choking agents** (e.g., phosgene, chlorine) enter the body through the lungs, but may harm the skin; consequently, respiratory protection is the key to protection in a choking agent environment. Choking agents are reasonably non-persistent, so the level of protection may be downgraded as soon as the concentration in the affected area is determined to be below IDLH, *if the respirator to be used has been proven to protect against the particular choking agent*.

d. **Blood agents** (e.g., Hydrogen Cyanide, cyanogens chloride) enter the body through the respiratory tract or through mucous membranes, not through the skin. Level B protection provides maximum protection for the respiratory system while providing a lesser degree of protection for the skin; however, it does provide more mobility than the level A protection. 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, but like choking agents, *only if the respirator to be used is known to protect against the particular blood agent*.

e. **Radiological agents** may enter the body through the respiratory tract, the digestive tract, breaks in the skin, (or in the case of gamma radiation through the skin). A HEPA Filter accompanied by Level C clothing provides adequate protection against alpha and beta radiation exposure hazards (the respiratory tract, digestive tract, or breaks in the skin).

f. **Biological agents** enter the body through the respiratory tract, digestive tract and breaks in the skin. A HEPA Filter accompanied by Level C clothing provides adequate protection against all biological agent threats.

If you are unsure of the agent employed, eliminate risk by only entering the Hot Zone in Level A protective clothing. If you see indications of nerve or blister agent employment, **DO NOT ENTER THE AREA IN BUNKER GEAR!**

Recommended Initial Protection Levels

- Hot Zone = Level A
- Possible to downgrade based on:
  – Agent identification
  – Agent concentration
  – Incident Commander approval

DPT 7.0 Domestic Preparedness

Initial Entry Requirements

As a technician 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 overburden 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.

Consequently, we recommend initial entry into the Hot Zone in Level A, 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.

Structural Firefighting Protective Clothing with SCBA

- Respiratory protection
- Limited splash protection
- Unknown protection against skin absorption of vapors/aerosols

DPT 7.0 Domestic Preparedness

Structural Firefighting Protective Clothing with SCBA

Structural Firefighting Protective Clothing (SFPC) with SCBA includes helmet, hood, coat, pants, boots, gloves and SCBA. Although not Level A or B protection, it will protect against inhalation exposure, and provide limited protection against small splashes. It will not protect against skin absorption from agent vapors.

SFPC can provide some limited degree of protection in a chemical agent environment, but there is a risk that vapors may be sufficiently concentrated to cause casualties through skin absorption. This is especially a concern with blister and nerve agents.

Scenario Introduction

Using the list of PPE selection considerations you developed at the beginning of this class, I want you to form 4-5 person groups, select a leader/spokesperson, and study the scenarios on the handout. Based on the information provided, determine the most appropriate personal protective equipment to be worn in each situation.

I will give you a few minutes to talk over the options, then I'll ask group spokespersons to give their solutions. You should be able to justify your response.

HAZMAT Technician
Protective Equipment
Student Handout No. 1: Scenarios

Module 9—Protective Equipment

Scenario 1—Mall

Given the mall scenario in the video (i.e., multiple victims, reports of choking by EMT First Responders, EMT personnel down at the scene), what protective equipment would you, as emergency responders, use to enter the area and pull victims from the incident site?

Scenario 2—High rise Hotel

There is a report that multiple guests and employees of a high-rise urban hotel are complaining of rapid breathing and severe headaches. Casualties report smelling bitter almonds, and also have red lips. Reports indicate the bitter almond odor to be emanating from the elevator shaft of the hotel lobby. You are familiar with the hotel's construction (it is an 18-story building with rooms surrounding an octagonal atrium/lobby on all 18 floors).

1. What does the initial entry team wear when entering the building?

2. The initial entry team receives a positive reading for the presence of hydrogen cyanide slightly below IDLH. What does the rescue team wear?

3. What steps should be taken immediately with regard to guests and employees on the upper floors? Why?

Student Handout No. 1: Scenarios

Scenario 3—United Nations Building Lobby

An explosive device is detonated inside the lobby of the United Nations Building shortly after the arrival of a letter threatening to “make the place glow.” Smoke from the device engulfs the lobby, but the explosion does not start a fire. Casualties report a lot of smoke and small pieces of metal on the ground in the lobby. Besides smoke inhalation symptoms and cuts from flying metal and glass, the injured do not appear to be exhibiting symptoms of chemical agent exposure.

1. What level of protection should be worn by First Responders when entering the building? Why?

2. Initial responders find low levels of radiation throughout the lobby. What level of protection should follow-on emergency responders and evidence collectors be wearing to ensure they are protected from the radiation?

Scenario 4—Residential Explosion

Neighbors report a small explosion in the basement of a local residence. Witnesses say a little white smoke came from the shattered basement windows. Neighbors indicate the owner of the residence is a loner who works in a pharmaceutical company and has bragged about experimenting with biological cultures in his basement laboratory.

1. What level of protection should be worn by First Responders? Why?

2. Assuming it was confirmed that only hazardous biological pathogens were released as a result of the explosion, what level of protection should be worn by follow-on personnel? Why?

Key Point

As can be seen, many factors must be considered when selecting personal protective equipment to respond to an incident involving nuclear, biological, or chemical warfare material. These factors include the type of agent, the form of the agent, its concentration, where you will be working (what zone? outside or inside? etc.), how long you expect to stay in the area, the equipment available, and your acceptable level of risk, among others. Careful consideration of these factors will ensure your survival in a CW agent environment.

Module 10: Decontamination Procedures (Technician Training)

Training Objectives:

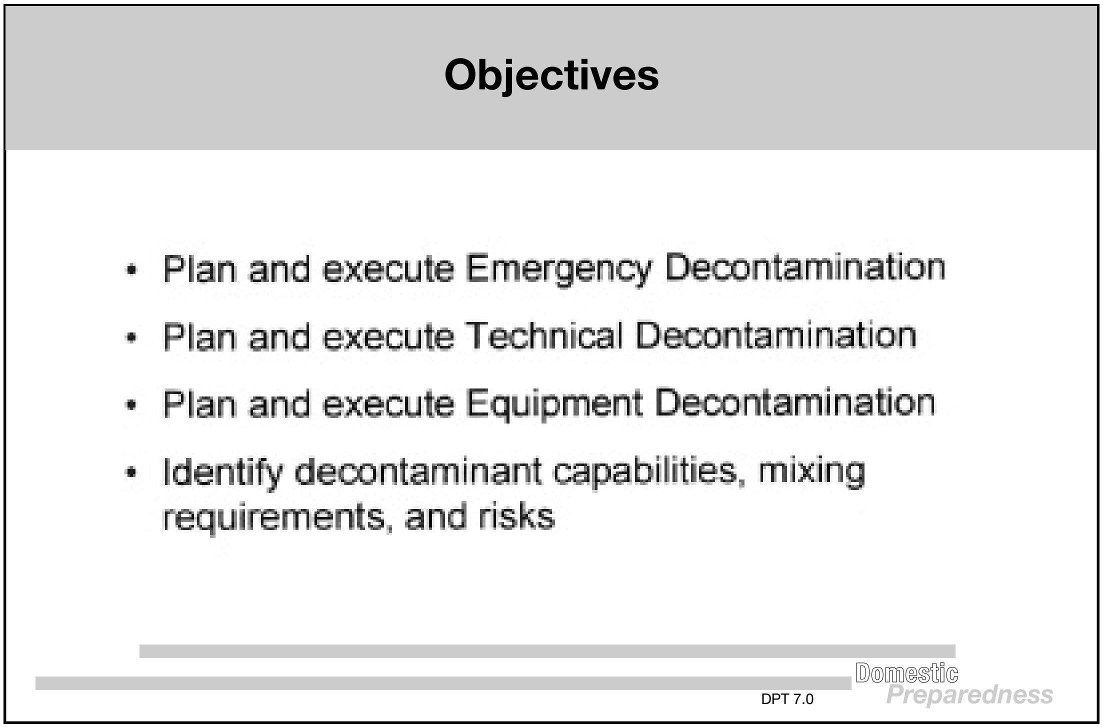
1. State considerations for Emergency Decontamination.
2. State considerations for Technical Decontamination.
3. State considerations for Equipment Decontamination.
4. State decontaminant capabilities, mixing requirements and risks.

References:

1. *FM 3-5*, NBC Decontamination, Headquarters, Department of the Army, November 1993.
2. *Medical Management of Chemical Casualties Handbook*, Chemical Casualty Care Office, Medical Research Institute of Chemical Defense, Aberdeen Proving Ground, Maryland, September 1995.
3. Medical Management of Biological Casualties Handbook, U.S. Army Medical Research Institute of Infectious Diseases, Fort Detrick, Maryland, August 1996.
4. Material Safety Data sheets for decontaminants.
5. NIOSH Pocket Guide to Chemical Hazards, U.S. Department of Health and Human Services, June 1994.
6. CHRIS Hazardous Chemical Data, Department of Transportation, United States Coast Guard, November 1984.

Introduction

During this module, we will address considerations for decontamination of nuclear, chemical, and biological warfare material, and take an in depth look at the decontaminants available.



Objectives

The purpose of this course is to ensure responders can transition from a standard HAZMAT decontamination situation to one involving NBC agents. This specifically includes the safe mixing, handling, and use of various decontaminants.

Decontamination Deltas

The Large Number of Victims—is the first major difference between standard HAZMAT and NBC incidents. Responders 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 corps seeking information about the incident.

A Rapid Response—is required because of the speed with which many of the chemical agents affect the body. Decontamination must be swift to save lives and minimize casualties.

Major Resource Demands—a response of this magnitude will require more personnel and material than is normally available; therefore, detailed contingency planning is required in advance.

Run-off Control—is required to reduce the spread of the hazard. Because of its potential toxicity, run-off resulting from decontamination should be kept away from sewer drains, ground water, streams, and watershed areas.

Crime Scene/Evidence Preservation—A terrorist incident is a crime scene; therefore, while decontaminating the area, evidence must be preserved for eventual use in apprehending and prosecuting perpetrators.

Decontamination Levels

There are two levels of decontamination; *Emergency* and *Technical.* These combine to cover the rapid decontamination of victims and the more deliberate decontamination of the responders at the scene.

a. Emergency Decontamination—is employed to save lives of potential victims by neutralizing agent on the skin and physically removing the agent hazard. Emergency decontamination must be performed quickly.

b. Technical Decontamination—is performed to remove contamination from personnel, protective equipment of responders, equipment, and facilities in a deliberate fashion.

Technician Level responders focus on emergency decontamination of victims and technical decontamination of responders. Depending upon the situation, HAZMAT Technicians may execute decontamination or supervise Operations Level responders as the Operations Level responder execute decontamination.

Emergency Decon Considerations

a. All personnel who come in contact with, or have the potential to come in contact with, exposed casualties must wear protective clothing and respiratory protection.

    (1) At a minimum wear structural firefighting protective clothing with positive pressure self contained breathing apparatus.

    (2) Always wear rubber gloves.

    (3) Minimize contact with the casualties.

    (4) Ensure all responders are aware of the signs and symptoms of agent exposure.

    (5) Consider responders contaminated following exposure to victims.

b. Isolate victims/casualties

(1) Communicate the need for assistance and what the victims must do.

- Use loudspeaker/PA system.
- Communicate “authority” with concern.

(2) Evacuate victims upwind, upgrade, and upstream of the hazard.

(3) Isolate and establish control of victims.

(4) Segregate the symptomatic victims from the asymptomatic victims and male from female.

- Take into consideration families, small children, the elderly, handicapped persons (the blind, persons in wheelchairs, the speech impaired, etc.).
- Isolate those who refuse to comply with directions to prevent further contamination of victims.

(5) Collect personal items.

- Use plastic bags and a method of identification; voucher personal articles.

(6) Have victims strip to their undergarments.

- Approximately 80% of the contamination will be removed with the clothing. Pantyhose should be removed as it can hold a large amount of liquid/vapor close to a large portion of the 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 them if the hazard is biological or radiological. This will prevent re-aerosolization of the agent.

c. Set up the Emergency Decon Corridor.

(1) Time will be critical!

(2) A large area is required upwind of the Hot Zone, to handle decontamination of large numbers of people.

(3) Control water run-off.

- Decontamination of casualties is a top level priority, especially with chemical agents.
- Control the run-off to the greatest extent possible. Know where it is going and ensure it will not flow into clean areas. Coordinate with local environmental management officials.
- If possible, and time and available resources allow, confine the water run-off to an isolated area.

- Confinement may be critical if radiological materials are involved.
- If run-off is not confined, notify the proper authorities downstream. If run-off goes into the storm drainage system, notify locations downstream as a precaution. If run-off goes into the sanitary sewer system, notify the receiving waste water treatment facility as a precaution.

(4) Establish segregated lanes for symptomatic and asymptomatic victims; and as time permits, male from female.

(5) Take into account modesty and the public eye (and media). Male and female decontamination corridors can be quickly established using ladder trucks with salvage covers hung from the base ladder section extended; or by using pike poles, ground ladders, and ropes strung between fire engines and covered with salvage covers. Sheets, blankets, robes, etc. can be used to provide cover and serve modesty requirements following decontamination.

(6) Consider weather conditions and the possible requirement to perform decontamination indoors (e.g., school gym with showers, car wash, etc.).

(7) Use hose lines and elevated master streams.

- Fog nozzles may be used with low pressure to rain the water down on victims.

(8) When capabilities and resources allow employ soap and water as the next best decontaminant of choice; with a solution of dilute household bleach (0.5%) being the preferred decon solution.

d. Decontaminate

(1) Communicate what victims should do.

(2) Spread victims arms/legs out.

(3) Wash victims from top down.

(4) If liquid mustard agent (a persistent agent) is believed present on a victim blot the agent off (using a pinching motion) first to remove the liquid.

(5) If a biological or radiological agent is suspected to be present start rinsing the victims as they begin removing their clothes to entrain the agent on the clothing of the victims and reduce the potential for the agent to adhere to the bodies of the victims.

e. Provide cover using items available from the local area, i.e., blankets, large towels, or sheets from local stores, hospitals, and hotels; table cloths from local restaurants; disposable ponchos or TYVECK coveralls; or salvage covers.

f. Establish a Triage, Treatment, and Transport (T^3) Area in a clean secure location, large enough to hold all the casualties. Ensure all responders are aware of the signs and symptoms of exposure, and maintain ABCs while minimizing exposure to the casualties. As victims may have some contamination on them, responders should wear PPE. Use of mechanical ventilation and pharmaceuticals may be required to stabilize casualties exposed to chemical agents. Use mass transit to assist in transporting casualties.

g. Execute Self-decontamination if exposed. If emergency/technical decontamination is not available, responders should take appropriate precautions and decontaminate themselves.

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

- Minimize responder exposure. Employ structural firefighting protective clothing and positive pressure self contained breathing apparatus as minimum PPE. Limit the number of responders that contact victims.
- Use supports to hold stretchers and backboards off the ground (e.g., milk crates, saw horses, etc.).
- Keep clothing away from the victims faces during removal (to keep casualty from breathing in the agent).
- Remove/cut clothing from head to toe, front to back, keeping away from face.

Emergency Decon

NBC agents were designed to be more toxic than standard hazardous materials, and as such, present some unique problems:

a. The Hot and Warm Zone locations must be periodically reassessed to ensure liquid contamination is contained within the Hot Zone, and that decontamination efforts are within the Warm Zone. Runoff and changes in the wind may require alteration of zones or relocation of decontamination corridors.

b. The large number of possible victims can present a control problem as many people may panic. An expedient emergency decontamination capability such as a wide, low pressure fog pattern from master streams or hand lines, using a 2.5-inch hose may be used to hydrolyze.

c. Monitoring the site for agent presence is critical as only small amounts of agent can cause many additional casualties. If contamination is found to have spread, neutralize it.

d. There will be uncontrolled runoff in spite of most efforts. Notify agencies that treat or routinely have access to runoff areas. Track and monitor the runoff as the agent source strength may not degrade over time. Contact the municipal environmental management agency for assistance with run-off control. They can be of great assistance with proper disposal of contaminated run-off.

Because of the highly toxic nature of the materials, use a bleach solution (0.5% on personnel and 5% equipment) if available.

Contamination transfer translates into contaminated medical transport vehicles and crews. Other response vehicles can also serve to transfer contamination. If a vehicle goes into the Hot Zone it must remain there until it is decontaminated and monitored. Until proven otherwise, assume that any equipment entering the Hot Zone is contaminated. This may reduce resources in the short term, but contamination transfer will reduce resources over the long term by spreading contamination.

Hospital emergency rooms and clinics may require support as some victims may have departed the scene for the hospital emergency rooms prior to the First Responders arriving on site. If victims are not effectively decontaminated and monitored, they will spread contamination.

Technical Decon

As the need for a rapid response is critical, HAZMAT crews should be on the scene early to conduct reconnaissance, rescue victims, identify the agent, and provide technical advice. For the HAZMAT teams to perform these missions, a technical decontamination capability must exist.

When setting up the Technical Decontamination corridor, establish it away from the Emergency Decontamination corridor (responders are likely to be contaminated and victims will have no protective clothing). In Emergency Decontamination, the emphasis is on speed and agent removal, since the victims have no protection from the agent. Technical Decontamination concentrates more on accuracy and neutralization since the responders are in protective clothing.

The distance between the stations of the corridor is critical in minimizing the vapor hazard and cross contamination. The distance is most critical in the last station where personnel there remove respiratory and move to the Cold Zone.

Equipment Decon

Initially isolate and hold potentially contaminated equipment for monitoring decontaminating only that which is absolutely necessary. In the early phases, time and resources are critical, and wasting either on non-essential equipment is counterproductive. Natural weathering may neutralize the agent, and monitoring may even reveal that neither individuals or equipment were contaminated.

Emergency response vehicles may become contaminated by entering the Hot Zone. One major incident can produce a series of smaller incidents due to agent transfer or cross-contamination. Monitoring of personnel after emergency decontamination will ensure reduction of the cross contamination risk.

Given the nature of the agents involved, additional technical guidance may be required. If so, contact the Information Line or the Hot Line cited at the beginning of the course.

Types of Decontaminants

- **Commercial**
  - HTH (Calcium hypochlorite)
  - Acetone and ether
  - Ethylene glycol (anti-freeze)
  - Sodium hypochlorite (bleach)
  - Formalin (formaldehyde)
  - Sodium hydroxide (caustic soda or lye)
  - Sodium carbonate (washing soda, soda ash)
  - Ammonia/ammonium hydroxide
- **Natural**
  - Steam
  - Soaps & detergents
  - Absorbents
  - Sealants
  - Ultraviolet light
- **Military**
  - DS-2
  - STB
  - M258A1 kits
  - M291 kits

DPT 7.0 Domestic Preparedness

Types of Decontaminants

The three basic types of decontaminants are: commercial, natural, and standard military. HTH and bleach are generally the preferred decontaminants, but the available stock may be quickly expended. It is, therefore, important to have an understanding of other types of decontaminants, to include, the military decontaminants as the military may support you after the “response phase” is completed. Natural decontaminants are important, as in some cases they may be the preferred method for decontaminating items such as electronic equipment or other water sensitive items. Starting with commercial products, we will discuss each of the decontaminant’s use, preparation, and risks. In no case do the pictures constitute an endorsement of any product.

Calcium Hypochlorite (HTH)

- **Use:**
  - L, V-agents, G-agents, Blister agents
  - All biological agents (to include spores) - 15 min contact time
- **Application:**
  - Chemical
    - 5% solution (equipment) = 5 lb HTH + 12 gal water
    - 0.5% solution (personnel) = 0.5 lb HTH + 12 gal water
  - Biological
    - 2% solution (equipment) = 1 lb HTH + 6 gal water
    - 0.5% solution (personnel) = 0.5 lb + 12 gal water
    - Paste = 3 parts HTH to 97 parts water

DPT 7.0 Domestic Preparedness

Calcium Hypochlorite (HTH)

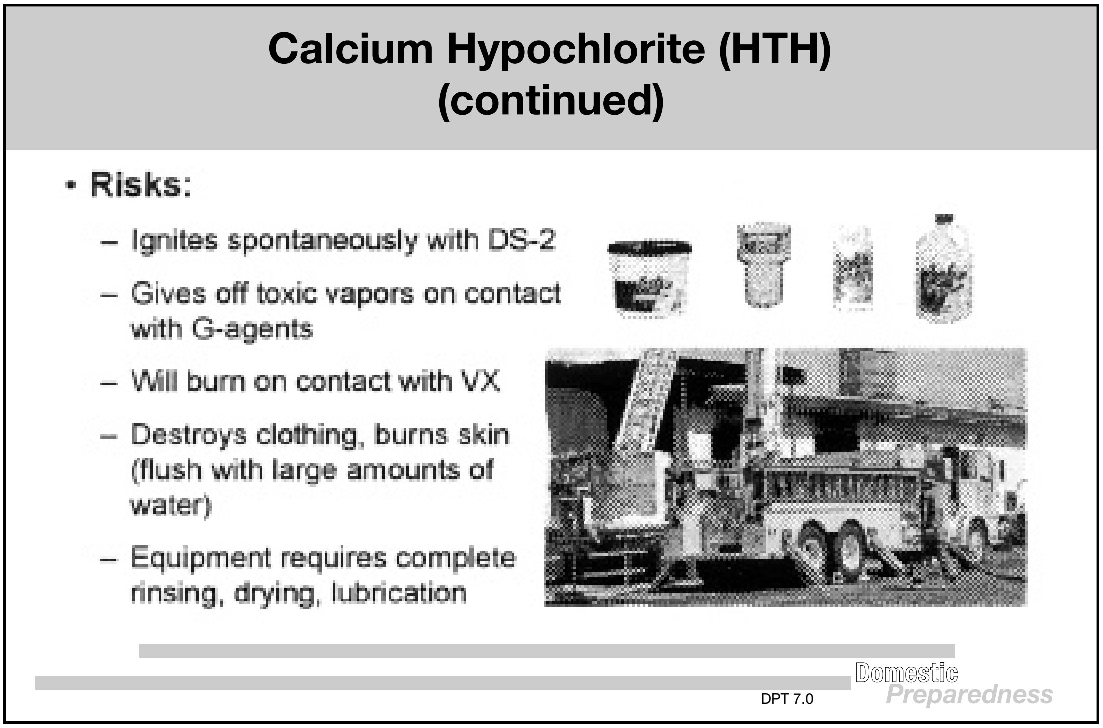
Use. High test hypochlorite or HTH, also known as high test bleach or HTB, is one of the most versatile decontaminants, effective against all categories of chemical and biological agents. HTH reacts rapidly with blister agents, but requires a 15 minute contact time for biological agents. The military also uses HTH for decontamination.

Application

<u>Chemical.</u> ***Equipment (5% solution):*** 5 lb HTH mixed with 12 gal water or 48 oz HTH with 5 gal water. ***Personnel (0.5% solution):*** 0.5 lb with 12 gal water or 6 oz with 5 gal water.

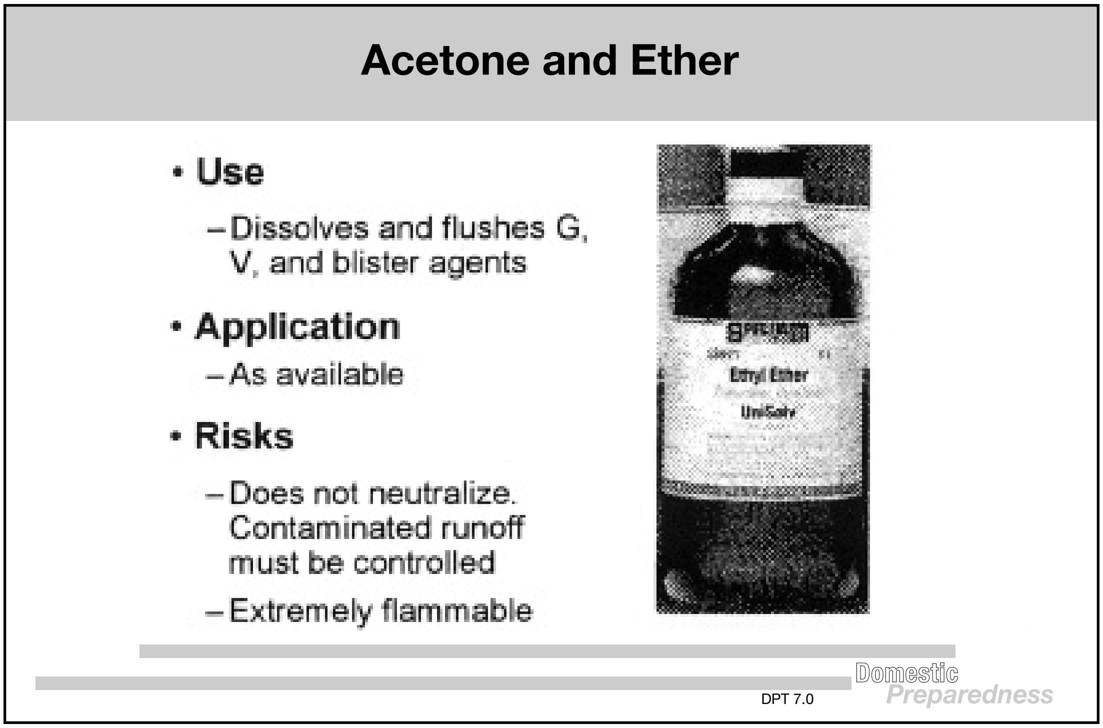
<u>Biological:</u> ***Equipment (2% solution):*** 1 lb HTH to 6 gal water. ***Personnel (0.5% solution):*** 0.5 lb with 12 gal water or 6 oz with 5 gal water.

<u>Paste for decontamination of horizontal surfaces:</u> 3 parts HTH to 97 parts water.



Calcium Hypochlorite (HTH) (continued)

Risks. *Ignites spontaneously with DS2. Gives off toxic vapors upon contact with G-agents, respiratory protection required. Pure undiluted HTH will burn on contact with VX. Will destroy clothing, has a toxic vapor, will burn skin; requires protective gloves and respiratory protection. Clothing or skin contact require flushing with large amounts of water. Equipment decontaminated with HTH must be thoroughly cleaned with hot (176°) soapy water, dried, and lubricated.*

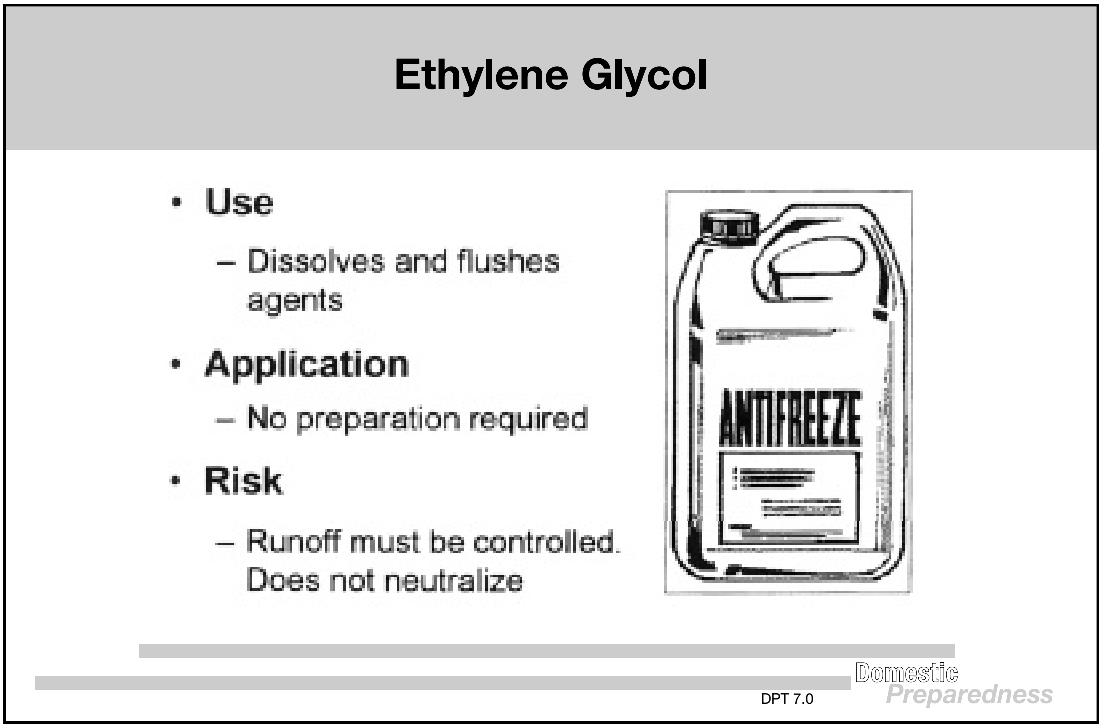


Acetone and Ether

Use. For equipment decontamination only. Solvents such as acetone and ether are effective in physically dissolving and flushing chemical based contaminants.

Preparation. None

Risk. *Does not neutralize the agent. Runoff must be controlled and neutralized and the materials are extremely flammable.*



Ethylene Glycol

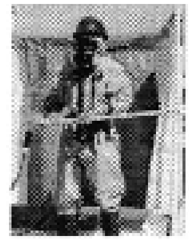
Use. For equipment decontamination only. Ethylene Glycol based antifreeze is also effective in dissolving and flushing chemical based contaminants.

Preparation. Dilute to half and half with water.

Risk. *Again, this does not neutralize the agent. The runoff must be controlled and neutralized as it will cause environmental damage.*

Sodium Hypochlorite
(Bleach)

- Use
  - G- and V-agents, blister agents
  - Biological agents (minus spores) - 15 min contact time
- Application
  - CWA - no preparation required, apply undiluted (equipment)
  - CWA - dilute 10:1 (people)
  - BWA - 2 parts NaOCl (dry) + 10 parts water (equipment)
- Risks
  - Reacts rapidly with V-agents, blister agents
  - Skin and clothing hazard (flush with water)
  - Corrosive to metals (dry and lubricate)
  - Requires cool storage



DPT 7.0

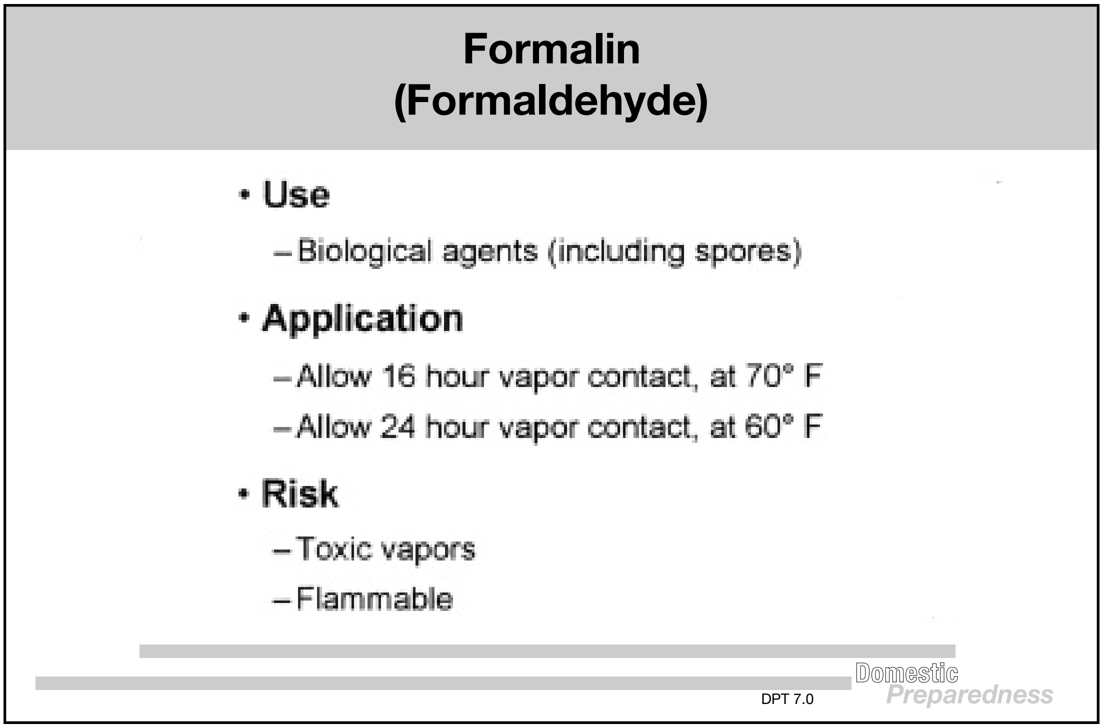
Domestic Preparedness

Sodium Hypochlorite

Use. Used for personnel and equipment decontamination. Clorox or household bleach is effective against all categories of chemical and biological agents. Bleach reacts rapidly with blister G- and V- agents, but requires 15 minutes contact time for biological agents. Apply undiluted with brooms, brushes, or swabs.

Preparation. Chemical decontamination: None. Biological decontamination: 2 parts bleach to 10 parts water.

Risk. *Oxidizer. Harmful to skin and clothing, remove from skin by flushing with water. Corrosive to metals unless rinsed, dried, and lubricated after decontamination. Requires cool storage.*



Formalin (Formaldehyde)

Use. For equipment decontamination only. Formaldehyde is effective for sensitive equipment in neutralizing biological agents to include spores. You must allow vapors to remain in contact with agent for 16 hours, in order for it to be effective in temperatures above 70°F, then aerate. If temperature is 60°F, contact time is raised to 24 hours.

Preparation. None.

Risk. *Vapors are flammable and very toxic. Respiratory protection required. Impermeable suit required.*

Sodium Hydroxide and Potassium Hydroxide (Lye)

- Use
  - G-agents, L - 15 minute contact
  - All bacteria (including spores)
- Application
  - 10% solution = 10 lb lye + 12 gallons water

DPT 7.0

Domestic Preparedness

Sodium Hydroxide and Potassium Hydroxide

Use. For equipment decontamination only. Sodium hydroxide (NaOH) or “caustic soda” and potassium hydroxide or caustic potash are effective against G-, V, Lewisite, and all bacterial materials including spores. Neutralizes G- on contact. Allow to remain in contact with Lewisite for 15 minutes.

Preparation. 10% solution = 10 lb lye to 12 gal water. Use with a 10% alcohol solution.

Sodium Hydroxide and Potassium Hydroxide (continued)

- **Risks**
  - Reacts quickly with G-agent (neutralizes on contact)
  - Harmful to skin, eyes, respiratory system (level A required). Remove clothing. Flush with diluted acetic acid/vinegar. Flush with water.
  - Never prepare in aluminum, zinc, or tin container. Use iron or steel
  - Always add the lye to the water
  - Do not handle mixing container with bare hands
  - Run off is corrosive and toxic; must be contained
  - Rinse equipment completely; dry; lubricate

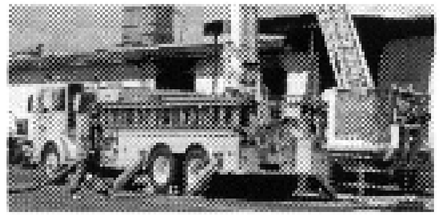
DPT 7.0 Domestic Preparedness

Sodium Hydroxide

Risks. *Damaging to skin, eyes, clothing, and the respiratory system. Full impermeable clothing required. In case of contact, wash with large amounts of water, flush with diluted acetic acid or vinegar, remove clothing, and get medical attention. Must be prepared in an iron or steel container, never aluminum, zinc, or tin. Always add the lye to the water to avoid splattering. Do not handle the mixing container with bare hands. Runoff is highly corrosive and toxic, and must be contained. Equipment must be flushed with large amounts of water after decontamination to reduce danger of burns. Corrosive to most metals.*

Sodium Carbonate
(Laundry Soda/Soda Ash)

- Use
  - G-agents (normally within 5 minutes)
- Application
  - 10% solution = 10 lb Na_2CO_3 + 12 gal water
- Risk
  - Toxic by-products if used on VX



DPT 7.0 Domestic Preparedness

Sodium Carbonate

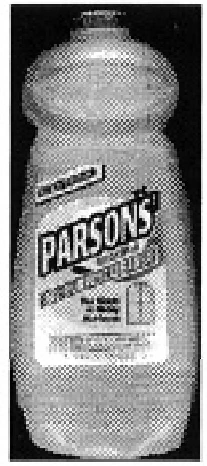
Use. For equipment decontamination only. Sodium carbonate (Na_2CO_2) or “washing soda” is effective against only G agents and normally reacts within 5 minutes.

Preparation. 10% solution = 10 lb washing soda + 12 gal water. Use with a 10% alcohol solution.

Risk. *Create extremely toxic by-products if used on VX.*

Ammonia

- Use
  - G-agents
- Application
  - No preparation required
- Risk
  - Respiratory protection required



DPT 7.0 Domestic Preparedness

Ammonia

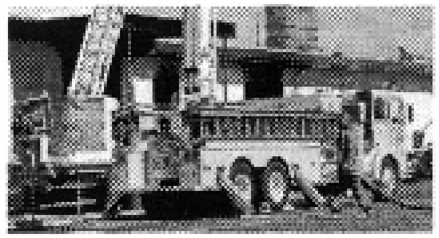
Use. For equipment decontamination only. Ammonia and ammonium hydroxide are basic variations of “household ammonia” and are effective against G- agents and non-spore bio agents.

Preparation. None.

Risk. *Inhalation in closed space. Wear respiratory protection. Ammonia and bleach create toxic fumes.*

Steam

- Use
  - Hydrolyzes G-agent
- Application
  - Requires heat
- Risks
  - Removes but does not neutralize some agents; hazardous runoff remains
  - Run off requires control



DPT 7.0

Domestic Preparedness

Steam

Use. For equipment decontamination only. Steam can be used to flush large areas of contamination, as it hydrolyzes G-agents and removes bio agents including spores.

Preparation. None.

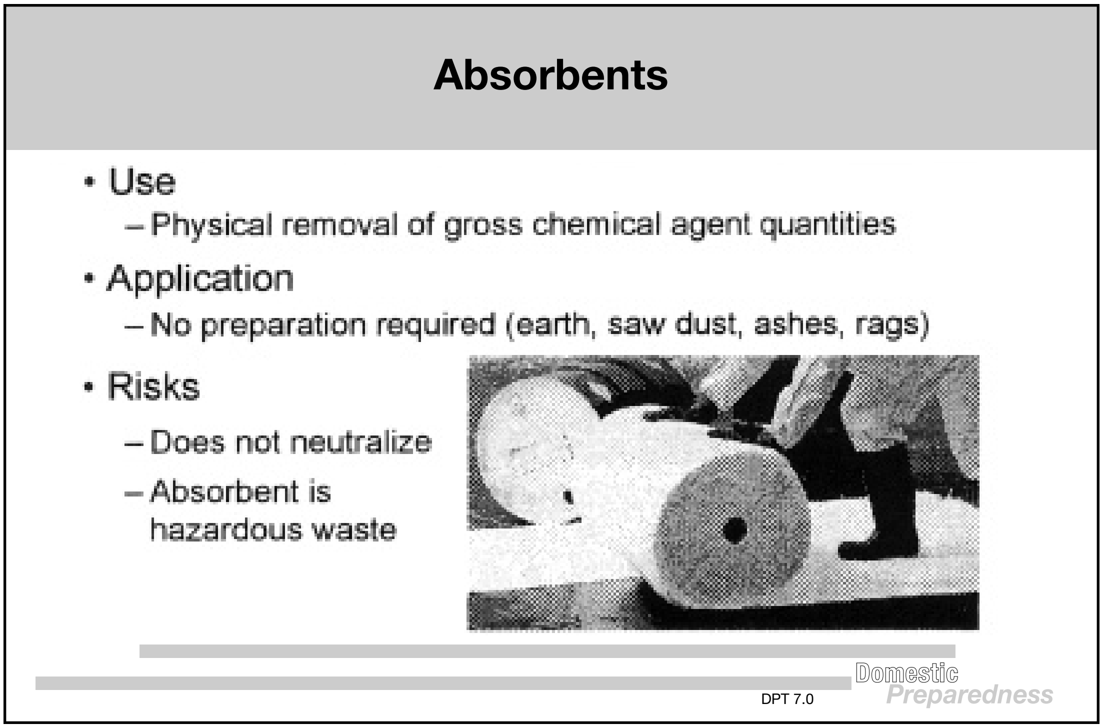
Risk. *Will physically remove some agents, but will not generally neutralize (except G-agents). Runoff must be regarded as contaminated and controlled.*

Soap and Detergents

Use. Soap and detergents are effective in removing all agents when accompanied by scrubbing and wiping. Helps get the agent into solution where it is more readily hydrolyzed.

Preparation. Ratio is 1 lb powdered soap to 5 gal water.

Risk. *Will physically remove agents, but will not generally cause neutralization. Runoff must be regarded as contaminated and be controlled.*



Absorbents

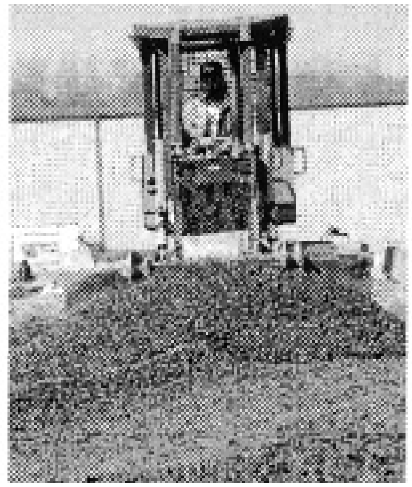
Use. Absorbents such as earth, sawdust, ashes, and/or rags physically remove most gross chemical contamination from surfaces.

Preparation. None.

Risk. *Contamination will be transferred to the absorbent, which must be treated as contaminated and disposed of accordingly.*

Sealants

- Use
  - Seal off all agents
- Application
  - Bury agent under 4 inches of earth, pack
- Risks
  - Surface breaks expose agent
  - Does not neutralize



DPT 7.0

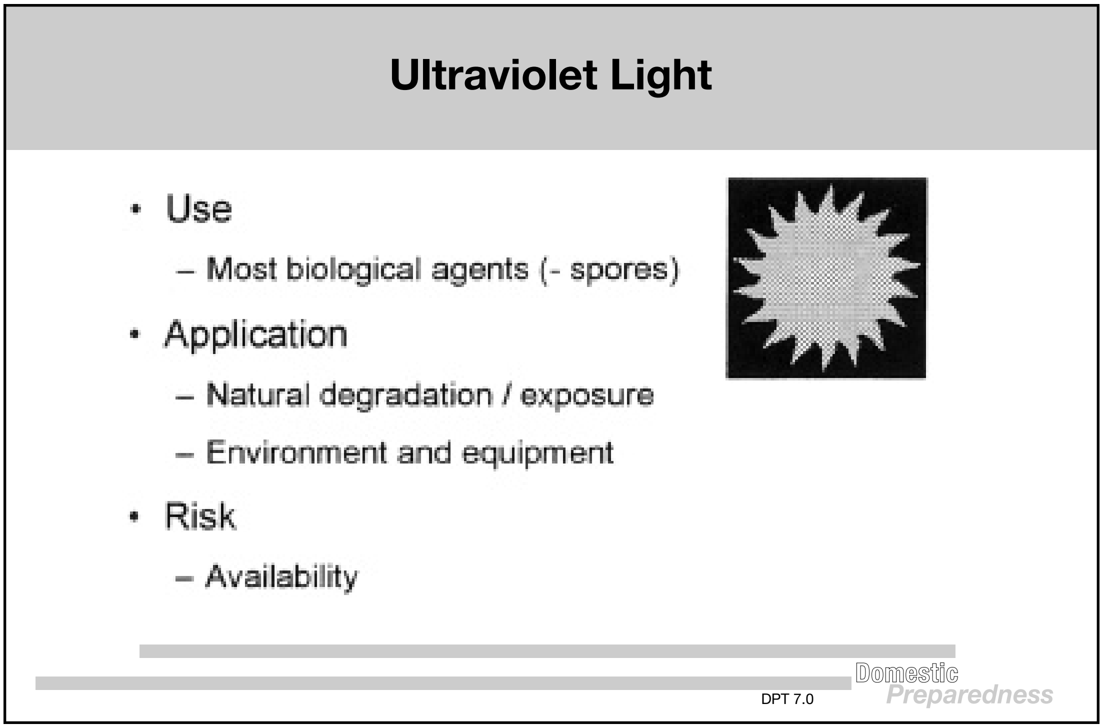
Domestic Preparedness

Sealants

Use. For terrain and equipment only. Sealants such as earth, concrete or asphalt can be used to seal off contaminated areas. Four inches of earth provides good protection from chemical contamination.

Preparation. None.

Risk. *A break in the surface of the sealant will expose contamination. Contaminated areas must be marked for later decontamination.*

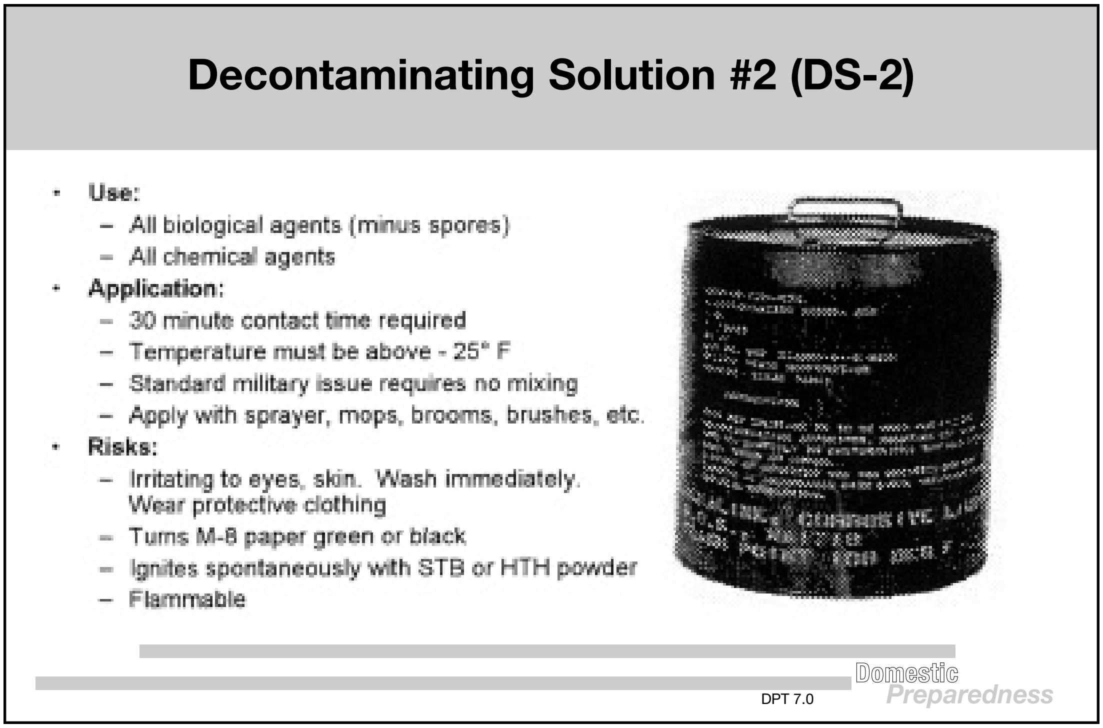


Ultraviolet Light

Use. Ultraviolet light kills most biological agents, minus spores.

Preparation. None.

Risk. *Availability and time required (extremely slow process).*



Decontaminating Solution No. 2 (DS-2)

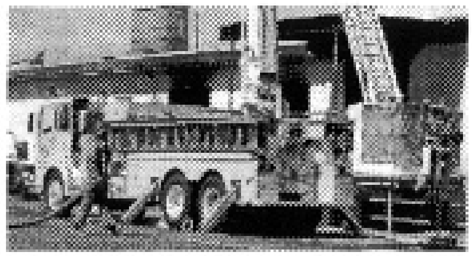
Use. For equipment decontamination only. Decontaminating Solution No. 2 (DS-2) can be used to decontaminate both chemical and biological agents except for bacterial spores. DS-2 must be allowed to remain in contact with the contaminated surface for a period of 30 minutes, and can be used at temperatures above -25°. It is normally applied with a spraying device, brooms, or scrub brushes; and it is most effective when accompanied by scrubbing.

Preparation. Military issue is ready to use, no mixing required.

Risk. *Extremely irritating to the eyes, so a mask and gloves must be worn. If skin contact occurs, wash with soap and water. Will cause a green to black color change upon contact with M-8 paper. Ignites spontaneously on contact with supertropical bleach (STB) or calcium hypochlorite (HTH). Avoid spilling on overgarment. Flammable, do not confuse with fire fighting equipment. May present a fire hazard if used on hot surfaces.*

Supertropical Bleach

- **Use:**
  - Lewisite
  - V-agents
  - G-agents
- **Application:**
  - Slurry paste
    - 50 lb STB & 6 gal water
    - 30 min contact time
- **Risks:**
  - Ignites spontaneously with DS-2
  - Gives off toxic vapors upon contact with G-agents



DPT 7.0 Domestic Preparedness

Supertropical Bleach (STB)

STB is chlorinated lime. It contains approximately 30% available chlorine.

Use. For equipment decontamination only. Supertropical Bleach (STB) is effective against lewisite, V-, G-, and biological agents. As a slurry paste, allow to remain in contact with contaminated surfaces for 30 minutes, then wash with clear water. Used for preparation of shuffle pits in a dry mixture.

Preparation. Dry mix = 2 shovels STB + 3 shovels of earth or other inert material (ashes). Slurry paste = 50 lb STB + 6 gal water.

Risk. *Ignites spontaneously with DS2. Gives off toxic vapors upon contact with G-agents, respiratory protection required.*

Key Points

There are four key points to be remembered when conducting nuclear, biological or chemical decontamination.

a. Ensure the safety of all responders.

b. Because many of the agents can cause injury quickly, decontamination of victims must be performed as soon as possible.

c. NBC agents can cover large areas; and therefore, produce a large number of victims.

d. It is the HAZMAT technicians who have the training to provide technical oversight and guidance.

Module 11: Chemical Downwind Hazard Analysis (Technician Training)

Training Objectives: At the conclusion of this lesson the students will:

1. Understand the reasons for conducting a downwind hazard analysis.
2. Understand the factors which affect the downwind travel of a toxic cloud, and the limitations of a prediction.
3. Be able to construct a simplified downwind hazard prediction.

References:

1. 1996 North American Emergency Response Guidebook
2. FM 3-6 Field Behavior of NBC Agents, Department of Defense, 1986

Chemical Downwind Hazard Analysis

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.

Training Objectives

At the conclusion of this lesson, students will:

a. Understand the reasons for conducting a downwind hazard analysis, so people in the path of a toxic cloud can be alerted, evacuated, and/or directed to take other steps to minimize exposure to the hazard.

b. Understand the factors which affect the downwind travel of a toxic cloud, and the limitations of a prediction.

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

Chemical Downwind Hazard Analysis

This lesson 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.

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 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 and so will the cloud. Because many 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 are also factors. Some liquid materials (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 cloud formation. Vapor evaporating from a liquid puddle will form a less dense 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). The weather at the airport can be much different than it is at the incident site. Even if you know the micro-weather at the site, you may not likely 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.

Current computer models (ALOHA, D2PC, etc.) do not model the effects of terrain and cities well. They are based on assumptions and 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. Since all predictions are based on many pieces of data you won't know very well, don't be fooled by the sophistication of a computer model. Remember, "garbage in, garbage out" still applies. All this means that any hazard prediction is only a prediction, not a fact.

What can we do?

So does that mean we 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 current edition of 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.

Guide Book Method—Step 1

- Using chemical name, look up 4-digit ID number (blue pages)
- If chemical name is not found, use:
  - Nerve - 2810
  - Blood - 1051
  - Blister - 2810

DPT 7.0 Domestic Preparedness

Guide Book Method—Step 1

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 earlier in this awareness course.

Guide Book Method—Step 2

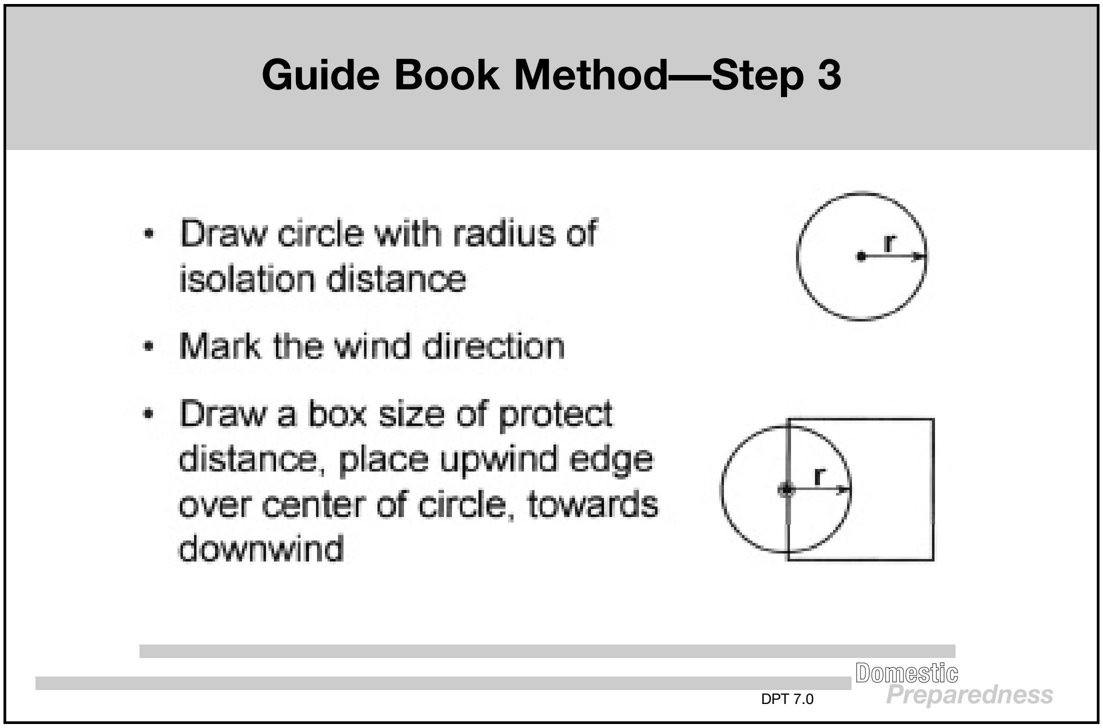
- Determine isolate and protect distances (green pages)
- Need to know size and time of release

ID	Name	Small spills			Large spills		
		Isolate	Protect		Isolate	Protect	
			Day	Night		Day	Night
1017	Chlorine	200 ft	0.2 mi	0.5 mi	600 ft	0.5 mi	1.9 mi

DPT 7.0 Domestic Preparedness

Guide Book Method—Step 2

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

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 x time = distance).

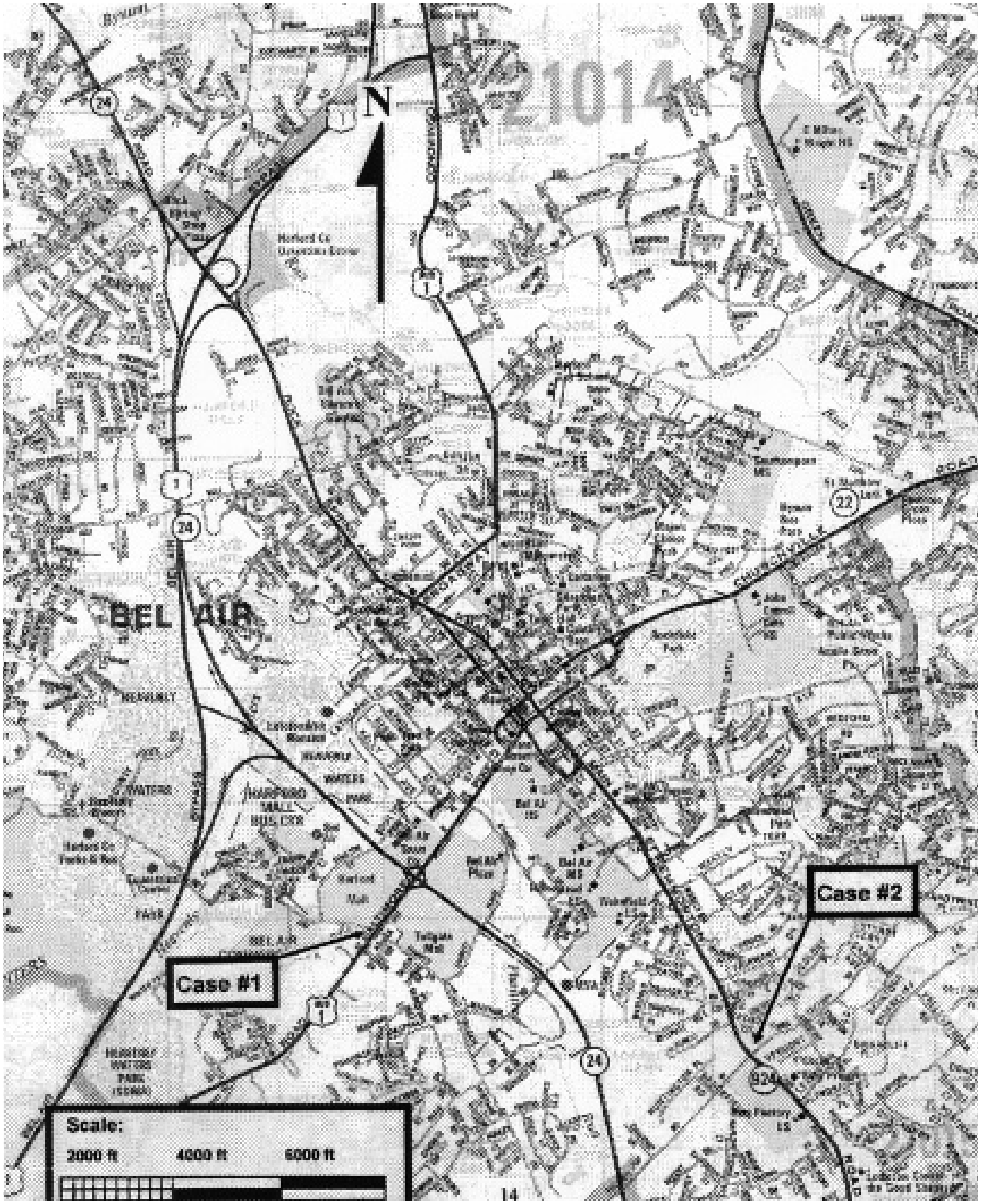
Practical Exercise

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?


N
21014
BEL AIR
Case #1
Case #2
Scale:
2000 ft
4000 ft
6000 ft
14

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 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.

Are there any questions?

Module 12: Responder Actions (Technical Training)

Training Objectives:

1. State the actions which take place during each phase of an incident involving NBC agents.

2. State actions and considerations appropriate to the technician equipment and level of training in response to an incident involving NBC agents.

3. Apply the correct response based on the considerations provided during the module.

References:

1. 29 CFR 1910.120, Hazard Waste and Emergency Response

2. NFPA Code 472

3. Hazardous Materials, Managing the Incident, Noll, Hildebrand, and Yvorra; Peake Productions, Inc., 1988.

Responder Actions

In the event a terrorist employs a chemical, biological, or radiological device, local responders are going to be "on their own" for the initial critical phase of the response. Because of this, responders 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 at the scene, particularly that at the technician level, since these are the responders who are trained and equipped to take offensive action.

Objectives

At the conclusion of this class, Technician Level responders should be able to:

a. Perform actions appropriate to their level of training and equipment in response to an incident involving the employment of NBC agents.

b. Apply the appropriate considerations when responding to an NBC incident.

In other words:

a. Know the appropriate actions required for the Awareness, Operations, and Technician levels of training.

b. Supervise Awareness and Operations level responders.

c. Initiate and perform Technician Level actions.

OSHA Level Technician Level Requirements

By definition, responders at the technician level are those individuals “who respond to releases or potential releases for the purpose of minimizing or stopping the release. They assume a more aggressive role than an emergency responder at the operations level in that they will approach the release in order to patch, plug, or otherwise stop the release of a hazardous substance.” Responders at this level should have had sufficient training or experience to:

a. Know the classification, identification, and verification procedures for known and unknown materials by using field survey instruments and equipment.

b. Know how to select and use proper specialized personal protective equipment provided to the hazardous materials technician.

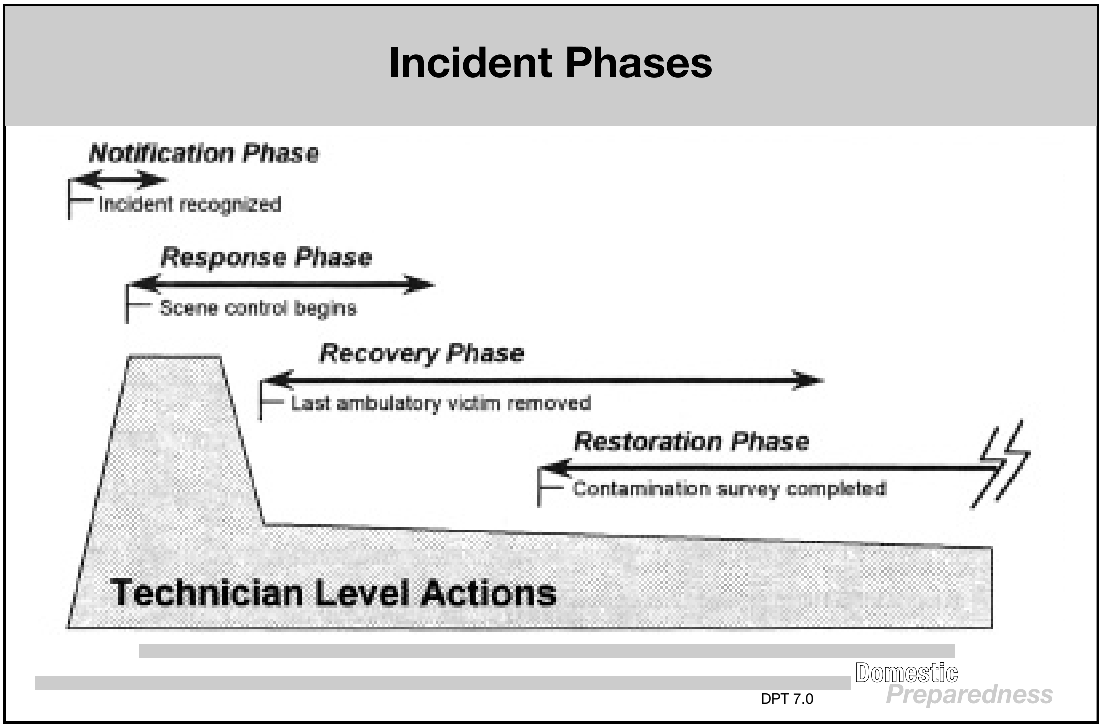
c. Understand hazard and risk assessment techniques.

d. Perform advanced control, containment, and/or confinement operations within the capabilities, resources, and personal protective equipment available with the unit.

e. Understand and implement decontamination procedures.

f. Understand termination procedures.

g. Understand basic chemical and toxicological terminology and behavior.



Incident Phases

Response to an incident generally can be broken down into four phases:

a. Notification

b. Response

c. Recovery

d. Restoration

Of the actions that occur during these phases, Technician Level Responders will be involved with those that are offensive in nature and should ensure that all Awareness and Operations Level tasks have been properly completed.

The graphic depicts the level of intensity of technician level responders in response to an NBC terrorist incident.

The Notification Phase

The Notification Phase begins with notification that an incident has occurred and continues until the first emergency vehicle arrives and response personnel begin site management. 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.

This phase should optimally conclude with 15 minutes and never last more than 30 minutes. The first priority is, as always, responder safety. During this time, information must be gathered, particularly location of the incident and wind direction, because it is critical that all responders approach incidents involving NBC agents from the upwind, upstream, and upgrade direction. Responders should also begin site management, to include site security, and begin to restrict movement into the downwind vapor hazard zone.

Only ambulatory casualties are evacuated during this phase. Emergency decontamination of victims is performed by having them remove their clothing and flushing them with large amounts of water. They are then provided covering and first aid.

Notification Phase Actions—Awareness Level

During each of these phases, there are actions that Awareness Level responders should take.

The Notification Phase. Awareness Level responders observing a dissemination device or what appears 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, upgrade, and upstream of the attack. A safe upwind distance for a chemical attack is 300 feet; for an explosive is 1,000 feet.

b. Ensure all Awareness actions have been properly implemented:

    (1) Protect yourself and other responders. Are any Awareness responders in jeopardy? Are any Awareness responders potentially contaminated?

    (2) Have proper authorities been notified?

    (3) Are walking casualties being corralled, moved upwind and upgrade, and segregated?

Notification Operations Level Responder Actions

During each of these phases, there are actions that Operations Level responders should take.

The Notification Phase. 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, upwind, upgrade, and upstream, of the attack. A safe distance for a chemical attack is 300 feet; for an explosive device it is 1,000 feet.

b. Ensure all Awareness actions have been properly implemented.

- Are any Awareness responders in jeopardy? Are any Awareness responders potentially contaminated?
- Have proper authorities been notified?
- Are walking casualties being corralled, moved upwind and upgrade, and segregated?

Notification Phase Technician Level Responder Actions

During each of these phases, there are actions that Technician Level responders should take.

During the Notification Phase, Technician Level responders observing or responding to a dissemination device or what appear to be the signs and symptoms that a device has functioned should immediately.

a. Ensure the safety of all responders.

b. Ensure that actions at the Awareness and Operations Levels have been properly executed.

c. Be aware that secondary devices may be present, and that the perpetrators of the attack may be either observing the response or part of the casualty cache.

d. Position all vehicles and equipment properly. Minimize potential for contamination of equipment.

The Response Phase

The Response Phase starts with the beginning of site management and concludes with the evacuation of the last living casualty from the hazard area. This phase will typically last several hours, and focuses on the saving of lives. It includes actions such as rescue, emergency decontamination, agent identification, evidence collection, searches for secondary devices and perpetrators, and emergency decontamination or neutralization of large concentrations of agent.

Response Phase Actions—Awareness Level

During the Response Phase, Awareness Level responders should:

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

b. Isolate the area. Begin establishment of Hot, Warm, and Cold Zones.

c. In no case should you, as an Awareness 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. The elderly and small children will require special attention because they are more susceptible to the toxic effects of chemical agents.

e. Assist with the set up of decontamination corridors (usually under the supervision of HAZMAT technician level personnel). The emergency decontamination corridor should be located upwind, upgrade, and upstream of the contaminated area, so that any hazard (e.g., contaminated runoff) will flow into the already contaminated area.

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

    (2) 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 possible to do safely without PPE, execute emergency decontamination of victims that have evacuated the immediate area of the incident. Assist as possible (without PPE) in the operation of a decontamination corridor to support decontamination of ambulatory victims. 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 and with setting up a triage site for the triage, treatment and follow-on transport of victims away from the hazardous area.

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

i. Preserve evidence as much as possible, realizing that it may be required later to apprehend and prosecute the perpetrators.

Response Phase Operations Level Responder Actions

During the Response Phase, Operations level responders should:

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.

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

e. Set up decontamination corridors (usually under the supervision of HAZMAT technician level personnel). Emergency decontamination stations should be located upwind, upgrade, upstream of the contaminated area, so that any contamination hazard will flow into the already contaminated area.

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

(2) 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 the victims that have evacuated the immediate area of the incident. Operations level responders may also operate a decontamination corridor to support decontamination of ambulatory victims, if they 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, and assist in setting up a site for the triage, treatment and follow-on transport of victims away from the hazardous area.

h. Within the limitations of PPE, establish and support a personnel decontamination capability that will support deployment of HAZMAT personnel upon their arrival, and 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 PPE, operate a technical 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 neutralizing the source of the hazard, evidence that could be used later in apprehending and prosecuting the perpetrators may be destroyed. Balance evidence collection with hazard neutralization, realizing that, if the hazard is not neutralized quickly, the downwind hazard may continue to grow.

Response Phase Technician Level Responder Actions

During the Response Phase, Technician Level responders should:

a. Don PPE appropriate for the hazard involved and the task to be performed.

b. Operate and/or supervise operation of the emergency and technical personnel decontamination corridors. While Operations Level personnel may actually conduct decontamination, Technician Level personnel are responsible for oversight and providing guidance.

c. Rescue victims in the Hot Zone. This will be a major mission for Technician Level responders in Level A protection.

d. Attempt to identify the agent employed using available detection and identification equipment. Most items of equipment may provide false alarms, so detection and identification with multiple systems employing different technologies minimizes the risk of false detection. No chemical detection system (with the exception of the GC/MS) is an “all clear” device; however, no detection is generally an indication that the level of agent present is at least below the IDLH threshold.

e. During the initial site survey, be alert for (or search for if law enforcement personnel have been trained at the technician level) perpetrators and secondary devices. Many perpetrators have placed secondary devices with the intent of injuring or killing responders and making the crisis and consequence management missions take longer. Often perpetrators are the first casualties of their attacks, since most are only marginally trained.

f. Collect evidence. The need to collect and document evidence, both to identify and prosecute, is a vital part of any response. Both samples of the agent and identification/evacuation of the dissemination device should occur prior to remediation efforts.

g. Locate and neutralize large areas of contamination (offensive control action). As soon as evidence collection is completed (or before, if the hazard is determined to be of such a magnitude that evidence collection becomes a secondary issue), large areas of contamination that contribute to the generation of a downwind vapor hazard should be isolated and neutralized. The sooner the volatilization process can be stopped, the sooner the downwind hazard can be remediated.

The Recovery Phase

The recovery phase begins after the last of the living casualties has been evacuated from the hazard area and 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, and will include actions such as establishment of an equipment decontamination corridor and decontamination of essential equipment. It is during this phase that state and federal responders may arrive to provide assistance. At this time, fatalities are moved to the Hot Line pending instructions for the disposal of the remains.

Recovery Phase Awareness level actions

Awareness Level responders:

a. Continue to support the technical decontamination corridor.

b. Continue to provide first aid to victims after they are evacuated and decontaminated.

c. Follow-up with medical assessments after the incident to ensure there are no symptoms of agent exposure. If signs and symptoms appear, get immediate treatment.

d. Provide assistance to continue restricting movement within the incident site, enforce the staging area control measures, and provide other assistance as required.

Recovery Phase Operations Level Responder Actions

Properly protected Operations Level responders:

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

b. Within the limitations of available personal protective equipment, complete operation of the emergency decontamination corridor to support decontamination of non-ambulatory victims who have been 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 corridor 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 after they are evacuated and decontaminated.

e. Follow-up with medical assessments after the incident to ensure there are no signs of symptoms of agent exposure. If signs and symptoms appear, get immediate treatment.

Recovery Phase Technician Level Responder Actions

During the Recovery Phase, Technician Level responders should:

a. Continue to perform and/or supervise operation of the emergency and technical personnel decontamination corridors.

b. Supervise closure of (or close) the emergency decontamination corridor. This process will involve the removal of all hazardous waste and decontamination of any terrain.

c. Provide first aid to casualties after they are evacuated and decontaminated.

d. Supervise/establish and operate the equipment decontamination corridor 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.

e. Re-establish essential services.

f. Conduct surveys to determine the extent of contamination.

g. Be prepared to adjust personal protective equipment level based on changes in the situation.

h. Support mortuary activities and the disposition of remains.

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. Emphasis will be on restoration of the site to its original state with emphasis on site safety.

Restoration Phase Actions

Awareness Level responders:

a. Continue to support Operations level responders with technical decontamination of HAZMAT personnel.

b. Continue to provide first aid to victims after they are evacuated and decontaminated.

c. Follow-up with medical assessments after the incident to ensure there are no signs or symptoms of agent exposure. If these exist, seek immediate treatment.

d. Continue restricting movement within the incident site, enforce the staging area discipline, and provide other assistance as required.

Restoration Phase Operations Level Responder Actions

Properly protected Operations Level responders:

a. Within the limitations of available personal protective equipment, continue to support/operate a technical 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 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 all terrain and equipment. Ensure runoff resulting from decontamination operations is controlled and contained/confined as best as possible.

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

e. Follow-up with medical assessments after the incident to ensure there are no symptoms of agent exposure. If so, seek immediate treatment.

Restoration Phase Technician Level Responder Actions

During the Restoration Phase, Technician Level responders should:

a. Provide decontamination corridor support in the decontamination of any remaining hazard. Ensure runoff resulting from decontamination is controlled and contained/confined.

b. Upon completion of decontamination, supervise closure of all decontamination corridors.

c. Be prepared to adjust the personal protective equipment level based on changes in the situation.

Considerations

a. Ensure all Awareness and Operations Level actions are being properly completed.

b. Many actions hinge on fast and accurate identification of the agent employed. Treatment of casualties can be more specific, personal protective equipment levels can be downgraded, and evacuation/shelter in place decisions can be made more cogently after the threat agent is identified. Many detection devices that provide the quickest response are also subject to the most interferents. The detection devices that are the most accurate are also those that respond the slowest. If there is an indication, based on casualty symptoms of the agent employed, the detection and identification time may be reduced by proceeding to the steps required only for contamination that that specific agent is present. If there is no indication of which agent is present, the devices with the quickest response time can almost immediately indicate that, if present, an agent is above or below IDLH.

c. Because many of the chemical agents kill rapidly (5-15 minutes), rapid decontamination of those exposed to the agent is critical. Emergency decontamination corridors must be established quickly, and all individuals exposed to the agent brought under control.

d. All responders must be alert at all times for the potential presence of secondary devices, designed to kill or injure them. These secondary devices may be composed of either high explosive or nuclear, biological, or chemical material.

e. There are currently no NBC personal protective clothing ensembles that can be used to provide ordnance disposal (bomb squad) protection; nor are there bomb disposal units that provide NBC protection. The Incident Commander, in concert with bomb disposal and HAZMAT personnel, will have to decide whether to treat devices as explosive or dissemination vehicles.

f. Site safety is a critical consideration, both to control/contain the hazard and to ensure responder safety.

g. While decontamination of the site is important, so is the requirement to collect evidence. Unfortunately, these two tasks often compete for resources in terms of personnel and time.

Key Points

During the past hour we have addressed Technician Level responder actions should a chemical, biological, or radiological attack occur. The key actions for the Technician Level responder are:

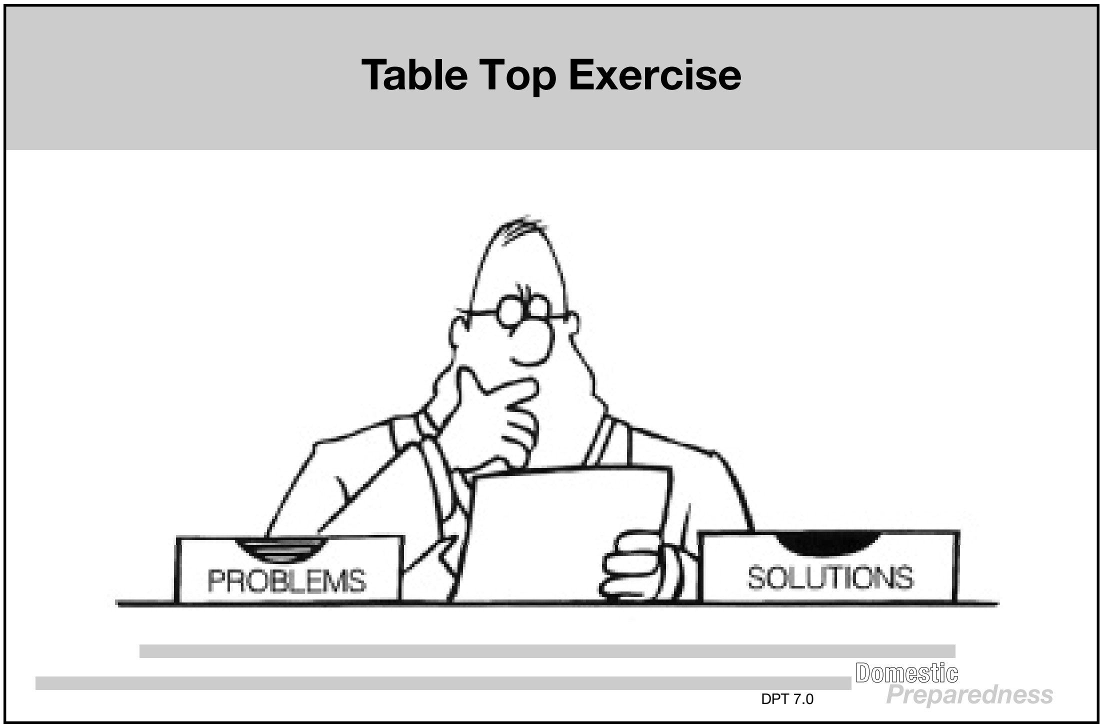
a. Ensuring the safety of all responders. Do not allow the focus of the response to shift to responder rescue because a responder becomes a casualty.

b. Establishment and supervision/operation of both emergency and technical personnel decontamination corridors.

c. Rescue of victims in the Hot Zone. Technician Level responders are the only personnel who have the appropriate clothing to execute this task.

d. Initiation of contamination control and containment/confinement operations to the greatest degree possible.

e. The Incident Commander and First Responders at the Awareness and Operations Levels will look to HAZMAT Technicians for guidance and technical advice.



MOTIVATOR. Throughout this course, we have discussed what the different responder activities will be and where you, at the Technician 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.

1. 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.

   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 their agencies and outline their tactical objectives. We will compare these and develop a single list for the rest of the exercise.

   b. Time permitting, teams will be challenged with several situations, each focusing on 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 an overhead diagram of the scene.

2. 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 fire and police authorities were dispatched to the Mall. This will be 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 on a typically crowded shopping day. The package contained a broken jar, with liquid leaking at 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 elderly man clutched his chest and collapsed near the trash bin. Other shoppers rushed over to help. A security guard observed the scene on the mall security camera and called 9-1-1. His call stated that the elderly 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, including those who were help. 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 casualties.

    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.

4. Knowing what you know now 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 executed any response actions better than those shown in the video, especially where your local SOP differs. Fill in the blank forms depicted in this slide and in the next. Then we will discuss your results. A representative teach 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.

5. Located at Appendix A and you will find several situations which address some of the activities which occur during the NBC incident at the Harford Mall. These situations are designed to stimulate discussion about response procedures and allow you to address how you would handle each using our local SOP. We can discuss a few of these in the class, but you should review all of them on your own.

APPENDIX A

EXAMPLE SITUATIONS FOR "TERROR AT HARFORD MALL" VIDEO

1. For the next several situations, discuss the responses among your team. Include what assets you would need, where you would position them, when they would take action with respect to the other activities on site, and who is in charge of them.

2. The starting situation is the terrorist NBC attack at the Harford Mall. Recall all of the information that 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 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 on a typically crowded shopping day. The package contained a broken jar, with liquid leaking at 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 elderly man clutched his chest and collapsed near the trash bin. Other shoppers rushed over to help. A security guard observed the scene on the mall security camera and call 9-1-1. His call stated that the elderly 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 elderly man, including those who were helping, 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.

    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.

3. Situations.

    a. Situation #1 (initial response): The phone rings and dispatcher tells you that there has been a report of some kind of incident and panic at Harford Mall. An earlier 9-1-1 call was placed for a medical response team, which is already on scene to assist a man having an apparent heart attack in the food court section of the mall. A mall security officer reported in the second 9-1-1 call that there are now several victims in the area and that the medical team has apparently been overcome by an unknown hazard which may have affected the victims they were trying to help. Other people are fleeing the mall.

b. Situation #2 (Initial site management): You are now at the site. The scene is chaos. A few people are still coming out of the mall, several unconscious individuals are in the parking lot. Two ambulances have arrived, and a fire truck is just pulling up. Some shoppers are wandering about looking for family members. Some shoppers are arriving and milling around to see the action. No one seems to be in charge.

c. Situation #3 (Security): Shoppers continue to try to get into the mall. Traffic is piling up in the street. A second fire truck and 3 ambulances are trying to get down the street. A collision occurs in the parking lot by the highway exit from the mall when two cars are slowing down to watch the events while a third car was trying to flee the mall area. They are blocking the entrance to the parking lot. A man wearing a store ID badge is shouting “Stop, thief!” and pointing at the crowd. People are running in both directions, toward and away from the mall entrance.

d. Situation #4 (Initial entry): Recall that firefighters entered the mall wearing structural firefighting clothing and SCBA to determine what was happening there. They tested for oxygen, carbon monoxide, and explosive gasses and found no unusual readings. They also observed from a distance that the victims and three medical responders were lying motionless on the floor.

e. Situation #5 (HAZMAT): The HAZMAT team entered wearing Level A protection. They noticed several items, some of which were wet or leaking, near the bodies of the victims. There were packages, trash, food trays, a video camera (still running), and some articles of personal equipment on the floor. There were several wet spots, some from these objects and some from unknown origins.

f. Situation #6 (Secondary devices): The HAZMAT team reported that they observed the victims were prone and motionless on the floor in close proximity to each other. They also saw the leaking package nearby and the video camera on the floor near the victims. They saw abandoned packages and food trays on some of the tables.

g. Situation #7 (HAZMAT/medical/decon): The HAZMAT team determined that a nerve agent is probably present in liquid and vapor form. Of the victims remaining in the food court, most are dead but two are still alive but unconscious.

h. Situation #8 (Medical triage and evacuation): Many of the victims outside are exhibiting symptoms of nerve agent poisoning in varying degrees of severity from meiosis to severe convulsions. Many of the other people with the victims show no symptoms, but are afraid they may have been exposed to the hazard. Others are insisting they are all right and want to leave.

i. Situation #9 (Decon of victims): Some of the victims have liquid spots on their clothing and skin, others do not. Some of the ones who do have liquid on them say that they were at the other end of the food court from where the device was found. They also say that those with liquid on them were in the immediate area where the victims collapsed. Many of the ambulatory victims do not want to remove their clothes or get them wet. Many mothers do not want to be separated from their children while other women refuse to remove their clothes in front of the older children. Nobody wants to leave behind their personal belongings. It is not cold outside, but nobody wants to be showered with cold water either.

j. Situation #10 (Collection of evidence): Since it appears that this is some type of criminal event, evidence must be preserved and collected.

k. Situation #11 (Responder with symptoms): One of your team members develops pinpointing of the pupils and complains that it is hard to see.

Note: Ask: “What does this mean? What are your actions? When should medication be administered?” Students should discuss assessing the condition of the responder, administering antidote if necessary, and processing through the decontamination line to medical observation. Other team members should also be evaluated.

l. Situation #12 (Meet with the press): The press has arrived at the incident site, and are asking questions. One of the news vehicles had already been on site when your team arrived and their camera crew is interviewing victims and other people in the crowd. Other reporters are filming everything they can, including the emergency decontamination and the care of the victims. One news team has been filming the actions of your team and wants you to comment.

m. Situation #13 (Decon the site): All victims are cleared from the site, and the evidence has been collected. The incident commander says that the mall needs to be reopened as soon as possible.