Chapter 4
Biological Agents

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

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

Pathogens

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

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

Bacteria

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

Viruses

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

Rickettsiae

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

Toxins

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

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

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

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

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

Characteristics of BW Agents

Delayed Effects

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

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

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

Large Area Coverage

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

Control

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

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

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

Skin Penetration

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

Weather Effects on Biological Agents

Sunlight

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

Humidity

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

Wind

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

Temperature Gradient

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

Precipitation and Temperature

Precipitation will tend to wash biological agents out of the air more rapidly. This will slightly reduce the downwind hazard. Most pathogens are stable at normal temperatures, thus, the effects of temperature are

Table 4-1. Pasquill Stability Classes

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

Conditions:

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

expected to have little or no effect on hazard predictions. With the advent of toxins, bioengineering of pathogens and encapsulation, even arctic or desert conditions are much less restrictive to the user of BW. Most toxins are more stable than pathogens and are less susceptible to the influence of temperature, relative humidity, and radiation. As a general rule cool temperatures favor the employment of wet agents and warm temperatures favor the employment of dry agents.

Windows of Vulnerability

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

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

Persistence of Biological Agents/hazard

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

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

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

Use of Biological Agents Against US Forces

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

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

Possible targets of toxins include —

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

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

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

Recognizing a pattern of employment to predict an attack.

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

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

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

Using Intelligence Sources

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

Recognizing a Pattern of Employment

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

Recognizing Distinguishing Symptoms, Signs, and Effects

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

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

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

Dissemination Techniques and Avoidance Procedures

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

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

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

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

Aerosol Dissemination Procedures

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

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

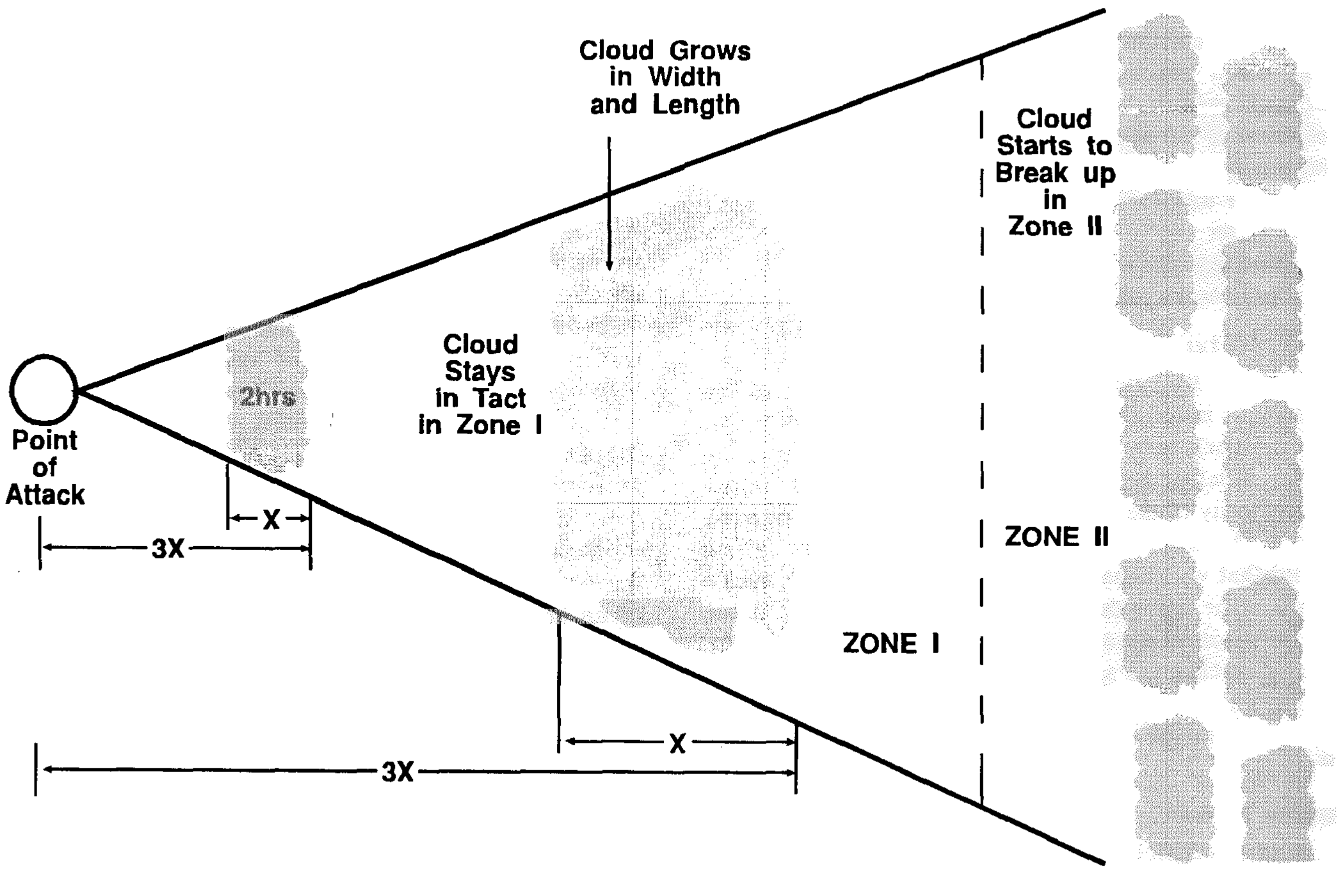


Figure 4-1. Downwind Movement and Characteristics of a Biological Agent Cloud.

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

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

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

There are two primary aerosol dissemination techniques:

- Bursting type munitions.
- Spray tanks/generators.

Bursting type munitions

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

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

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

Spray Tanks/Generators

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

Zones of Contamination

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

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

Aerosol Avoidance Procedures

Before the attack

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

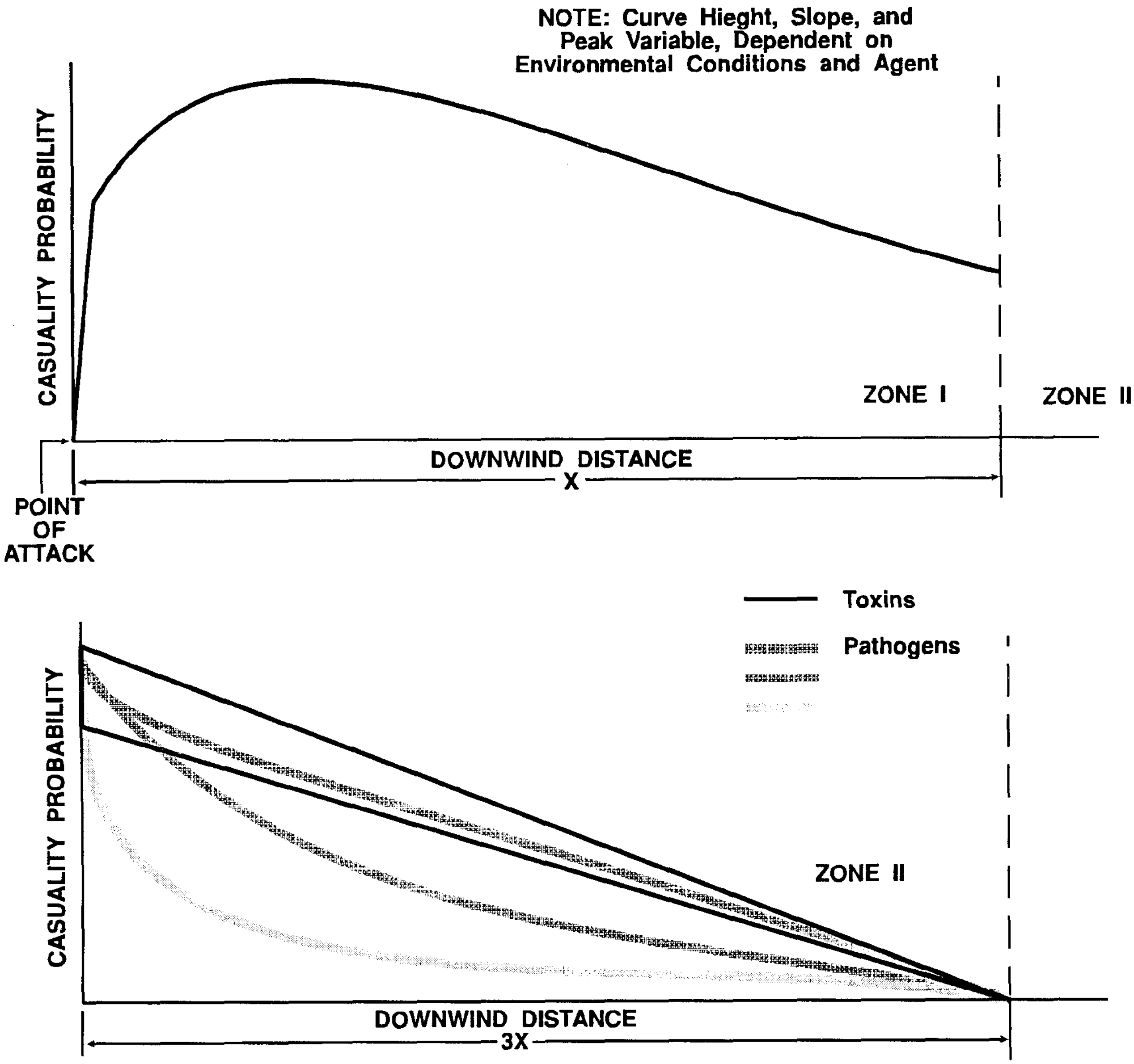


Figure 4-2. Biological Casualty Probability Curves for Zone I and II.

collective protection must be airtight.)

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

During the attack:

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

After the attack:

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

Vector Dissemination Procedures

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

Vector Avoidance Procedures

Before the attack:

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

During the attack:

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

After the attack :

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

• Begin insecticide and other pest control measures as outlined by preventive medicine personnel. Logistical support for unit-size pest control procedures should be a coordinated effort between the NBCC and the supporting medical authority. Physically remove body lice, ticks, and fleas by self aid and buddy aid as necessary.

• Make hazard estimates. Recon and medical reports may help the NBCC in assessing hazard areas.

Convert Dissemination and Avoidance Procedures

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

Before the attack:

• Maintain OPSEC.

• Identify covert/sabotage threat force capabilities and intentions through intelligence.

• Arrange for security measures to be taken based upon threat assessment.

• Identify alternate supply sources for those high-risk items.

• Instruct troops to be alert to dissemination devices or signs of covert tampering as intelligence dictates.

• Establish and enforce preventive medicine programs to include immunizations, area sanitation, personal hygiene standards, and rest and nutrition needs of the troops. (NOTE: Based on intelligence, protection of food and water may prevent successful employment of a specific biological agent.)

During the attack:

• Report the observation of an attack, the apprehension of enemy agent(s) engaged in such activity, or the finding of signs and indications of covert attacks.

• Initiate personnel and collective protection. For maximum protection and the lowest risk of incurring casualties, soldiers should maintain this protective posture for at least 4 hours.

After the attack :

• Warn personnel downstream, downwind, and/or down supply lines. The NBCC will do so based on at-hand medical and intelligence information and analysis of NBC 1 Reports.

• In conjunction with the veterinary and surgeon general initiate disposal and replacement of food, water, and other supplies. The NBCC can coordinate inspections and medically approved replenishment sources. Actions involving disposal of major quantities of food must be coordinated with the supporting veterinary personnel. Actions involving disposal of major quantities of other nonmedical supplies should be coordinated with the NBCC.

• Initiate sampling based on knowledge, consent, and special sampling requirements of the NBCC. If a BW attack is suspected, wash surfaces with at least a 5% solution of bleach. Bleach is a very effective form of decontamination for most BW agents.

Warning and Reporting

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

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

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

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

The observations should be reported on line Zulu Bravo. The report is then sent to all units in the division/corps operational area as an NBC 3 Suspected Biological Report. In order to send an NBC 3 Suspected Biological Report, the NBCC will have to analyze the nature of the attack as well as other information available. Presume that a biological attack has occurred based on the following factors:

- Analysis of NBC 1 Chemical Follow-up Reports.
- Analysis of intelligence data regarding enemy capabilities, tactics, and activities.
- If attack occurs during the "window of vulnerability".
- Analysis of preliminary laboratory examinations or completed reports from past attacks (NOTE: Complete agent identification may take days or longer).

precognition of a pattern of established warfare.

- Analysis of samples
- Onset of symptoms related to biological agents

Units use NBC 3 Suspected Biological Reports as battlefield intelligence. With knowledge of the biological agent aerosol cloud characteristics, units can approximate the area in relation to the simplified downwind hazard prediction of a chemical agent. Figure 4-3 and 4-3a depict a flow chart for the agent identification as it pertains to biological attacks. Figure 4-3 represents the role of field units (Bn and below). The process begins with the observation of a suspicious attack. If the unit is unable to immediately identify the agent they will then generate an NBC 1 Agent Unknown Report (circle A, Figure 4-3). The NBC 1 Report is forwarded to the NBCC (circle A, Figure 4-3a) and an NBC 3 is generated assuming an unknown chemical attack. This NBC 3 is transmitted back to the field unit (circle D, Figure 4-3a). The unit will receive the NBC 3 Report (circle D, Figure 4-3) and take the appropriate defensive measures. The field unit will continue to attempt to identify the agent and will send an NBC 1 follow up Report based on its findings for either a known or unknown agent (circles B, Figure 4-3). The NBCC will process the NBC 1 follow up Reports (circle B, Figure 4-3a) and evaluate the data. If a biological attack is suspected the NBCC will issue an NBC 3 Suspected Biological Report (circle D, Figure 4-3a). The affected unit will take the appropriate defensive measures (circle D, Figure 4-3a) and plan and conduct sampling operations IAW unit SOP (circle C, Figure 4-3). Sampling should be conducted by trained personnel, usually chemical infrastructure personnel trained in sampling techniques.

After a unit (Bn or lower) receives an NBC 3 Suspected Biological Report from higher, they may be directed to perform a sampling operation. The unit will report its data in an NBC 4 format with line Hotel specifying that the agent is unknown. Once the higher headquarters receives confirmation of the samples contents they will transmit an NBC 5 based on the previous data from the submitted NBC 4's. The final NBC report is the NBC 6 Biological Report. It is a narrative description of biological attacks that have occurred in the reporting units' area of operation. It is written at the battalion level or above. The NBC 6 Biological Report contains as much information as possible about the attacks. It is submitted only when requested and is sent hard copy. Figure 4-4 shows examples of biological reports.

In some cases the NBCWRS may have to be modified for a biological attack. This will occur when:

- The "windows of vulnerability" are present for the optimum weather conditions.
- Observation of suspicious activity by the enemy (e.g., low flying aircraft or generators emitting a vapor or powder substance).
- Area sampling teams, equipped with air samplers and Elisa tickets as outlined in Chapter 5, in pre-planned positions obtain a positive sample or test for a biolgical agent.
- When the conditions occur, the area sampling team will prepare an NBC 6 Suspected Biological Report and send the report to the NBCC. The sample is evacuated for laboratory analysis. The NBCC will:
- Plot the sampling teams position on the situation map.
- Prepare and disseminate an NBC 3 Suspected Biological Report.
- After laboratory analysis confirms that the sample taken is a biological agent, the NBCC will determine the pattern of deposition and decay rate for the agent. This may be accomplished by receiving other sampling reports within the area, developing a pattern based on information gathered from medical or intelligence sources, or by the simplified techniques for downwind hazard prediction outlined in this chapter. Once this area of deposition is defined by the NBCC, the NBCC will prepare and disseminate an NBC 5 Biological Report.

Principles of Hazard Prediction

When a chemical or biological agent is employed as an aerosol, there will be an initial, lethal concentration of agent in the area employed. The agent will form a cloud that will be carried downwind, spreading at a 30 degree angle to either side of the wind direction. The

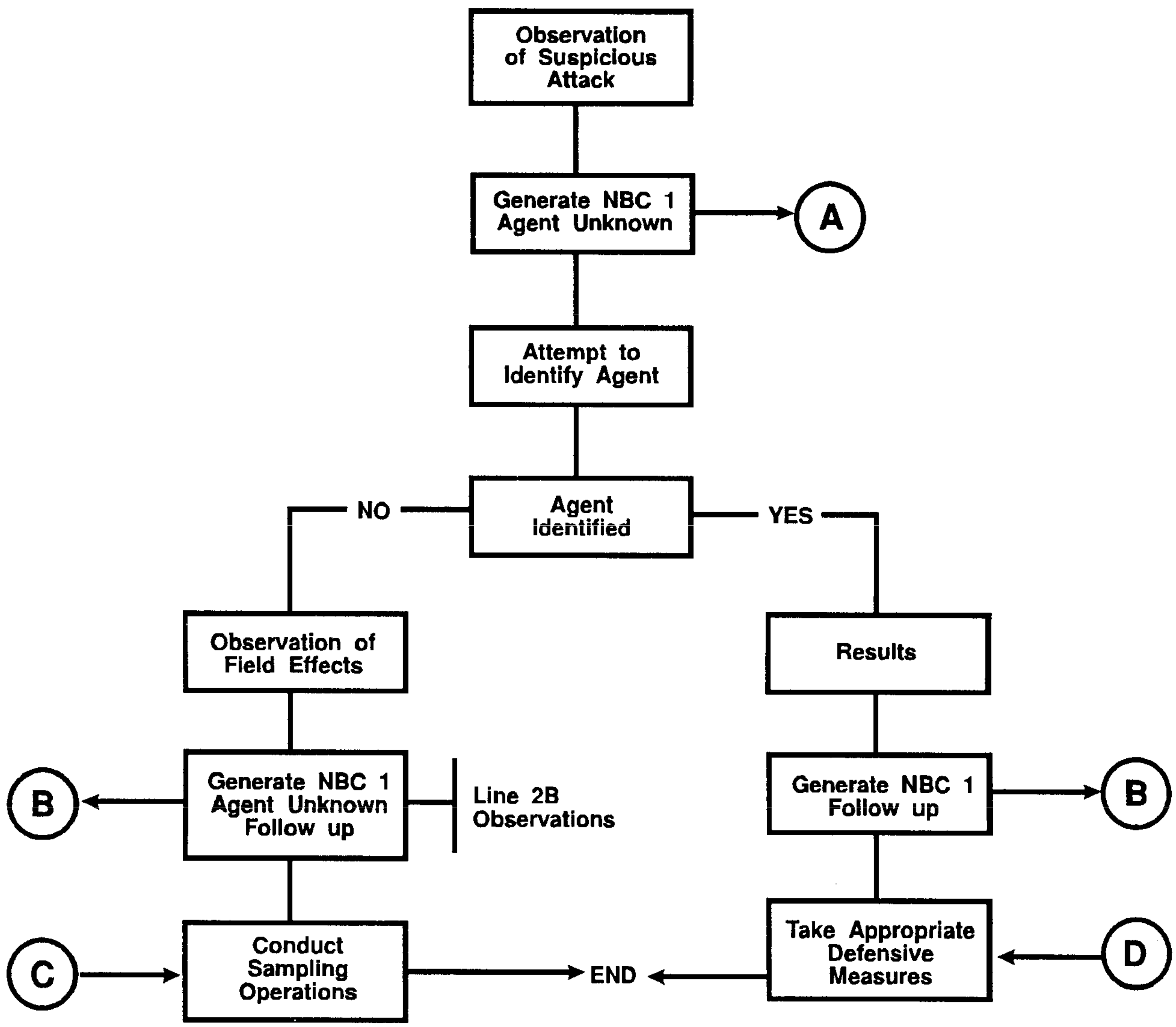


Figure 4-3. Flow chart for biological attack identification Part 1. Role of field units.

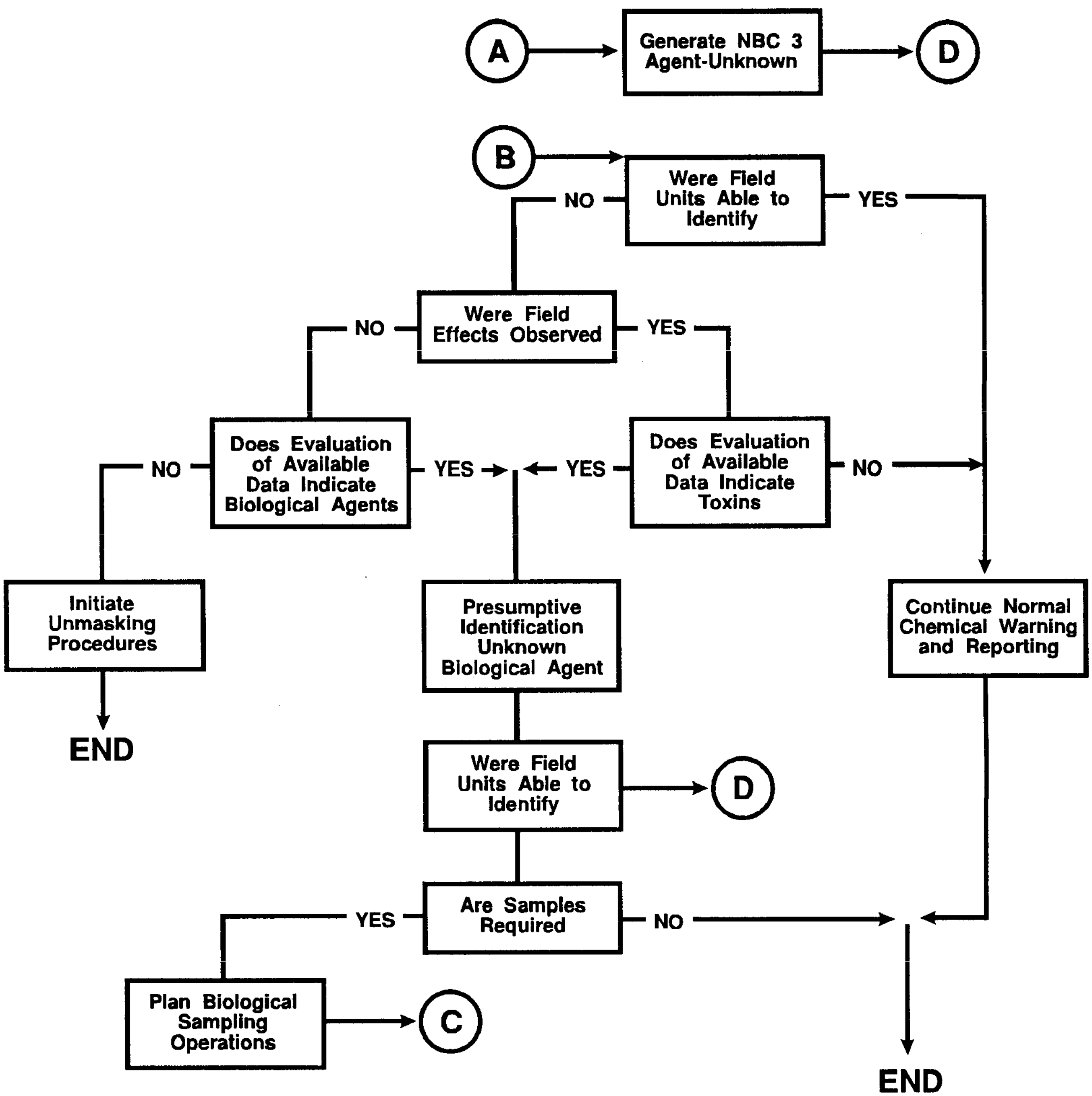


Figure 4-3a. Flow chart for biological attack identification Part 2. Role of NBC center.

NBC 1 Chemical (Attack observed that could be chemical or biological)	NBC 1 Follow-up (Observations indicating biological)
B LB200300 D 200430Z E 200435Z F LB200300 Actual G Aerial Spray H Unknown NBC 3 Chemical A C001 D 200430Z F LB200300 to LB208304 Actual G Aerial Spray H Unknown PA LB216298, LB203290, XX700000, XX700609, LB213313 (XX Left Adjacent Gridzone) Y 0270 Deg, 015 kmph ZA 6158-0 NBC 4 Suspected Biological H Unknown-Suspected Biological Q LB200300, Liquid S 200530Z	B LB200300 D 200430Z E 200435Z F LB200300 Actual G Aerial Spray H Unknown-Suspect biological ZB M8 and M256 negative detection/identification. Masked personnel and cattle staggering,collapsing — paralyzed and dying. NBC 3 Suspect Biological A C001 D 200430Z F LB200300 to LB208304 Actual G Aerial Spray H Unknown-Suspect biological PA LB216298, LB203290, XX700000, XX700609, LB213313 Y 0270 Deg, 015 kmph ZA 6158-0 ZB Line PA is maximum casualty area. Significant casualties with unprotected personnel four times this downwind area possible.

FIGURE 4-4. Examples of biological reports.

wind will then carry the agent and dissipate it. The length of the cloud is approximately 1/3 of the total distance traveled. As the cloud increases in width and length, the actual exposure hazard will increase, because although the concentration of the cloud has decreased the exposure time will be greater due to the increased size of the cloud. Therefore troops will be exposed to a lower concentration of agent, but for a longer period of time. The cloud is expected to produce at least a 20% casualty rate for exposed, unprotected troops in Zone I. In time, the cloud dissipates (and the agent degrades) to the point at which it can no longer produce casualties. In Zone II, the casualty rate for exposed, unprotected troops is less than 20%, but greater than 1-3%. Beyond Zone II, less than 1-2% of exposed troops are expected to be casualties. There are three questions of tactical importance to both commanders and troops in the field

1. Will personnel be exposed? A prediction of this is Zone I and II areas defined by the SBDWHP.

2. At what time will troops be first exposed to the agent? This can be found from the cloud arrival time (CAT), the time when the aerosol cloud will first reach a unit. CAT is calculated by:

CAT = cloud arrivat time
TOA = time of attack

$$CAT = TOA + \frac{\text{Distance (km) from attack area}}{\text{windspeed (kmph)}}$$

3. How long will troops in the area be exposed? This can be found from the cloud exposure time (CET), the total time that a unit will be within the cloud. CET is calculated by:

CET = cloud exposure time (in hours)

$$CET = \frac{\text{distance (km] from attack wee}}{\text{3 x windspead (kmph)}}$$

Simplified Downwind Hazard Prediction for Biological Agents (SBDWHP)

Downwind hazard prediction for biological agents is very similar to the produre for chemical agents. The resulting prediction provides a minimum estimate of the danger zones for biological agents in general. After employment, actual sampling by trained personnel will produce a better indication of the areas affected.

Indications of a biological attack: You should suspect a biological attack when 1) there are indications of a chemical attack, but no effects, and 2) a presumed chemical attack has occurred, but the agent has not been identified. In the first case, soldiers would observe such enemy activities as low flying aircraft or generators spraying mists or fogs, or munitions detonating with little or no explosive effect. There would be no symptoms of a chemical attack, however. In the second situation, there would be the effects of a chemical attack such as casualties among unprotected troops, but the agent cannot be identified with standard detection equipment.

In both cases described the unit observing the attack will submit an NBC 1 Chemical Report, agent unknown, to the NBCC. Soil, liquid, and surface samples should be collected and sent to servicing identification laboratories as quickly as possible, when directed by the NBCC.

Upon receipt of the initial NBC 1 Chemical Reports, the NBCC will issue an NBC 3 Chemical Report to alert units m the immediate downwind hazard area. The NBC 3 Chemical Repro-t equates to approximately 50% of the Zone I of the Simplified Biological Downwind Hazard Prediction (SBDWHP). This warning will be adequate for the first 1 to 5 hours (dependent on windspeed); the units in the remainder of Zone I and Zone II of the biological hazard will need to receive an NBC 3 Biological Report for adequate warning.

The hazard area prediction will be less reliable as the distance and time from the point of attack increases (If the wind changes, follow the same procedures for recalculation as for chemical hazard prediction.

Units in the downwind hazard area will not be able to detect arrival of the aerosol cloud. Thus, no NBC 4 Biological Reports will be generated. Downwind units should collect soil, liquid and surface samples at various times following calculated cloud time arrival, as directed by by NBCC. These samples will be handled through the technical intelligence chain. This will allow determination as to where the downwind hazards actually occurred.

Due to the infectious nature of pathogens, close co-operation and coordination between medical and maneuver units will be required to limit and control the effects of biological attacks. Biological agents could be reaerosolized by vehicle traffic, etc., in the downwind hazard area, especially Zone I.

Hazard Prediction

Three kinds of Biological attacks will be discussed.

a. Type A Case a: a point-source attack (ex: aerosol generator, bomb) or an area attack (as in artillery or bomblet attack). This type of attack is also used for toxins.

b. Type A Case b: a spray-line.

c. Type B: A large liquid drop/ground contaminating attack.

The following information is required:

- NBC 1 Chemical (Initial report will indicate unknown chemical)
- Chemical Downwind Message
- Being Morning Nautical Twilight (BMNT)

Cloud Duration of the Greatest Effects (Zone 1)

Engineered/Hardened Pathogens Nonherdened Pethogens	# of hours from time of attack to BMNT + 2 hours. Max 8 hours.
Toxine	8 hours

Type A Case a (point Source Attack and Toxins)

All attacks that occur during daytime and all toxin attacks will be presumed to have a cloud duration of the greatest effects of 8 hours. Only for night attack is it necessary to compute this duration.

The 8 hour maximum for cloud duration is based upon agent decay by environmental conditions, particle fall. and cloud dissipation. The actual effectiveness to minium hazard levels may extend to as much as 32 hours. [Four times (4X) the cloud duration of greatest effects.]

1. Derive the location of the attack from NBC I Chemical Report and plot the" location on a map or template.

2. Draw a 1 km circle around the point of attack.

3. Determine the maximum Downwind hazard (MDWHD)

MDWHD = 4 x Windspeed (kmph) X Cloud Duration* of greatest effects (Zone I)

* The cloud duration is a measure of the length of time a biological agent is likely to remain effective and aerosolized in the environment.

4. Draw a line from the point of attack along the representattive downwind direction, equal in length to the MDWHD (example #4, step 4).

5. Draw a line perpendicular to the representative wind direction, intersecting the point of the MDWHD (example #4, step 4).

6. Extend the line along the representative wind direction for a distance twice the radius of the circle around the attack area from GZ in the direction behind the attack area (example #4, step 5).

7. From the rear endpoint of the representative wind direction line, draw two lines that intersect this point, are tangent to the attack area circle, and intersect the line of MDWHD (example #4, step 6).

8. Erase the area behind the attack area circle. The remaining area constitutes the Zones I & II hazard area. The points shown on the diagram define the hazard area. Indicate these points on line PA of the NBC 3 Report.

9. Divide the MDWHD by 4. Plot this distance along the representative wind direction line. Draw a line perpendicular to the representative wind direction and which intersects both tangent lines at this point. The area within this smaller plot is the Zone I hazard area (example #4, completed diagram).

Example of full downwind hazard prediction (see diagrams for step by step solution).

10. Report the two points at which the Zone I hazard line intersects the tangent lines on line ZB of the NBC 3 Biological Report.

Example 1: Time of attack: 0130
BMNT: 0430
wind direction: 150 grid
windspeed: 15 Km/Hr
cloud duration = 5 hrs MDWHD = 4 x 15 x 5 = 300 Km
(3 hours from time of attack to BMNT + 2 = 5 hours)

Example 2: Time of attack: 1130
BMNT: 0600
wind direction: 75 grid
windspeed: 10 Kmph
MDWHD = 4 x 10x 8 = 320 Km
(6.5 hours from time of attack to BMNT + 2 = 8.5; which cannot exceed 8 hours)

Example 3: Time of attack: 0430 (Toxi,n presumptive identification)
BMNT: 0530
windspeed: 12 Kmph
wind direction: 60 deg grid
MDWHD = 4 x 12 x 8 = 384 Km
(All toxin attacks have cloud duration of greatest effect of 8 hours)

Example 4: Time of attack: 0330
BMNT: 0530
windspeed: 13 Kmph
wind direction: 90 deg grid
MDWHD = 4 X 13 X 4 = 208 Km
(2 hours from time of attack to BMNT +2 hours = 4)

Type A Case a (area attack)

1. Derive the location of the attack from NBC 1 Chemical Report and plot it on the map.
2. Plot a circle with a radius of 1 Km, unless the attack area radius is known to be more than 1 Km. If the attack area is known to be greater than 1 Km, then plot a circle with a radius equal to the radius of the attack area around the center of the attack area. The circle must have a minimum radius of 1 Km.
3. All subsequent procedures are exactly as outlined in Type A Case a point source sample. (See diagrams for Step by step solution).

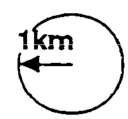
Example 5: Time of attack: 2230
BMNT: 0700
windspeed: 15 Kmph
wind direction: 60 deg grid
MDWHD = 4 x 15 x 8 = 480 Km
(maximum 8 hours BMNT)

Type A Case b (linear spray)

1. Derive the location of the attack area from NBC 1 Chemical Report. (A number of reports may need to be evaluated). Plot the attack area or spray line on the map. Draw a line through the attack area from the start point to the end point (example #6, step 1).
2. Draw a 1 Km circle around the beginning point and endpoint of the spray line (example #6, step 2).
3. Determine the MDWHD, as in Case a.
4. From each endpoint of the sprayline, draw a line equal in length to the MD along the representative downwind direction (example #6, step 3).

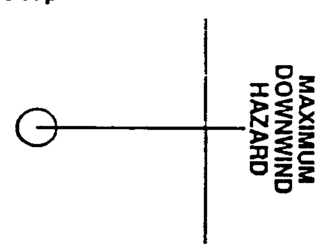
Example #4, Step 1

Example #4, Step 2

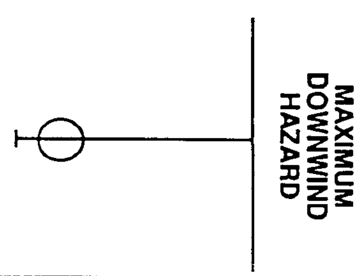


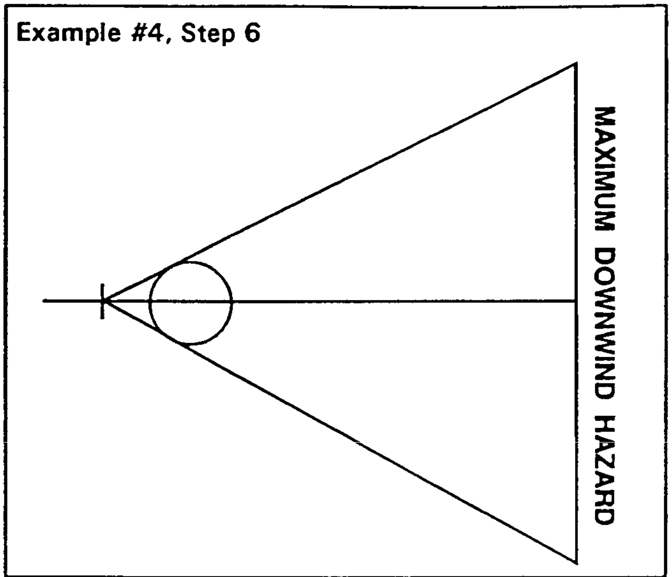
Example #4, Step 3

Example #4, Step 4

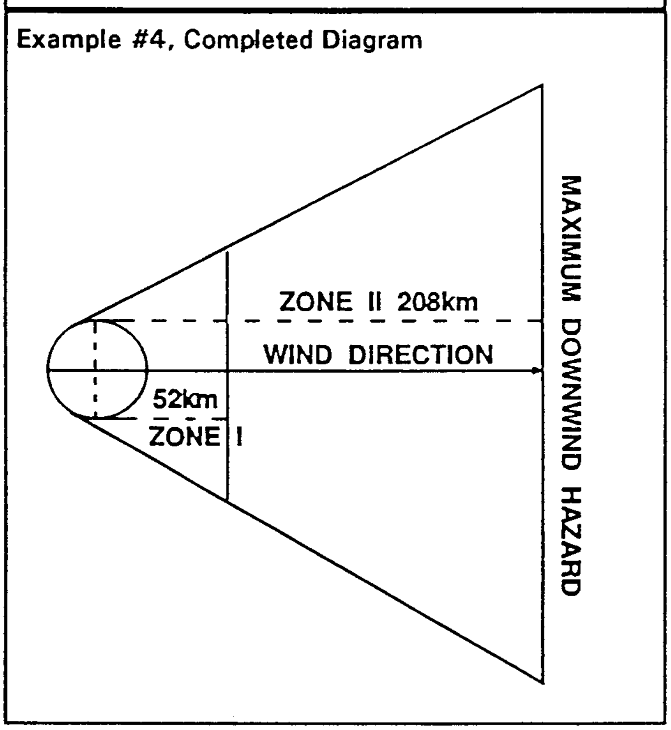


Example #4, Step 5





Example #4, Step 6



Example #4, Completed Diagram

5. Draw a perpendicular line intersecting the MDWHD point on the representative wind direction line drawn from the attack area endpoint furthest downwind (This is the line of Maximum Downwind Hazard - example #6, step 4).

6. Extend each representative wind direction line 2 km behind each endpoint of the spray line (example #6, step 5).

7. Draw a line from each point 2 Km behind the endpoints tangent to the outer side of each circle. until it intersects the MDWHD line. (example #6, step 6).

8. Draw a line tangent to the rear of both attack circles. Erase any area behind the attack circles. This figure encompasses the Zone II hazard area. Report the points delineating this area. (See figure on line PA of NBC 3 Reports (example #6, step 6).

9. Divide the MDWHD by 4. Plot this distance from the attack area endpoint furthest downwind on the representative wind direction line. Draw a line perpendicular to this point which intersects both tangent lines. This smaller figure is the zone I hazard area. Report the point of intersection with the tangent lines as Zone I on line ZB of the NBC 3 Biological Reports (example #6, step 6).

Example 6: Time of Attack 0930 (See diagram for step by step solution).

BMNT: 0700
wind speed: 12 Kmph
wind direction: 90 deg grid
spray length: 10 Km
MDWHD=4x12x8=384Km

Type B (Large Liquid Drop / Ground Contamimting Attack)

1. Derive the locaation of& attack area from NBC 1 Chemical Report and plot it on the map.

2. Draw a circle with a radius equal to the radius of the attack area. This circle should have a minimum radius of 5 Km.

3. Report the hazard area as rhree digits on line PA of NBC 3 Biological Report.

Sampling

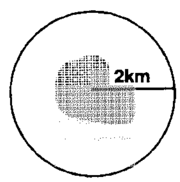
Sampling aids in the identification of an agent and enhances determinaion of medical treatment required. Obtain a large amount of agent relatively free of interfering rnaterials. Sampling identfies which agents were used in an attack. Identification can aid in -

- Confirming that an attack has taken place.
- Determining the proper therapy for personnel exposed to the agent.
- Estimating the possible number and type of casualties.
- Determining the time-to-casualties if time of the attack is known.
- Evaluating an enemy's biological capability.

Sampling should be conducted by trained personnel. (These are chemical infrastructure and NBC recon personnel specifically; but by prior coordination in SOPs and OPLANs, intelligence or medical technical assistance and / or specific advise could be rendered.) Trained personnel ensure uniformity, viability, safety, and accountability in sampling procedures. Sampling is not done indiscriminately, but only when an attack is indicated. Sampling operations, other than medical

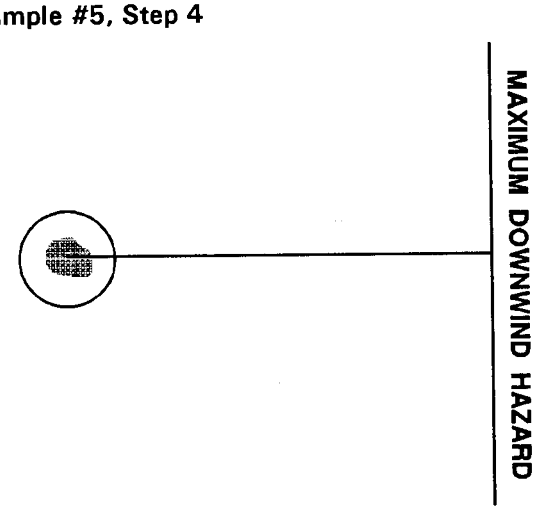
Example #5, Step 1 (Type A, Case A, Area Attack)

Example #5, Step 2

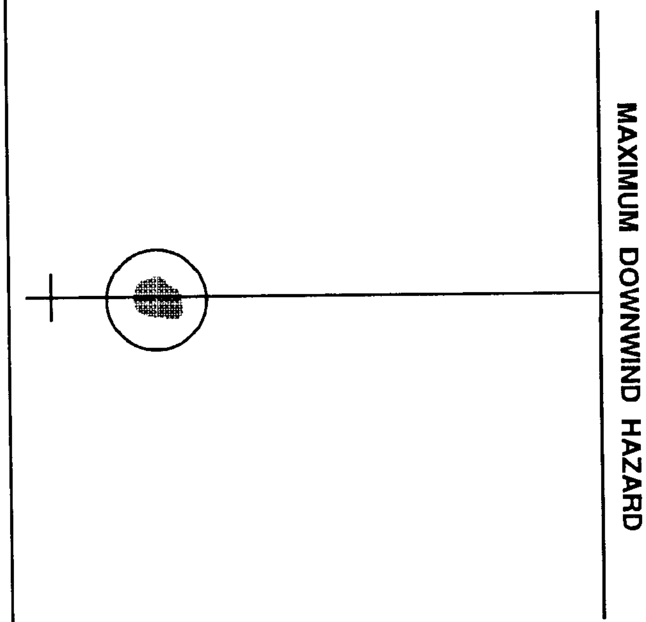


Example #5, Step 3

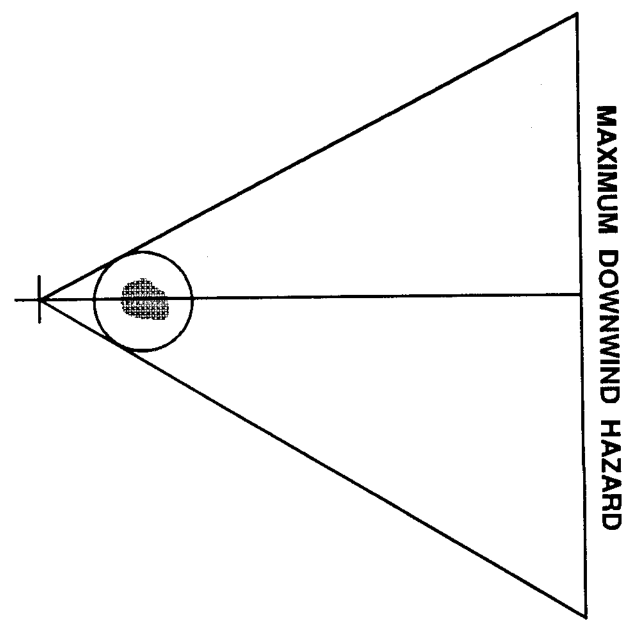
Example #5, Step 4



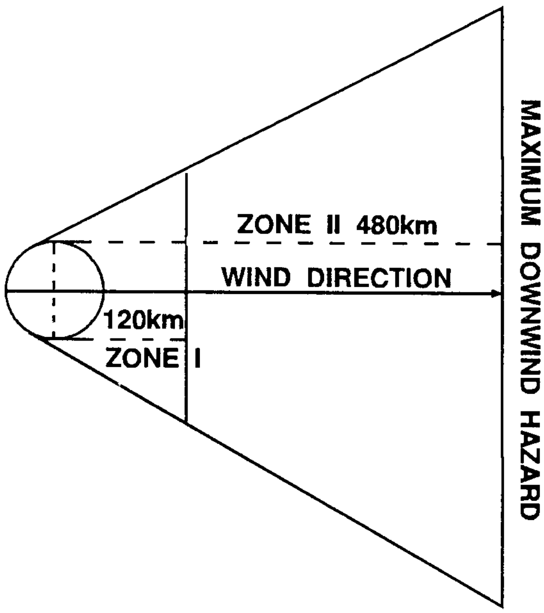
Example #5, Step 5



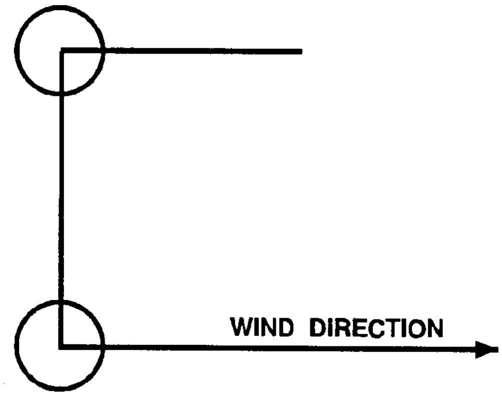
Example #5, Step 6



Completed Example #5



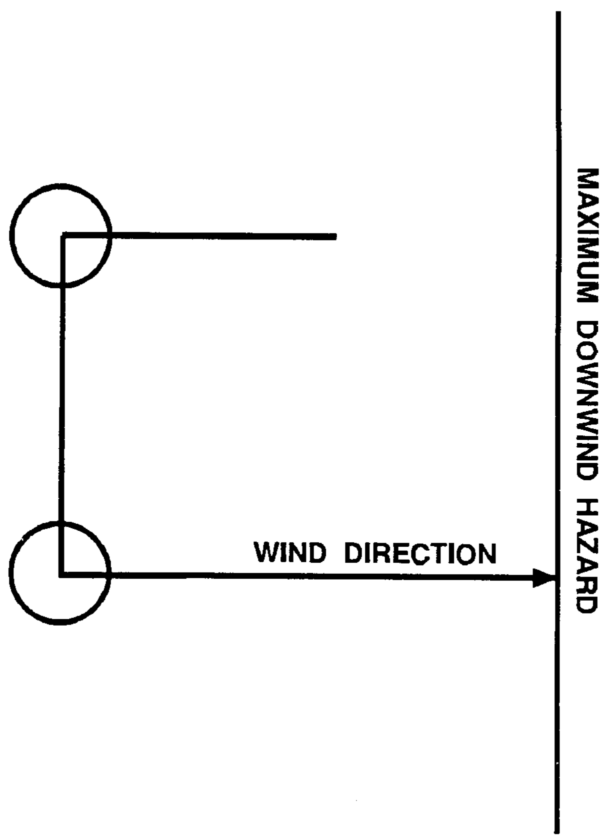
Example #6, Step 3



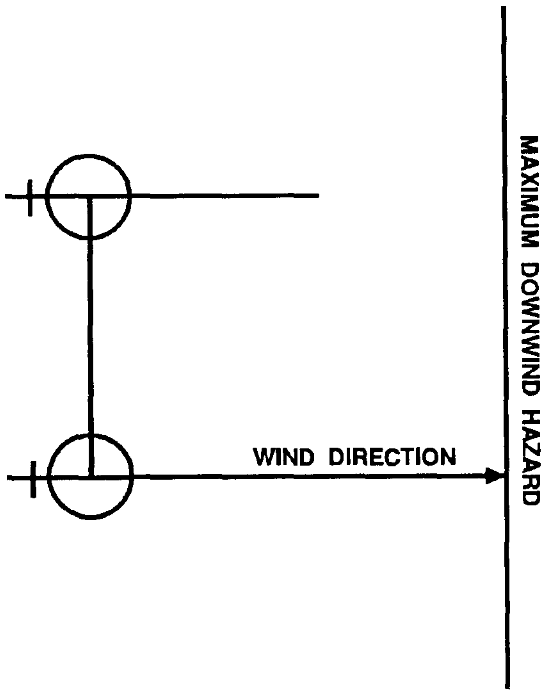
Example #6, Step 1
(Type A, Case b)

Example #6, Step 2

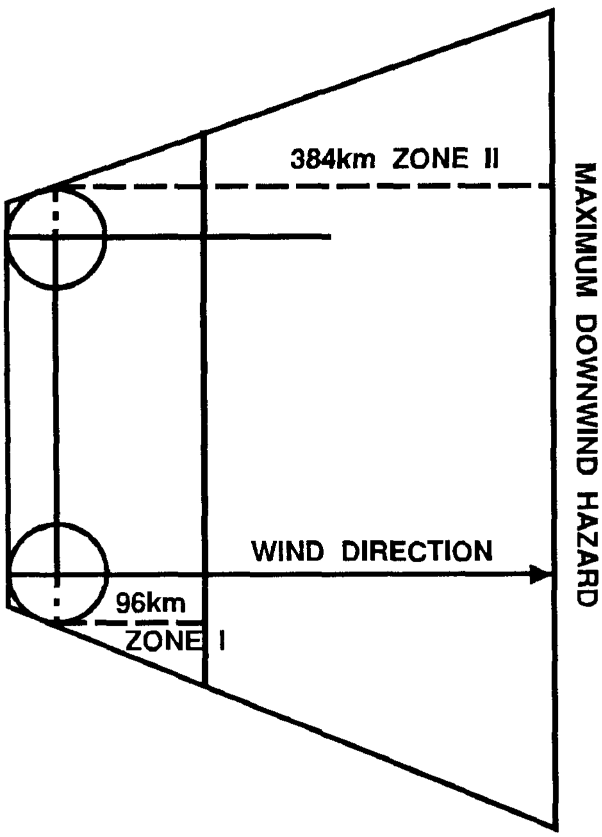
Example #6, Step 4



Example #6, Step 5



Completed Example #6



pathological sampling will be initiated only upon the knowledge and consent of the NBCC. Sample priorities are bulk agent and delivery systems, first environmental (contaminated vegetation, soil, water, and clothing), second; and biomedical (patient or autopsy tissue, urine, and sputum) samples, third.

The standard sampling kit is the M34 CBR agent sampling kit. This kit contains material necessary to obtain small liquid and solid samples. Directions for its use are contained in TM 3-6665-268-10. Additional sampling operation guidance is as follows:

- If the M34 kit is not available, a field expedient kit can be assembled from like materials with the help of supporting medical units.
- Hand-off points, sample couriers, special packaging and handling procedures, chain of custody, and diagnostic laboratory delivery points should be coordinated and specified in SOPs/OPLANs. Otherwise, the NBCC will have to coordinate and specify requirements between medical, intelligence, recon, and decon units not previously coordinated (along with any special requirements dictated by the situation).
- Commanders will ensure priority sample transport to diagnostic laboratories.
- Trained medics, intelligence, or chemical personnel should be utiliized as sample couriers.
- A strict chain of custody must be maintained. This allows samples to be traced to their origin.
- Sample data must accompany the sample.
- A1l samples will be in double containers to prevent leakage during transport.

Detailed sampling techniques are further described in FM 3-19, NBC Reconnaissance.

Evacuation of Biological Samples

Biological samples must be evacuated to the appropriate laboratory facilities for confirmation of a biological attack. Under normal circumstances labs will be established in the theater of operations to minimize confirmation time. CONUS Labs will also be utilized to verify the results of the theater labs. This information will then be disseminated to subordinate units to ensure that adequate protective measures are implemented for protection of both civilian and military personnel. Confirmation of an enemy biological attack will also be reported to the National Command Authority (NCA) for a decision concerning the appropriate military and diplomatic response. Figure 4-5 shows the standard chain of custody for the evacuation of biological samples.

Biological sampling and detecting on board ships follows the same format as described in this chapter except samples will be sent to the Navy Forward Laboratory for the area concerned.

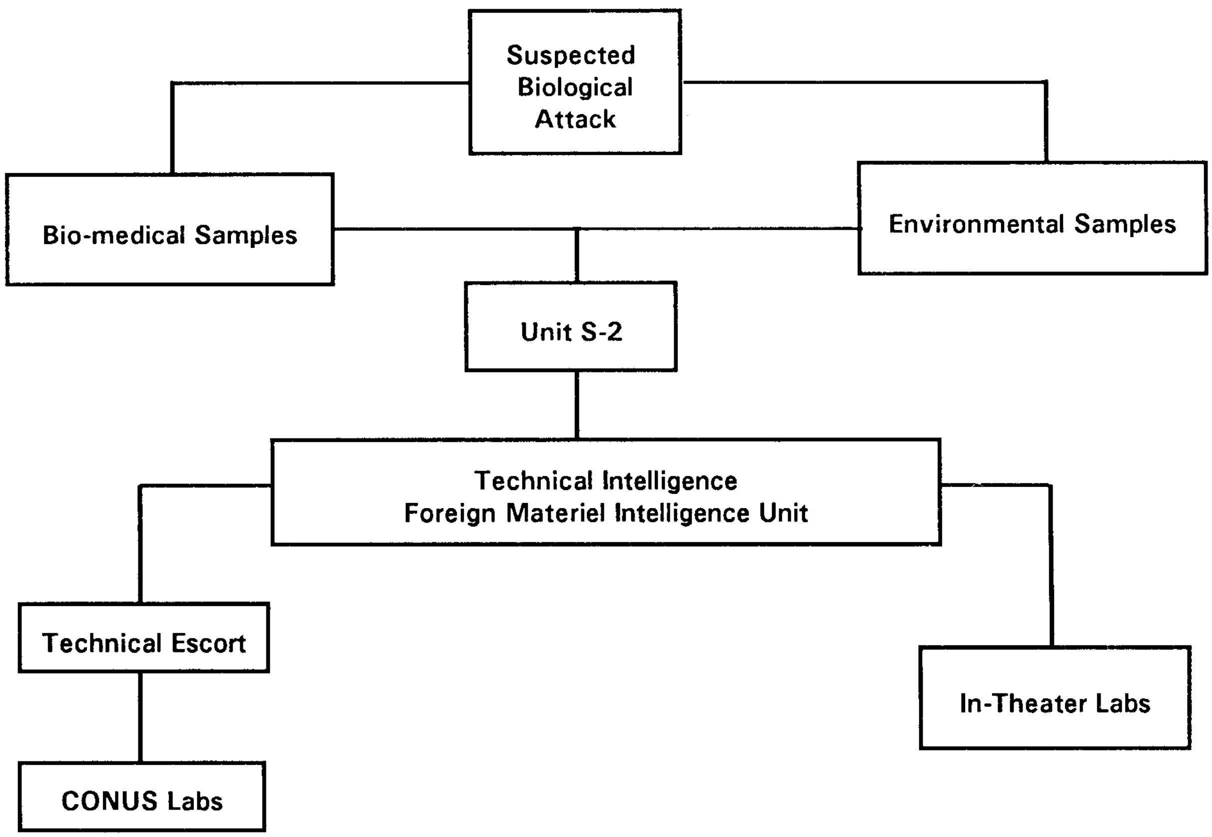

Suspected
Biological
Attack
Bio-medical Samples
Environmental Samples
Unit S-2
Technical Intelligence
Foreign Materiel Intelligence Unit
Technical Escort
In-Theater Labs
CONUS Labs

Figure 4-5