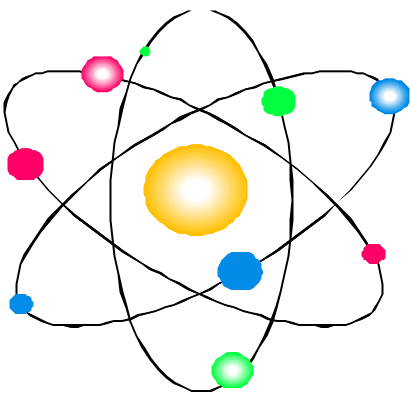
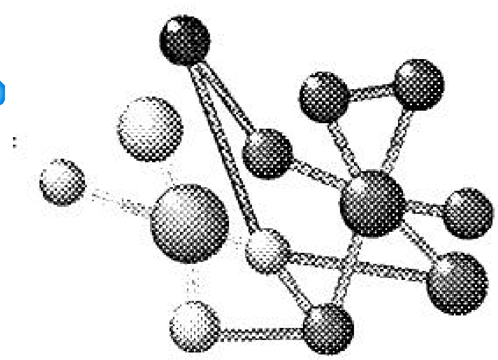
FM 3-14
MCRP 3-37.1A

NUCLEAR, BIOLOGICAL, AND CHEMICAL (NBC) VULNERABILITY ANALYSIS





Headquarters, Department of the Army
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Headquarters
Department of the Army
Washington, DC 12 November 1997

Nuclear, Biological, and Chemical (NBC) Vulnerability Analysis

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Change 1

Headquarters
DEPARTMENT OF THE ARMY
UNITED STATES MARINE CORPS
Washington, DC, 24 September 1998

NUCLEAR, BIOLOGICAL, AND CHEMICAL (NBC) VULNERABILITY ANALYSIS

FM 3-14/FMFM 3-37.1A, 12 November 1997, is changed as follows:

1. New or changed material is indicated by a BAR (|).
2. Remove old page and insert new page as indicated below:
3. File this transmittal sheet in front of the publication.

Remove Old Pages	Insert New Pages
3-5	3-5
3-6	3-6

Editor's NOTE: Required changes have been posted to the ADTDL version. This entailed deleting the follow text from the end of the first bullet under DU on page 3-8 of the ADTDL version (page 3-6 of the printed version) "…and clothing (MOPP4). The hazards of DU do not preclude entering contaminated vehicles to save lives or secure sensitive equipment. The primary hazard is unexploded ordnance."

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PREFACE

Enemy forces, terrorists, or warring factions may employ a variety of nuclear, biological and chemical (NBC) weapons in future conflicts, terrorism, or stability and support operations (SASO). The possible combinations of agents and delivery systems place military and civilians at risk at almost anytime or anyplace. Most nations can develop offensive NBC warfare capabilities through the restructuring of legitimate nuclear, medical, biotechnology, and chemical facilities. Additionally, the sale of technology and loss of control over weapons of mass destruction (WMD) increase the risk of employment against the US and its allies. Potential enemy nations or terrorist groups may believe these weapons provide a decisive advantage or psychological benefit against US forces and their allies.

The manual's purpose is twofold: a) aid chemical staff officers in conducting NBC vulnerability analyses and risk assessments during all phases of hostilities (pre-, conflict, and post-) and b) assist in advising commanders on force protection measures. Background information is provided for clarity or a baseline for understanding the chapter's focal points.

Chapter 1 addresses the intelligence preparation of the battlefield (IPB) and the chemical staff's role within the process.

Chapter 2 details friendly vulnerability analyses for enemy nuclear, biological and chemical weapons employment including low-level radiation, depleted uranium, and toxic industrial chemical concerns.

Chapter 3 outlines vulnerability reduction measures the chemical staff can advise the commander to implement for force protection.

The Appendices provide checklist formats for conducting risk assessments and possible employment indicators. Tables are included for information pertinent to vulnerability analyses.

The words "he" and "her" used in this manual represent both the masculine and feminine genders unless stated otherwise.

U.S. Marine Corps Publication Supersession: FMFRP 11-12, Chemical Hazard Assessment Guide, dated October 1990.

The US Army Chemical School is the manual's proponent. Submit changes for improving this publication on DA Form 2028 (Recommended Changes to Publications and Blank Forms) or any other available format and forward to:

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CHAPTER 1
INTELLIGENCE PREPARATION OF THE BATTLEFIELD

Prior to conducting vulnerability analyses, the chemical staff must identify the enemy's and/or terrorist's NBC offensive capabilities and intentions. This is accomplished through the intelligence preparation of the battlefield process. FM 34-130, *Intelligence Preparation of the Battlefield*, outlines this process in detail.

IPB is a systematic, continuous process of analyzing the threat and environment in a specific geographic area. It is designed to support staff estimates and military decision making. Applying the IPB process helps the commander selectively apply and maximize his combat power at critical points in time and space on the battlefield by:

- Determining the threat's likely course of action (COA).
- Describing your unit's operating environment and its effects.

IPB consists of four steps that are performed each time you conduct IPB:

- Define the battlefield environment.
- Describe the battlefield's effects.
- Evaluate the threat.
- Determine threat COAs.

Conduct IPB prior to and during the commander's initial planning for an operation, but also continue to perform IPB during the operation. Each process function is performed continuously to ensure IPB products remain complete and valid and the chemical staff is providing support to the commander and direction to the NBC intelligence system throughout the current mission and future operations.

IPB
Define the Battlefield Environment
Describe the Battlefield's Effects
Evaluate the Threat
Determine Threat COAs

Chemical Staff IPB Responsibilities

The intelligence officer (S2/G2) has primary responsibility for the command's IPB. However, he is not the only staff officer conducting IPB. He is responsible for facilitating the unit IPB effort, but he and his staff cannot provide all unit IPB requirements. Every commander and staff officer, including the chemical officer, must think through the effects the significant characteristics of the battlefield and other aspects of the environment have on both threat and friendly operations. Furthermore, every staff officer must prepare detailed IPB products and staff estimates tailored for his own functional area. The NBC estimate provides facts and assumptions for use in the decision making process. It can be a separate estimate; however, is it is normally included in the intelligence estimate (either written or graphically depicted). The chemical officer must work in coordination with the intelligence officer, understanding his focus on the "big picture."

A chemical officer's requirements guide for each IPB step follows:

Step 1. Define the battlefield environment. The battlefield environment identifies for further analysis specific features of the environment or activities within it, and the physical space where they exist, that may influence available COAs or the commander's decisions. This is done by:

- Identifying significant environmental characteristics. When identifying significant battlefield characteristics, consider threat forces and all other aspects of the environment that may have an effect on accomplishing the mission. These might include:

  - Geography, terrain, and weather of the area.
  - Population demographics (ethnic and religious groups, income).
  - Political and economic factors (leadership, clans, tribes).
  - Infrastructures (transportation and telecommunications).
  - Industrial and research facilities (nuclear power and waste facilities; weapon, chemical, pharmaceutical and dye plants).
  - Hospitals and universities.
  - Rules of engagement or legal restrictions (treaties and agreements).
  - Threat forces (including terrorist groups) and their capabilities.

Initially, examine each characteristic only in general terms to identify those of significance to the command and its mission. Further evaluation takes place during later steps of the IPB.

- Identifying limits of the command's area of operations (AO) and battlespace. The AO is the geographic area where the commander is assigned the responsibility and authority to conduct military operations (Figure 1-1). A thorough knowledge of the characteristics of this area leads to its effective use. The command's battlespace limits are determined by the maximum capabilities of a unit to acquire targets and physically dominate the threat. The command's capabilities in this regard include the target acquisition and long-range assets of supporting and higher commands as well as its own organic systems. The battlespace generally includes all or most of the AO, as well as areas outside of the AO.
- Establishing area of interest (AI) limits. The AI is the geographical area from which information and intelligence are required to permit planning or successful conduct of the command's operation. Because the commander and staff need time to process information and to plan operations, the AI is generally larger than its AO and battlespace

(Figure 1-1). The AI's limits include each of the characteristics of the battlefield environment you identified as exerting influence on available COAs or command decisions and on the threat's ability to project power or move forces into the AO.

- Identifying amount of detail required within the time available for IPB. Overcoming time limitation requires a focus on the most important IPB parts.
- Evaluating existing data bases and identifying intelligence gaps. A gap is any area in which sufficient detail is not known. Not all the information required to evaluate each battlefield characteristic's effects and each threat force will be in the current data base. Identifying the gaps early allows you to initiate action to collect the intelligence required to fill them.

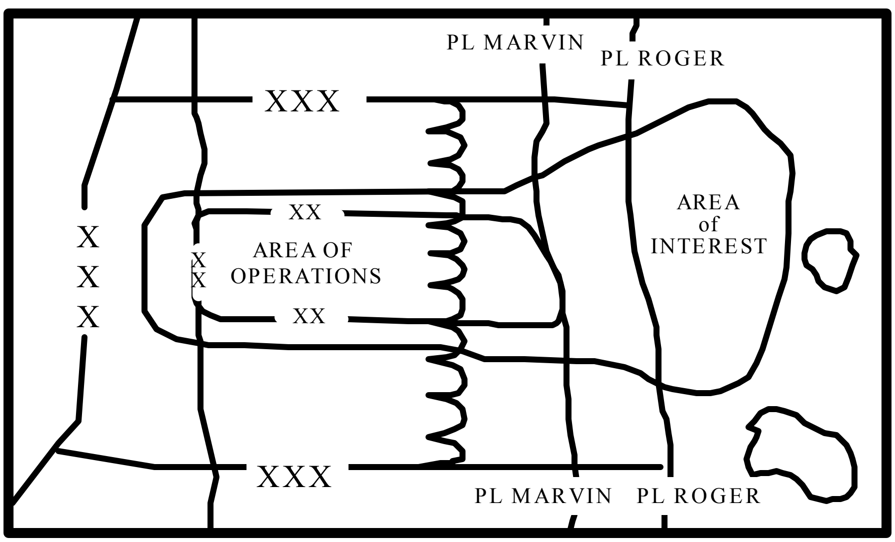

Figure 1-1. Battlefield Areas.

- Collecting any material or information required to conduct the remainder of the IPB. Initiate collection or request for information (RFI), through the S2/G2, to fill intelligence gaps to the level of detail required to conduct IPB. RFIs should contain specific questions for a particular event or disposition. RFI examples include:

  Are any NBC production, storage, or research facilities located in AI?
  - Does enemy have aerial chemical agent employment capability?
  - Has there been an increase in activity at NBC storage sites?
  - Are there special operations, intelligence, or terrorist units in AO?

In this step, the chemical officer would attempt to identify threat forces and their capabilities (such as delivery systems, chemical units), the geography, terrain, weather, and any relevant political factors. For example, is enemy's national or military leadership willing to use NBC weapons on own territory or expose population to NBC hazards? Again, examine each characteristic only in general terms to identify those of significance to the command and its missionFurther evaluation of characteristic effects takes place during later steps of IPB. For example, at this step the evaluation of threat

Step 1. Define the Battlefield Environment

Chemical staff must:

- Attempt to identify threat forces and their NBC capabilities, such as chemical units and delivery systems.
- Assess geography, terrain, weather, and any political factors, such as the enemy's national/military leaderships' willingness to use NBC weapons on their own territory or other's territory or expose civilian populations to NBC hazards.
- Define NBC area of interest.
- Obtain rules of engagement for responding to NBC events.
- Examine the area's infrastructure.
- Obtain information on the availability of reconnaissance assets.

forces is limited to an identification of forces that have the ability to influence the command's mission based on their location, mobility, general capabilities, and weapons ranges. During later steps you will actually evaluate each threat forces' specific capabilities and probable COAs.

Step 2. Describe the battlefield's effects. The determination of how the battlefield environment affects both threat and friendly operations. The specific steps are:

- Analyze the battlefield environment.
- Conduct terrain analysis.
- Conduct weather analysis.
- Analyze other battlefield characteristics.
- Describe battlefield's effects on threat and friendly capabilities and broad COAs.

The chemical staff must address terrain and weather effects on NBC operations (see Appendix F), such as soil type, surface drainage, vegetation type and distribution, precipitation, wind patterns, temperature, humidity, cloud cover, and topography. This information is key for chemical staffs to conduct NBC IPB. These variables affect agent and radiation persistency, effectiveness, and probable contamination areas. The chemical staff must also consider these variables for hazard prediction and reduction measures, such as decontamination. Most of this information can be found through a map analysis supplemented by reconnaissance (chemical, aerial, military intelligence or scout assets), the chemical downwind message (CDM), the effective downwind message (EDM), and any supporting weather elements.

Step 2. Describe the Battlefield's Effects

Chemical staff must:

- Address terrain and weather effects on NBC weapons.
- Obtain weather predictions.

Step 3. Evaluate the threat. Threat force capabilities and the doctrinal principles and tactics, techniques and procedures (TTPs) employed. This is done by:

- Updating or creating threat models, ideally before deployment.
- Convert threat doctrine and operational patterns to graphics (doctrinal template). Doctrinal templates illustrate the deployment patterns preferred by the threat's normal tactics when not constrained by the battlefield's environmental effects.
- Describe in words the threat's NBC employment tactics.
- Identify high-value targets (HVTs). HVTs are assets the threat commander requires for successful mission accomplishment.
- Identify threat capabilities. Threat capabilities are the broad COAs and supporting operations the threat can take to influence the accomplishment of the friendly mission. They take the form of statements such as:

> Enemy has the ability to deliver chemical weapons by fixed wing, artillery, rockets, cruise and ballistic missiles.
> Enemy chemical units are well trained in NBC operations.
> Enemy has previously used NBC weapons.

During threat evaluation, the chemical staff, in coordination with the intelligence officer, determines the enemy type/composition (NBC capable units) in the AO/AI , disposition (command and control posts, threat training status), capabilities (ranges and effectiveness of NBC delivery systems, types of WMD available, NBC protective and detection equipment available), and intent (national policy and NBC employment doctrine). A nuclear-capable threat normally bases employment doctrine on weapon type, yield, and delivery systems available. How the enemy employs biological weapons is dependent on similar factors, usually agents and delivery systems available. Enemy chemical employment doctrine can be classified into three groups: terrain-oriented, force-oriented, or a combination of the two. A terrain-oriented threat will attempt to use chemical agents, particularly persistent agents, to restrict terrain or shape the battlefield. A force-oriented threat directly targets troop concentrations. Both nonpersistent and persistent chemical agents can be used in a force-oriented attack.

Step 3. Evaluate the Threat.

Chemical staff must assist the G2/S2 in determining :

- Enemy type and composition, particularly NBC capable units in the AO/AI.
- Enemy disposition, such as command and control posts.
- Threat training status, especially NBC training.
- Threat capabilities, such as NBC delivery system ranges, weapons of mass destruction available, protective and decontamination equipment available, and possible covert or terrorist operations.
- National and military policy regarding NBC employment.
- Any previous NBC weapons use.
- NBC employment doctrine
- Probable employment indicators (Appendices D and E).

Step 4. Determine threat COAs. The identification and development of likely threat COAs that will influence accomplishment of the friendly mission. Specific steps are:

- Identify threat's likely objectives and desired end state.
- Identify the full set of COAs available to threat.
- Evaluate and prioritize each COA.
- Develop each COA in the amount of detail that time allows.
  Identify initial collection requirements.

In this step, the chemical staff combines the information developed previously to identify possible enemy NBC employment courses of action. Ensure each NBC employment COA meets the five criteria outlined in FM 34-130: suitability, feasibility, acceptability, uniqueness, and consistency with doctrine.

Once the S2 has identified the complete set of COAs, he develops each COA into as much detail as the situation requires and time allows. The chemical staff must ensure their input is included. Each developed threat COA has three parts:

- Situation template (SITEMP).
- Description of the COA and options.
- HVT listing.

Situation templates are graphic depictions of expected threat dispositions should he adopt a particular COA. They usually depict the most critical point in the operation as determined by the intelligence and operations officers. They are used to support staff wargaming and develop event templates.

The intelligence officer begins with the threat model representing the operation under consideration. He overlays the doctrinal template on the products that depict the battlefield's environmental effects on operations, usually the modified combined obstacle overlay (MCOO).

The dispositions are then adjusted to account for the battlefield environment. He also depicts locations and activities of HVTs, points where forces would transition from one formation to another, and potential assembly areas. He then develops time phase lines (TPLs) depicting threat movement based on doctrinal rates of movement, drawing them on the template to depict the expected progress of attacking forces, movement of reserves, and deep forces.

The description of COAs can range from narrative description to a detailed "synchronization matrix" depicting the activities of each unit and battlefield operating system (BOS) in detail. The intelligence officer will rely on staff experts, such as chemical officer, for help with each particular BOS.

After the intelligence officer identifies the set of potential threat COAs, the challenge is to determine which one the enemy will adopt. Initial collection requirements are planned to help answer this challenge. Identifying initial collection requirements revolves around predicting specific areas and activities, which, when observed, will reveal which COA the threat has chosen. These areas where key events are expected to occur are named areas of interest (NAI), see Figure 1-2.

An NAI can be a specific point, a route, terrorist target, industrial facility, or an area (as in the case of a predicted chemical strike). NAIs are used to confirm or deny enemy courses of action. The activities that reveal the selected enemy COA are called indicators. An indicator can be a positive or negative threat activity that points toward threat vulnerabilities or the adoption or rejection of a particular capability. They may result from previous actions or from threat failure to take action. The chemical staff ensures templated NBC events become NBC NAIs and are placed on the situation template for each COA. When templating the use of enemy chemical agents, the chemical staff must identify enemy trigger lines or decision points. This information is also valuable in conducting mission-oriented protective posture (MOPP) analysis, designating time-driven MOPP levels and automatic masking criteria.

> An excellent indicator for a threat COA is the placement of a persistent chemical strike prior to an enemy offensive operation. This is an area the enemy uses to shape the battlefield. He probably does not intend to use this terrain.

The differences between NAIs, indicators, and TPLs associated with each COA form the basis of the event template (EVENTEMP). The intelligence officer compares the NAIs and indicators associated with each COA against the others and identifies their differences, concentrating on the differences that provide the most reliable indications of adoption of each unique COA. He then marks the selected NAIs (from each COA) on the event template (Figure 1-3). The event template is the guide for collection efforts and reconnaissance and surveillance (R&S) planning. It depicts when and where to collect the information indicating which COA the threat has adopted. This impacts the chemical staff by driving the reconnaissance tasking for available chemical assets.

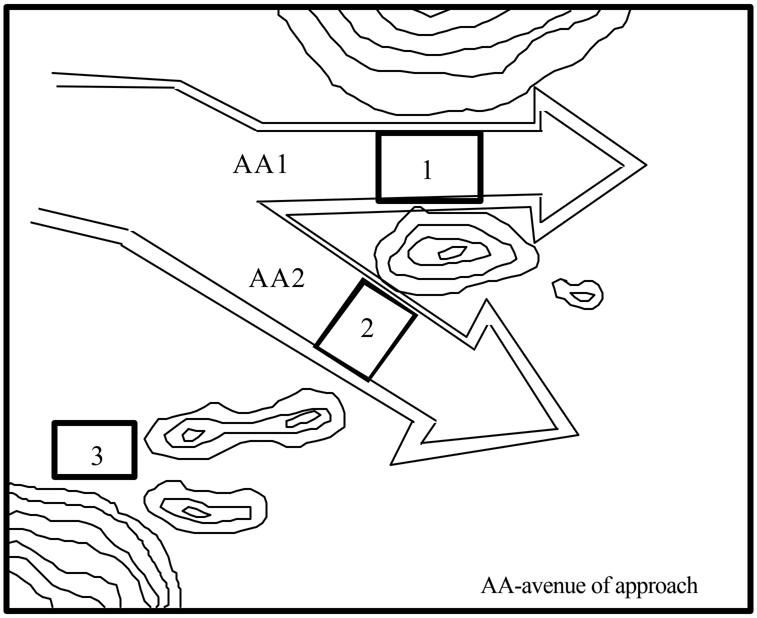

Figure 1-2. Named Areas of Interest.

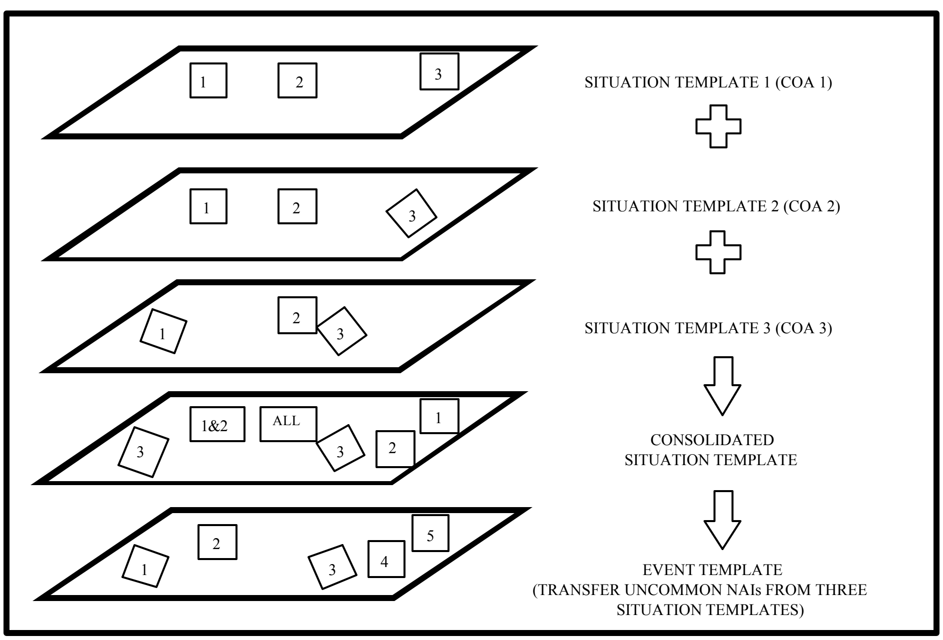

Figure 1-3. The Event Template Process.

The event matrix supports the event template by providing details on the type of activity expected in each NAI, the times the NAI is expected to be active, and its relationship to other events on the battlefield. Its primary use is in planning intelligence collection.

The commander directs the intelligence effort by selecting and prioritizing intelligence requirements. They support the commander in conducting and planning operations. The information the commander needs to visualize the outcome of current operations and the critical information the commander must understand to make timely decisions are called the commander's critical information requirements (CCIR). CCIR include information of both friendly and threat forces. These requirements focus the staff's efforts. It is the NBC staff's responsibility to assist the commander in prioritizing his WMD CCIR.

Threat COA models drive the wargaming of potential friendly COAs. They aid in decision support template development and other synchronization tools the staff uses during mission execution. As the chemical staff, you must coordinate with the intelligence section to ensure you understand threat doctrinal models to ultimately develop more detailed products and provide sound, timely advice to the supported commander.

During analysis and comparison of friendly COAs (staff wargaming), the staff identifies a set of intelligence requirements (IR) for each potential friendly COA. Each requirement supports a friendly decision expected to occur during execution of a COA. This is the basis of the command's list of intelligence requirements. To this list are added those received from higher units, in the form of intelligence acquisition tasks, and lower units, in the form of requests for intelligence. After arranging the list of requirements in priority order, the collection manager recommends the most important to the commander as priority intelligence requirements (PIR).

PIR are intelligence requirements that are critical to accomplishing the mission. They are usually related to the command's COA, becoming apparent during mission analysis and wargaming. They may, however, come from the intelligence requirements of higher or lower units. The commander approves the prioritized list of intelligence requirements and designates some of them as PIR. Only the commander can approve PIR.

Each PIR should come from the original list of intelligence requirements developed during wargaming. Hence, each should be focused, specific, and directly related to a friendly decision expected to occur during execution of the COA. Just as there are no standard situation templates or friendly COAs that will serve in all situations, there are no standard PIR. Good PIR have several things in common:

- They ask only one question.
- They focus on a specific fact, event, or activity.
- They provide intelligence required to support a single decision.

A good example for the chemical staff is-

- Will the enemy use chemical agents on our reserve force before it leaves AA Dragon?

Based on this PIR, the staff must wargame the command's response or reaction if the enemy does in fact use chemical agents on the reserve.

Step 4. Determine Threat Courses of Action

Chemical staff must:

- Template probable target areas for all COAs.
- Designate NAIs and overwatch responsibilities. NAIs include terrorist targets; N, B, or C industrial hazards; or routes, points, and areas of concern.
- Determine probable friendly ground point of penetration.

NBC IPB Summary

How do the NBC IPB efforts support the force? Once the initial IPB is completed (remember IPB is a continuous process), the information gathered drives:

- Vulnerability analysis.
- Automatic masking criteria.
- NBC threat status (FM 3-4, STANAG 2984).
- MOPP analysis.
- NBC protective measures.
- Chemical asset employment and task organization.

You, as the commander's advisor on NBC defensive operations, can provide a valid recommendation based on a logical thought process.

Once suspected strikes are templated, decontamination sites can be established to best support the force should it become contaminated. Stand-off detection, surveillance, and reconnaissance assets can be positioned to overwatch NBC NAIs or task organized to support a maneuver element, while smoke can be employed to counter the threat's capabilities.

IPB results and products are essential elements of the decision making process (see FM 101-5). Commanders and staffs use the decision making process to select a friendly COA and develop an operations plan (OPLAN), operations order (OPORD), or fragmentary order (FRAGO) to implement the COA.

Failure to conduct NBC IPB will result in failure to support your commander and the unit.

Chapter 2
VULNERABILITY ANALYSIS

Vulnerability analysis is a systematic method for estimating friendly casualties and/or consequences from enemy or terrorist NBC attacks. Then end state of vulnerability analysis is the chemical staff's recommendation to the commander on vulnerability reduction measures and to provide the information needed to make decisions concerning the acceptable level of risk in mission accomplishment.

Section A, Nuclear

The proliferation of nuclear-capable nations in all contingency regions increases the likelihood of US and allied forces being targets of nuclear attack. Deploying forces must be capable of accurately assessing the nuclear or radiological threat imposed by the opposing force and be capable of addressing unit vulnerability to attack or contamination. To assess a unit's vulnerability to nuclear attack, the commander determines the unit's protection level and the type and size of weapon likely to be employed by the enemy. The commander then weighs various courses of action to determine which one presents an acceptable risk while allowing for mission accomplishment. Appendix A provides a nuclear attack risk checklist.

Nuclear weapons are similar to conventional weapons insofar as their destructive action is due mainly to blast or shock. However, there are several differences between nuclear and high-explosive weapons. Nuclear explosions can be millions of times more powerful than the largest conventional detonations. Second, for the release of a given amount of energy, the material mass required for a nuclear explosion would be much less than that of a conventional explosion. Consequently, in the former case, there is a much smaller amount of material available in the weapon itself that is converted into hot, compressed gasses. This results in somewhat different mechanisms for the initiation of a blast wave (a shock wave in the air resulting from the

<u>Enemy WMD Uses/ Targets</u>

<u>Strategic</u>

- √ Break up coalitions.
- √ Inflict political defeat.
- √ Drive end-game bargains.
- √ Last act of defiance.

<u>Operational</u>

- √ Airfields and associated infrastructures/resources.
- √ Critical points of naval operations to include ships and supporting coastal facilities.
- √ Ground forces and their support facilities.
- √ Critical command, control, communications, and computer nodes.
- √ Logistics and supply depots.
- √ Civilian population centers, seats of government, industries.
- √ Overwhelm medical system.
- √ Disrupte sequence and timing of campaign.

<u>Tactical</u>

- √ Brak up assults.
- √ Facilitate attacks.
- √ Canalize forces.
- √ Shape the battlefield.

sudden increase in pressure). Third, the temperatures reached in a nuclear explosion are much higher than in a conventional explosion, and a fairly large proportion of the energy in a nuclear explosion is emitted in the form of light and hear, generally referred to as “thermal radiation.” This can cause skin burns and start fires at considerable distances. Fourth,the nuclear explosion is accompanied by highly penetrating and harmful invisible rays, called the “initial nuclear radiation.” Finally, the debris remaining after a nuclear explosion is radioactive, emitting similar radiation over an extended period of time. This in known as the “residual nuclear radiation,” “residual radioactivity,” or more commonly “fallout.”

Nuclear explosions also produce electromagnetic signals, referred to as “electromagnetic pulse (EMP).” These EMP induced currents and voltages can cause electronic component equipment failure, affecting communication equipment, global positioning systems, command and control nodes, vehicle ignition systems, avionics, and fire control systems.

Therefore, when addressing the unit’s vulnerability to nuclear weapons employment the chemical staff must consider blast or shock wave, thermal radiation, initial and residual radiation (fallout), and electromagnetic pulse. Remember, the potential exists for an enemy to employ a weapon that only produces one of these effects, for example radioactive dust particles or EMP. Consequently, the chemical staff must assess vulnerabilities to each effect, not just the greatest effect.

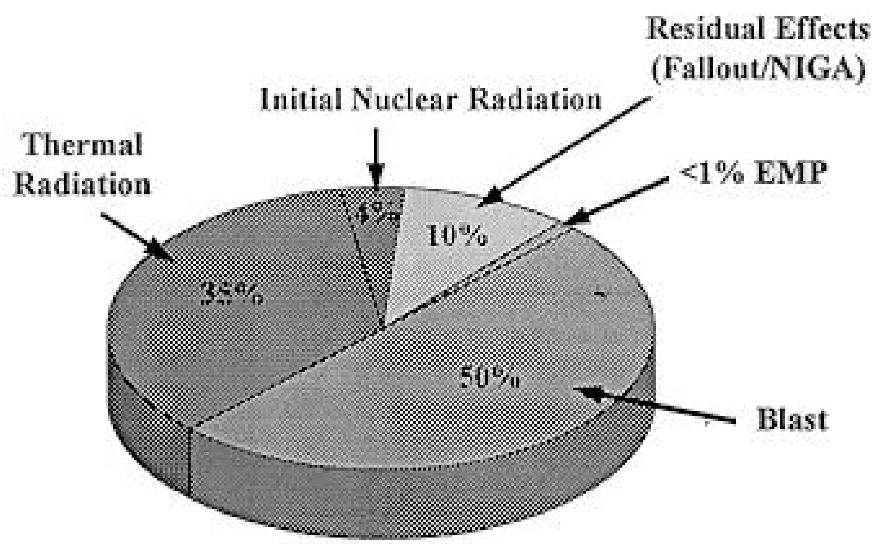

Figure 2-1. Nuclear Explosion Effects.

The immediate phenomena associated with a nuclear explosion, as well as the effects of shock, blast, and thermal and nuclear radiation, vary with the location of the point of burst in relation to the surface of the earth. For descriptive purposes, five types of burst are distinguished, although many variations and intermediate situations can arise in practice.

The main burst types are air (exploded below 100,000 feet, but the fireball does not touch the earth's surface), high-altitude (above 100,000 feet), underwater, underground, and surface. Although there are five types, there is no clear line of demarcation between them. As the explosion's height is decreased, a high-altitude burst becomes anairburst and an airburst will become a surface burst, and so forth.

The following descriptions mainly concern air and surface bursts, those strikes with the most military significance:

Blast (or shock) wave. A fraction of a second after a nuclear explosion, a high-pressure wave develops and moves outward from the fireball. This is the blast orshock wave that is the cause of much destruction accompanying an airburst. The front of the wave (the shock front) travels rapidly away from the fireball, behaving like a moving wall of highly compressed air. When the blast wave strikes the surface of the earth, it is reflected back, similar to a sound wave producing an echo. This reflected blast wave, like the original (or direct) wave, is also capable of causing material damage. At a certain region on the surface, the position depending chiefly on the height of the burst and the energy of the explosion, the direct and reflected wave fronts merge. This merging is called the "Mach effect." The overpressure (the pressure in excess of the normal atmospheric value) at the front of the Mach wave is generally about twice as great as that at the direct blast wave front. Strong transient winds are associated with the passage of the shock and Mach front. These blast winds are much stronger than the ground wind due to the updraft caused by the rising fireball, which occurs at a later time. The blast winds may have peak velocities of several hundred miles an hour fairly near to ground zero. It is evident that such strong winds can contribute greatly to the blast damage resulting from the nuclear weapon explosion.

Nuclear Effects' Arrival Times

Time After Detonation

Less than a second	Less than a minute	Min/hrs/days
Prompt gamma rays	Airblast	Residual radiation
Electromagnetic pulse	Ground shock	Communication/ radar blackout
Neutrons	Dusk/Debris	Firestorms
Initial thermal radiation	Cratering	High-altitude dust
Major portion of thermal radiation		

Thermal radiation. In an ordinary airburst, roughly 35 to 40 percent of the total energy yield of the explosion is emitted as effective thermal radiation. A nuclear airburst can cause considerable blast damage, but thermal radiation can result in serious additional damage by igniting combustible materials, thus creating fire hazards. In addition, thermal radiation is capable of causing skin burns and eye injuries to exposed persons at distances at which fuels are not ignited. One of the serious consequences is the production of "flash burns" resulting from the absorption of radiant energy by the skin. In addition, because of the focusing action of theeyelens, thermal radiation can cause permanent eye damage to personnel who happen to be looking directly at the burst. However, suchdirsct viewing will be rare. Yet, the temporary loss of visual acuity (flash blindness or dazzle) resulting from the extreme brightness, especially at night, will be much more frequent. This may be experienced no matter what direction the individual is facing.

Initial radiation. The initial nuclear radiation generally refers to the radiation emitted within 1 minute of the detonation. This radiation consists of gamma rays, neutrons, beta particles, and a small proportion of alpha particles. Most of the neutrons and part of the gamma rays are emitted in the fission and fusion reactions, simultaneously with the explosion. The remaining gamma rays are produced in various secondary nuclear processes, including decay of the fission products. The beta particles are also emitted as the fissionproducts decay. Some of the alpha particles result from the normal and radioactive decay of the uranium or plutonium that has escaped fission in the weapon, and others (helium nuclei) are formed in fusion reactions. The ranges of alpha and beta particles are comparatively short and they cannot reach the surface of the earth from an airburst. The range of an alpha particle depends on its initial energy, but even those from plutonium which have a moderately high energy have an average range of only 1.5 inches in air. Many of the beta particles travel a distance of about 10 feet before they are absorbed. Even when the fireball touches the ground, the alpha and beta particles are not very important. Thus initial radiation may be regarded as consisting only of gamma rays and neutrons produced during a period of 1 minute after the explosion. Gamma rays and neutrons can travel considerable distances through the air and cause significant injuries, regardless of the fact that the energy of the initial gamma rays and neutrons is only about 3 percent of the total explosion energy.

This initial nuclear radiation can also affect material, especially that used in electronics, such as communication systems and computers. These effects are commonly referred to as transient radiation effects (TRE). The effect on electronics is referred to as transient radiation effects on electronics (TREE). The adjective “transient” applies to the radiation since it persists for a short time. However, the damage can be temporary or permanent.

Residual radiation. The residual radiation is defined as that which is emitted later than 1 minute from the instant of the explosion. The primary hazard of the residual radiation results from the creation of fallout particles that incorporate the radioactive weapon residues and the induced activity in the soil, water, and other materials in the vicinity of the explosion. These particles may be dispersed over large areas by the wind and their effects may be felt at distances well beyond the range of the other effects of a nuclear explosion. A secondary hazard may result from the neutron-induced gamma radioactivity (NIGA) on the earth’s surface in the immediate vicinity of the burst point. Fallout is broken into early (local) and delayed, with early defined as that which reaches the contamination over large areas and can represent an immediate physiological hazard. Delayed fallout consists of very fine, invisible particles which settle in low concentrations over a considerable portion of the earth’s surface. The radiation from the fission products and other substances is greatly reduced as a result of radioactive decay during the relative long time the delayed fallout remains suspended in the atmosphere. Consequently, delayed fallout radiation pose no immediate danger to health, although there may be long term hazards.

Electromagnetic pulse. The instantaneous gamma rays emitted in the nuclear reactions and those produced by neutron interactions with weapon residues or the surrounding medium are basically responsible for the processes that give rise to EMP in the lower atmosphere. The gamma rays interact with air molecules and atoms and produce an ionized region surrounding the burst point. Nuclear explosions of all types are accompanied by an EMP. The strongest electric and magnetic fields are produced near the burst by explosions at or near the earth's surface, but for those at high altitudes, the fields at the earth's surface are strong enough to be of concern for electrical and electronic equipment over a very much larger area. Space-based nuclear bursts can damage ground-based electronic equipment, however, and are usually employed to destroy communications or monitoring satellites.

A unit's vulnerability to nuclear attack depends on the warhead yield, the unit's available protection, and its dispersion. Table 2-2 assists in estimating the damage caused by a nuclear detonation. The table is safesided and simplified and assumes the worst case of a ground zero (GZ) nuclear burst and uniformly dispersed equipment/positions.

Nuclear explosion's biological effects are measured according to the amount of centigrays to which personnel are exposed. For the biological effects of radiation refer to Appendix F, Table F-1. Radiation casualty criteria are divided into three levels (Table 2-1).

Table 2-1. Radiation Casualty Criteria.

Response	Criteria Initial Dose (cGy)
	Physically Demanding/Physically Undemanding
Immediate Permanent Ineffectiveness (IPI)	8,000 for both
Immediate Transient Ineffectiveness (ITI)	3,000/3,800
Latent Ineffectiveness (LI)	450/600

- Immediate Permanent Ineffectiveness (IPI) At 8,000 cGy, personnel become ineffective within 3 minutes of exposure and remain ineffective until death (usually within one day).
- Immediate Transient Ineffectiveness (ITI). At 3,000 cGy for physically demanding tasks or 3,800 cGy for physically undemanding tasks, personnel become ineffective for any task within 3 minutes of exposure and remain so for approximately 7 minutes. Personnel recover to greater than 75 percent of their pre-exposed performance levels after about 10 minutes and remain so for about 30 minutes. Their performance degrades for around 5 hours for undemanding tasks or 2 hours for demanding tasks, when radiation sickness becomes so severe that they are ineffective. They remain ineffective until death (usually 5-6 days).
- Latent Ineffectiveness (LI). At 450 cGy for physically demanding tasks or 600 cGy for physically undemanding tasks, personnel will become performance degraded (PD) within 3 hours and remain so until death some weeks post-exposure, or become combat ineffective (CI) at any time within 6 weeks post-exposure).

Combat ineffective personnel, function at less than 25% of their pre-irradiation performance levels. CI is manifested by shock and coma at the high-dose levels. At lower dose levels, CI is manifested by a slowed rate of performance resulting from physical inability and/or mental disorientation.

Performance degraded personnel, while not CI, function at between 25% and 75% of their pre-irradiation performance levels. They suffer acute radiation sickness in varying degrees of severity and at different times. Radiation sickness is manifested by various combinations of projectile vomiting, propulsive diarrhea, hypertension, dry heaving, nausea, lethargy, depression, and mental disorientation. In an active nuclear environment, the more concentrated a unit is, the more lucrative a target it becomes. If the unit itself is not the target but falls within the fallout pattern, unit monitors will be capable of providing the commander with essential information regarding the hazard. Nuclear hazard prediction is addressed in FM 3-3-1/FMFM 11-18, Nuclear Contamination Avoidance.

Based on vulnerability radius and unit size, commanders may determine risk to the unit from a nuclear attack and whether or not to adjust unit dispersion. However, personnel may not be the target. Often a unit's equipment, due to sensitivity and vulnerability, becomes the target.

The information in Table 2-2 is for planning purposes only. For actual vulnerability radii refer to Joint Publications (JP) 3-12.2 (Secret Restricted Data (SRD)).

Two techniques to evaluate friendly unit vulnerability to nuclear detonations are (1) a technical approach in which unit dispersions are compared with the effects of an expected weapon yield, and (2) and operational approach in which unit dispositions are compared with targeting criteria used by the threat target analyst.

The primary tool for analyzing friendly dispositions is the radius of vulnerability (RV). RV is the radius of a circle within which friendly troops will be exposed to a risk equal to, or greater than, the emergency risk criterion 5 percent combat ineffectiveness) and/or within which material will be subjected to a 5 percent probability of the specified degree of damage (see the RV tables in JP 3-12.2(SRD) or JP3-12.3).

The GZ for the R V is always assumed to be the point where detonation will do the greatest damage to the friendly unit or installation. Delivery errors are not considered. For RV of categories not given, see comparable table chard in JP 3-12.2 (SRD) or JP 3-12.3.

Analyzing then vulnerability of friendly dispositions and installations consists of:

- Determining the appropriate threat yields based on current intelligence.
- Determining the disposition of friendly unit personnel.
- Obtaining the appropriate vulnerability radii from the RV table.
- Estimating fractional coverage for each target category, using the visual, numerical, or index technique. For information concerning these techniques reference JP 3-12.2 (SRD) (visual technique is discussed below).
- Recommending ways to decrease vulnerability and increase protection.

To determine vulnerability using the visual technique, outline the unit battle position. Use a compass, a piece of plastic with the RV drawn to scale on it, or a circular map scale. Superimpose the RV chosen from Table 2-2 or JP 3-12.2 (SRD) over the predicted targeted area.

The GZ used for the analysis is the location that would result in the highest fractional coverage of the target. From this worst case GZ and the appropriate RV, an estimation of the percentage of casualties or materiel damage that might result from an enemy nuclear strike may be determined.

Using the center point of the compass, template, or circular map scale as the GZ, choose the GZ that would result in the highest fractional coverage of the target area. Visually estimate the percent of the unit covered by the RV.

If this fractional coverage yields unacceptable losses of personnel or equipment, the commander must then make a decision of how to best reduce this casualty rate. This may be done by adding shielding or enacting vulnerability reduction measures (see Chapter 3).

If a mechanized battalion occupies a battle position 5 km wide and 2.5 km deep, it could be positioned as in Figure 2-2. Target elements are uniformly dispersed in the area. In this example, the RV for personnel is armored personnelcarriers from a 5-kiloton weapon is 1250 meters (as determined from Table 2-2). Worst cast the RV by placing the GZ where it provides the highest target coverage. Fifty percent of the battalion is covered by the RV, thus up to 50 percent of the battalion's personnel in armored personnel carriers could become casualties. When the same battalion deploys in three company battle positions in depth, the distances between positions significantly reduce the damage possibility, even assuming the weapon detonates at the worst case GZ. In Figure 3-4, although one company is 100 percent vulnerable, the battalion overall is only 33 percent vulnerable.

Table 2-2. Radii of Vulnerability (RV)(meters). Notes: a) To obtain RV, enter yield column at nearest listed yield, b) Unclassified, For Planning Purposes Only.

Category	Personnel In - (Latent ineffectiveness, based on governing effect.)					Moderate Damage				Severe Damage		
						Wheeled Vehicles		Tanks	Towed Arty	Supply Depot	Randomly Parked Helicopters	
Yield (kt)	Open	Open Fighting Position	APC	Tank	Earth Shelter	Exp	Shld				Cargo Transport	Light Observ
0.1	700	600	600	500	300	200	150	100	100	100	400	500
0.5	900	800	800	700	450	300	250	200	200	200	500	800
1	1200	900	900	800	500	400	350	300	250	250	700	1100
2	1700	1000	1100	900	600	500	450	400	300	300	850	1300
3	2000	1100	1200	1000	700	600	500	500	400	450	1000	1600
5	2500	1200	1250	1100	800	700	600	600	500	500	1200	1900
10	3200	1300	1300	1250	900	800	700	700	600	600	1500	2500
15	3700	1400	1400	1300	950	900	800	800	700	700	1800	2800
20	4000	1500	1450	1400	1000	1000	900	900	800	800	1900	3400
30	5000	1600	1500	1500	1100	1200	1100	1000	900	950	2200	3700
40	5500	1700	1600	1600	1200	1400	1250	1100	1000	1200	2500	4100
50	6000	1800	1700	1700	1300	1700	1500	1200	1200	1400	2700	4500
100	8000	1900	1800	1800	1400	2200	1900	1300	1300	1700	3200	5700
200	12000	2000	1900	1900	1500	2500	2000	1500	1500	1900	3700	6200
300	14000	2100	1950	1950	1600	3000	2100	1600	1600	2000	3800	7100

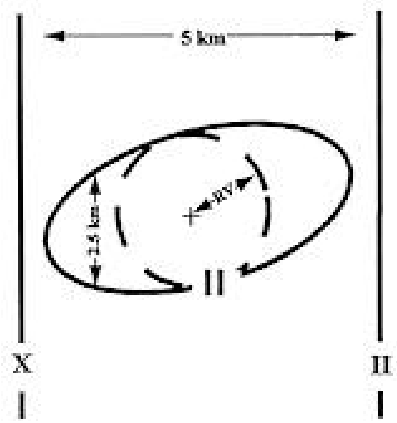

Figure 2-2. Single Position (not to scale).

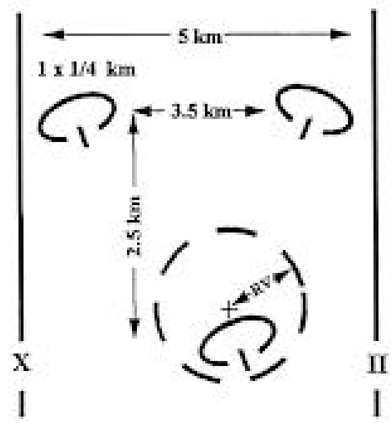

Figure 2-3. Multiple Positions (not to scale).

Section B,
Low-Level Radiation (LLR) and Depleted Uranium(DU)

LLR. In addition to the nuclear detonation threat, there exists, in all operations, the possibility of a low level radiation threat. This threat can exist in certain expended rounds, damaged or destroyed equipment, or contaminated shrapnel. It also may occur from inadequate nuclear waste disposal, deterioration of nuclear power facilities, damage to facilities that routinely use radioactive material/sources, and terrorism. Commanders must be aware threat forces could use radiological hazards to increase tensions.

LLR exposure produces a risk to soldiers of long term health consequences. The doses received from these exposures are higher than those routinely received by heath physics workers and the general public and are in the range from background radiation to 70cGy. The primary consequence of exposure may be induction of cancer in thelonger term post exposure with several additional risks. These hazards may result from alpha, beta, or gamma radiation.

DU. All uranium extracted from ore is composed of three primary isotopes of uranium. Thes are U-234, U-235, and U-238. Natural uranium contains 99% U-238, .72% U-235, and .005% U-234. Depleted uranium is uranium that has had some of the U-235 removed, resulting in a change in the isotopic composition.

Depleted uranium has qualities that lend themselves to military and industrial uses. Uranium metal is very dense, even more than lead, and has a relatively high melting point, 1132 degrees Celsius. It is a lustrous metal resembling iron and is ductile and malleable. It can be rolled and drawn into rods, tubes, wire, sheets, and so forth. It is an inexpensive by-product of nuclear fuel production, essentially a waste product. It has a very low specific activity, although it is radioactive. DU is pyrophoric (it will spontaneously burn and ignite) and produces large quantities of heat.

Because of its qualities, DU is used for counterbalances for rotating mechanisms, counterweights, ballast, dampening, vibration, and balancing control surfaces. It is particularly effective when used as a penetrator in anti-tank and armor-piercing munitions, as in the M1 Abrams tanks and M2/3 Bradley vehicles. It can also be used as spotter rounds and in nuclear weapons.

There are disadvantages to DU, which is where the vulnerability arises. As stated earlier, it is radioactive and must be treated as such. DU found in munitions does not present significant radiation hazards as long as the round is intact. However, care must be taken around vehicles that have been hit or destroyed by FU munitions and any resulting fires or explosions. Internal exposure is the primary hazard. This internal hazard is caused by DU's heavy metal toxicity and radiological hazard. Alpha radiation, the principle radiation emitted from uranium, is easily shielded. However, if the uranium is inhaled or ingested into the body, there is no shielding between the radiation and living cells. If inside the body, all the radiation (alpha, beta, and gamma) irradiates body tissues. In addition, since the source is inside the body, irradiation is continuous. See Chapter 3 for vulnerability reduction measures.

BACKGROUND HISTORY

During WW II, the US implemented an all-out effort to develop a nuclear weapon, the atomic bomb. This effort was called the "Manhattan Project." Part of the processes required fissionable material to produce the bombs. Two isotopes were identified as being fissionable, U-235 and plutonium-239. The fissionable isotope of uranium, 235, was extremely difficult to separate from the other uranium isotopes. It could not be done chemically since all uranium reacts the same in chemical processes. Gas diffusion was developed. It was very slow, tedious, and costly; however, the final product was a highly purified U-235. The waste was uranium from which much of the 235 isotope had been removed, that is, depleted uranium.

Section C, Biological

The potential for biological attack against US forces is greater today than at any time in modern history. The variety of biological agents and their delivery systems make a careful, thorough IPB a necessity. Biological delivery systems have the potential to cover larger areas than any other weapon system, in the order of thousands of square kilometers. Very large numbers of infective doses can be provided by a very small volume of biological agent due to the organism's microscopic size, its ability to replicate in victims, its potential transmissibility, and the extreme toxicity when compared to classical chemical weapons.

Biological agents are generally directed against the respiratory system to maximize the organism's effect to diffuse directly into the bloodstream and bodily tissue. While none of the recognized biological warfare (BW) agents are thought to be developed for their percutaneous effects, some secondary hazards are unavoidable and must not be overlooked.

Expect dissemination in the early morning and late evening when air stability is optimal and direct sunlight (ultraviolet (UV) rays) is minimal. Once settled out of the air, reaerosolization is minimal.

Most BW agents decay rapidly when exposed to the environment, especially in direct UV rays. Anthrax spores are an exception in that they may blend in with the soil that provides protection from natural decay for long periods, months to years. Tables F2 through F6, Appendix F in this manual, list possible biological agents and diseases (not all-inclusive).

This section addresses the tools required for the chemical staff to conduct an effective biological vulnerability analysis and provide a feasible recommendation to the supported commander.

Prior to conducting vulnerability analysis, we must first determine the unit's risk of biological attack or the enemy's capability and probability of use (Figure 2-4). A checklist format is provided in Appendix B, while possible employment indicators can befount in Appendix D.

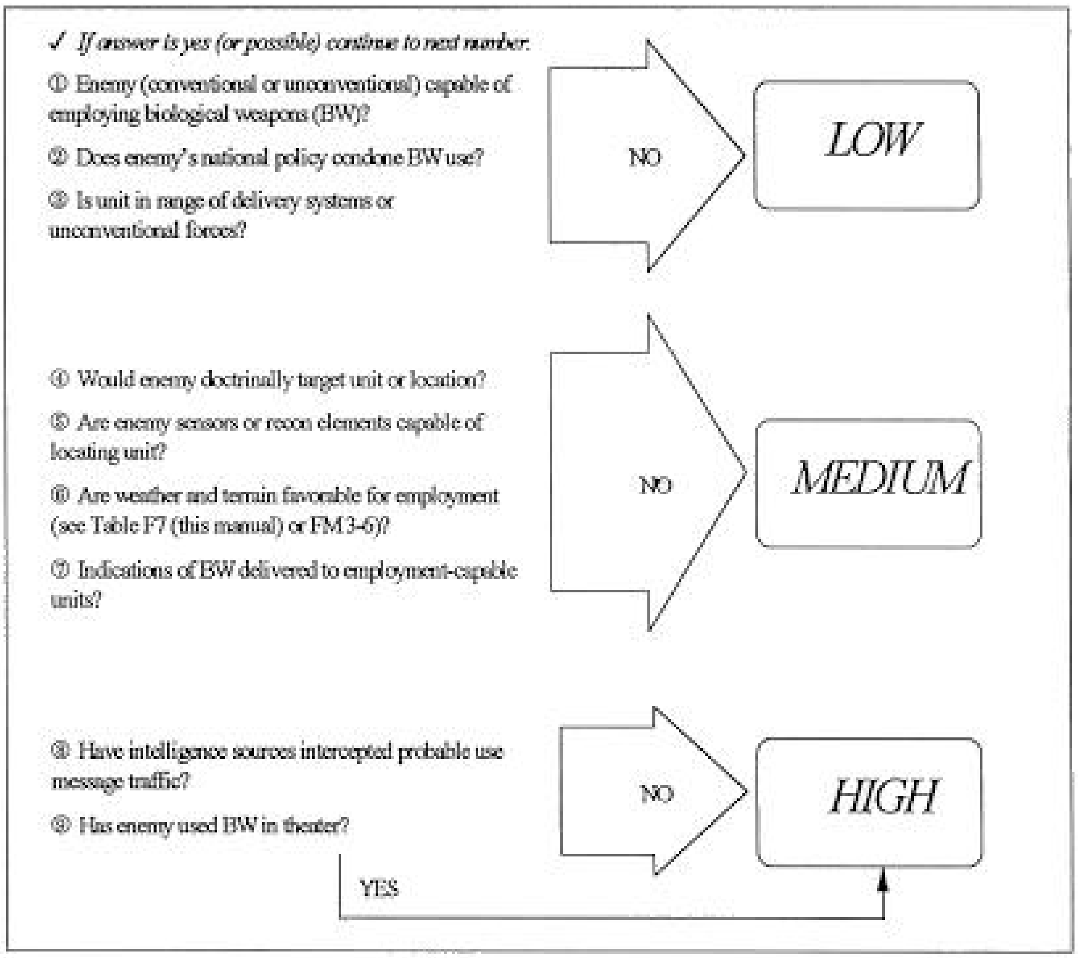

Figure 2-4. Biological Attack Risk

Once you have determined the enemy has the capability and the possible willingness to employ biological weapons (remember, even if an enemy has no capability to employ biological weapons, the unit is still vulnerable to endemic diseases), the next step is to determine the unit's vulnerability to an attack (Table 2-3):

- Determine immunization levels in relationship to predicted agents.

- Unit's protective posture
- Current or projected maneuver status.
- Unit's hygienic practices, such as are troops provided means to bathe/cleanse regularly?

Begin at the left column and successively add the values from each following column.

Table 2-3. Biological Vulnerability Rating Matrix

IMMUNIZATION (AGAINST PREDICTED AGENTS)	PROTECTIVE POSTURE	HYGIENE	DISPOSITION
COMPLETE (>=90%)-2	MOPP 3, 4-2	GOOD -2	MOBILE-2
INCOMPLETE (<90%)-4	*MOPP 1, 2, MASK ONLY-4	AVERAGE -2	SEMI-MOBILE-2
NONE-6	MOPP READY, ZERO-6	POOR-3	STATIC-3
RELATIVE VALUES TOTAL	SUBJECTIVE VULNERABILITY RATING		
6-10	LOW		
11-14	MEDIUM		
15-18	HIGH		
* If "mask only" protective posture provides required protection for predicted agent, use a value of 2.			

Ratings are subjective in nature. Apply rating measures in relationship to probable agent of use. Also, ratings do not consider troop motivation/moral factors.

The final rating provides a general vulnerability analysis and should be used as a basis for a thought-process leading to sound recommendations to the commander on vulnerability reduction measures. See example on following page.

EXAMPLE: BIOLOGICAL VULNERABILITY ANALYSIS

1. Biological attack risk: Enemy is capable of employing biological agents, national policy condones use, would doctrinally target and can locate unit, and is trained and equipped to operate in BW environment; however, weather is not favorable. These factors place unit in medium category for attack risk.

2. Vulnerability analysis: Go to unit vulnerability rating matrix; approximately 30% of Unit has been immunized against predicted agents (value of 4), unit is currently in MOPP ZERO (6), practices good hygienic measures (1), and is in a static position (3). Adding the values shows a relative values total of 14; therefore, the unit would be at a high vulnerability rating. This simple analysis provides the chemical staff a basis to advise the commander on his unit's vulnerability (and the reasoning used) and, more importantly, provide vulnerability reduction measures (Chapter 3).

Section D, Chemical

The purpose of chemical vulnerability analysis is to determine how susceptible a unit is to enemy chemical attack, thereby identifying possible reduction measures.

The enemy generally employs nonpersistent agents over terrain that is planned for crossing or occupation. Nonpersistent fires force troops to assume and maintain protective posture for prolonged periods, thereby degrading combat effectiveness.

ENEMY USE OF NONPERSISTENT AGENTS

- Produce immediate casualties among unprotected troops.
- Restrict friendly use of terrain or objectives (limited).
- Degrade friendly combat effectiveness by forcing protective posture and creating confusion and stress, especially among leaders.

The enemy employs persistent agents over terrain he plans to avoid or against rear area targets. These fires force troops into protective posture for extended periods, force decontamination operations, disrupt logistical operations and deny ports of entry.

ENEMY USE OF PERSISTENT AGENTS

- Produce casualties among unprotected troops.
- Restrict use of terrain, facilities, such as ports and airfields, and equipment.
- Degrade friendly combat effectiveness by forcing protective posture and creating confusion and stress, especially among leaders.

- Delay friendly movement, such as repositioning or flanking moves.

Prior to conducting vulnerability analysis, we must first determine the unit's risk of chemical attack or the enemy's capability and probability of use (Figure 2-5). A checklist format is provided in Appendix C, while Appendix E provides possible enemy employment indicators.

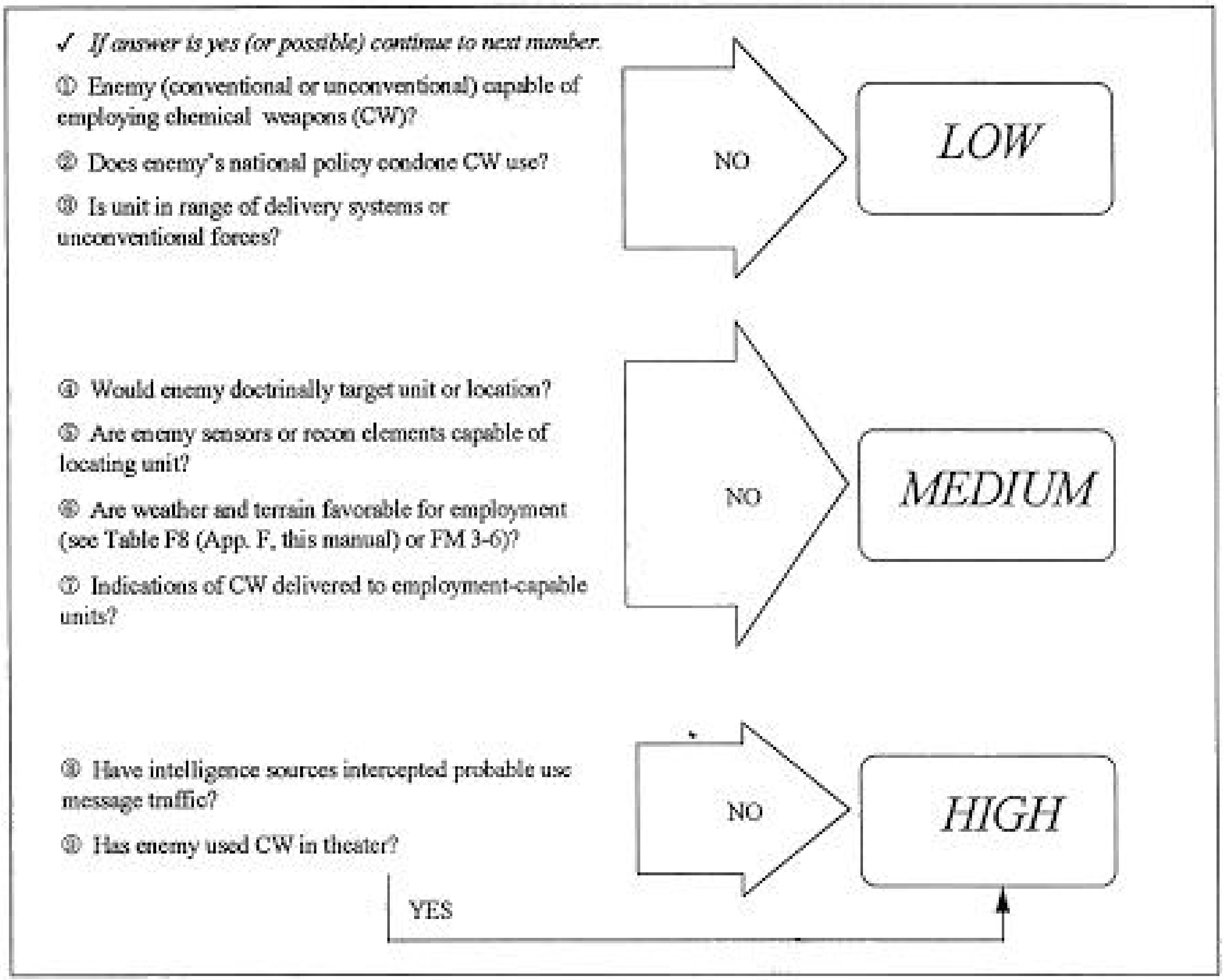

Figure 2-5. Chemical Attack Risk.

If the possibility exists for the enemy to employ chemical agents, the chemical staff must conduct a vulnerability analysis. Conduct the analysis in two parts. First, make an estimate of the treat's capability to employ chemical munitions in the unit's AO/AI within a specific time period. Second, use this information to generate simplified effects information.

ESTIMATE DELIVERY CAPABILITY

Step 1. Determine time periods of interest. Time periods of interest are determined based on the commander's operational concept and situation variables ((METT-T) mission, enemy, terrain, troops, and time available). The time period is determined by the chemical staff in coordination with the intel and operation officers. They will normally conform to phases or the expected duration of an operation; however, it may be desirable to use other criteria. For example, a light infantry unit may want to use the expected time lag between an anticipated enemy chemical attack and the arrival of their protective gear (as in "MOPP READY" protective posture) as the time period of interest. A time period may also be based on factors relating to enemy tactics, such as the expected arrival time of a second echelon force. Further, significant weather changes could also influence the selection of time periods. The time period of interest can range from 6 to 48 hours. Vulnerability analysis is generally conducted in support of the planning process, not in support of current operations. A brigade-planning window usually focuses on a 12 to 48 hour period, with time periods of 24 hours or greater used when IPB allows. Time periods of less than 6 hours are generally not used. For short-term actions, shorter time periods could be used to estimate the effects of initial enemy preparation fires or to estimate the effect of a single chemical attack.

Step 2. Associate weather data with each time period. Associate each time period with a temperature, wind speed, and stability category. All required information can be obtained from the CDM. Temperature will impact primarily on agent persistency. For each time period, temperature should be expressed as one of the following (all in degrees Celsius): 55, 50, 40, 30, 20, 10, 0, -10, -20, -30. Determine temperature by taking the average of the temperatures from each CDM line applicable to the time period of interest. Use this average temperature for all calculations except for one condition – when estimating persistency for agents expected to last beyond the time period of interest, use the average daily temperature of the day in which the attack may occur. Wind speed will impact on casualty production, persistency, and downwind agent travel. It should be expressed as one of the following: 3, 6, 9, 12, 15, 18 kmph. As a rule of thumb, for any wind speed above 18kmph, use 18 kmph. Calculate wind speed in the same manner used above for temperature. In some situations it may be necessary to modify this number for casualty estimate purposes. For example, if a 24-hour period contains 6 hours of expected high wind speeds (unstable conditions), you will probably elect to disregard those figures and develop a separate (lower) average for casualty estimation. Then chemical staff estimates an enemy would not employ chemicals for casualty effects during that 6-hout period of high winds. Base the decision on the magnitude and duration of the wind change and the expected enemy COA. Stability categories also affect casualty production and downwind agent travel. However, their impact isminor compared to temperature and wind speed. Expressed as stable, neutral, unstable, determine the stability category in the same way as temperature and wind speed.

Other environmental factors exist that could impact the analysis. For example, terrain and vegetation could affect the estimate. However, these factors have been incorporated in the persistency estimate process.

Step 3. Estimate delivery capability. Estimate the number of chemical munitions likely to be employed in your AO for each required time period. Coordinate with the intelligence officer and / or fire support officer (FSO) to produce the estimate. The chemical staff provides the intel officer with the time periods of interest. He can produce information concerning the threat's capability to deliver chemical munitions in your AO. The estimate should indicate the number of delivery units, by type, and the number of rounds by agent types if available. The intel officer also provides estimates on when, where, and what types of agent the enemy will use in unit's AO. If the situation or event template does not yield needed information, assume the enemy can optimize his agent mix. For example, to determine the threat's capability to create contamination barriers, we assume they will fire all persistent agents. Likewise, to predict casualty effects, assume the enemy will fire agents that have the greatest casualty producing effects.

When the primary threat is covert or unconventional, express enemy delivery capability in terms of agent weight or as agent weight times some expected delivery means, for example ten kilograms of nerve agent delivered by an agricultural sprayer.

If threat estimates indicate limited agent supply, it will be difficult to estimate how much of that supply will be used each day. As an option for this situation, conduct the analysis for a single enemy attack based on the treat's maximum employment capability during the selected time period.

The intelligence officer considers a number of factors in making his estimate:

- Number of employment assets within range of unit.
- Other AOs the enemy force must service. Do not assume every delivery system within range will be firing into unit's AO.
- Enemy locations of chemical munitions.
- Weather effects on probably agents.
- Threat forces' capability to delivery chemical munitions to delivery systems.
- Impact of threat attacks on civilians.

The intelligence estimate should provide a range of numbers based on estimated COA for each time period. For example, the estimate should provide the enemy's maximum capability and its likely delivery capability. Alternatively, different estimates can be provided that would support various enemy COAs. Estimates should not be based on friendly COA unless they would significantly impact on enemy delivery capability. It is not necessary to assess every possible situation and enemy option. To do so would result in inefficient us of available time. The goal is to provide estimates to the commander/staff, which can be alter refined. Continuously assess the situation and look for events and options with the potential of changing the outcome of the battle.

GENERATE EFFECTS INFORMATION

At this point you have a set of time period / munition delivery estimate combinations. For each of these combinations you can now develop a set of effects information: casualty estimates, contamination barriers, persistence, and times and locations of downwind agent effects. Effects information will provide the following estimates:

- Casualty effects.
- Downwind agent effects.

DETERMINE CASUALTY ESTIMATE

Step 1. Determine probable friendly targeted size.

a. Based on the chemical staff's S2/G2 IPB, select and area / unit the enemy would probably target then determine target size. For example, determine the area occupied by a maneuver company in a defensive position, in this case 400m X 600M.

b. Calculate number of hectares (ha) in target area. One hectare is 10,000 square meters. For the example, 400 X 600 = 240,000 square meters or 24 hectares.

Step 2. Determine probable agent. Unless it is known which agents the enemy will employ, assume the most effective casualty-producing agent available.

Step 3. Estimate casualties.

a. Estimate, based on IPB, the number of rounds the enemy will engage a specific target and predicted temperatures (From CDM or other sources), then referto Table 2-4, 5 and 6 for casualty estimates. The casualty estimates are valid for wind speeds less than 20 kmph. Other factors such as air stability category, humidity, variations in wind speeds under 20 kmph, and delivery errors were found to have minimal effect on casualty estimates for a given time period as opposed to a specific point in time.

For example, the templated target area is 24 hectares, predicted agent is GB, the temperature is 10 degrees Celsius and the weapon is 152 mm. Intelligence analysis estimates the enemy will fire 240 round at the target. 240 rounds divided by 24 hectares is 10 rounds per hectare. Go to Table 2-4 and extract approximate casualty percentage (50%).

b. To determine blister agent casualties, use same procedures and Table 2-6. However, use MOPP level rather than temperature.

Note: For Tables 2-4, 5 and 6, if the number of rounds falls between given numbers, worse case by rounding up.

Table 2-4. Sarin (GB) Casualties.

Munitions in Rounds per Hectare (10,000 m^2)			Temperature (degrees Celsius)			
MLRS	150-155 mm	120-122 mm	-12	0	10	20
			Casualty Percentage			
1	2	4	10	16	24	33
2	4	7	14	22	30	40
3	6	10	19	27	37	47
4	8	14	25	34	43	54
4	10	17	31	40	50	60
Based on 15 liter/minute breathing rate (rest or light work) and 15 second masking time.						

Associated risks from downwind hazards (see ATP-45 (A)/FM 3-3 for downwind prediction models) can be broken into three categories:

a. High casualty risk. Occurs at winds speeds of 10 kmph or less during slightly stable, stable or extremely stable atmospheric conditions. Agent clouds will produce very narrow and very long hazard clouds. Dosages over 100 times the lethal levels are possible in the hazard area.

Table 2-5. Thickened Soman (TGD) or VX Casualties.

Munition in Rounds				Temperature (degrees Celsius)			
Missiles per 1000 ha	Missiles per 150 ha	Bombs per 1000 ha	Bombs per 150 ha	-12	0	10	20
				Casualty Percentage			
6	1	26	4	5	14	20	21
9	2	40	6	8	18	25	25
12	2	54	8	12	24	31	31
15	2	68	10	16	28	36	36
18	3	80	12	19	32	40	41
21	3	94	14	21	35	42	43
24	3	106	16	23	37	44	45
Based on MOPP ZERO. At higher levels, agents are not as effective due to increased skin protection.							

Table 2-6. Blister Agent Casualties.

Munitions in Rounds per Hectare (10,000 m^2)		Protective Features	
		Casualty Percentage	
150-155mm	120-122mm	MOPP ZERO	MOPP 1
4	7	17	13
7	14	24	18
11	20	34	23
14	27	43	28
18	33	51	32
21	40	57	36

b. High degradation risk. Occurs during stability categories of neutral to very unstable and wind speeds less than 10 kmph. Agent clouds will produce wide hazard areas with lethal effects rarely extending as far as 10 kilometers. The casualty risk to warned, unmasked personnel is low. However, due to the large cloud width it is possible for every unit in the downwind hazard area to be forced to mask for several hours.

c. Low casualty risk. Occurs at wind speeds of 10 kmph or greater at stability categories of neutral to very unstable. The casualty risk is very low outside the area of immediate effects. Although a significant number of units will be forced to mask, agent duration will be short and will not extend as far as in previous category.

Section E, Toxic Industrial Chemicals (TIC)

On 22 April, 1915, the German Army attacked Allied Forces by releasing 150 tons of chlorine from cylinders on a 4-mile front in the Ypres salient. Although the numbers of dead will never be known, estimates vary from 500 to 5,000 dead and 20,000 casualties, the military effect was to cause a deep and wide penetration of the salient with only minimal casualties to the attacker. On 3 December 1984, 30 to 35 tons of methylisocyanate were accidentally released from the Union Carbide plant at Bhopal, India. It killed an estimated 2,500 people and injured up to 200,000 more.

In both of these incidents casualties resulted from the release of toxic industrial chemicals. Although less lethal on a gram for gram basis than current chemical warfare agents, industrial chemicals are often available in enormous quantities, do not require extensive research programs, are easily mass produced, and do not violate the Chemical Weapons Convention. Toxic industrial chemicals could be released from industrial plants or storage depots through battle damage, as consequence of a strike against a particular facility, or as a desperation measure during military operations. They could also be attractive as improvised chemical weapons and have potential for inclusion in clandestine programs or contingency plans.

Chemical warfare agents are highly toxic and lethal compounds designed specifically for military purposes. However, the countries possessing chemical warfare agents are generally known and are relatively few in number. By contrast, industrial chemicals are almost universal in their distribution and available in quantities that dwarf the amounts of chemical warfare agents ever produced. Industrial chemicals include chlorine, ammonia, solvents, pesticides, fertilizers, and petrochemicals and are extensively used in plasticmanufacturing . Industrial chemicals are used within industrial plants as well as sold and transported to other plants and distributed through commercial and retail outlets. They can be found in almost every town, city, or country in the word, in chemical industries, warehouses, rail yards, or agricultural supply companies. Any military mission is virtually assured to encounter industrial chemicals.

It is estimated over 25,000 commercial facilities worldwide produce, process, or stockpile chemicals that fall within the scope of the Chemical Weapons Convention. These include dual use chemicals that can be used both for legitimate industrial purposes and as chemical warfare agents. Each year, more than 70,000 different chemicals amounting to billions of tons of material are produced, processed, or consumed by the global chemical industry. Many of these chemicals may be sufficiently hazardous to be a threat, either by deliberate or accidental release, in military situation. If deployed in less traditional but increasingly significant stability and support operations, forces will often deploy into highly populated regions where industrial chemicals are produced, distributed, or used.

A variety of actions can result in industrial chemicals being deliberately or accidentally released in a military situation. During peace operations, ordinance expended by warring factions could go off-target and impart an industrial site or hazardous material container resulting in the release of harmful chemicals or fires. Warring factions may deliberately release a hazardous chemical against an adversary or the peacekeeping forces. Deliberate actions by terrorists are difficult to predict or defend against because these acts can be performed by small groups with ill-defined objectives and motives.

> During Operation Joint Endeavor in Bosnia-Herzegovinia, chemical and preventative medicine personnel coordinated efforts to collect samples of suspected industrial hazards for analysis.

Based on this information, it is imperative the chemical officer can identify potential hazards, conduct risk assessment and vulnerability analysis from TIC in the AO. Issues include but are not limited to—

- Identifying possible industrial plants, storage sites, and shipment depots. What forces are conducting operations in vicinity or sites?
- Identifying chemicals routinely produced, used, or processed in the area.
- Identifying the chemical processes used to produce chemicals.
- Assessing whether deliberate release of TIC is realistic for a given situation.
- Determining if terrain and weather are favorable for overt or covert employment of TIC?
- Determining if the political environment is conducive to TIC attacks or releases?
- Assessing if the threat would gain a military advantage, either through military, civilian casualties or psychological means?
- Determining probable friendly response actions?

The chemical staff may obtain critical information from coordination with civilian authorities, host nation support personnel, or governmental agencies within the specific area of operation. Early coordination with these and other possible information sources will greatly improve the vulnerability analysis process, thereby minimizing possible contamination effects with early warning and enhances unit preparation.

CHAPTER 3
VULNERABILITY REDUCTION MEASURES

This chapter addresses vulnerability reduction measures for nuclear (including LLR and DU), biological and chemical (including TIC) weapons. Vulnerability reduction measures are those actions taken to avoid or mitigate WMD effects. These measures are defined as active or passive. Passive measures are broken into NBC (pertaining to all three events) and nuclear, biological, or chemical categories.

Section A, Nuclear, Biological, and Chemical

ACTIVE

Active measures involve destroying enemy production facilities, munitions, or delivery systems. The destruction of WMD stockpiles is usually beyond the capabilities of lower level commanders; therefore, echelons above corps usually have the responsibility for destroying those targets.

Corps and divisions normally do not have the capability to locate and destroy stockpiles or production facilities, however, they usually do have the capability to find and destroy delivery systems.

Obviously the preferred method of vulnerability reduction is to prevent WMD from being used. The concept of deterrence, while preeminent before a conflict starts, continues to play a role during and after hostilities. Table 3-1 provides guidance on using deterrence to reduce vulnerability.

PASSIVE

Passive defense begins in peacetime through counterproliferation and deterrence (Table 3-1). Counterproliferation attempts to limit the spread of WMD and delivery systems through treaties and control of critical technologies. Deterrence attempts to show potential adversaries that the use of WMD against US forces would be unsuccessful and counterproductive. If counterproliferation and deterrence fail, the next step is to implement active measures. It probably is not possible to destroy all threat WMD munitions and delivery systems, especially ballistic and cruise missiles. Therefore, units must always take precautions to avoid being targeted or to reduce the effects of an attack. These passive measures include:

Plan ahead.

NBC. Tasks take longer to perform in any contaminated environment. Commanders must take time to carefully think out courses of action and allow for the additional time required. FM 3-4, *NBC Protection*, contains tables to help commanders estimate how long it takes to accomplish missions in a contaminated environment. Also, NBC training must be fully integrated into all areas of unit training--individual and collective. A well-trained and well-equipped unit is much better prepared to survive and operate in an NBC environment.

Nuclear. Actions taken before an attack are most critical because they will increase the unit's survivability to the greatest possible extent. These actions are discussed throughout this chapter.

Biological. Plan for immunizations, the means for soldiers to wash and bathe regularly, and conduct sanitation/pest management measures.

Immunizations may be passive or active and are the most important forms of individual protection since it is the only one that provides continuous protection. It is especially critical since all units will not have real-time detection and warning capabilities and many individuals may be exposed before an attack is identified. Immunizations may not provide immediate protection, as the process of administering a complete immunization protocol may require several doses over a period of weeks or months. However, each dose administered increases the individual's protection from the disease. These time intervals must be taken into account during predeployment.

Develop a plan for facilities and support and allow time for soldiers to bathe regularly with frequent changes of clothing. Ensure soldiers have sufficient personal hygiene supplies, to include soap, washcloths, towels, and toothbrushes. These measures will significantly reduce the primary and secondary spread of diseases.

Determine naturally occurring endemic diseases in expected AO. Combat health services personnel should address this concern during their IPB.

Chemical. MOPP analysis and automatic masking criteria must be addressed during the planning process. Ensure chemical equipment stockages, including Class VIII chemical-specific items, are tracked. Class VIII tracking is the responsibility of the combat health logistics community; however, the chemical staff must be aware of any significant supply issues. Determine when pretreatment measures are to be implemented.

Avoid detection.

NBC. Employ good operational security measures such as camouflage, light discipline, and electronic signal signature reduction and electronic countermeasures and electronic counter-countermeasures. If feasible, plan deception operations into every mission. Smoke operations provide concealment and may attenuate the thermal energy effects of nuclear weapons.

Provide warning.

NBC. If a unit is unable to avoid a WMD attack, early warning of battlefield hazards is very important. The NBC warning and reporting system (NBCWRS) must be used to notify units that adjacent units have been attacked or a downwind hazard is present.

Nuclear. Ensure units are designated as observers (every unit is responsible for observing and recording nuclear attacks; however, every unit does not automatically forward NBC 1 reports). Ensure units have updated EDMs.

- Biological. Employ Biological Integrated Detection System (BIDS), which is a corps-level asset. Also, early detection of diseases will provide commanders timely information for planning and will better enable medical personnel to diagnose and provide appropriate treatment.
- Chemical. Employ recon assets, such as M93-series NBC reconnaissance vehicle or scouts, to cover NAIs. Non-chemical units can be employed to cover chemical NAIs. Ensure units have updated CDMs and unit-level monitoring is implemented.

Maintain discipline.

NBC. Units must maintain discipline and confidence in their ability to survive and operate in order to overcome the shock of a WMD attack. Commanders must be able to rely on their troops to wear MOPP gear when required, even for extended periods. To support this requirement, leaders must implement MOPP acclimatization training under all conditions.

The uncertain nature of NBC warfare may cause psychological stress degrading units' combat effectiveness. If a chemical or biological threat exists, some personnel may seek medical treatment although they have not been exposed to agents. These personnel need reassurance and follow-up visits with combat stress control (CSC) personnel. Trained and disciplined units will be less susceptible to the psychological effects of NBC warfare.

Biological. Only eat food that has been protectively wrapped or is in sealed containers. Drink only closed-container water that has been approved by medical authorities. Report/seek treatment for illnesses promptly. Ensure personnel practice personal hygiene.

Chemical. Only eat food that has been protectively wrapped or is in sealed containers. Drink only closed-container water that has been approved by medical authorities.

Seek protection.

NBC. Other than issued equipment, natural terrain and manmade structures provide shelter from WMD effects.

Nuclear. Reverse hill/mountain slopes give some nuclear protection. Heat and light from the fireball and the initial radiation tend to be absorbed or deflected. Gullies, ravines, caves and any natural depression can reduce casualties. Primary concern is shielding from gamma and neutron radiation. Gamma radiation protection requires thick layers of dense or heavy shielding material, such as lead, iron, or stone. Light, hydrogen-based material gives good neutron radiation protection, such as water, paraffin, and oil. Digging-in provides the best nuclear defense due to the earth's shielding properties. Well-constructed fighting positions give excellent protection against initial nuclear effects and can reduce fallout exposure. Soldiers must harden fighting positions against the blast wave as time permits. To reduce thermal radiation use light colored materials to cover reflecting surfaces, such as wool blankets or canvas. Simply covering a fighting position with ordinary metal screening material blocks about 50% of the thermal radiation. Continue to improve the fighting position with overhead cover as time permits. A vehicle may be used as overhead cover if time is scarce. Certain buildings offer excellent shelter from nuclear hazards and require minimum time and effort to use. The stronger the structure, the better the protection against blast effects. The strongest are heavily framed buildings of steel and reinforced concrete, while the worst are shed-type industrial buildings with light frames and long beam span.

Tents are not a preferred shelter against nuclear weapons, but they do provide some protection from thermal radiation. However, they present a serious fire hazard. Armored vehicles provide good nuclear protection with tanks usually providing the best vehicular protection available. If possible, dig-in vehicles or place in low areas. Usesandbags as radiation shielding. A single layer of sandbags placed on top of an armored vehicle provides valuable gamma shielding. Each sandbag layer reduces the gamma radiation by a factor of two. Avoid using wheeled vehicles as shelter. Generally, they provide little or no protection from nuclear weapons effects and are prone to overturning. Unhardened electronic equipment such as commercial radios and computers must be turned off and all external cables disconnected to mitigate EMP effects. A more detailed explanation of EMP mitigation techniques can be found in FM 3-3-1, Appendix C.

Biological. Protection involves individual and collective, such as updated immunizations, good hygiene, area sanitation, and physical conditioning. The respiratory tract is the most likely route of agent entry into the body and the majority of agents can be expected to be delivered in aerosol form. Current protective masks provide sufficient protection. However, field expedient measures such as placing folded handkerchiefs or several layers of cloth over the nose and mouth can substantially reduce the risk of agent inhalation. The skin is much less vulnerable to biological agent penetration as very few agents pose a percutaneous (through the skin) hazard. Typical lightweight combat clothing provides sufficient protection. Only insect vectors (of questionable utility) and a small number of toxins (for example, mycotoxins) can have a direct action on the skin or mucous membranes. Individual protective clothing provides sufficient protection against these toxins. Personnel can be infected via the digestive system through the consumption of contaminated food and water. Through routine monitoring and sampling preventive medicine and veterinary personnel can identify health hazards and recommend appropriate personal protective measures. Collective protection equipment provides required protection; however, if used inappropriately may enhance transmissibility. Protection can also be achieved by sheltering within buildings; however, entry and exit procedures must be strictly enforced. This may be the most suitable measure for noncombatants.

Chemical. Avoid low-lying areas, such as ditches and ravines, as these depressions allow accumulation of chemical agents. Fighting positions with overhead cover and shelters provide protection against the explosive and liquid effects; however, vapors will accumulate in these positions. Any overhead cover such as tents and ponchos offer some protection from liquid contamination. Collective protection equipment also offers protection from vapor and liquid hazards.

Disperse.

NBC. Any densely occupied assembly area is vulnerable to WMD. Commanders determine how much dispersion is needed based on METT-T.

Maintain mobility.

NBC. Tactical mobility gives the commander the best chance of avoidance. Consistent movement prevents the enemy from pinpointing locations and accurately employing WMD.

Cover supplies/equipment.

NBC. Store supplies/equipment under cover to prevent contamination. Buildings offer excellent protection from fallout, liquid, and biological contamination. Field expedient methods are abundant (see FM 3-4 for further guidance).

Limit exposure.

NBC. Plans must include post attack procedures for limiting exposure to contamination hazards. For all types of contamination, only mission-essential personnel are sent into a contaminated area. Persons working around equipment (mechanics, for example) must be aware of continuous, low-level contamination hazards. Mark equipment as contaminated if decon is not possible . Always dispose of contaminated collectors, such as air filters, as contaminated waste.

Nuclear. For nuclear attacks, every minute spent in a contaminated area increases a person’s total radiation dose. Personnel can limit exposure by waiting to enter a contaminated area allowing for radiological decay.

- Prevent contamination spread.
  - NBC. Limiting the number of personnel and equipment in the contaminated area helps prevent the spread of contamination. Make every effort to confine the contamination within as small an area as possible. Mark all contaminated areas and report them. Units moving out of a contaminated area should decon at or near the edge of contamination. Decon as far forward as possible, however if materiel must be transported or moved use following precautions--
    - Use as few transport vehicles as possible.
    - Use minimal number of routes.
    - Monitor route for contamination.
    - Cover contaminated materiel to prevent blowoff.
    - Warn personnel of any downwind hazard.
    - Decon transport vehicles before transporting uncontaminated equipment.
    - Ensure personnel wear appropriate protective gear to reduce hazards.

Contaminated equipment may be disposed of by burying, ensuring at least four inches of cover. Mark area as outlined in FM 3-5 and report to higher headquarters using NBC 5.

Contaminated remains may also pose a spread hazard. If time permits, remains should be decontaminated using the casualty's decontamination kit and placed in chemical casualty bag before transporting to mortuary affairs personnel.

Biological. Movement restrictions or quarantine measures may be necessary if a biological agent is identified as transmissible. The command surgeon will recommend movement restrictions and quarantine measures based on the type of agent present and the unit's mission. Encapsulated or spore forming agents will prove to be more resistant to environmental effects. However, their effectiveness as ground denial agents or their ability to re-aerosolize and present an operational hazard is limited. Nonetheless, commanders must ensure hazardous areas are identified, occupation of those areas is limited, and measures are taken to prevent agent transfer from contaminated to uncontaminated areas.

Table 3-1. Deterrence Measures

	Hostilities		
Prevent/Limit:	Pre-	Active	Post-
Use Against US Forces	- National Policy - Stated or Implied - Coalition's Position - PSYOPS - Visibility of NBC Readiness	- Counterforce - Active Defense - Passive Defense - PSYOPS - Visibility of NBC Readiness	- Reestablish NBC Taboo - Punishment - Destroy NBC Infrastructure - PSYOPS - Visibility of NBC Readiness
Damage, If Used	- NBC Trained and Ready Force	- Detection, Warning, and Reporting System - Individual and Collective Protection - Decontamination Capability	- Restoration of the Environment - Long-Term Health Care
Further Use	N/A	- Diplomatic - Conventional - Escalate Temp - Increase Scale and Target Scope - Nuclear - Threat - Selective Use - Strategic	- Iraqi Inspection Regime - Pay Damages

Section B, Low Level Radiation and Depleted Uranium

LLR. Appropriate staff officers, including the chemical and medical officers, must advise the commander prior to operations in LLR hazard areas. Commanders must be cognizant of the serious long-term medical effects involved with LLR exposure. Units that do not possess the appropriate equipment, personnel, and training should not conduct missions that involve operations in LLR environments. Appropriate ground and aerial exclusion zones (based on given situation and unit SOP) should be established around the known or suspected hazard area.

While in a known or probable LLR hazard area, individuals must wear clothing that prevents skin exposure to the dust and respiratory protection to prevent inhalation. The respiratory protection should be the protective mask; however, if the mask is not available, cover the nose and mouth with cloth.

Detailed and accurate record keeping of unit and individual exposure levels must be conducted. It is essential that dose rate and total dose instruments are able to measure alpha, beta, and gamma radiation and the most sensitive instruments available are used. SOPs or operation orders must address survey techniques, operational exposure guidance, turn back dosages, and monitoring operations.

DU. Vulnerability reduction measures for depleted uranium exposure include:

- When working within 50 meters of DU equipped vehicles that have been destroyed by fire or when entering vehicles that have been hit by DU munitions, wear protective mask and clothing (MOPP4). The hazards of DU do not preclude entering contaminated vehicles to save lives or secure sensitive equipment. The primary hazard is unexploded ordnance.
- Stay upwind of any smoke from burning vehicles that were carrying or were hit by DU munitions. Avoid dust clouds formed as a result of windy conditions or subsequent explosions around the vehicle.

Section C, Toxic Industrial Chemicals

Most toxic industrial chemicals are released as vapors. These vapors tend to remain concentrated downwind from the release point and in natural low-lying areas such as valleys, ravines, or man-made underground structures. High concentrations could be found in buildings, woods, or any area with low air circulation. Liquid hazards may also be present and spread via explosions and, if vaporized, may possibly condensate in cold air. Based on METT-T, preferred positions for locating static military positions are at maximum elevation, on open ground, and upwind from possible industrial chemical sources.

The majority of military protection and decontamination equipment was not designed for toxic industrial chemicals. Chemical officers, combat health services, and civil affairs personnel should identify prior to deployment, if possible, the local civilian authorities who may have additional emergency response procedures and resources that can be used. This is especially relevant to stability and support and peacekeeping operations.

Table 3-2 (taken from ITF-25) shows minimum downwind hazard distances to be observed from chemical production or storage sites. These are the distances a lethal exposure level could reach if a massive release occurred. The first figure is for day, second for night. TIC are most dangerous at night; the downwind hazard distance is farther than a day release. Additionally, avoidance is much more difficult at night. Troops are likely to be asleep and, even if awake, will have difficulty seeing the approaching cloud. For minimal safety, assembly areas should not be established within the nighttime hazard distance of a chemical plant or storage site.

Table 3-2. Industrial Chemical Site Minimum Downwind Hazard Distances

CHEMICAL	QUANTITY (Tons)	DAY	NIGHT
		Kilometer(s)	
Chlorine Phosgene Ammonia Hydrogen Cyanide in hot climate Hydrogen Sulfide Methyl Isocyanate	Up to 100 Up to 50 Up to 500 Up to 50 Up to 50 Up to 50	2	5
Hydrogen Cyanide in cold climate Hydrogen Fluoride Sulfur Trioxide Nitrogen Tetroxide Hydrogen Chloride Ammonia Bromine Sulfur Dioxide Acrylonitrile	Up to 50 Up to 100 Up to 50 Up to 50 Up to 50 Up to 100 Up to 50 Up to 50 Up to 50	1	2.5

The most important action in the case of a massive TIC release is immediate evacuation. Soldiers who see a storage tank explode or catch fire or vapor clouds being released from a known or suspected chemical storage site should immediately mask and evacuate the area as soon as possible. The greatest risk from a large scale toxic chemical release occurs when personnel are unable to escape the immediate area and are overcome by fumes or blast effects. The best defense against a toxic industrial chemical release is to evacuate the area and the hazard's path. Military respirators and protective clothing can provide limited protection and should only be used to escape the hazard area.

If possible, the chemical staff should conduct the following:

- Identify TIC hazards in AO/AI.
- Identify local hazard management procedures and civilian agencies responsible for handling hazardous material incidents.
- Identify local hazard identification labeling and placarding systems. A reference sheet listing local names for high hazard industrial chemicals should be developed for field use.

- Procure any special detectors (for example Draeger tubes), or specialized protection equipment (self-contained breathing apparatuses (SCBA)) .

For information on available assistance from outside agencies regarding industrial chemical hazards see Figures 3-1 and 3-2 on following pages.

For Additional Information

✓ The Chemical and Biological Defense Command (CBDCOM) and the Chemical Manufacturers Association (CMA) have a memorandum of understanding to facilitate acquisition of emergency response information concerning health and physical hazards, physical properties, handling procedures, material safety data sheets (MSDS), and protection needs relative to hazardous industrial chemicals encountered during military operations. This agency is known as CHEMTREC. Requests may be initiated worldwide and the free services are available 365 days/year, 24 hours/day .

EMERGENCY
Spill, leak, fire, exposure or other accident:
All 50 states, US Virgin Islands, Puerto Rico, Canada 1-800-424-9300
International Emergency (Mexico and outside US) 1-703-527-3887

NONEMERGENCY
CHEMTREC Information, company referrals, regulatory agencies referrals, and MSDS requests (Monday-Friday, 9AM-6 PM Eastern): 1-800-262-8200
Electronic Mail: chemtrec@mail.cmahq.com

✓ The National Institute for Occupational Safety and Health (NIOSH) publishes the *Pocket Guide to Chemical Hazards*. This document provides a quick, convenient source of information on general industrial hygiene and medical monitoring practices. Information includes chemical structures or formulas, identification codes, synonyms, exposure limits, chemical and physical properties, incompatibilities and reactivities, measurement methods, respirator selections, signs and symptoms of exposure, and procedures for emergency treatment. Printed copies are available from either NIOSH, the National Technical Information Service (NTIS), or the Government Printing Office (GPO). Single complimentary copies are provided, if available. You may request a copy by fax, mail, or email. See following page for ordering information.

✓ The US Department of Transportation (DOT), in conjunction with Canada and Mexico, developed the *North American Emergency Response Guidebook* It is primarily a guide to aid first responders in quickly identifying the specific or generic hazards of the materials involved in an incident, and protecting themselves and the general public during the initial response phase of the incident. It is not a substitute for emergency response training or sound judgement. It also provides information on the National Response Center (NRC), operated by the US Coast Guard, US Army Operations Center, and Defense Logistics Agency (DLA).

Figure 3-1. Available Industrial Chemical Hazard Assistance Information

NIOSH
Fax: 513-533-8573
Mail: NIOSH Publications
Mailstop C-13
4676 Columbia Parkway
Cincinnati, OH 45226
Email: pubstaft@NIOSDT1.em.cdc.gov

To order multiple copies, you must order them from NTIS or GPO:

NTIS
Request NTIS stock number PB95-100368.
Telephone: 703-487-4650
Fax: 703-321-8547
Mail: US Department of Commerce
National Technical Information Service
Springfield, VA 22161

GPO
Request GPO stock number 017-033-00473-1.
Fax: 202-512-2250
Email: help@eids05.eids.gpo.gov
Mail: Superintendent of Documents
US Government Printing Office
P.O. Box 371954
Pittsburgh, PA 15250-7954

To receive copies of the North American Emergency Response Guidebook contact the US Army Chemical School, Doctrine Development Division.

Note: Additional information may be required so please contact agencies before placing order.

Figure 3-2. Document Ordering Information.

Appendix A
Nuclear Attack Risk Checklist

Threat Capabilities and Intentions	Yes or Possible	No
Enemy's national policy permits nuclear weapons use?		
Enemy has nuclear employment doctrine?		
Enemy would doctrinally target unit?		
Enemy is capable of locating unit?		
Enemy is trained and equipped to operate in nuclear environment?		
Enemy has internal warning system?		
Is there a production capability?		
Other sources of radioactive material, such as nuclear power or waste plants?		
Has enemy purchased materiel/technology from other countries to support infrastructure?		
Are there known terrorist threat capabilities?		
Are there connections to known terrorist supporting countries?		
Are there known nuclear warheads?		
Is there a known stockpile?		
Are nuclear munitions present in our area of interest?		
Are units within nuclear delivery systems' (aerial, missiles, artillery, unconventional forces, other) ranges?		
Favorable conditions, such as weather and terrain, exist for employment?		
Intelligence sources (electronic or human) show probable use?		
Enemy has used nuclear weapons in theater?		
Remarks		

Appendix B
Biological Attack Risk Checklist

Threat Capabilities and Intentions	Yes or Possible	No
Enemy's national policy permits biological weapon use?		
Enemy has biological weapon employment doctrine?		
Enemy would doctrinally target unit?		
Enemy is capable of locating unit?		
Enemy is trained and equipped to operate in biological environment?		
Enemy has internal warning system?		
Is there a direct or indirect production capability (infectious diseases, toxins, or other)?		
Has enemy purchased weapons from other countries?		
Are there known terrorist threat capabilities?		
Are there connections to known terrorist supporting countries?		
Medical, biological research, or pharmaceutical facilities exist?		
Ability to weaponize exists?		
Is there a known stockpile?		
Are friendly units within delivery systems' ranges?		
Favorable conditions, such as weather and terrain, exist for employment?		
Intelligence sources (electronic or human) show probable use?		
Enemy has used biological weapons in theater?		
Remarks		

Appendix C
Chemical Attack Risk Checklist

Threat Capabilities and Intentions	Yes or Possible	No
Enemy's national policy permits chemical weapon use?		
Enemy has chemical weapon employment doctrine?		
Enemy would doctrinally target unit?		
Enemy is capable of locating unit?		
Enemy is trained and equipped to operate in chemical environment?		
Enemy has internal warning system?		
Is there a production capability?		
Has enemy purchased weapons from other countries?		
Are there known terrorist threat capabilities?		
Are there connections to known terrorist supporting countries?		
Industrial chemical (dye, pesticide, or other) plants exist?		
Ability to weaponize exists?		
Is there a known stockpile?		
Are friendly units within delivery systems' ranges?		
Favorable conditions, such as weather and terrain, exist for employment?		
Intelligence sources (electronic or human) show probable use?		
Enemy has used chemical weapons in theater?		
Remarks		

Appendix D
Possible Threat Biological Employment Indicators
(Activities are not prioritized)

Activity	Notes
- Movement of trailers with rockets or missile bodies. - Evacuation or exclusion of civilians from specific areas suitable for biological storage or delivery sites. - Construction of Free Rocket Over Ground (FROG) or SCUD launch sites. - Transporter-Erector-Launchers (TEL) moving to launch sites. - Passage of wind data from mid-range position to a command or technical element. - Passage of a "nonsense" word on command and selected fire control nets. - Troops wearing protective masks. - Movement of small convoys from warhead storage areas. - Missile or free rocket units within striking ranges. - Loss of known locations of identified missile units. - Air defense weapons deployed to cover possible warhead storage areas. - Widespread or simultaneous issue of special protective masks or filters. - Unusual or widespread biological defense activities. - Biological or decontamination equipment is issued to populations at large. - Widespread biological defense exercises in the civilian sector including activation of civil defense forces. - Significant increase in physical security afforded certain train movements from rear to forward areas. - Deployment of biological weapon loading teams to airfields. - Forward deployment of large numbers of decontamination vehicles or equipment capable of mass volume agent delivery. - Long Range Biological Standoff Detection System (LRBSDS) locates suspected biological cloud. - BIDS provides nonspecific, generic, or specific response to suspected biological event.	

Appendix E
Possible Threat Chemical Employment Indicators
(Activities are not prioritized)

Activity	Notes
- Enemy MOPP status increased in forward areas. - Movement forward of chemical defense equipment and decontamination supplies. - Chemical medical supplies are issued to enemy troops. - Non-artillery units in protective gear. - Chemical units collocated with artillery units. - Chemical munitions cached in forward areas. - Enemy sighted using or emplacing chemical agent detectors. - Enemy conducting chemical training. - Decontamination supplies cached in forward areas. - Chemical protective units sighted moving forward or in forward areas. - Chemical reconnaissance units sighted moving forward or in forward areas. - Surface-to-surface missile (SSM) units are in position to fire or have fired. - Enemy multiple launch rockets (MLR) are within 2/3 of their maximum range. - Enemy artillery is within 2/3 of its maximum range. - Confirmation of chemical munitions delivery to artillery or missile units. - Artillery, rocket, or missile crews in protective gear. - Heavily guarded convoy sighted or convoy personnel sighted wearing protective gear. - Unguarded convoys sighted in protective gear. - Movement of chemical munitions to unknown locations or firing units. - Disappearance of chemical munitions from known storage sites. - Filling of munitions with chemical agents. - Movement of small convoys from munitions storage sites. - Evacuation of civilians from possible chemical storage or delivery sites. - Unusual activity around suspected or known chemical storage sites. - Chemical munitions release authority given to field commanders. - Enemy has committed strategic reserves. - Intelligence reports, through radio intercepts, defectors, enemy prisoners of war, or other sources, show intentions of chemical weapon use. - Activation of special command and control channels that could be used to oversee chemical weapons employment. - Chemical protective gear or chemical medical supplies are issued to civilians. - Increased propaganda or warnings of chemical use to civilians.	

Appendix F
Tables

Explanatory Notes to Tables F-2 through F-6 Extracted from Development of a Trinational Biodefence Concept, International Task Force-23

1. Major militarily significant characteristics for biological warfare agents include a susceptible population, infectious or toxic properties, availability or adaptability to a scaled-up production, stability in handling and after dissemination, and suitability for aerosol dispersion. Limiting factors include biological properties, environmental factors and dissemination methods.

2. Biological agents can be classified as microorganisms and toxins:

Biological Agents
√ Microorganisms
√ Toxins

a. Microorganisms. Human pathogens are defined as organisms that cause disease in man. These organisms can produce a wide range of pathology. While aerosolized BW agents constitute the primary military hazard, there may be other routes of entry, such as through the skin and ingestion. Pathogens include bacteria, rickettsia, chlamydia, fungi, and viruses.

- Bacteria. Single cell microorganisms capable of reproducing outside of a living host. If a pathogenic bacteria in sufficient quantities enters a victim, the microorganism multiplies and produces disease. Pathogenic bacteria can be found in almost any environment.
- Rickettsia. Bacteria that require a living host to reproduce. Most require an arthropod vector to spread from one host to another. They are smaller than most bacteria but larger than viruses.
- Chlamydia. Obligatory intercellular parasites incapable of generating their own energy source. Like viruses, they require living cells for multiplication.
- Fungi. Primitive plants which do not use photosynthesis, are capable of anaerobic growth, and draw nutrition from decaying vegetable matter. Most fungi form spores, and free-living forms are found in soil. The spore forms of fungi are operationally significant.
- Viruses. Viruses require a living host to reproduce. Viruses multiply by taking over a cell and causing it to produce more virus instead of cell components. As more and more cells are taken over the disease develops. Viruses are the smallest of the five types of microorganisms.

b. Toxins. Toxins are byproducts of microorganisms. These sources include microbes, snakes, insects, spiders, sea creatures, and plants. Most are relatively unstable in the presence of heat and other traumatic and environmental factors. They can be either lethal or highly incapacitating- some have far greater toxicity than the most deadly chemical

warfare agents. The effects of toxins may closely resemble those of chemical warfare agents such as nerve, blister, vomiting, or choking agents. Toxins can be classified as neurotoxins or cytotoxins depending on their target systems. Neurotoxins interfere with nerve impulse transmission. Cytotoxins cause cellular destruction or interfere with metabolic processes such as cell respiration or protein synthesis.

3. Dissemination. Biological agents may be disseminated as aerosols, liquid droplets or dry powders. To a certain extent, the state in which an agent normally exists determines its use, persistancy and physiological action. It also determines the type of system used for its dissemination. Live microorganisms usually grow in a moist environment. Therefore, these agents may be disseminated in a liquid medium as wet aerosols. However, the technology exists to store microbiological materials as a powder (usually by a freeze-drying process), suitable for dissemination. Dissemination of spores and certain toxins as dry powders is likely. Many toxins are water-soluble, and disseminaton could be as sprays or wet aerosols. In general, agents disseminated as dry powder will survive longer than those disseminated as wet aerosols.

4. Transmissibility. Some agents cause disease that is transmissible from man to man, either directly or through other vectors. However, other microorganisms are nontransmissible thus limiting their spread. Toxins are not transmissible.

5. Infectivity. The agent's ability to cause disease or incapacitation in a healthy person.

6. Incubation time. The human rate of reaction to pathogens and toxins varies widely. The time for maximum effects for pathogens occurs within 18 hours to 7 days, while rapid-acting toxins can incapacitate within minutes though effects usually occur within 1-24 hours.

7. Illness duration. The length of time the average person's bodily defenses require to overcome the disease.

8. Lethality. Expected percentage of fatalities in untreated personnel.

9. Persistency. Refers to the effective duration in the environment. It varies greatly between agents and depends on the agents' characteristics and the influence of weather and terrain. The duration does not generally relate to its physical properties. Some toxins are stable in the environment and are resistant to heat, hydrolysis, or vaporization, increasing their persistancy. Weather and terrain influences include solar (ultraviolet) radiation, relative humidity, windspeed, and temperature gradient. These are the most important weather factors in determining duration. Ultraviolet light affects most biological agents. However, encapsulation (either natural or man-made protective coverings) or possibly genetic engineering may protect some agents from sunlight and other destructive natural forces.

Table F-1
Biological Effects of Nuclear Radiation (1 of 3)
(STANAG 2083, Edition 5)

DOSE RANGE (cGy, FREE-IN-AIR)	INITIAL SYMPTOMS	PERFORMANCE MEASURE (MID RANGE FOR DOSE)	MEDICAL CARE/DISPOSITION
0-70	From 6-12 hrs: none to slight incidence of transient headache and nausea, vomiting in up to 5% of personnel in upper part of dose range.	Combat effective.	None; RTD
71-150	From 2-20 hrs: transient mild nausea and vomiting in 5-30% of personnel.	Combat effective.	None. RTD: no deaths anticipated.
151-300	From 2 hrs to 2 days: transient mild to moderate nausea and vomiting in 20-70%, mild to moderate fatigability and weakness in 25-60% of personnel.	DT: PD from 4 hrs until recovery. UT: PD from 6 hrs to 1 day, 6 weeks until recovery.	At 3-5 weeks: medical care for 10-50%. At low end of range, <5% deaths. At high end, death may occur in up to 10%; survivors RTD.
301-500	From 2 hrs to 3 days; transient moderate nausea and vomiting in 50-90%; moderate fatigability in 50-90% at high end of range.	DT: PD from 3 hrs until death or recovery. UT: PD from 4 hrs to 2 days and from 2 weeks until death or recovery.	At 2-5 weeks: medical care for 20-60%. At low end of range, <10% deaths. At high end, death may occur for more than 50%; survivors RTD.

Legend:
CI- Combat ineffective (<25% performance capable)
DT- Demanding task
PD- Performance degraded (25-75% performance)
UT- Undemanding task
RTD- Return to duty

Table F-1
Biological Effects of Nuclear Radiation (1 of 3)
(STANAG 2083, Edition 5)

DOSE RANGE (cGy, FREE-IN-AIR)	INITIAL SYMPTOMS	PERFORMANCE MEASURE (MID RANGE FOR DOSE)	MEDICAL CARE/DISPOSITION
501-800	Within first hr: moderate to severe nausea, vomiting, fatigability and weakness in 80-100% of personnel.	DT: PD from 1 hr to 3 weeks; CI from 3 weeks until death. UT: PD from 2 hrs to 2 days and from 7 days to 4 weeks; CI from 4 weeks until death.	At 10 days to 5 weeks: medical care for 50-100%. At low end of range, death may occur for more than 50% at 6 weeks. At high end, death may occur for 90% at 3-5 weeks.
801-3,000	Within first 3 minutes; severe nausea, vomiting, fatigability, weakness, dizziness and disorientation; moderate to severe fluid imbalance and headache.	DT: PD from 45 minutes to 3 hrs; CI from 3 hrs until death. UT: PD from 1-7 hrs; CI from 7 hrs to 1 day; PD from 1-4 days; CI from 4 days until death.	Medical care from 3 minutes until death. 1,000 cGy: 100% deaths at 2-3 weeks. 3,000 cGy: 100% deaths at 5-10 days.
3,001-8,000	Within the first 3 minutes: severe nausea, vomiting, fatigability, weakness, dizziness, disorientation, fluid imbalance, headache and collapse.	DT: CI from 3-35 minutes; PD from 35-70 minutes; CI from 70 minutes until death. UT: CI from 3-20 minutes; PD from 20-80 minutes; CI from 80 min until death.	Medical care from 3 minutes until death. 4,500 cGy: 100% deaths at 2-3 days.
>8,000	Within the first 3 minutes: severe and prolonged nausea, vomiting, fatigability, weakness, dizziness, disorientation, fluid imbalance, headache, and collapse.	DT and UT: CI from 3 minutes until death.	Medical care needed immediately. 8,000 cGy: 100% deaths at 1 day.

Legend:
CI- Combat ineffective (<25% performance capable)
DT- Demanding task
PD- Performance degraded (25-75% performance)
UT- Undemanding task
RTD- Return to duty

Table F-2
Possible Militarily Significant Biological Agents, Bacteria (1 of 2)

DISEASE	DISSEMINATION	TRANSMISSIBILITY	INFECTIVITY	INCUBATION TIME	ILLNESS DURATION	LETHALITY (%)	PERSISTENCE
Inhalation Anthrax	Spores in aerosols .	No	Moderate	Few hours to 7 days ; most cases occur within 48 hrs of exposure.	3-5 days	Treated: presymptomatic rare Untreated: 100	Spores are very Stable, remaining viable for years in soil.
Brucellosis (undulant, Malta, or Mediterranean Fever)	1. Aerosol 2. Sabotage (food supply)	Rare	High	5-60 days (highly variable).	Weeks to years	Treated: rare Untreated: 3	Months in wet soil or carcasses.
Cholera	1. Sabotage (food and water supply) 2. Aerosol	Negligible except in conditions of poor hygiene.	Low	Few hours to 5 days, usually 2-3 days.	1 or more weeks	Treated: rare Untreated: 50	Unstable in aerosols and fresh water; stable for long periods in salt water.
Glanders	Aerosol	Rare	High	Days to years	Days to several weeks	Treated: rare Untreated: >90	2-3 weeks in decaying matter.
Melioidosis	Aerosol	No	High	2 days (several months/years may lapse between exposure and clinical disease).	4-10 days	Treated: rare Untreated: variable	Stable in soil and water.
Pneumonic Plague	Aerosol	High	High	1-7 days	1-6 days	Treated: rare Untreated: 100	Up to one year in soil, 270 days in bodies.
	Sabotage (food	High, caused by	Low	1-3 days	Week	Treated: <1	Up to 30 days in

DISEASE	DISSEMINATION	TRANSMISSIBILITY	INFECTIVITY	INCUBATION TIME	ILLNESS DURATION	LETHALITY (%)	PERSISTENCE
Shigellosis	and water supply)	lapses in hygiene.				Untreated: 3-8	foods, 3 days in sea water .
Tularemia (Rabbit or Deer-Fly Fever)	Aerosol	No	High	1-14 days	2 or more weeks	Treated: <1 Untreated: 5-25	Months on moist soil or snow, in water, straw, grain dust or carcasses.
Typhiod Fever	1. Sabotage (food and water supply) 2. Aerosol	Negligible except in conditions of poor hygiene.	Low	3-60 days	Several weeks	Treated: <1 Untreated: 12	Weeks in water, ice, dust, dried sewage .

Source: FM 8-33 and Development of a Trinational Biodefence Concept .

Notes: 1. This table is not all-inclusive and does not imply weaponization or the ability to weaponize exists.

2. For explanatory notes see page F-2.

Table F-3
Possible Militarily Significant Biological Agents, Rickettsia

DISEASE	DISSEMINATION	TRANSMISSIBILITY	INCUBATION TIME	ILLNESS DURATION	LETHALITY (%)	PERSISTENCE
Epidemic Louseborne Typhus	1. Aerosol 2. Infected vectors	No	7-14 days	Weeks to months	Treated: 2 Untreated: 30-70	Weeks in louse fecal material.
Query (Q)-Fever	1. Aerosol 2. Sabotage (food supply)	Rare	2-3 weeks	Weeks	Treated: <1 Untreated: rare	Months on wood and sand.
Rocky Mountain Spotted Fever	1. Aerosol 2. Infected vectors	No	3-14 days	2 weeks to months	Treated: 3-7 Untreated: 13-25	Unstable
Scrub Typhus	Aerosol	No	6-21 days	2-3 weeks	Treated: rare Untreated: 1-60	Unstable

Source: FM 8-33 and Development of a Trinational Biodefence Concept.

Notes: 1. This table is not all-inclusive and does not imply weaponization or the ability to weaponize exists.
2. Listed rickettsia have high infectivity.
3. For explanatory notes see page F-2.

Table F-4
Possible Militarily Significant Biological Agents, Chlamydia and Fungi

DISEASE	DISSEMINATION	TRANSMISSIBILITY	INFECTIVITY	INCUBATION TIME	ILLNESS DURATION	LETHALITY (%)	PERSISTENCE
CHLAMYDIA							
Psittacosis (Parrot Fever)	Aerosol	Rare	Moderate	1-4 weeks	Weeks	Treated: 1-2 Untreated: 10-40	20-30 days on surface.
FUNGI							
Coccidioidomycosis	Aerosol	No	High	1-4 weeks	Weeks to months	Low ; primary disease usually resolves spontaneously without therapy.	Months or years in soil.
Histoplasmosis	Aerosol	No	High	3-17 days	Weeks to months	Low in acute pulmonary form, severe progressive diseases are rare.	Months in soil, organic matter, and tap water.

Source: FM 8-33 and Development of a Trinational Biodefence Concept .
Notes: 1. This table is not all-inclusive and does not imply weaponization or the ability to weaponize exists.
2. For explanatory notes see page F-2.

Table F-5
Possible Militarily Significant Biological Agents, Viruses (1 of 2)

DISEASE	DISSEMINATION	TRANSMISSIBILITY	INCUBATION TIME	ILLNESS DURATION	LETHALITY (%)
Chikungunya Fever	Aerosol	No	2-3 days	2 weeks	<1
Crimean-Congo Hemorrhagic Fever	Aerosol	Moderate	2-7 days	Days to weeks	10-50
Dengue Fever	Aerosol	No	2-5 days	Days to weeks	5-10
Eastern Equine Encephalitis	Aerosol	No	5-15 days	1-3 weeks; death 3-5 days from onset	80
Ebola Fever	Aerosol	Moderate	4-16 days	Death between 7-16 days	50-90
Hantaan (Korean Hemorrhagic Fever)	Aerosol	No	2-4 weeks	Days to weeks	<1-10
Influenza	Aerosol	High	1-3 days	Week	<1
Junin (Argentine Hemorrhagic Fever)	Aerosol	No	10-14 days	Weeks	5-30
Lassa Fever	Aerosol	Low to moderate	7-15 days	Weeks	10-50
Machupo (Bolivian Hemorrhagic Fever)	Aerosol	No	10-14 days	Weeks	5-30
Marburg	Aerosol	Moderate	3-9 days	Weeks; death between 7-16 days of onset.	50-90
Omsk Hemorrhagic Fever	1. Aerosol 2. Water	Negligible	3-7 days	7-10 days; prolonged convalescence.	.5-3
Rift Valley Fever	1. Aerosol	Low	1-6 days	2-5 days; prolonged	<1

DISEASE	DISSEMINATION	TRANSMISSIBILITY	INCUBATION TIME	ILLNESS DURATION	LETHALITY (%)
	2. Infected vector			convalescence.	
Russian Spring-Summer Encephalitis	1. Aerosol 2. Water	No	7-14 days	Days to months	<30
Smallpox	Aerosol	High	10-12 days	4 Weeks	25-50
Venezuelan Equine Encephalitis	1. Aerosol 2. Infected vectors	Low	1-6 days	Days to weeks	<1
Western Equine Encephalitis	Aerosol	No	1-20 days	Days to weeks	5-15
Yellow Fever	Aerosol	No	3-6 days	Weeks	20-50

Sources: FM 8-33 and Development of a Trinational Biodefence Concept.

Notes: 1. This table is not all-inclusive and does not imply weaponization or the ability to weaponize exists.

2. Listed viruses have high infectivity.

3. For explanatory notes see page F-2.

Appendix G Echelons Above Corps Chemical/Biological Threat Analysis and Planning Procedures

This appendix provides a method for chemical staffs at echelons above corps (EAC) to address theater-level chemical and biological (CB) threats and the requisite planning and execution procedures. Through its questioning-style format, it ensures the staff addresses relevant information and intelligence requirements throughout all phases of conflict. While intended for EAC chemical staffs, lower level staffs will find the information useful in developing plans to mitigate the CB threat.

A. IDENTIFY AND DISEMINATE THE CB THREAT

1. How well do we understand the CB threat?
    - What is the threat?
        - Which adversaries have verified CB threats?
        - Which adversaries are thought to have a CB threat?
        - By adversary, what chemical agents are known to be on-hand?
        - By adversary, what chemical agents are thought to be available?
        - By adversary, what biological agents are known to be on-hand?
        - By adversary, what biological agents are thought to be available?
        - What and how many delivery systems are available to the enemy?
        - Are CB preventive measures by adversaries (such as inoculation and training) being noted?
        - Is there a release other than attack (ROTA) threat?
        - How have we considered the “collateral damage” threat posed by industrial compounds?
        - Will coalition forces be subjected to environmental hazards that have aspects similar to deliberate chemical agent attacks and if so, what?
        - What specific environmental hazards have been identified that might affect coalition proposed routes of advance of withdrawal?
        - Where are WMD production facilities and stockpiles?
    - How will it be employed?
        - When do we anticipate attack in terms of deployment?
        - What is the most likely type of strike that might occur early in the deployment process?
        - What is the anticipated priority of attack against ports, airfields, and similar locations?
        - Is the enemy conducting noticeable recon of these ports, airfields, and similar locations?
        - What is the enemy agent of choice for specific scenarios?

    - What is the stated national resolve and capability of the enemy regarding WMD employment in the region as well as in CONUS to prevent or disrupt deployment?
    - What WMD terrorist threat exists?
    - What is the enemy's anticipated concept of operations with regard to employment of WMD? For example, is the enemy expected to use CB to disrupt OPTEMPO, cause mass casualties, or both?
    - Will adversarial use of CB increase their regional "prestige" and/or alter psychological balance?
    - Will adversaries be able to threaten US forces throughout the depth of their deployment?
    - What is the prioritization of gathering CB threat information?
    - Have friendly or neutral population centers been identified as potential targets?
    - What friendly commercial chemical or radiological facilities are potential targets?
- What effect will its employment have on our operations?
    - Which pre-positioned storage areas are critical to the allied effort?
    - What is the vulnerability of storage areas for pre-positioned assets?
    - What is the enemy's resolve and threat toward noncombatant US citizens in theater?
    - What level of deployment degradation will the enemy seek to achieve using CB?
    - What are the impacts of threat usage in respect to psychological, medical, logistical, and so forth implications?
    - Will the use of WMD impact the cohesiveness of coalitions? How?
    - Which ports and airfields will be prime targets for enemy use of chemical and biological agents under current operational plans?
    - Will CB use produce a strategic, political, and/or psychological effect that overshadows their actual military utility?

2. Have appropriate intelligence activities been tasked to develop the threat?
    - Which agencies are developing the threat?
    - What resources does the commander-in-chief (CINC) have for obtaining threat data when deployed?
    - What is the timeliness of CB threat data?
    - How are the above resources informed of specific information to be watched for?
    - What system is in place to prioritize intelligence requests?

3. Have we pieced together the various intelligence reports to identify and deconflict contradictory information?
    - How is contradictory information deconflicted?
    - Which staff sections or personnel contribute to deconflicting CB intelligence?
    - What criteria are in place to determine when a piece of information should be incorporated into planning?

4. Have we disseminated this information to the whole team (services; planners; Office, Joint Chiefs of Staff (OJCS) units)?

- When is data considered ready to be sent out to other team members?
- How is CB threat data routed?
- How and when do we share information and conclusions with actual or potential allies (coalition partners)?
- What is the threat to Host Nation (HN) population/forces and how might this impact coalition operations?
- What HN emergency response and reporting agencies are included in the dissemination of CB data? When? What types of data?

5. Do we have the capability to monitor for changes to the threat and rapidly disseminate major changes?

B. INCORPORATE THE CB THREAT INTO PLANS AND OPERATIONS

1. Do CINC OPLANs accurately identify the current CB threat?
    - What is the US doctrinal operational response to a confirmed CB use on US forces?
        - What is the doctrine?
        - What should be the US response?
    - What other operational responses are authorized to be made by the CINC?
    - When is he authorized to make these operational responses?
    - How do friendly targeting plans consider the environmental aspects of industry and potential enemy weapon storage areas?
    - What are the plans and priorities for distribution of force protection assets?
        - Decon units and material
        - CB recon units and equipment
        - Bio defense (detection, protection, and decon)
        - Smoke and obscurants (units and munitions)
        - Medical (prophylaxes and support)
        - Engineer (equipment)
        - Individual protection material
        - Collective protection material
    - What are the plans for distribution of force protection assets to--
        - Combatants?
        - Noncombatants (US, HN, and others)?
        - EPW?
    - What plans are in place regarding handling and evacuation of contaminated corpses?
        - How has the CINC ensured that units are aware of this policy?
        - How and when has knowledge of this policy been evaluated?
    - What if any passive avoidance measures are required by the theater commander?
    - In consideration of joint doctrine, how are HN support needs determined?

- How do the plans provide NBC protection guidance for the entire spectrum of operations, from operations other than war to general war?

2. Are we addressing the CB threat, in peacetime, to forward deployed forces?
   - How are changes in threat status in the unit's AO/AI sent quickly with a proper priority?
   - What priority is used to ensure timely receipt of information?

3. Is there a structured plan to reduce/mitigate the CB threat?
   - Do we understand which "smart" sensors are available and how to use this information?
   - Once "smart" sensor detects agent, how (what commo system) is this information transmitted, especially across service and coalition lines?
   - What is the (our) standard to confirm enemy use of CB? For example, is a Gold Seal biological laboratory required for BW confirmation?
   - Which staging areas are most critical to our success?
   - What alternate staging areas been identified?
   - What priority are enemy CB delivery and storage units being given in the targeting sequence?
   - What nonmilitary steps are planned to negate or deter the use of WMD?
   - What steps are planned to eliminate enemy capability to target ports, airfields, and so forth?
   - What protective and defensive measures are being used throughout the coalition depth of deployment?
   - Are we prepared to portray enemy use of CB in such a negative way as to rally world opinion against our enemy?
   - What active and passive measures have been instituted to protect the key points of entry?
   - What CB units will be deployed early to provide the deterrence to enemy use of CB at points of entry?
   - Which, if any, warning systems have digitization connectivity?
   - What "risk analysis" methods are in place to determine decontamination requirements?
   - How does the command know what units are trained and equipped to perform decontamination in the absence of chemical units?
     - What can the command do about it if it is not?
   - What steps have been taken to ascertain the CB readiness of potential coalition partners?
   - What means are available to alleviate shortcomings in coalition partners' CB defense postures and capabilities?
   - If deployment is planned to be continuously over a relatively long period of time, what protective measures are planned for later deploying units?
   - How frequently are field artillery and air defense artillery (ADA) units required to move?

- What is the theater guidance with regard to dispersion?
- What steps have been taken to mitigate the effect of WMD employment on OPTEMPO?
- What awareness training have component forces received to negate the threat of covert positioned NBC weapons?

4. Is the entire staff involved in the CB defense process (checklists for medical, logistics, and civil-military operations (CMO), Public Affairs Office (PAO), legal)?

- Medical
    - What medical protection assets in the form of vaccines, pretreatment, and/or skin protectants are in place?
    - What plans are in effect for using them?
    - What is the immunization protocol?
    - What plans have been made to address the significant implications concerning provision of medical assistance in the event of enemy use of WMD?
    - What levels of medical protection have been provided to the subordinate units to increase an individual's resistance to CB attack, indigenous medical threat, and environmental hazards and do they understand how to use them?
    - What provision of providing military supplied medical assistance to nonmilitary personnel are included in campaign plans?
    - What plans are in place to alleviate shortfalls caused by providing medical support to nonmilitary personnel?
    - What steps have been taken to ensure proper medical assistance is available for combat units, US and HN civilian workers, dependents, and EPWs?
    - Are hospitals (component, HN, coalition) equipped to care for CB casualties?
    - What vaccines are available with the theater?
    - If sufficient vaccines are not available to inoculate all personnel, what is the protocol for determining who receives vaccinations?
    - What is the policy towards decontaminating and evacuating the wounded?
    - What steps have been taken to ensure that the decontamination and evacuation policy is known and understood?
    - What steps have been taken to ensure that an adequate number of medical personnel have received specialized training in CB casualty treatment and management?
    - Have plans been made for combating the indigenous medical threat within the theater?
    - What medical force structure, by Department of the Army master priority list (DAMPL) sequence, is available to the theater?
    - What is the policy to determine the priority of medical attention to nonmilitary personnel: US allies, EPWs, and HN?

- Logistics
  - What CB defensive procedures have logistical commanders initiated to limit exposure of their units and facilities to CB attacks and to protect personnel and supplies from CB contamination?
  - What command and control procedures are established to ensure the effective NBC defense of multiservice, HN, coalition, and major logistics bases, including ports and airfields?
  - What plans are in effect for ensuring that sufficient protective equipment is available for issue to US civilians, HN personnel, and allies?
  - How much equipment for protecting EPWs has been ordered?
    - What is a reasonable amount to plan for?
    - Where is it stored?
  - How do you determine if the required amount of individual protective gear and unit CB defensive equipment is on hand in each subordinate unit?
  - What procedures are in place to ensure that sufficient water and other supplies are on hand in the proper location to permit effective and efficient decon operations?
  - What plans have been made to ensure that necessary medical supplies are kept at the level required to execute the mission?
  - What steps have been taken to ensure that sufficient alternate supply routes exists for logistical operations?
  - What plans are in place to address CB equipment resupply?
  - What training has been conducted with HN police, fire, and other emergency organizations regarding NBC defense?
- Civil-Military Operations
  - What action plans are in place to depict a CB trained force as was done in Operation Desert Shield/Storm?
  - What provisions have been made to protect or replace the noncombatant work force if evacuation is ordered?
  - What cross training of military to perform civilian technician work has been conducted?
  - What evacuation routes for noncombatants have been designated?
  - How has this information been communicated to those affected?
    - How has it been practiced, if at all?
  - What plans have been made for controlling civilian evacuations?
    - How has this been practiced?
  - How has information concerning potential environmental hazards been communicated to the noncombatant population?
  - What steps have been taken to protect the nonmilitary personnel from environmental hazards?
  - When was the last noncombatant evacuation operations (NEO) exercise? What was the percentage of participation?

        - How do you ensure personnel with wartime missions are not simultaneously slotted for NEO?
        - What steps have been taken to ensure that the guards have been trained in how to teach EPWs the proper use of protective equipment?
        - What units have been designated to protect civilians, medical facilities, and so forth?
            - What steps have been taken to ensure that these units are not called for elsewhere in operations plans?
        - What are the CB-related duties and responsibilities of the various civil affairs units deployed in support of the OPLAN?
        - Who is responsible for coordinating CB matters with the various other US and HN government agencies in the theater? Is he/she prepared to do so?
    - Public Affairs Office
        - What PAO plans are in place to deter CB use?
        - What PAO plans are in place to rally world opinion before and after CB use?
        - What PAO plans are in place to deter further CB use?
    - Legal
        - What are CB rules of engagement?
        - What are rules of engagement for employing riot control agents?
        - What is the US policy for use of NBC weapons?

5. Do we provide enough guidance to synchronize the component CB defense plans?
    - What decision support tools are available to assist the unit commander in determining proper protective posture?
    - What decision support tools are available to assist the unit commander in determining when to decontaminate?

6. Is the CB threat adequately considered in the OPLAN?
    - What are the alternate ports and airfields available?
    - What protective and defensive measures are in effect at ports and airfields?
    - What is our policy on sending out CB warning reports--affected units only? All units? If all units, do we differentiate on urgency?
    - How do we transmit this information across service and coalition lines?
    - What is time phased arrival of medical units in theater?
    - What flexibility for changing arrival sequence exists? If CB assets are needed more quickly, what is the mechanism for making it happen?
    - What provisions are in place to ensure adequate CB force protection units are sequenced for early entry operations?
    - What is the deployment sequence for components as applicable to--
        - Reconnaissance units?
        - Biological detection (BIDS and Gold Seal Lab) units?
        - Decontamination units?
        - Medical units and personnel?

    - Smoke generation units?
- What CB defense measures are integrated into the overall force protection plan?
- What measures are taken to protect deep strike capabilities?
- What methods of CB warning and reporting have been established to ensure dissemination of information to subordinate components and coalition forces?
- What is the current method of determining the need for decontamination?
- What priorities of decontamination have been established in the theater?
- What provisions have been made to ensure knowledge of all joint force unit locations?
- What steps are being taken to ensure that subordinate commanders know where contaminated areas are during operations?
- What priority is placed on avoiding contamination?
- What is the plan for deploying CB sensor suites in the theater of operations?

7. Do supporting component OPLANS adequately address CB defense?
    - How are supporting component assets organized to dedicate efforts to CB functions?
    - How do supporting component commanders determine CB readiness?
    - What is the status of supporting component commanders'--
        - Plans?
        - Equipment?
        - Training?
        - Personnel?
    - What CB functions have the other components planned for conducting internally?
    - For which CB functions will the CINC need to provide the LCC support to the other components?
    - What methods are in place to monitor CB readiness of component forces in the areas of training, equipment, and personnel?
    - How are component CB defense assets coordinated into a comprehensive theater CB defense plan?

8. Do the plans maximize joint service synergy, effectively utilize resources, and produce a seamless CB defense posture across the operation?
    - How has CB warning and reporting been integrated into the joint force C^2S systems?
    - When was it last practiced?
    - How have the services' requests for CB defense forces been incorporated into OPLANs?
    - Where are the recon assets located?
    - Where do plans call for CB recon units to be located during offensive and defensive operations?

9. Have CB defense shortfalls been addressed?

- What actions are taken to alleviate shortfalls in the CB readiness of supporting service commanders' units?

ENSURE ADEQUACY OF GUIDANCE AND DOCTRINE

1. What enemy WMD employment concepts are being considered in plans?
2. How is specific standardized CB defense guidance to all CINCs worded in the defense planning guidance (DPG), and later in campaign plans?
3. What JCS guidance is in place to synchronize the component CB defense plans?
4. What improvements are required in joint doctrine, as espoused in Joint Pub 3-11, Joint Doctrine for CB Defense?
5. What deficiencies exist in written, service-developed doctrine to provide US forces instructions on how to survive and operate in a CB defensive environment?
6. What are the procedures for decontaminating the wounded? What are the shortcomings?
7. What procedures have been written regarding handling and evacuation of contaminated corpses?
   - How has the CINC ensured that units are aware of this policy?
   - How and when has knowledge of this policy been evaluated?
   - What steps have been taken to ensure that this policy is known and understood?
8. What is the stated national policy of massive response to enemy use of WMD?
9. When do we publicly state the policy?
10. What plan exists to obscure high priority/high signature targets with smoke and obscurants from enemy acquisition assets (including smoke deception plan)?
11. What is the policy of coalition partners on response to enemy use of WMD?
12. Does the policy of coalition partners include acting independently if WMD are used on their troops or homeland?
13. Has the issue of a coordinated response concerning coalition partners been coordinated in advance?

D. TRAIN AND EXERCISE THE JOINT FORCE IN CB DEFENSE

1. Do CINC staff and service senior leaders understand the CB threat and how they support the theater CB defense strategy? (Suggestion: "Wargame" the

plan with senior leaders and talk them through CB attacks. Have them briefback how their units will respond. Discuss what key decisions have to be made, when and what the available options are).

- What steps have been taken to negate the operational difficulties likely to be encountered if attacked by CB weaponry?
- What steps have been taken to prevent the occurrence of needless casualties if attacked by CB weaponry?
- What steps are being taken to improve leader awareness of the CB threat and how to counter it?
- What steps are being taken for CB defense of power projection operations?

2. Do necessary models and simulations support the CINC's training and exercise needs?

- What computer models/simulations are currently used to train the CINC's staff and subordinate services?
- How often are models/simulations used to exercise the staff and services?
- How thoroughly is CB integrated into these models?
- What model(s) would the CINC or his staff like to see CB thoroughly integrated into?

3. Has the CB threat been adequately addressed in joint exercises and training?

- What is the CINC's stated goal for CB defense in joint exercises?
- What universal joint task list (UJTL) tasks have been incorporated into joint exercises? Does this accommodate the GAO findings?
- How are the modern computer based tools being used to exercise CB tasks?
- How many times during the past year were each of the CB tasks of the UJTL exercised?
- How were they evaluated?
- How is the staff being trained to ensure their understanding of their responsibilities with regard to the CB tasks tested?
- What is the requirement to perform realistic missions for extended periods of time while fully encapsulated? What is the CINC's expectation?
- What training objectives are mandatory for major joint task force and CINC-level exercises?
- What training has been provided for leaders to mitigate the demonstrated extra toll that encapsulation takes on leaders?
- What is the minimum "required" CB defense training specified by command directives?
- How have unit leaders been trained in hazards and protective measures associated with depleted uranium on the battlefield?
- How have unit leaders been trained to distinguish between an environmental hazard and a chemical agent attack?
- What training has been given to both soldiers and leaders with regard to protecting themselves from an environmental hazard?

- What training has been given to both soldiers and leaders with regard to avoiding an environmental hazard?
- What training has been given to both soldiers and leaders with regard to decontaminating an environmental hazard?
- What practice have personnel had in communicating while encapsulated?
- How has medical unit ability to perform their mission with contaminated casualties been assessed?
- What plans are in place for movement of contaminated patients within theater?
    - What units are responsible for this mission?
    - When did they last practice this mission?
    - What evacuation routes have been designated?

4. Have plans and responses been adequately exercised against the CB threat?

- What action plans are in place to ensure quality CB play is included in exercises?
- How does the command envision (written in specific planning documents) maintaining OPTEMPO following enemy use of biological or chemical weapons?
- Do multinational coalition force exercises include sufficient CB plans to determine coalition readiness?
- What are the coalition force political policies that discourage the inclusion of CB defense events in major exercises?
- What is the CINC's standard regarding practice of self-sustaining decontamination operations (without a chemical unit available)?
- How are exercises designed to ensure that CB warnings are received across both service and coalition lines?
- How do exercises incorporate both active and passive measures to protect key ports of entry from CB hazards?
- How do joint exercises measure the proper use of dispersion and movement as preventive measures against CB attacks?
- How is targeting of enemy WMD capabilities played in exercises?
- How are the CB effects on the civilian population played in exercises?
- How is the need for additional medical support in a CB war exercised?
- How do exercises test a unit's ability to decontaminate wounded personnel?
- How have military personnel slated to take the place of key civilian personnel exercised to ensure that they can perform their wartime mission?
- How has exercising around massive evacuations been accomplished?
- When was the last NEO exercise? What percentage of noncombatants participated?
- How do exercises give leaders opportunities to make realistic CB defense decisions? Do exercise scenarios anticipate the use of decision support tools?
- How often is using EPW guards to train EPWs in the use of US CB defense equipment incorporated into exercises?

- How do exercises adequately account for the time-phased arrival of CB and medical support?
- How often are using decontamination priorities included in exercises?

E. ASSESS READINESS AND IDENTIFY NEEDS

1. Have CINC issues identified in wargames and exercises (for example, how to handle civilian/coalition requirements, logistics shortfalls, gaps in command and control, CB warning and reporting in developing theaters) been identified for resolution? What process is being used for resolution?

2. What is the process to ensure plans have been updated to reflect exercise lessons learned?

3. What mechanism(s) do the CINC and staff use to determine unit CB readiness?

4. How is the CB readiness incorporated into unit readiness reporting? Are ratings based on objective criteria or subjective criteria? Can the commander call his status anything he wants regardless of what the data indicates?

5. How has the staff ensured that the process for resolving CB readiness issues is known to all subordinate commands?

6. What are the CB defense standards that the CINC expects all deploying units to meet? What steps are being taken to ensure that this is true?

7. What is the CINC's criteria for determining CB readiness?

8. How do the CINC and staff consider and encourage technological developments related to NBC defense individual protection?

9. To what degree has the combatant command elevated the requirement for uniform and meaningful NBC readiness standards and reporting to OJCS?

10. What are the measurement standards that the CINC and staff use to ensure uniform and meaningful standards and assessment of NBC readiness among the assigned forces?

11. What CINC NBC guidance has been published?

12. What is the system to ensure issues that cannot be resolved at service component or CINC staff level have been identified to appropriate organizations for resolution?

13. What mechanisms exist for providing theater CB defense readiness needs to service chiefs for their information/action?

14. What is the process to ensure CB defense needs have been incorporated into the CINC integrated priority list (IPL) process?

GLOSSARY

A

Airburst. Nuclear weapon explosion at such a height that the expanding fireball does not touch the earth's surface when the luminosity is a maximum.
ADA. Air defense artillery .
AI. Area of interest.
AO. Area of operations.
Area of interest. Geographical area from which information and intelligence are required to permit planning or successful conduct of the command's operation. The AI is usually larger than the command's AO and battlespace; it includes any threat forces or characteristics of the battlefield environment that will significantly influence accomplishment of the command's mission.
Area of operations. Portion of a conflict area necessary for military operations. AOs are geographical areas assigned to commanders for which they have responsibility and in which they have the authority to conduct military operations.

B

Battlespace. Components determined by the maximum capabilities of a unit to acquire and dominate the enemy, includes areas beyond the area of operations and varies over time according to how the commander positions his assets.
BDO. Battledress overgarment.
Beta particle. Charged particle of very small mass emitted spontaneously from the nuclei of certain radioactive elements. Most of the direct fission products emit (negative) beta particles. Physically, the beta particle is identical with an electron moving at high velocity.
BIDS. Biological integrated detection system .
Biological agent. Microorganisms and toxins that cause disease in man, plants, or animals or cause the deterioration of materials.
Biological defense. Methods, plans, and procedures involved in establishing and executing defensive measures against attacks using biological agents.
Biological weapons. Any item of material that projects, disperses, or disseminates a biological agent, including anthropoid vectors.
Blast wave. A pulse of air in which the pressure increases sharply at the front, accompanied by winds, and propagated from an explosion.

Blister agent. Chemical compound that injures the eyes and lungs and burns or blisters the skin.
Blood agent. Chemical compound that affects bodily function by preventing the normal transfer of oxygen from the blood to the body tissues. Also called cyanogen agent.
BOS. Battlefield operating system .
BW. Biological warfare .

C

C. Celsius.
CB. Chemical/biological .
CBDCOM. Chemical and Biological Defense Command.
CCIR. Commander's critical information requirements.
CDM. Chemical downwind message.
Centigray. Unit of measurement for radioactivity.
cGy. Centigray.
cGyph. Centigray per hour.
Chemical agent. Chemical substance intended for use in military operations to kill, seriously injure, or incapacitate through its physiological actions. Excludes riot control agents, herbicides, smoke, and flame.
CI. Combat ineffective.
CINC. Commander-in-chief.
CMA. Chemical Manufacturers Association .
CMO. Civil-military operations .
COA. Course of action.
Collective protection. Use of shelters to provide a contamination-free environment for personnel and equipment.
Collective-protection shelter. A shelter, with filtered air, that provides a contamination-free environment for personnel/equipment and allows relief from increased protective postures.
Commander's critical information requirements. The information the commander needs to visualize the outcome of current operations. Includes information on both friendly and enemy forces.
Contamination. Deposit and/or absorption of radioactive, biological, or chemical agents on and by structures, areas, personnel, or objects; food and/or water made unfit for human consumption by the presence of environmental chemicals, chemical agents, radioactive elements, bacteria, or organisms.
Contamination avoidance. Individual and/or unit measures taken to avoid or minimize NBC attacks and reduce NBC hazard effects.

Course of action. A possible plan open to an individual or commander that would accomplish or is related to mission accomplishment. A COA is initially stated in broad terms with the details determined during staff wargaming.
CPE. Collective-protection equipment.
CSC. Combat stress control.
CW. Chemical warfare.

D

DAMPL. Department of the Army master priority list.
Decision point. An event, area, line, or point on the battlefield where tactical decisions are required resulting from the wargaming process before the operation order. Decision points do not dictate commander's decisions, they only indicate that a decision is required, and they indicate when/where the decision should be made to have the maximum effect on friendly or enemy courses of action.
Decontaminate. To break down, neutralize, or remove a chemical, biological or radioactive material.
Depleted uranium. Uranium with a concentration of Uranium-235 smaller than that found in nature (0.711 percent). It is largely obtained as by-product "tails" of the uranium enrichment process.
DLA. Defense Logistics Agency.
Doctrinal template. A model based on postulated threat doctrine. They illustrate the disposition and activity of threat forces and assets (HVTs) conducting a particular operation unconstrained by the effects of the battlefield environment. They represent the application of threat doctrine under ideal conditions.
DOT. Departure of troops.
DPG. Defense planning guidance .
DU. Depleted uranium.

E

EAC. Echelons above corps.
EDM. Effective downwind message.
Electromagnetic pulse. A sharp pulse of radio frequency (long wavelength) electromagnetic radiation produced when an explosion occurs in an unsymmetrical environment, especially at or near the earth's surface or at high altitudes. The intense electric and magnetic fields can damage unprotected electrical and electronic equipment over a large area.
EMP. Electromagnetic pulse.

Event matrix. A description of the indicators and activity expected to occur in each NAI. It normally cross-references each NAI and indicator with the times they are expected to occur and the COAs they will confirm or deny. There is no prescribed format.
EVENTEMP. Event template.
Event template. A guide for collection planning. The template depicts the NAIs where activity or lack of activity will indicate which COA the threat has adopted.

F

F. Fahrenheit.
Fallout. Process or phenomenon of the descent to the earth's surface of particles contaminated with radioactive material from the radioactive cloud. Term is also applied in a collective sense to the contaminated particulate matter itself. The early or local fallout is defined as those particles that reach the earth within 24 hours after a nuclear explosion. The delayed fallout consists of the smaller particles that ascend into the upper troposphere and into the stratosphere and are carried by winds to all parts of the earth. The delayed fallout is brought to earth mainly by rain or snow over extended periods ranging from months to years.
Fission. The splitting of the nucleus of a heavy atom into two lighter nuclei. It is accompanied by the release of neutrons, gamma rays, and kinetic energy of the fission products. It is usually triggered by collision with a neutron, but in some cases can be induced by protons and other particles or gamma rays.
Fizzle. The initiation of the fission chain reaction in the fissile material of a nuclear weapon at any time before the designed criticality or the maximum compression or degree of assembly is attained. Also called "pre-initiation."
FRAGO. Fragmentary order .
FROG. Free rocket over ground.
FSO. Fire support officer.
Fuel processing plant. A plant where irradiated fuel elements are dissolved, waste materials removed, and reusable materials recovered.
Fusion. Process by which two light nuclei atoms, deuterium and/or tritium, combine to form a heavier nucleus with the release of a substantial amount of energy. Extremely high temperatures, resulting in highly energetic, fast-moving nuclei, are required to initiate fusion reactions.

G

Gamma radiation. Electromagnetic radiations of high photon energy originating in atomic nuclei and accompanying many nuclear reactions such as fission. Physically, gamma rays are identical with X-rays of high energy.
GB. A nerve agent (Sarin); an organophosphate ester derivative of phosphoric acid.
Gold Seal biological laboratory.
GPO. Government Printing Office.
Ground zero. The point of detonation for an explosive device, usually used with regard to nuclear devices.
Gun-type weapon. A gun-barrel-shaped device in which two or more pieces of fissionable material, each less than a critical mass, are brought together very rapidly so as to form a supercritical mass that can explode as the result of a rapidly expanding fission chain reaction.
GZ. Ground zero.

H

Ha. Hectare; 10,000 square meters.
HD. Distilled mustard; a sulfur mustard agent.
Height of burst. Height above the earth's surface at which a bomb is detonated in the air.
High-altitude burst. A detonation at an altitude over 100,000 feet.
High-payoff target. Target whose loss to the threat will contribute to the success of the friendly COA.
High-value target. Assets the threat commander requires for the successful completion of a specific COA.
HN. Host nation.
HPT. High-payoff target.
HVT. High-value target.
Hydrogen bomb. A nuclear weapon that derives its energy largely from fusion, also known as a thermonuclear weapon.

I

IAW. In accordance with.
ICW. In coordination with.
ICE. Individual chemical equipment.
Immunize. To increase resistance and/or protection from disease.
Improvised nuclear device. Term used to refer to any type of explosive device designed to cause a nuclear yield.
IND. Improvised nuclear device.

Indicators. Positive or negative evidence of threat activity or any characteristic of the AO which points toward threat vulnerabilities or the adoption or rejection by the threat of a particular capability, or which may influence the commander's COA selection. Indicators may result from previous actions or from threat failure to take action.
Intelligence preparation of the battlefield. Systematic, continuous process of analyzing the threat and environment in a specific geographic area. It is designed to support staff estimates and military decision making.
Intelligence requirement. A requirement for intelligence to fill a gap in the command's knowledge and understanding of the battlefield or threat forces. They are designed to reduce the uncertainties associated with successful completion of a specific friendly COA.
Ionization. Separation of a normally electrically neutral atom or molecule into electrically charged components.
IPB. Intelligence preparation of the battlefield.
IPE. Individual protective equipment.
IPL. Integrated priority list .
IR. Intelligence requirement.

J

JCS. Joint Chief of Staff.

K

Kilometer. Unit of linear measure equal to 1,000 meters or .62137 miles.
Kg. Kilogram.
Km. Kilometer.
Kmph. Kilometers per hour.

L

LLR. Low-level radiation.
Loading. The force on an object or structure or element of a structure. The loading due to blast is equal to the net pressure in excess of the ambient value multiplied by the area of the loaded object.
Low-level radiation. Exposure from radioactive sources that is higher than those routinely received by health physics workers and the general public and are in the range from background radiation to 70 cGy. The primary consequence of exposure may be induction of cancer in the longer-term post exposure. The hazard from LLR may result from alpha, beta, or gamma radiation.
LRBSDS. Long-range biological standoff detection system.

M

Mach stem (front). Shock front formed by the merging of the incident and reflected shock fronts from an explosion. Term is generally used with reference to a blast wave, propagated in the air, reflected at the earth's surface.
MCOO. Modified combined obstacle overlay.
METT-T. Mission, enemy, terrain, troops, and time available.
Mission, enemy, terrain, troops, and time available. Used to describe the factors that must be considered during the planning or execution of a tactical operation. Since these factors vary in any given situation, the term "METT-T" is a common way of denoting that the proper approach to a problem in any situation depends on these factors and their interrelationship in that specific situation.
Mission-oriented protective posture. A flexible system that provides the maximum NBC protection for the individual with the lowest risk possible and still maintains mission accomplishment.
Modified combined obstacle overlay. A product used to depict the battlefield's effects on military operations. It is normally based on a product depicting all obstacles to mobility, modified to also depict the following:
- Cross-country mobility classifications.
- Objectives.
- Avenues of approach and mobility corridors.
- Likely locations of counter-mobility obstacle systems.
- Defensible terrain.
- Likely engagement areas.
- Key terrain.

MOPP. Mission-oriented protective posture.
MRS. Multiple launch rockets.
MSDS. Material safety data sheets.

N

NAI. Named area of interest.
Named area of interest. Geographical area where information that will satisfy a specific information requirement can be collected. NAIs are usually selected to capture indications of threat COAs but also may be related to conditions of the battlefield.
NBC. Nuclear, biological, and chemical.
NBCWRS. NBC warning and reporting system.
NEO. Noncombatant evacuation operations.

Neutron. A neutral particle (no electrical charge) of approximately unit mass present in all atomic nuclei except those of ordinary hydrogen. Neutrons are required to initiate the fission process, and large numbers of neutrons are produced by both fission and fusion reactions in nuclear (or atomic) explosions.

NIGA. Neutron-induced gamma activity.

NIOSH. National Institute for Occupational Safety and Health.

NRC. National Response Center.

NTIS. National Technical Information Service.

Nuclear radiation. Particulate and electromagnetic radiation emitted from atomic nuclei in various nuclear processes. Of importance are alpha and beta particles, gamma rays, and neutrons.

Nuclear reactor. A device in which a controlled, self-sustaining nuclear chain reaction can be maintained with the use of cooling to remove generated heat. Types include power reactors, research and test reactors, and production reactors.

Nuclear weapon. A device that releases nuclear energy in an explosive manner as the result of nuclear chain reactions involving the fission or fusion, or both, of atomic nuclei.

Nuclear yield. The energy released in the detonation of a nuclear weapon expressed in kilotons or megatons of trinitrotoluene (TNT) required to produce the same energy release. Yields are categorized as:

Very low: less than one kiloton.
Low: 1 kiloton to 10 kilotons.
Medium: over 10 kilotons to 50 kilotons.
High: over 50 kilotons to 500 kilotons.
Very high: over 500 kilotons.

Nucleus. Small, central, positively charged region of an atom which carries essentially all the mass. Except for hydrogen (which is a single proton), all atomic nuclei contain both protons and neutrons.

O

OJCS. Office, Joint Chief of Staff.

OPLAN. Operations plan.

OPORD. Operations order.

P

PAO. Public Affairs Office .
Parts per million. Measure of proportion by weight; equivalent to a unit weight of solute per million unit weights of solution.
PD. Performance degraded.
PIR. Priority intelligence requirement.
Proton. A particle of mass carrying a unit positive charge; it is identical physically with the nucleus of the ordinary hydrogen atom.
ppm. Parts per million.
Priority intelligence requirement. An intelligence requirement associated with a decision that will affect the overall success of the command's mission. PIRs are a subset of intelligence requirements of a higher priority than information requirements. PIRs are prioritized among themselves and may change in priority over the course of the operation's conduct. Only the commander designates PIRs.
Psychological operations. A planned psychological activity in peace and war directed towards enemy, friendly, and neutral audiences, in order to create attitudes and behavior favorable to the achievement of political and military objectives.
PSYOPS. Psychological operations.

R

Radii of vulnerability. The radius of the circle within which friendly troops will be exposed to a risk equal to, or greater than, the emergency risk criterion (5 percent combat ineffectiveness) and/or within which material will be subjected to a 5 percent probability of the specified degree of damage.
Radioactivity. The spontaneous emission of radiation, generally alpha or beta particles, often accompanied by gamma rays from the nuclei of an unstable isotope. As a result of this emission the radioactive isotope decays into the isotope of a different (called a daughter) element which may also be radioactive. Ultimately, a stable (nonradioactive) end product is formed.
Radiological dispersal device. Any device that is intended to spread radioactive material. An improvised nuclear device can be a radiological dispersal device if the explosion does not cause a nuclear yield, but "fizzles," spreading radioactive materials.
Rainout. Removal of radioactive particles from a nuclear cloud by precipitation when the cloud is within a rain cloud.
Reconnaissance. A mission undertaken to obtain information by visual observation, or other detection methods, about the activities and resources of an enemy or potential enemy, or about the meteorologic, hydrographic, or

geographic characteristics of a particular area. Reconnaissance differs from surveillance primarily in duration of the mission.
Residual nuclear radiation. Nuclear radiation, mainly beta particles and gamma rays, which persists for some time following a nuclear (or atomic) explosion. The radiation is emitted mainly by the fission products and other bomb residues in the fallout, and to some extent by earth and water constituents, and other materials, in which radioactivity has been induced by the capture of neutrons.
RDD. Radiological dispersal device.
RFI. Request for information.
ROTA. Release other than attack.
R&S. Reconnaissance and surveillance.
RV. Radii of vulnerability.

S

SASO. Stability and support operations.
SCBA. Self-contained breathing apparatus.
Shielding. Any material or obstruction that absorbs or attenuates radiation and thus tends to protect personnel or materials from explosion effects.
Shock front. The fairly sharp boundary between the pressure disturbance created by an explosion and the ambient atmosphere, water, or earth. It constitutes the front of the shock or blast wave.
SIR. Specific information requirement.
Situation template. Depictions of assumed threat dispositions, based on threat doctrine and the effects of the battlefield, if the threat should adopt a particular COA. In effect, they are the doctrinal templates depicting a particular operation modified to account for the effects of the battlefield environment and the threat's current situation.
SOP. Standing operating procedures.
SOR. Specific order or request.
Specific information requirement. Statement that describes the information required to answer all or part of an intelligence requirement. Generally, each intelligence requirement generates sets of SIRs.
Specific order or request. The order or request that generates planning and execution of a collection mission or analysis of data base information. SORs sent to subordinate commands are orders. SORs sent to other commands are requests.
SSM. Surface-to-surface missile.
SRD. Secret restricted data.
Surface burst. The explosion of a nuclear (or atomic) weapon at the surface of the land or water at a height above the surface less than the radius of the fireball at maximum luminosity. An explosion in which the weapon is detonated

actually on the surface (or within $5W^{.3}$, where W is the explosion yield in kilotons, above or below the surface) is called a contact surface burst or true surface burst.
Surveillance. The systematic observation of airspace or surface areas by visual, aural, photographic, or other means. Surveillance differs from reconnaissance primarily in duration of the mission.

T

TAI. Target area of interest.
Target area of interest. The geographical area where HVTs can be acquired and engaged by friendly forces. Not all TAIs will form part of the friendly COA; only TAIs associated with HPTs are of interest to the staff. These are identified during staff planning and wargaming.
TEL. Transporter-erector-launchers.
TGD. Thickened Soman .
Thermal energy. The energy emitted from the fireball (or other heated region) as thermal radiation.
Thermal radiation. Electromagnetic radiation emitted (in two pulses from an airburst) from the fireball as a consequence of its very high temperature. It consists essentially of ultraviolet, visible, and infrared radiations.
Threat course of action model. A model of one COA available to the threat. It consists of a graphic depiction (situation template), a description (narrative or matrix), and a listing of assets important to the success of the COA (HVTs).
Threat model. A model of the threat force's doctrine and TTPs for the conduct of a particular operation. Threat models are based on the study of all available information, structured by the order of battle factors, of the particular threat force under consideration. Ideally, threat models consider all battle operating systems in detail and are usually prepared prior to deployment.
TIC. Toxic industrial chemicals.
Time phase line. A line used to represent the movement of forces or the flow of an operation over time. It usually represents the location of forces at various increments of time, such as lines that show unit locations at 2-hour intervals.
Toxic industrial chemicals. Any chemical hazard that is toxic and/or lethal and that is not designed specifically for military purposes, however, may be employed as a chemical warfare agent.
TPL. Time phase line.
TRE. Transient radiation effects.
TREE. Transient radiation effects on electronics.
TTP. Tactics, techniques, and procedures.

U

Underwater burst. Explosion of a nuclear (or atomic) weapon with its center beneath the water's surface.
UJTL. Universal joint task list.

V

VX. A nerve agent; very persistent and similar to GB in mechanism and effects.

W

Washout. The removal of radioactive particles from a nuclear cloud by precipitation when this cloud is below a rain (or snow) cloud. See rainout.
Weapons of mass destruction. In arms control usage, weapons that are capable of a high order of destruction and/or of being used to destroy large numbers of people. Can be nuclear, chemical, biological, and radiological weapons, but the means of transporting or propelling the weapons is excluded where such means are separable and divisible parts of the weapons.
WMD. Weapons of mass destruction.

X

X-rays. Electromagnetic radiations of high energy having wavelengths shorter than those in the ultraviolet region, that is, less than 10^{-6} cm.

Y

Yield. The total effective energy released in a nuclear (or atomic) explosion. It is usually expressed in terms of the equivalent tonnage of TNT required to produce the same energy release in an explosion. The total energy yield is manifested as nuclear radiation, thermal radiation, and shock (blast) energy, the actual distribution being dependent upon the medium in which the explosion occurs and also upon the type of weapon and the time after detonation.

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