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.