

CHAPTER 4

PROTECTION

There are two principles of protection -- individual and collective. Protection is needed when the chance of contamination from NBC weapons is unavoidable. Therefore, fixed site commanders must ensure that their personnel have adequate protective measures for an NBC hazard.

Individual protection actions are taken by personnel to survive and continue the mission with a minimal loss in efficiency. Personnel on fixed sites, at a minimum, must have individual protection against NBC hazards. This individual protection consists of protective mask, suit, gloves, and boots. The individual protection is referred to as MOPP. There are five standardized MOPP levels (MOPP zero to MOPP4) adopted by the Army. These levels are designed to allow commanders to increase or decrease the level of protection rapidly without providing long explanations. A commander determines the initial level of MOPP based on a MOPP analysis, found in FM 3-4, which finds the balance between reducing the risk of casualties and accomplishing the mission; he adjusts the level as the situation develops. Remember, degradation in efficiency will occur for personnel placed in individual protection (MOPP4) for extended periods of time. See FM 3-4 for a MOPP performance-degradation table.

Collective protection is an important aspect of the NBC countermeasures for fixed sites. It provides a contamination-free environment for personnel, allowing relief from continuous wear of MOPP equipment. FM 3-4 discusses four different systems in the family of collective protection. This FM will focus on the overpressure system for fixed sites, since this system allows reduction of MOPP level. A site can enhance its capability through the implementation of collective protection into its critical function(s). A fixed site can use a combination of permanent and movable collective protection strategies.

METHODS

There will be functions on a site which will require work to be done outside a toxic-free area (TFA). The basic individual protection (MOPP suit) will provide the required protection. This suit's protective capabilities can be enhanced with an impermeable disposable cover, which is provided to individuals who need increased protection from gross quantities of liquid agent for limited periods of time (see Figure 4-1). Special encapsulating suits can be provided for individuals performing hazardous duties or requiring long hours in a contaminated environment where no collective protected rest and relief areas are provided (for example, heavy maintenance bays). This special suit is connectable to portable cooling stations, is operable without the protective mask, and is a system with very high protection factors for extremely hazardous conditions. This suit will be for select personnel. It will be necessary for all fixed site personnel to be proficient in all protective measures before, during, and after an NBC attack as discussed in FM 3-4. Commanders with a predominantly civilian work force may encounter extensive training program requirements in this area.

- LIGHTWEIGHT, IMPERMEABLE SUIT
- WORN OVER THE CP OVERGARMENT
- PROTECTS CP OVERGARMENT FROM GROSS LIQUID CONTAMINATION
 - LIQUID AGENT (1 HOUR VS 10 GM/M²)
 - POL AND DECONTAMINANTS
 - WATER
- PRIMARY USERS
 - PERSONNEL IN COLLECTIVE PROTECTION
 - FOR PERSONNEL EMERGING FOR SHORT DURATIONS (1 HOUR OR LESS)
 - LESSENS REENTRY TIME
 - DECONTAMINATION PERSONNEL
- INEXPENSIVE AND DISPOSABLE



Figure 4-1. Suit, contamination avoidance and liquid protective (SCALP).

In addition, collective protection is broken down into the following areas: rest and relief (break and sleep areas), work (C³I, maintenance, and supply), and storage ammunition supply point (ASP) (POMCUS, theater reserves, and so forth) areas. It will be necessary to tailor collective protection to each fixed site based on its mission and manpower. A decision matrix is provided in this chapter in order to determine collective protection requirements. C³I and light maintenance operations are better performed in some form of collective protection. Because of the large machinery and frequent need to breach the building, heavy maintenance and supply operations are better performed in IPE using collective protection for rest and relief.

Existing buildings can be used for collective protection. Sealing the buildings will be necessary in order to create an airtight seal so that overpressure can be achieved. Generally, commercial sealing materials (such as caulking, sprayed in place foam, plywood, and acrylic sheets) are available on the local market and are capable of doing the job. Some features of a building that require sealing are exhaust fans, gas-fired hot water heaters, air-conditioning ducts, wall to ceiling and floor joints, and electrical conduits. Use shelter entryways to provide a protected entry and exit processing area for collectively protected areas (see Figure 4-2), and use

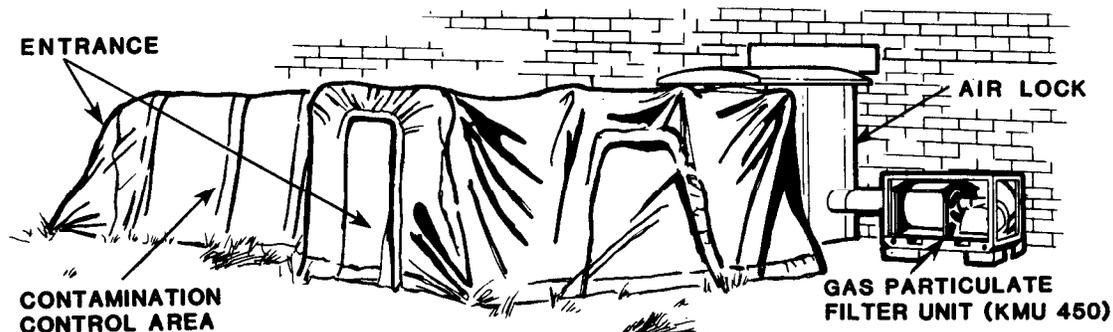


Figure 4-2. Shelter entryways.

locally fabricated airlocks to segregate the protected and nonprotected areas (see Figure 4-3). As an example, a collectively protected area can be created with an expedient room liner system for storage of items after they are cleaned and repaired. This type of room sealing technique is very simple and inexpensive. It is particularly useful for high leakage areas or expedient applications. Collective protection systems should be integrated with the existing heating and cooling systems. The preferred environmental control system is one that uses an interior evaporator with an exterior condenser (see Figure 4-4). building with an air supply and distribution system is recommended when considering a structure for collective protection. The air supply facilitates pressurizing the building.



Figure 4-3. Fabricated airlocks.

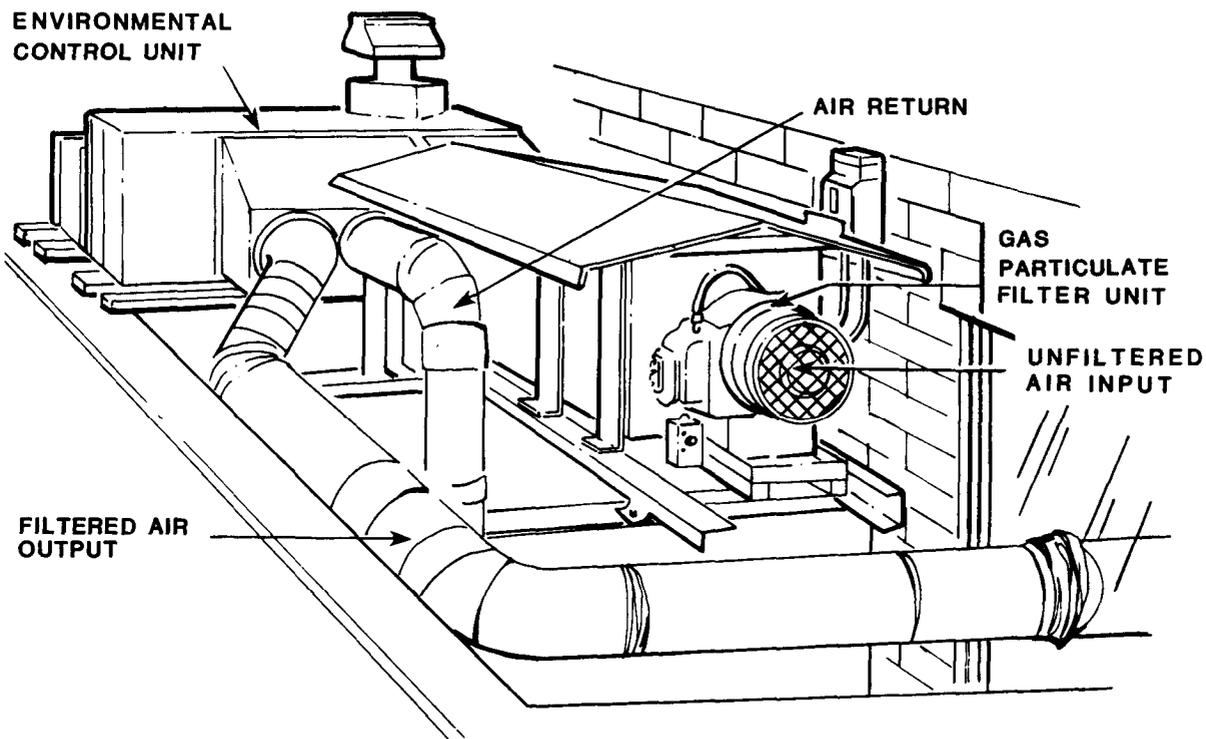


Figure 4-4. Adding gas particulate filter units to existing environmental control systems.

The simplified collective-protection equipment (SCPE) M20 and the M51 shelter system can be useful as temporary rest and relief shelters (for example, as a break area for personnel working in heavy maintenance and supply operations and as a medical facility). The SCPE M20 provides a contamination-

free environment in which 10 soldiers can work, eat, or rest without the encumbrance of the IPE. The use of a detector is critical to the safe operation of the shelters. For instance, tests using simulants have indicated that, when personnel enter the SCPE M20 from areas of chemical contamination, vapor concentrations can reach levels that would require shelter operations to be suspended to prevent miosis or other effects. Currently, the M256A1 kit is sufficiently sensitive to detect a vapor level that would cause miosis in a 60-minute period. The use of the CAM (as it becomes available) would speed up this detection process during entry and exit operations. However, this vapor level may be exceeded if a soldier has had any previous exposure. Commanders should consider reducing the number of entries and exits and/or stay time.

Contamination is transported into collectively protected areas mainly through vapor adsorption on and desorption from fatigue garments exposed to ambient vapor concentrations during removal of the overgarment. Transfer of liquid contamination from overgarment to fatigues also results in transport of contamination into collective protection areas but to a lesser degree when procedures are performed properly. FM 3-4 provides guidance for entry and exit operating procedures.

Existing buildings and those under design that are selected for collective protection should be rated on their chemical and structural integrity. That is, they must withstand a given ballistic effect (bomb weight) of conventional weapons at a given distance. See TM 5-855-1 for optimal structural integrity. There are two levels of hardness of interest for conventional weapons effects. Both are dependent on the distance a given detonation is from the building. A detonation at a farther distance from the building causes damage that could render the chemical protection ineffective due to cracking of walls or roof. However, the structure would still provide a reduced measure of continued protection against conventional weapons effects. At a closer distance the building would suffer severe structural damage rendering it useless. These two levels of hardness are quantified by ductility (flexibility) factors which represent acceptable levels of cracking and extensive damage. The following figure (Figure 4-5) illustrates this point.

Figure 4-5 represents the blast and shock hardness for building X and is presented as a plot of threat bomb weight versus allowable range (distance from the bomb impact to the building). Building X is a rectangular, reinforced concrete, three-story structure with a basement. Evaluation of the building for blast and shock was based on the critical sections for the most critical location of the surface explosion. In this case, the critical location for a conventional weapon threat is facing either a front or back wall of the building. The interior reinforced concrete walls were assumed to provide adequate bracing to the exterior wall and slabs. For the exterior ground floor (walls at ground floor are 12 inches thick with minimal reinforcement), the critical wall section, 32 feet wide by 9 feet high, was evaluated for reflected blast pressure. Blast protection is provided by the 9-inch-thick top floor slab, in which the critical section is 21.5 feet by 32 feet. For blast and shock considerations, the two top floors were considered sacrificial. The floor slabs above the ground floor are 9 inches thick with minimal reinforcement. The wood truss construction of the roof provides little protection from incident blast overpressure and was considered sacrificial as well. The basement walls and first floor slab are somewhat thicker and will survive any threat survived by the upper structure.

The curves in Figure 4-5 represent the calculated values for both the roof (top floor slab) and front wall sections for the two levels of hardness. For example, the building front wall should survive the blast from a 2,000-pound bomb at a distance of 75 feet or greater, but the roof may not survive unless the range is 90 feet or greater. Similarly, the chemical protection may be lost when the roof is destroyed if the 2,000-pound bomb impacts less than 180 feet away. Thus, the roof is the most vulnerable element of this building. If building X were to be used for operational purposes, then the noncritical functions should be housed in the upper two floors and terminated under threat conditions. The first floor and basement would be used for more critical functions. Structural modifications to building X would involve construction of two small reinforced concrete walls with doors at the stairwell to isolate the ground floor from the upper floors and the basement from the ground floor. These walls will provide chemical protection for the critical functions on the basement and ground floors.

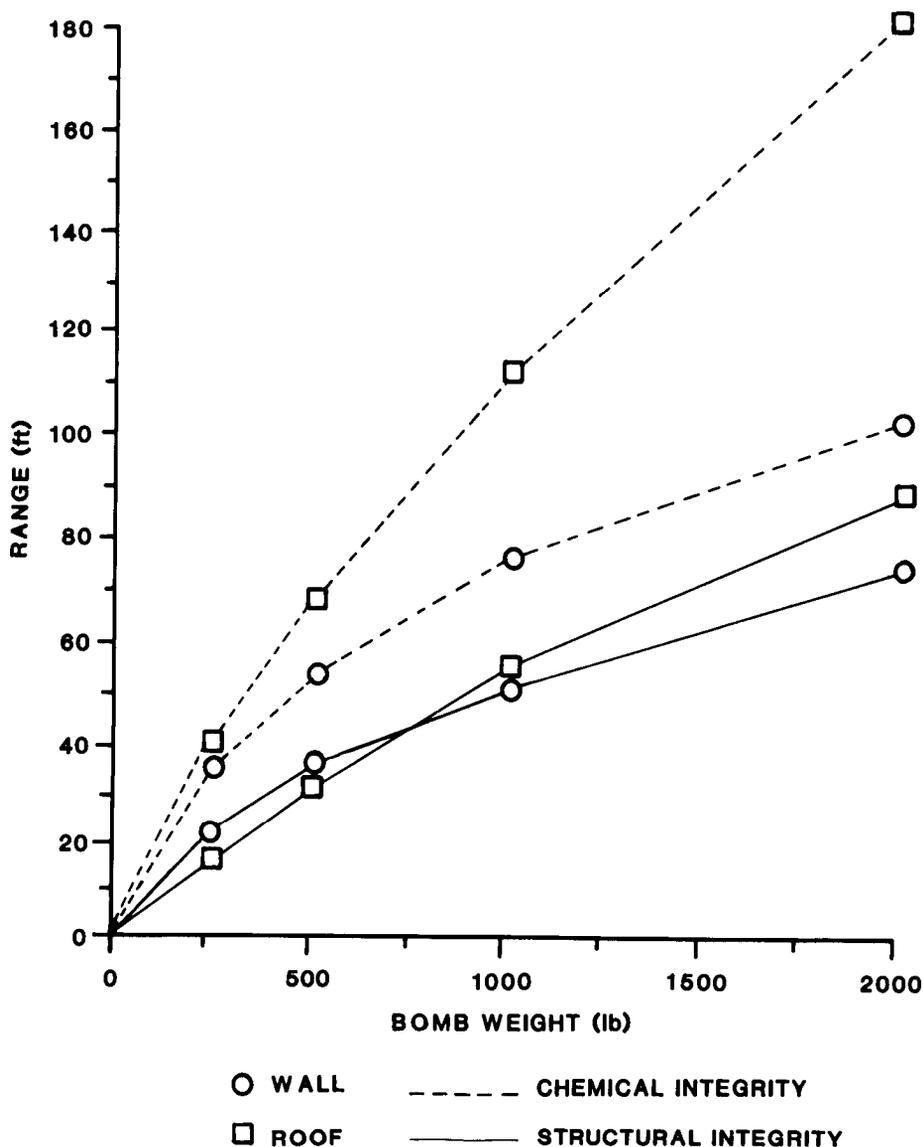


Figure 4-5. Blast and shock hardness for building X.

Structures that provide substantial protection from conventional weapons should be considered for collective protection. An example of this would be an ammunition bunker that also provides an additional advantage of being out of more important target areas such as remote storage areas. Obviously, the weakest elements in any building for blast or chemical threats are windows and doors. Typical commercial windows and exterior doors offer little protection against conventional weapons effects; defeat of the windows or doors by conventional weapons also defeats the chemical protection. Protection that is unobtrusive and nondisruptive in normal operations can be provided by emplacing blast shutters and doors. These shutters should be relatively strong, and will require sufficient anchorage into existing walls. These doors should be installed interior to normal weather doors, and would remain open under normal operations.

FM 3-4 describes certain structures that provide excellent shelter from nuclear hazards and that require a minimum amount of time and effort to adapt for use. These types of structures are: framed buildings of steel and reinforced concrete (such as pre-World War II design and construction), full basements constructed of concrete or stone, ammunition bunkers, thick-walled masonry structures, and buildings with minimal amounts of glass.

Personnel will need to be diagnostically evaluated to determine training shortfalls for entry and exit procedures for collective protection shelters and areas. Train civilian work force as well.

PLANNING

When considering the need for collective protection, the fixed site commander must evaluate the internal functions required to perform its mission. Typically these functions fall into the general categories of: C³I, light maintenance (electronics and avionics repair), heavy maintenance (vehicle and airframe repair), general supply (daily issue and receiving), and storage (POMCUS, ASPs and theater reserves). Generally speaking, C³I and light maintenance (type I) are better performed in some type of collective protection. The other functions (type II) normally require individual protection with some rest and relief capability at the work site for periodic breaks. The protection options are, as you would expect, synonymous with the type I and type II functions (see Figure 4-6). However, each of the critical

TYPE	FUNCTION	PROTECTION OPTION
I	C ³ I Light maintenance	A Hardened collective protection (CP) B CP C Expedient shelters D IPE
II	Heavy maintenance General supply Storage	A IPE with hardened CP for rest and relief B IPE with CP for rest and relief C IPE with expedient shelters for rest and relief D IPE

Figure 4-6. Protection options.

functions that support a fixed site's mission must be considered individually for the impact of accomplishing operations while wearing MOPP4. Supporting functions on a site are evaluated in the same manner.

DECISION MATRIX GUIDE

Evaluating each function on a fixed site is accomplished by analyzing each step of the decision matrix (see Figure 4-7) contained in the decision matrix guide below. The first three steps contained in this guide have been analyzed previously in Chapter 1. The analysis for the remaining steps contained in this guide (MOPP degradation, probability of restrike, and conventional threat) are discussed separately in each step.

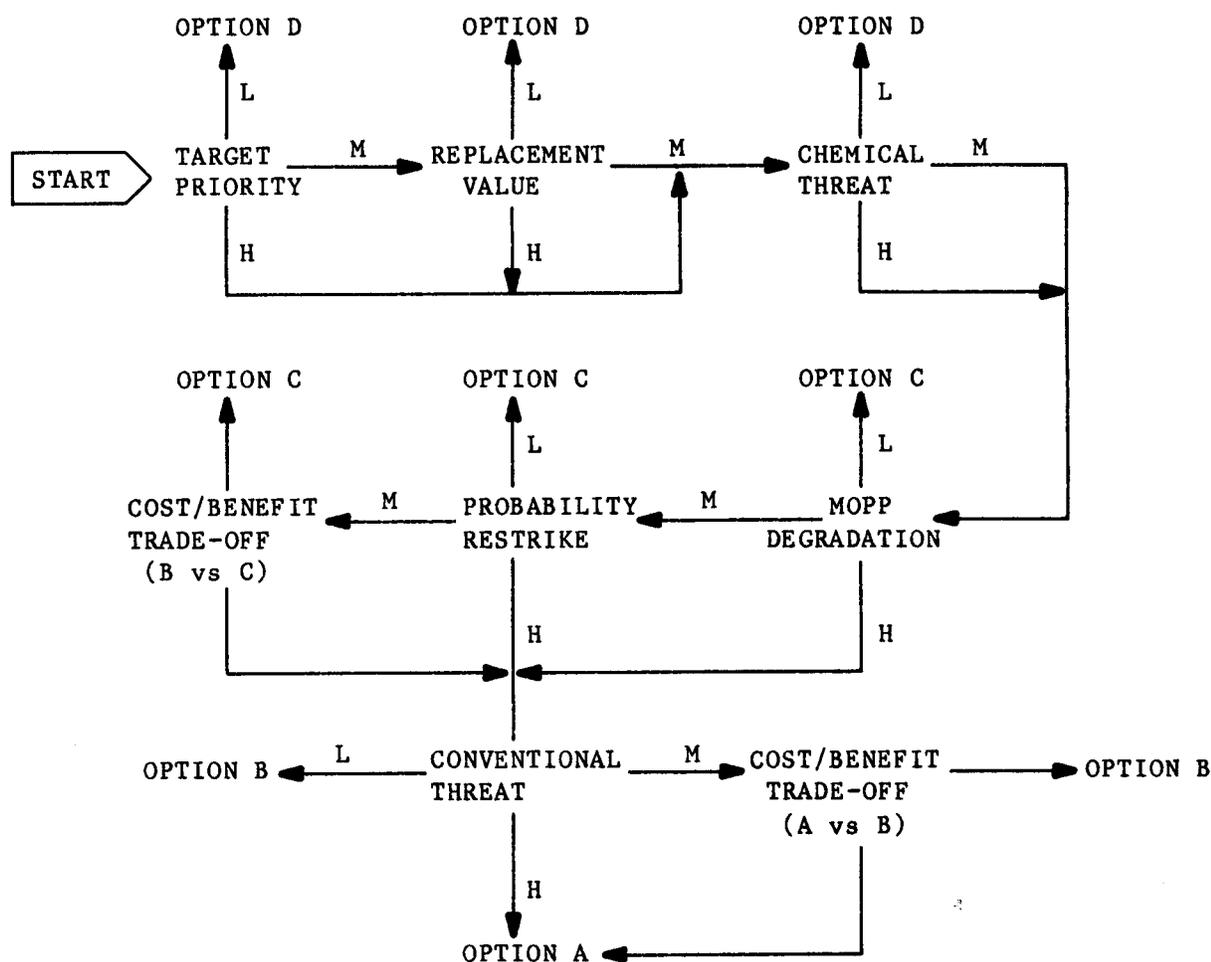


Figure 4-7. Decision matrix.

Target Priority to Enemy

Low (L) -- The site is in lower section of enemy target priorities and would be a secondary target for air-delivered systems.

Mid (M) -- The site is higher on enemy target lists but may not be of sufficiently high priority to use scarce, expensive weapons systems (for example, missiles) on the target.

High (H) -- The site is very high on enemy target lists and would receive priority consideration for all means of attacking the target.

Replacement Value to Friendly Forces

Low (L) -- The site destruction has little immediate or delayed impact on force effectiveness. Redundant capabilities exist at other sites.

Mid (M) -- The site destruction has significant indirect or delayed impact of force effectiveness. Redundant capabilities exist, although destruction of this site may result in a reduced mission capability.

High (H) -- The site destruction has significant direct impact on force effectiveness or significant delayed and/or indirect impact where no redundant capability exists.

NBC Threat

Low (L) -- NBC threat is from probable off-target attack.

Mid (M) -- NBC threat is from probable off-target, possible on-target attack.

High (H) -- NBC threat is from probable on-target attack.

MOPP Degradation

The commander needs to consider the type of work performed by his personnel and whether they will be seriously degraded or not while operating in MOPP4. Performance-degradation data are provided in FM 3-4 to assist the commander in analyzing this problem.

Low (L) -- Operations can continue with personnel operating in MOPP4 with little or no degradation. This indicates that the NBC threat causes no serious impact to operational performance. Therefore, the site needs to provide, at a minimum, expedient collective protection.

Mid (M) -- Operations will be degraded but can continue with personnel in MOPP4. This indicates that the commander should analyze the probability of restrike even though the degradation in MOPP4 is not that significant.

High (H) -- The mission cannot be accomplished with personnel operating in MOPP4. This indicates that collective protection must be provided to all site personnel and commander should next analyze the possibility of a conventional threat to determine whether or not hardened collective protection is needed.

Probability of Restrike

The commander must analyze a possibility of successive NBC attacks if he determined that the degradation caused by MOPP4 is insignificant to his mission performance. That is, the commander must determine if his mission performance will be seriously degraded by repeatedly placing his personnel in MOPP4.

Low (L) -- The number of enemy weapons or delivery systems, coupled with the priority of the target, makes restrike unlikely. This indicates that providing expedient shelters for work and rest and relief is the best option for this site.

Mid (M) -- The number of enemy weapons or delivery systems, coupled with the priority of the target, makes restrike possible, but frequent restrikes are unlikely. The commander needs to determine whether it would be feasible to emplace more than just expedient shelters. A cost/benefit trade-off analysis of option B versus option C should be made.

High (H) -- The number of enemy weapons or delivery systems, coupled with the priority of the target, makes restrikes likely. This indicates a need to analyze the possibility of a conventional threat to determine whether hardened collective protection is needed.

Conventional Threat

This is an important step for the commander to analyze, since it would not make any sense to emplace collective protection systems without hardening against conventional weapons effects if such a threat is imminent. Likewise, the commander should not waste resources hardening collective protection systems when a conventional threat is not imminent.

Low (L) -- The primary threat to the target is from enemy unconventional warfare (NBC) elements; air strikes are possible; rocket and/or missile attacks are possible but not probable. This indicates that option B is the best collective protection strategy when no immediate conventional threat exists.

Mid (M) -- Enemy unconventional warfare (NBC) attacks are likely; air strikes and rocket and/or missile attacks are likely. This indicates that a cost/benefit trade-off analysis of option A versus option B should be made since there is a likelihood of a conventional attack. The commander should consider whether it would be cost-effective to emplace hardened collective protection facilities.

High (H) -- Enemy unconventional warfare (NBC) attacks are likely; air strikes and rocket and/or missile attacks are likely; artillery and multiple rocket launcher attacks are likely. The commander must emplace hardened collective protection for his work and rest and relief areas because of the strong probability of a conventional attack.

After establishing the strategy for operating functions on the site, rest and relief facilities for off-shift workers must be considered. The options for type I functions and the decision matrix will apply for the selection of a rest and relief strategy. Upon establishing operations and rest and relief strategies, the next step is to determine the amount of each and locations. The commander will determine sizing and locating operation functions primarily by the current location and the amount of equipment required, plus 50 square feet per person. Base rest and relief sizing on 10 square feet per person; determine location by a cost benefit trade-off of converting various existing facilities. This is a minimum and should be increased if feasible.

ACTIONS

Once a recommended course of action is determined from the matrix and approved, the commander must consider support documentation for those items of equipment identified. He should include revisions to the TDA, TOE, or CTA for authorization of equipment items determined to be essential for fixed site collective protection. Facility engineers should be notified when planning to upgrade existing or build new structures for collective protection. A plan divided into three time increments (near term -- one to two years, mid term -- three to four years, and far term -- five years and beyond) is provided as assistance to the commander at Table 4-1. This plan is a systematic way of programming necessary items of equipment and facility requirements over a period of time to upgrade the site with collective protection for critical functions and rest and relief shelters.

The analysis that went into Table 4-1 is as follows: Near term consists of expedient measures to provide some collective protection in 15 months, mid term consists of permanent measures to provide collective protection within 37 to 38 months, and far term consists of new construction after 60 months or more.

In Table 4-1, we used building X (a site command post), a weapon storage building, an ammunition bunker (a rest and relief shelter), and movable systems as examples of some typical functions in a given structure that could be hardened both conventionally and chemically. In the near term for building X, the basement area is first upgraded with collective protection since it offers good protection from conventional munitions already. This is done by using three of the four components from the SCPE M20 (the gas particulate filter, protective entrance, and support kit -- containing a motor blower, sealing materials, and miscellaneous operational supplies). Sandbag barriers should be placed around the generators and filter units located outside the structure. The windows in the basement are sealed to create overpressure in the areas or rooms provided with collective protection. Figure 4-8 shows this near term fix.

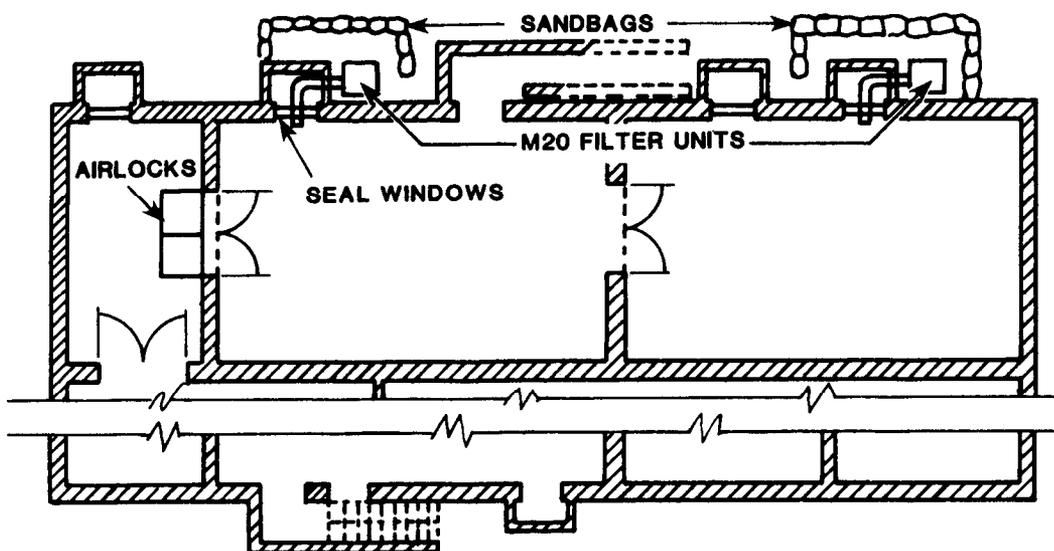


Figure 4-8. Building X -- command post near term concept.

Table 4-1. Collective protection.

NEAR TERM	MID TERM	FAR TERM
<p>1. Command Post (Bldg X)</p> <ul style="list-style-type: none"> • Simplified collective protection equipment (SCPE) entryways with blower units to basement. • Seal building areas in basement. • Provide sandbag barriers around the generators and filter units located outside the structures. 	<p>1. Command Post (Bldg X)</p> <ul style="list-style-type: none"> • Gas particulate filter unit (GPFU) with environmental control unit (ECU) in cellar. • Dedicated entry/exit for basement. • Recirculation blowers. • Chemical toilet area. • Water storage tank. • Emergency generator. • Seal basement and first floor areas. • Blast protect first floor windows. • Provide concrete walls or revetments. 	<p>1. Command Post (Bldg X)</p> <ul style="list-style-type: none"> • Improve entry/exit area.
<p>2. Weapon Storage Bldg</p> <ul style="list-style-type: none"> • SCPE. • Provide sandbag barriers around the generators and filter units located outside the structures. 	<p>2. Weapon Storage Bldg</p> <ul style="list-style-type: none"> • GPFUs incorporated into air handling unit. • Integrated entry/exit system using fabricated on post items. • Improved life sustainment features: <ul style="list-style-type: none"> - Generator. - Water supply. - Bunk area. - Chemical toilets. • Provide concrete walls or revetments. 	<p>2. Weapon Storage Bldg</p> <ul style="list-style-type: none"> • Building modification for entry/exit control.
<p>3. Rest and Relief (R&R) Shelter - Ammo Bunker</p> <ul style="list-style-type: none"> • SCPE. • Provide sandbag barriers around the generators and filter units located outside the structures. 	<p>3. R&R Shelter - Ammo Bunker</p> <ul style="list-style-type: none"> • Modify bunker with improved facilities. • GPFU. • Crew support kit. • Rapid entry/exit capability. • Provide concrete walls or revetments. 	<p>3. R&R Shelter - Ammo Bunker</p> <ul style="list-style-type: none"> • Improve entry/exit area.
<p>4. Movable Systems</p> <ul style="list-style-type: none"> • SCPE. • M51 shelter system. 	<p>4. Movable Systems</p> <ul style="list-style-type: none"> • SCPE and SCPE P31. • M51 shelter system. 	

For building X in the mid term, collective protection is provided to the ground floor and upgraded in the basement. The windows on the ground floor are sealed and provided with blast shutters. Some life sustainment features are needed (such as recirculation blowers, chemical toilet area, water storage tanks, and an emergency generator) to provide comfort for sustained operations and contingency for any unforeseeable disaster. There is a contamination control area on both the ground and basement floors, and the basement floor has an airlock system in case the ground floor CB protection is destroyed. Structural modifications to building X include construction of two small reinforced concrete walls with doors at the stairwell to isolate the ground floor from the upper floors and the basement from the ground floor. An environmental control unit is installed in the basement to provide heating and air cooling comfort, because of the survivability characteristics of the basement over the ground floor. See Figure 4-9 for mid term fix of the ground floor, and Figure 4-10 for the mid term fix for the basement floor. A cast-in-place concrete revetment can be constructed to further harden the ground floor from conventional munitions (see Figure 4-11). In the far term, the entry/exit area can be upgraded by dividing it into liquid and vapor hazard areas for better contamination control measures.

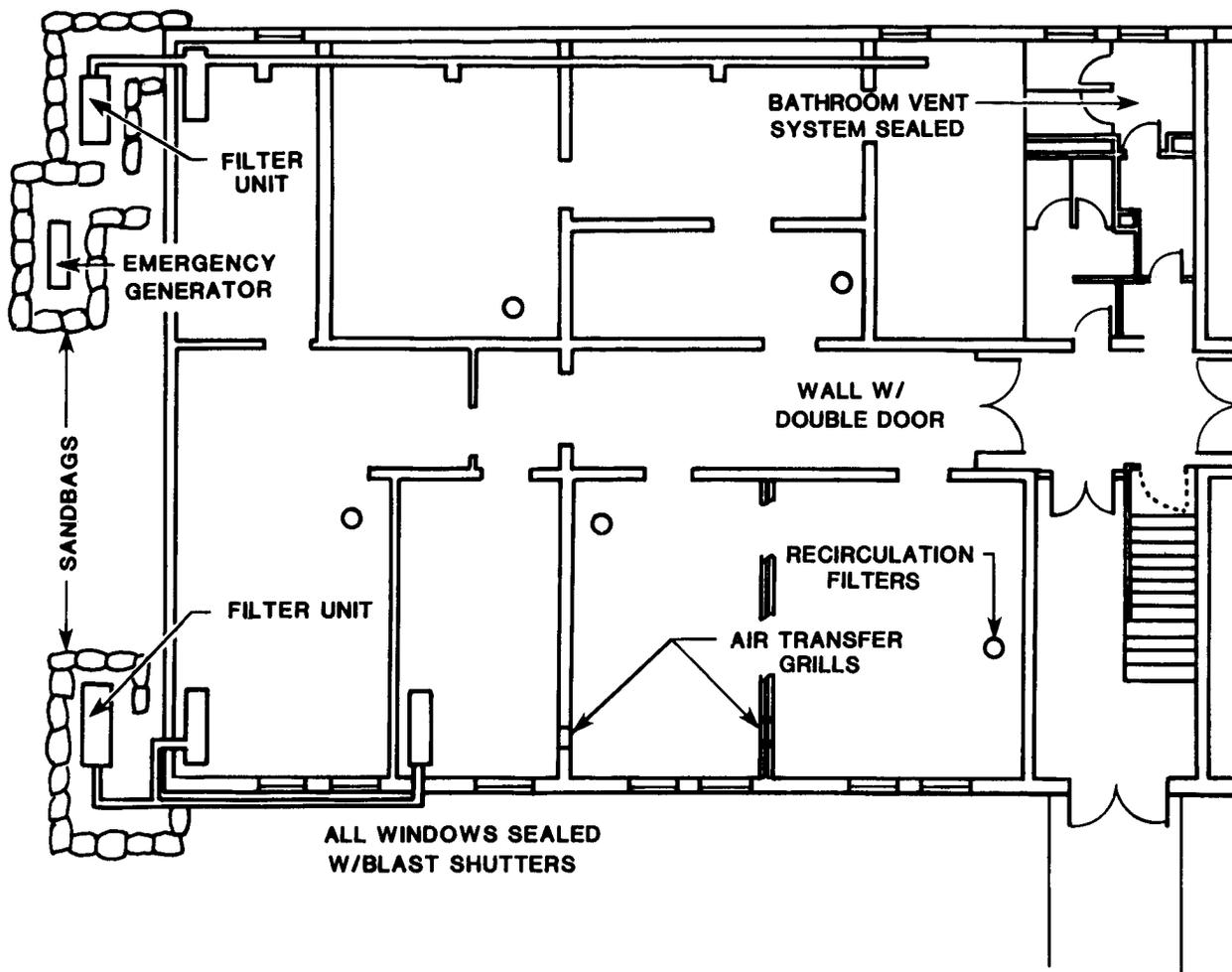


Figure 4-9. Mid term building X ground floor.

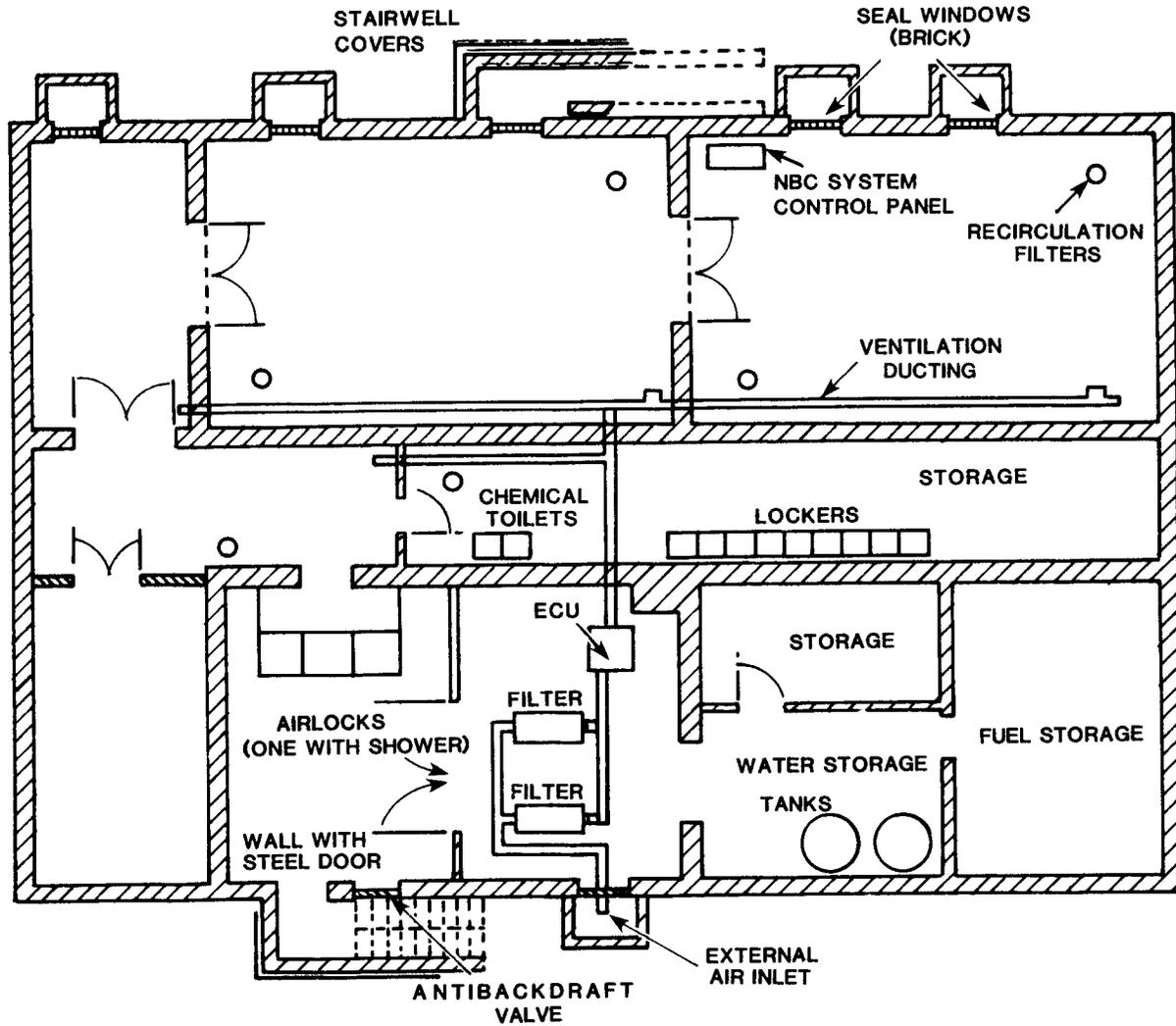


Figure 4-10. Mid term building X basement.

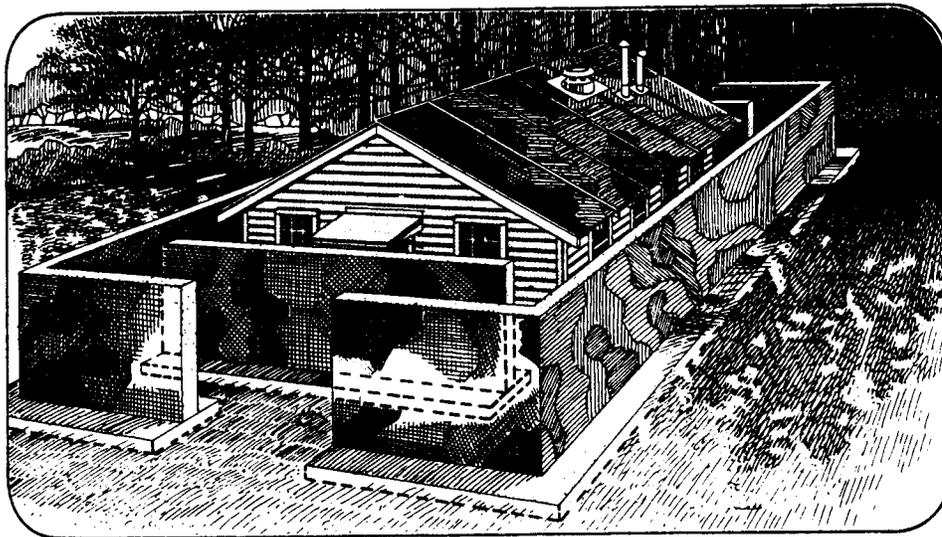


Figure 4-11. Cast-in-place concrete revêtement.

The same type of modifications in the near and mid term are done to the other structures as to building X (see Figures 4-12 and 4-13). The weapon storage building is a rectangular, single-story reinforced concrete building which serves as a cleaning and storage location for small arms. Its function and availability for rest and relief make this building a good selection for collective protection. In the far term for this building, the entry/exit area can be further modified by dividing the contamination control area into a liquid and vapor hazard area.

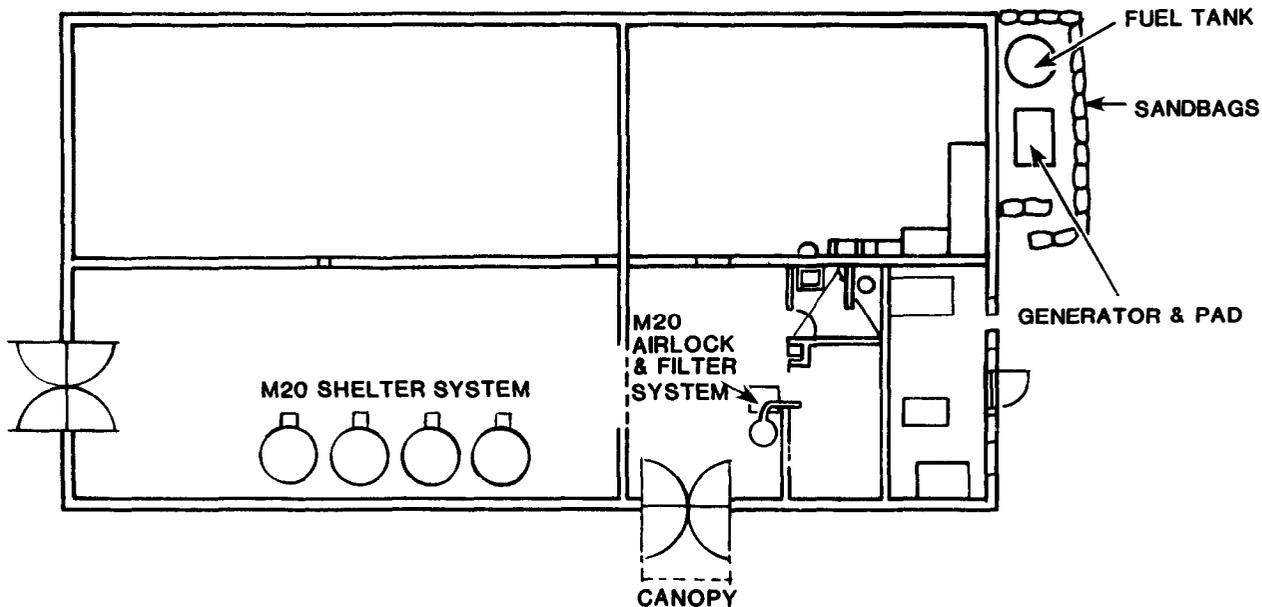


Figure 4-12. Arms room R&R concept (near term).

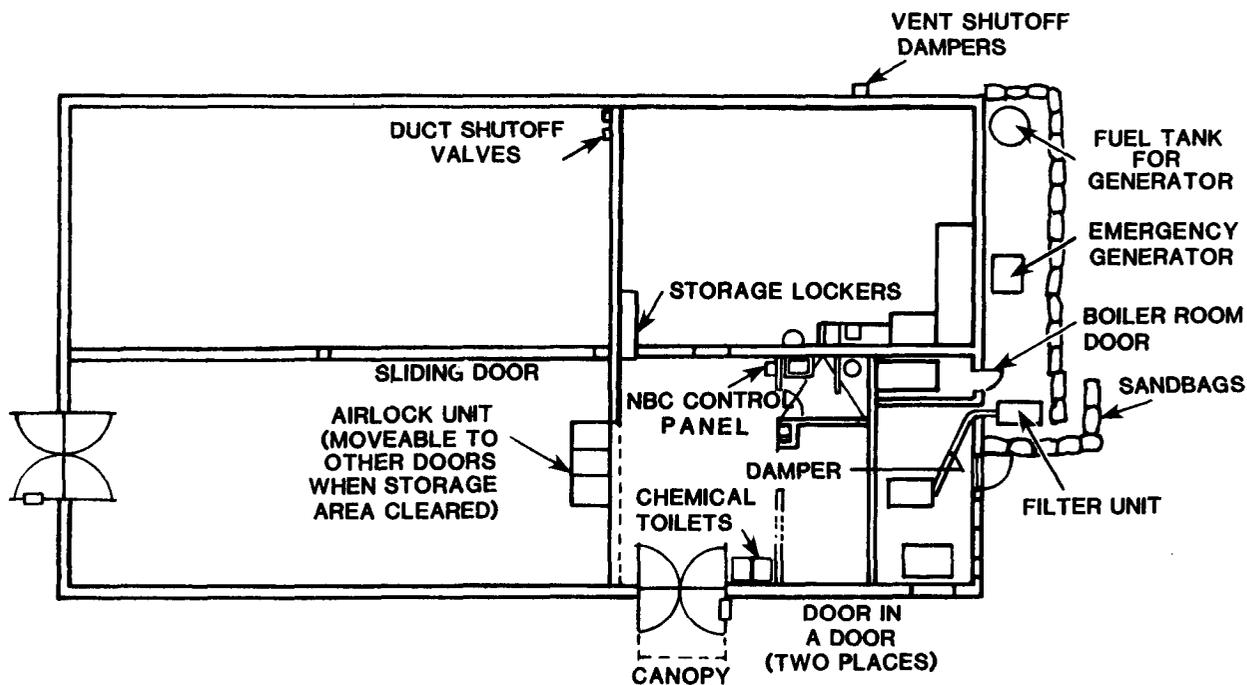


Figure 4-13. Arms room R&R concept (mid term).

The ammunition bunker (typical reinforced concrete bunker) is constructed at ground level with three sides beamed and the roof covered with about 2 feet of soil. Due to inherent hardness, a favorable location away from normal target sites, and large, usable internal spaces, these type of bunkers are a natural site for CB protection. In the near term, the SCPE M20 is emplaced as an expedient fix (see Figure 4-14). In the mid term, the same type of upgrade is done as that of building X and the weapon storage building (see Figure 4-15). Crew support kits containing additional protective clothing, gloves, and boots plus individual decontamination kits are emplaced for the personnel who will use this collective protection area for rest and relief. In the far term, the entry/exit area can be upgraded as well as the contamination control area by providing a liquid and vapor hazard area.

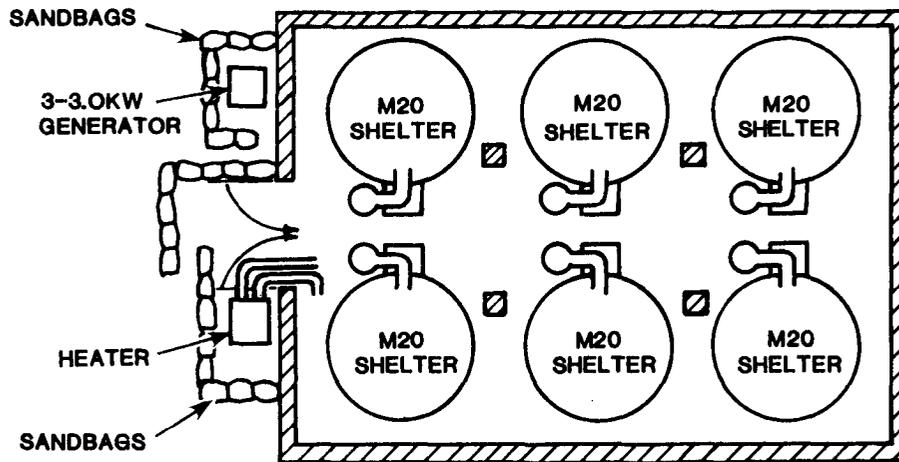


Figure 4-14. Ammunition bunker R&R concept (near term).

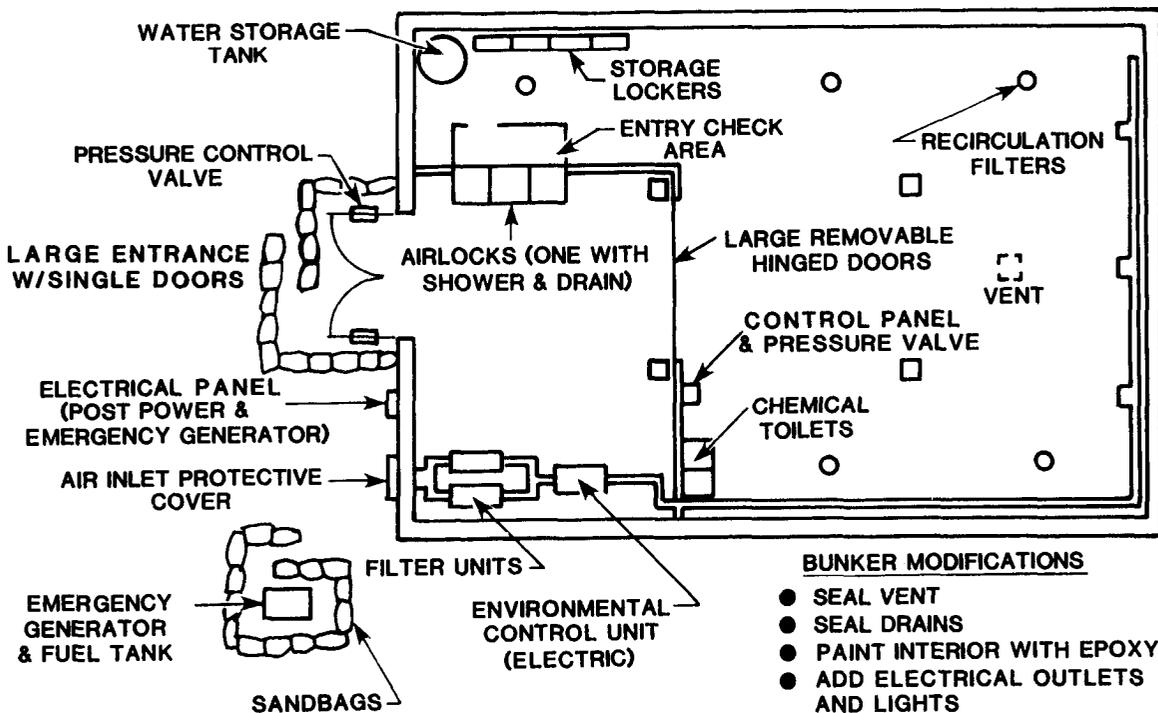


Figure 4-15. Ammunition bunker R&R concept (mid term).

Movable systems used for CB protection give a fixed site the flexibility of providing rest and relief shelters as break areas for functions in which collective protection would not be feasible and they can be used as temporary medical shelters. The SCPE M20 will be available in the near term, and the M51 shelter system is currently fielded. In the mid term, commanders would continue to use these same systems with the addition of a new system, the SCPE P31 (an improved version of the M20). The SCPE P31 will provide stand-alone operations, improved EMP protection, reduced electromagnetic impulse (EMI), reduced noise hazard, and a clean operating environment.