CHAPTER 6

OPERATIONS

NBC DEFENSE ORGANIZATION

Since each fixed site organizational structure will vary based on mission, each commander must be able to organize his staff to deal with likely NBC hazards. The commander needs his site to react, survive, recover, and continue its mission during all phases of an NBC attack.

The fixed site commander will be responsible for the overall NBC readiness of his site. He must ensure that all site personnel become proficient with those tasks applicable to them in STANAG 2150. He must establish an operation center, in accordance with FM 90-14, which is capable of conducting NBC survivability actions and coordinating with various key personnel for necessary support of his operations (such as engineer, military police, fire support, explosive ordnance disposal, and medical officer or representative). In addition, he must establish the operational exposure guidance (OEG) for site personnel. Within the operation center, establish an NBC cell to organize, conduct and supervise the NBC survivability measures on the site for the commander. An NBC defense officer (a chemical officer or an additional duty appointment for an officer) who will be responsible for the NBC defense measures as outlined in this FM, should control this NBC cell on the site. In addition, he is responsible for the warning and reporting process; supervising the survey and monitoring teams, decontamination teams, and shelter managers; plotting NBC attacks; and maintaining OEG records for the site on all personnel. At a minimum, the NBC defense officer should have a noncommissioned officer (NCO) and two enlisted members assisting him in the NBC cell to conduct 24-hour manning.

Site personnel must be integrated into support teams (such as survey and monitoring, decontamination, and shelter management) to conduct various NBC survivability missions. These support team functions can be integrated into current site functions; for example, personnel performing a security function for the site can also perform the survey and monitoring team function since they monitor critical routes and areas already. The survey and monitoring teams will be responsible for performing NBC reconnaissance for all CB agents and radiological fallout. This team can also assist in damage assessment during area damage control (ADC) operations. The decontamination teams will be responsible for partial and complete decontamination of all organic and external equipment and limited terrain decontamination. The shelter managers will be responsible for the operation and maintenance of their assigned rest and relief shelters. They will provide assistance in the entry and exit procedures, and maintain an entry and exit log on all personnel assigned to that shelter. All supervisors will maintain OEG records on their personnel, ensure their personnel are proficient with those individual and unit survival tasks outlined in STANAG 2150, and support all NBC survivability measures set by their command.

ACTIONS BEFORE, DURING, AND AFTER NBC ATTACKS

Again, the commander must consider his mission for any unique actions before, during, and after an NBC attack that should be taken for his particular site. In this manual, we will discuss some general things to consider including before, during, and after NBC attack actions.

BEFORE AN NBC ATTACK

Actions before an NBC attack take place on commencement of hostilities. The detector array is set up and activated. The MOPP level status is upgraded from MOPP zero to MOPP1 or 2. The collective protection systems are activated. Periodic monitoring is initiated for radiological contamination, and the passive measures (discussed in Chapter 3) are initiated. The upgrade of MOPP level is for those personnel who perform tasks which require them to be outdoors (exposed). For nuclear hazards, the following preattack measures must be taken:

Implementation of Basic Estimates by the Fixed Site

In preattack planning for continuation of the mission, results of the estimate of mission entry time (the time at which the mission can be resumed) using available countermeasures (see discussion on the operational recovery phase, page 58) represent the present capability of a fixed site to recuperate from a contaminating attack. Regardless of whether or not the estimated entry time is considered fully satisfactory, the best combination of available countermeasures can be implemented as the current fixed site plan for radiological recovery.

Choice of Countermeasure System

In some cases, the estimate or recovery effort using available countermeasures may result in several alternative estimates. These alternates represent various possible combinations of reclamation, shielding, and adjustments of operating procedure (discussed in after NBC attack actions, page 58). The fixed site command should select the most suitable alternative for incorporation into the fixed site passive defense plans directed by higher authority. The degree to which adjustments of operating procedures are employed is usually a question requiring command decision. Extensive use of shifts usually entails a requirement for the existence of a good staging area nearby. Furthermore, the command will find that, by cutting the workweek, it can exchange rate of operation for an earlier entry time. Questions of this nature often require consultation with higher authority.

Implementation of Plan

Once a specific combination of available countermeasures has been selected, the plan must be implemented by selecting and training essential personnel, procuring or storing necessary equipment, and performing other related activities. The steps that must be taken before an attack to assure a proper state of readiness are: designation of mission essential personnel and recovery personnel, plus appropriate assignment to shelters; site preparation for staging and recovery; acquisition of reclamation equipment and equipment for supporting functions; and training of recovery personnel.

Use of Basic Estimates of Higher Headquarters

It is probably desirable initially for the area command to request subordinate fixed site commanders to prepare estimates of mission entry time using available countermeasures. A review of these estimates at the area level will give the upper and lower limits of the effect of a nuclear attack on operations in the area, based on present capabilities. That is, mission entry time without countermeasures is a measurement of the maximum delay caused by nuclear attack, while mission entry time with available countermeasures is a measurement of the minimum delay expected using present capabilities. The actual delay for a situation represented by the planning intensity dose rate will lie between these values, depending on the state of readiness.

Initial Assumptions

To make the recovery from a number of fixed sites most useful to a higher headquarters, it is usually desirable to specify the planning assumptions that should be common in all the estimates. The main assumptions are mission duration and acceptable dose over this period. A decision has to be made as to what extent late effects in personnel will be accepted. In most cases, the initial estimates should avoid such effects. Additional estimates can be made with higher acceptable doses at a later stage where a clear military advantage is indicated. One of the basic decisions that must be made, usually at a higher headquarters, is the expectancy of repeated future doses. In planning the dose to be accepted by fixed site personnel, consideration must be given to the use of the personnel in future operations involving unknown radiation exposure. The commander must decide whether planning will be on the basis of a single attack, or whether he wants the fixed sites to be able to deal effectively with two or more successive contaminating nuclear attacks. If the latter, the acceptable dose must be allocated among a number of attacks. The number of attacks that should be planned for depends on war plans. It is also important to recognize that the likelihood of fixed site personnel becoming casualties from other sources will probably increase with the number of attacks. Thus, a point exists where precautions to minimize the dose per attack reach a stage of diminishing returns.

Evaluation of Recovery Estimates

For each dose rate planned, the initial recovery estimates prepared by the fixed site will consist of an estimate of entry time or a statement that recovery using fixed site personnel is not feasible. There is a probability that a given fixed site will experience at least a given planned dose rate as the result of the nuclear attack. The probability will depend upon the number and size of weapons delivered, the location of the bursts, and the winds at the time of attack. Most of these factors cannot be predicted in advance. However, some appreciation of the risks of encountering the delays shown in the recovery estimates can be gained by analysis of simple cases.

In addition, recovery estimates form an important basis for passive defense planning. The need for improved shelters and other emergency-phase planning can be obtained from these estimates. Material assistance arrangements among fixed sites can be formulated providing for recovery manpower and equipment, for development of staging areas, and for sources of replacements for mission essential personnel. Where key fixed sites are embedded in a larger civilian target complex, area planners will often have to consider the situation outside the borders of the fixed site. Cooperative arrangements may be required between members of military fixed sites, key industrail facilities, and civil authorities. Joint arrangements for recovery of key access routes, staging areas, and public utilities will be especially important. Needs for these arrangements can be obtained from adequate recovery estimates.

DURING AN NBC ATTACK

During an NBC attack, personnel take protective action. That is, they upgrade their MOPP level status from MOPP1 or 2 to MOPP3 or 4 (mainly for those exposed personnel in a CB attack) and seek protection. FM 3-100 discusses the following two chemical attack indicators:

- A high probability of attack. This includes sounding chemical alarm, a positive reading on chemical agent detector paper, and individuals exhibiting symptoms of chemical agent poisoning.
- A possible attack. This includes artillery shells that explode less powerfully than high-explosive (HE) rounds, aircraft- or rocket-delivered bombs or containers filled with bomblets that pop rather than explode, and aircraft that are spraying a mist or fog.

A nuclear attack is indicated by a bright flash, enormous explosion, high winds, a mushroom-shaped cloud, plus positive readings on radiacmeters. In addition, warning and reporting actions are initiated upon suspicion of an NBC attack (such as alarms, observer reports, or reports from adjacent units or sites). The site initiates continuous monitoring for nuclear attack. In the case of a nuclear attack, the first phase of nuclear defense (emergency phase) is initiated. That is, immediately following the arrival of fallout, a gamma radiation hazard exists that is so high that no unshielded operations are feasible without casualties (or without exceeding the acceptable personnel exposure). All operations during this phase must take place in shelters that provide adequate shielding against the gamma radiation hazard. Therefore, adequate personnel shelters are the minimum requirements during this phase. All other functions that must continue in operation must be carried out in such a way that the personnel involved are provided with adequate shielding.

The following information should be obtained during the emergency phase for use in planning the most effective operational recovery:

- The number of nuclear weapons delivered in the area, with estimated yields and burst locations.
- Standard dose rate contours for contaminating attacks, with zero times for weapon bursts and information on the decay rate.
- The location of radiation-free areas suitable for staging areas and evacuation points.
- Estimates of personnel casualties from all causes and personnel radiation exposures of survivors in all installations.
- Areas of physical damage, with emphasis on the functional utility of fixed sites, utilities, and access routes.
- Major sources of unexposed manpower and undamaged equipment and transport that may be available for operational recovery.

AFTER AN NBC ATTACK

After an NBC attack, the presence or absence of contamination is confirmed through the use of detection equipment. Site personnel perform basic skills decontamination as outlined by FM 3-100, estimate downwind hazard for CB attacks, and prepare fallout prediction patterns for nuclear attacks. Again, in the case of a nuclear attack, the second phase of nuclear defense is initiated (operational recovery phase). At some time after the attack, the gamma radiation hazard will have decreased to the point where short-term unshielded operations are feasible although long-term or normal functions are not. By performing these short-term functions, the necessary conditions are created for the resumption of the longer-term functions.

The three types of countermeasures useful in operational recovery are reclamation, shielding, and adjustment of operating procedures. Reclamation is the removal or covering (with some heavy material) of fallout in the operation area rather than destruction of it. Shielding is the placement of a barrier between a radiation source and an area where people are present. Dense materials provide better shielding than light materials because they absorb more gamma radiation. Some natural shielding is afforded by existing buildings, and is used whenever practicable in operational recovery. Applied shielding can be used to augment the natural shielding around work areas through the use of lead, steel, concrete, brick, earth, and sand. Adjustment of operating procedures is often an effective way of allowing an earlier recovery of essential functions. Adjustments that can reduce radiation doses include using shifts of personnel, shorter work periods, and replacement of personnel. It is unlikely that enough trained manpower will be available after a nuclear attack to allow use of the last procedure. However, this countermeasure is generally most useful when used in combination with reclamation.

It can be seen that the process of radiological recovery is a straightforward one that involves the use of adequate shelter during the attack and for several days thereafter. It involves the establishment of a suitable staging area, either outside the contaminated area or at the fixed site, whichever is more feasible. It also involves suitable countermeasures in the vital area (area where essential functions are carried on) of the fixed site so that personnel can perform the essential functions for the ensuing year or two without exceeding the acceptable dose set by the command. The capability for establishing a suitable staging area at the site, in case of widespread fallout, must be determined. If necessary, personnel must be selected and trained, and equipment must be earmarked for use in creating a staging area.

SHELTER MANAGEMENT AND PLANNING

The installation commander ensures that each functional area on his site (such as C^3I center, maintenance activities, and supply activities) is assigned a shelter for rest and relief. Supervisors from each functional area will be the shelter commanders of the shelters they are assigned. They will establish a manageable span of control and are responsible for all in-shelter functions, such as communications, NBC monitoring, safety, supply, maintenance, feeding, sleeping, health and sanitation, information and training. These in-shelter functions will be delegated to other personnel by the shelter commander to assist him in his duties. Civilian personnel should be considered in the shelter organization (commander or key staff) since they will replace military personnel or will be, in some cases, the key people in the operation of a site's functions due to the TDA of the site. Two shelter managers for each rest and relief shelter are required to perform 24-hour manning. Their duties are outlined below.

The shelter commander must establish both internal and external communications. Use an intercom telephone system or chain-of-command for internal communication. Use a telephone or radio link to the site C^3I center and functional area operation center for external communications. The shelter commander should consider using messengers as a communication backup. The individual appointed as the primary operator for communication equipment by the shelter commander is responsible for the maintenance of that piece of equipment and for keeping a 24-hour communications watch and maintaining a log. FM 3-4 gives guidance on supply, maintenance, communications, sanitation, illumination, water, and detection and warning for in-shelter functions. AR 500-3, Army Survival Measures, states that there should be at least 14 days of supplies considered for survival measures; such supplies should include food, water, rescue tools, medical supplies, and so forth. For sufficient stockage of food, at a minimum, plan 2,500 calories per day per occupant required to operate while in the shelter and 2,000 calories per day per occupant for all other shelterers. Personnel responsible for NBC monitoring will monitor the interior of the shelter for contamination, check personnel for contamination entering the shelter after an NBC attack is initiated, check radiation dose rate hourly after arrival of fallout, ensure that personnel leaving the shelter are issued a dosimeter during radiation hazard, and check exterior of shelter for NBC contamination upon suspected attack.

The shelter manager should develop a plan before an attack for dividing the shelter area into sleeping quarters, management, medical, storage, supply, distribution, and other required spaces. He should also give consideration to traffic requirements. He should design the plan to keep movement within the shelter to a minimum. He should consider radiological contamination when dividing the shelter area. The effectiveness of a shelter as a radiological countermeasure is often expressed as a protection factor (PF). The PF is the ratio of the dose that would be received outdoors, without any protection, to the dose received in the shelter. Radiation PFs will vary at different locations within the designated shelter area itself. Spaces with low PFs should be used for storage, issue of supplies, and temporary storage of human and other waste. As radiation levels decrease with time, it may be possible to move shelterers with safety to areas with low PFs.

The following information should be posted in a prominent place within the shelter: management roster or actions to be taken if predesignated management personnel are not present; a checklist of initial actions to be taken; a shelter layout plan; a list of emergency equipment and supplies including the storage location of the various items and their respective quantities; instructions on equipment operations and maintenance; SOPs; and an installation map showing locations of control centers, shelters, and other essential emergency resources.

Orientation to the shelter should be performed, which includes an official introduction of the shelter commander and his key staff to the shelterers, with an explanation of the responsibilities and functions of each; the shelter organization and command structure, including relationships between the shelterers and the shelter commander; instructions on the location and use of shelter facilities; SOPs and daily routines; policies pertaining to the retention and protection of personal possessions; the dependence of the shelterers on one another for the good of each and for the safety and welfare of the total shelter population; and questions from the shelterers on clarification of the instructions.

Selected collective protection shelters should be upgraded and/or new structures designed to meet expectations of NBC hardness for a particular fixed site. These collectively protected shelters are integrated into both work (C^3I, maintenance, supply, and so forth) and rest and relief areas.

The peak population of each site should be determined when considering shelter space, that is, the total population on the site during duty hours, excluding transients. The following groups of individuals are considered: the number of on-post military and civilian personnel, the number of military and civilians who live off-post but must be considered for shelters during duty hours, and the estimated number of transients (such as contractors, civilian service companies, or guests) who will be on-post.

The fixed site population should be advised of shelter assignments by the use of maps of the installation showing the shelter locations, the shelter numbers, and the recorded area assignments posted in each building. Drills should be conducted on a timely basis as part of normal training on the site.

The fixed site commander should consider rotation of personnel off the site if there is not enough shelter space for all required site personnel. This location for off-site rest and relief should be upwind and at least 10 miles and no more than 20 miles from the site location.

POSTATTACK RECOVERY

The postattack recovery phase involves actions required to bring the installation to some desired effective operating capability. These actions include ADC, monitoring and survey, and decontamination operations. The commander and his supervisors must maintain control to begin recovery operations. An immediate assessment of damages must be made as prescribed in FM 90-14. It is important that the commander follow the procedures outlined in ADC operations of FM 90-14. Conduct survey and monitoring operations for critical and surrounding areas to determine extent of contamination and prevent any further spread of contamination, through the identification and marking of those area(s) contaminated. Survey and monitoring procedures are fully discussed in FM 3-3. The MOPP level should be downgraded once it is determined that the hazard does not exist or decontamination operations allow reduction of MOPP. In addition, conduct rescue operations if necessary depending on the nature of the attack. You may have to perform these rescue efforts in the presence of NBC contamination or with the possibility of fallout or agent cloud arrival at a later time. Organized survey and monitoring teams, or possibly members in the rescue operation, should be available to determine presence of CB agents and the extent of contamination, or to measure radiation dose and dose rates, and determine whether or not operations can be carried on and, if so, for how long.

The third phase (restoration phase) of nuclear defense takes place at this time. One or two years after a nuclear attack has taken place, in most of the area contaminated, the gamma radiation hazard will have decreased to a level that is no longer significant. This may be conveniently taken as the level at which the present peacetime permissible exposure would not be exceeded. A somewhat higher exposure might be acceptable during wartime. The restoration phase will begin at this time and continue indefinitely. Nonessential areas that were by-passed during the operational recovery phase could be reoccupied. External gamma radiation would no longer be significant, but the control of internal alpha and beta radiation hazards would constitute a major public health problem.

FM 90-14 calls for rapid removal of debris, but only if it interferes with combat support and combat service support missions. Consider fallout and its effect on debris clearance when operating in an NBC environment. In considering the radiation problems connected with the rubble left after a nuclear attack on a community or installation, the following questions are raised:

- How much radioactivity is present in the rubble?
- How can it be predicted?
- How can it be measured?
- What problem does the radioactivity cause in disposing of the rubble?

Information that would help to answer these questions is largely speculative. The area contaminated by fallout from a surface burst is usually much larger than the area in which blast and thermal effects occur. It is to be expected that, under most conditions, the rubble produced by blast and thermal effects will be contaminated by radioactive fallout as well.

The weather effects on fallout (such as those resulting from winds, precipitation, or the surface flow of rain water or melting snow) in and around rubble must be considered in the larger context of the local situation. Consider the problem of the radioactive rubble after the immediate needs of survivors are met. Specially trained radioactive survey teams will use their radiation meters primarily to assess the local dangers rather than to survey the entire rubble-covered area. Once the contamination survey of the rubble has been completed, the problem of disposing of the radioactive rubble remains. Two courses of action can be considered --

- Decontaminate it without removal.
- No matter what is done with the rubble, the accumulated fallout will produce radiation levels limiting the length of time unshielded personnel can work in the region.

In addition to nuclear exposure from fallout, personnel performing missions in the regions of structural demolition must consider the problem of possible ingestion of radioactive material. Personnel should wear masks in such operations to prevent possible ingestion of radioactive particles and to make breaching easier. Where food is eaten during a mission, use special precautions to prevent dust from getting on the food. After the mission, a bath and change of clothing should be standard procedure. If decontamination of rubble does not appear to be feasible, then plowing the rubble under is one method of providing the same effect as decontaminating it. An area that has been cleared of rubble can be hosed down with water. This is one of the most effective means of decontamination.

INDIRECT ATTACKS

An indirect attack is considered when the installation receives warning that an NBC attack occurred upwind of the site. The site also considers this when an unexpected activation of alarms in the detector array occurs, or there is detection of chemical poisoning symptoms among site personnel, or there are chemical vapor and radiological hazards expected. Sites with primarily an off-target threat would expect this type of attack. For attacks occurring upwind, the NBC cell can provide advanced warning to site personnel of a hazard before arrival based on downwind hazard prediction; the NBC cell may choose to allow the detection network to warn personnel by activation of alarms. This will depend on how the fixed site commander views the importance of the mission his site provides; he must decide whether to risk operational effectiveness because of an increase in the MOPP level or rely on the detector array to provide enough advanced warning so personnel can assume the higher level of MOPP protection.

PLANNING FOR THE USE OF SMOKE AND OBSCURANTS

Smoke operations are well suited to the rear area support areas, especially fixed sites, since these areas are difficult to camouflage and displace. It is important to conceal them to ensure their survivability. FM 3-50 discusses how deliberate smoke operations can be used effectively for rear area operations such as urban areas, ports, and supply routes. Deliberate smoke operations are characterized by --

- Operational level planning, coordination, and execution.
- Large or small area screens.
- A longer period of time for smoke buildup.
- Long or short duration missions.
- A large logistic requirement.
- Intensive logistical support.

There are two types of smoke screens that are of significant value for fixed sites -- smoke blanket and smoke haze. The smoke blanket provides a dense concentration of obscuration to conceal large operational areas. This reduces visual recognition of personnel and equipment to less than 50 meters. The smoke haze restricts accurate enemy observation from the air and ground through the production and sustainment of a light concentration of obscuration. The smoke haze allows limited visibility from 50 to 150 meters, which does not adversely disrupt some friendly operations. Obviously, smoke screens will not have an effect on missiles, which are one of the threats facing these sites. Both smoke screens would degrade the ability of the enemy aircraft to acquire a target and accurately hit it. Enemy observation from the air or ground would be degraded in pinpointing targets. Smoke screens can be a detriment when CB agents are present. A smoke screen will hold CB agents in an affected area longer and will delay the normal weathering of these agents especially when they are persistent.

It will be very important to monitor the meteorological conditions when pre-positioning smoke generators and making smoke screens. The wind direction, relative humidity, visibility, and atmospheric stability have the most effect on smoke screening and munition expenditures. Atmospheric stability is divided into three conditions: unstable (lapse), neutral, and stable (inversion). An unstable condition exists when the air temperature decreases with an increase in height above ground level. This condition causes the smoke to rise quickly. A neutral condition exists when there is little change in air temperature with a change in altitude. Stable conditions exist when the air temperature increases with an increase in the height above ground level. In this condition, the smoke will tend to stay near the ground. Table 6-1 provides a summary of favorable and unfavorable conditions for smoke employment. Both the smoke blanket and haze require optimal weather conditions (such as neutral or stable) for initial establishment and can be maintained indefinitely under most weather conditions after that.

Table 6-1. Summary of favorable and unfavorable conditions for smoke employment.

Factor Wind	Unfavorable above 10 knots	Moderately favorable below 10 knots	Favorable 5 to 10 knots
Atmospheric stability category	Unstable (lapse)	Neutral	Stable (inversion)
Favorable for	Smoke curtain	Smoke haze and blanket	Smoke haze and blanket
Humidity	Low	Moderate	High
Precipitation	None (low humidity)	Light rain (med humidity)	Mist/fog (high humidity)
Cloud cover	No cloud cover	Scattered clouds	Overcast with low ceiling
Terrain	Even terrain	Gently rolling terrain	Complex topography terrain
Vegetation	Sparse or none (desert)	Medium dense	Heavily wooded or jungle
Time	Heat of the day	Mid-morning	One hour before EENT and four hours after BMNT

To better understand the capabilities of smoke screens, consider following trial from the Air Force's demonstration test using camouflage with large area smoke screens (ACLASS) for airbase concealments conducted at Eglin Air Force Base in September 1984. The Air Force used decoys in conjunction with smoke screens to confuse the attacker as well as obscure his vision.

In an attempt to ensure sufficient smoke coverage over the target area of airfield, the generators were placed 200 feet (60 meters) from the edge of the taxiway and approximately 200 feet (60 meters) apart. The generators were not moved during the trial. As typical throughout the trials, only about 18 out of 24 smoke generators were operational at any particular time. Sky cover was about 60 percent and variable during the trial; clouds were at 3,000 feet (915 meters) altitude, and there was a light rainshower near the beginning of the trial. The temperature was 310 Celsius through the run of the trial, and the runways were cool. Winds were generally steady from the north. The smoke rose to about a 300-foot (90-meter) altitude. The generators were turned on at 1133 hours, and good coverage of the targets and taxiway was apparent by 1140 hours. An F-4 was the attack aircraft. The smoke held close to the ground during the trial and produced an obscuring haze for at least 3 miles (4.8 kilometers) downwind. The smoke generators were ordered shut down at 1230 hours, and the field was generally clear by 1234 hours.

The F-4 pilot (CPT Ron Roberts) commented:

"The smoke would have been more effective had the generators been moved farther back from the runways and allowed to disperse more before it was used to obscure the taxiway. The smoke does not have to be too thick to be effective. A strong haze would be sufficient. Natural haze restricted visibility and made the smoke more effective. Smoke made the two-dimensional target look real, and the decoy material looked real. It was most difficult to acquire targets when attacking into the direction of the smoke flow. It would be difficult, if not impossible, to hit point targets under the smoke condition of this trial."

In all trials of the ACLASS test, the atmospheric stability conditions were a big factor in dispersion of the smoke screens and the spacing and number of generators. This supports current smoke doctrine.

Through analyzing the smoke operations planning guide at Table 6-2, you can see that the spacing for the smoke generator varies based on the type of smoke screen desired, the type of terrain, the distance from the smoke source to the area to be screened, and the atmospheric stability conditions. The fixed site commander must develop a strategy on how he would like to use smoke. He should give first priority in his smoke strategy to critical site functions. The objective is to install smoke systems in hardened positions away from the perimeter of the area to be screened and to plan for 360-degree coverage. The emplacement of smoke generators should take advantage of the predominant wind direction. The number of smoke generators needed will be determined by the length of the smoke line divided by the generator spacing acquired from Table 6-2 and adding one. This computation method comes from FM 3-50. These smoke generators should be supplemented with smoke pots to fill in any gaps left in the smoke screen and to provide concealment for the smoke generator positions (see Table 6-3). A smoke reconnaissance should be conducted first to obtain information about the area terrain. This reconnaissance can be done by map, air, or ground. The site NBC defense officer will conduct the smoke planning, to include the reconnaissance. He will coordinate with the site operations officer to support the commander's overall plan. The objectives of the smoke reconnaissance are to --

- Locate a selected area to determine extent of the smoke screen required.
- Designate smoke lanes. Based on mission and spacing requirements for smoke generators, the NBC Defense Officer designates the general location and length of smoke lines.
- Locate control points to provide observation of the smoke screen from designated smoke control points and observation posts. Aerial observation provides the best smoke control.
- Select and designate supply routes and access areas for all smoke generator positions.
- Study local weather and terrain to identify conditions or peculiarities that may significantly influence smoke generator placement. These conditions include unusual wind currents, lengthy neutral and stable temperature gradients, and a tendency of the air to stabilize in layers. Smoke grenades or smoke pots may be used to accomplish this. This cannot be over emphasized enough with relation to fixed sites. Before emplacing smoke generators on the site, conduct various trials with smoke grenades or smoke pots (using smoke pots is suggested because they are a better simulator for generators). The smoke planning guide will help you get optimum coverage on the area to be screened.
- Determine security and defense requirements. Study the terrain and look for positions that offer good coverage and concealment for both smoke generators and defensive positions.

Table 6-2. Smoke generator spacing guide.

WIND SPEED KMPH	WIND SPEED KNOTS	TEMPERATURE GRADIENT	TERRAIN DESCRIPTION	POSITION SPACING (METERS) HAZE	POSITION SPACING (METERS) BLANKET	DISTANCE (METERS) SMOKE LINE FROM SELECTED AREA
1-14	1-7	Inversion/ Neutral	Over water	90	45	450
			Open	110	55	550
			Wooded	140	70	700
1-14 / 15-25	1-7 / 8-13	Lapse / Inversion/ Neutral	Over water	70	35	350
			Open	90	45	450
			Wooded	130	65	650
15-25 / 26-32	8-13 / 14-17	Lapse / Inversion/ Neutral	Over water	50	25	250
			Open	70	35	350
			Wooded	110	55	550
26-32	14-17	Lapse	Over water	40	20	200
			Open	50	25	250
			Wooded	90	45	450

Table 6-3. Smoke pot characteristics.

TYPE, NSN & IGNITION	BURN TIME (Min)	WEIGHT (Lb) FILLING	WEIGHT (Lb) TOTAL	POSSIBLE USES	SMOKE DURATION (Min)
ABC-M5, 30-1B, HC 1365-00-598-5207 Ignited by manual matchhead or electrical squib.	12	31	33	Same as M1 above	12 to 22
M4A2, HC, floating 1365-00-598-5220 Issued w/fuze M207A1 Ignited by a manual fuze only. WARNING: The M4A2 smoke pot must be vented for 5 minutes within 24 hours prior to ignition. This will be accomplished by folding back the tape from at least two of the emission holes.	10	27-1/2	11	Small area screen; Small smoke curtains (ground based or over rivers, small streams, and other operations that require floating capability); may be helicopter-delivered.	10 to 15

After the smoke reconnaissance, make the smoke plan preparations. The NBC defense officer ensures that the smoke plan positions the smoke generators to effectively provide 360-degree coverage of the designated area. This plan designates primary and alternate smoke generator positions. Select the smoke control points and observation posts. An operations overlay is then prepared. The overlay reflects this information plus logistical elements that provide class III (petroleum, oils, and lubricants) and class IX (repair parts). Coordination with higher, subordinate, and adjacent units is necessary to avoid the disruption of friendly operations. To be effective, smoke must start on time, have the desired effect on the objective, and stop quickly, on order. Smoke is dependent upon the weather conditions; therefore the smoke plan must be flexible with alternate terrain or timing objectives built into the plan. Do not overlook the logistical burden when planning smoke operations. The initial stockage resupply of class III and IX should be included as part of the smoke plan. Support of smoke operations in rear areas should be easier to plan because of close proximity to class III or other supply activities. Smoke operations will usually be longer in duration in the rear where they will require more fog oil, other fuels, and class IX support.

Stationary smoke points are resupplied on-line during a mission. This will require logistical teams to be dedicated during smoke missions. The smoke generators at fixed sites can be resupplied by two different ways. One way is to resupply them by a tank and pump unit (TPU). The TPU can carry twelve 5-gallon cans of motor gasoline (MOGAS), one 600-gallon tank of diesel fuel, and one 600-gallon tank of fog oil. Fog oil can be transferred from 55-gallon drums to the TPU tanks by using --

- Barrel overpressure from a 5-ton truck compressor.
- The 65-gallons-per-minute (GPM) pump.
- The electric- or gas-driven TPU pump assembly.
- Barrel handpump.
- Gravity flow.

Yet another way, perhaps cheaper but a drain on manpower, is to deliver 55-gallon drums of fog oil plus 5-gallon cans of MOGAS to each smoke generator. This is the current strategy of replenishing class III to stationary smoke generators.

For mission planning, estimate fog oil consumption at one drum per hour per generator. Estimate gasoline consumption at 3 gallons per hour per generator. See Table 6-4 for a quick reference for determining fog oil consumption.

Table 6-4. Smoke generator fog oil consumption.

GENERA-TORS	HOURS 1	2	3	4	5	6	7	8	9	10	11	12	24	36	48
1	1	2	3	4	5	6	7	8	9	10	11	12	24	36	48
6	6	12	18	24	30	36	42	48	54	60	66	72	144	216	288
8	8	16	24	32	40	48	56	64	72	80	88	96	192	288	384
12	12	24	36	48	60	72	84	96	108	120	132	144	288	432	576
18	18	36	54	72	90	108	126	144	162	180	198	216	432	648	864
24	24	48	72	96	120	144	168	192	216	240	264	288	576	864	1152
36	36	72	108	144	180	216	252	288	324	360	396	432	864	1296	1728
48	48	96	144	192	240	288	336	384	432	480	528	576	1152	1728	2304

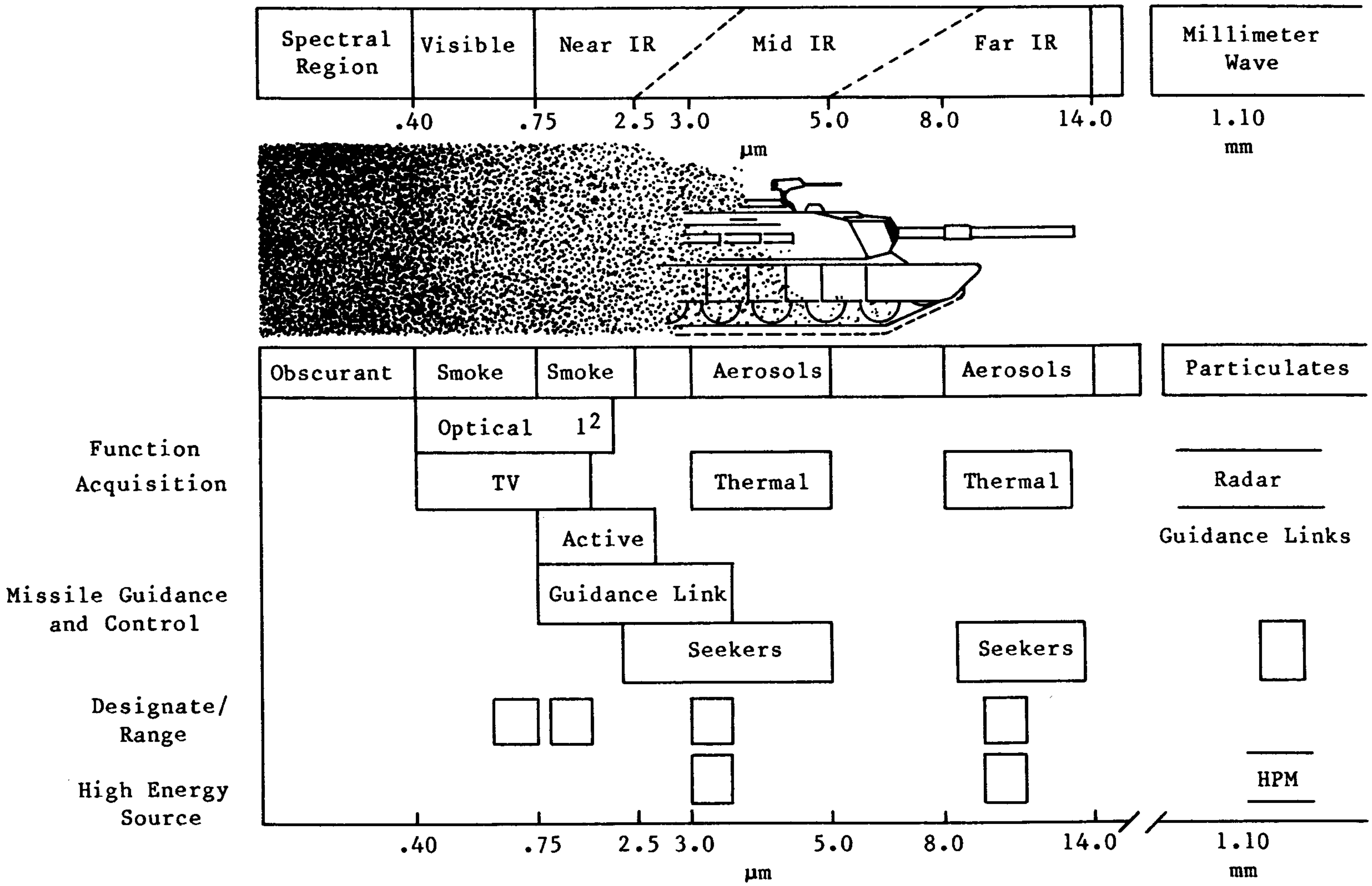
See Table 6-5 on the next page for determining gasoline consumption.

Table 6-5. Smoke generator gasoline consumption.

GENERATORS	HOURS 1	2	3	4	5	6	7	8	9	10	11	12	24	36	48
1	3	6	9	12	15	18	21	24	27	30	33	36	72	108	144
6	18	36	54	72	90	108	126	144	162	180	198	216	432	648	864
8	24	48	72	96	120	144	168	192	216	240	264	288	576	864	1152
12	36	72	108	144	180	216	252	288	324	360	396	432	864	1296	1728
18	54	108	162	216	270	324	378	432	486	540	594	648	1296	1944	2592
24	72	144	216	288	360	432	504	596	648	720	792	864	1728	2592	3436
36	108	216	324	432	540	648	756	864	972	1080	1188	1296	2592	3888	5184
48	144	288	432	576	720	864	1008	1152	1296	1440	1584	1728	3456	5184	6912

Furthermore, obscurants cause a decrease in visibility; this happens when there is a decreased level of energy available for the function of seekers, trackers, vision enhancement devices, and the human eye. There are three categories of obscurants: natural, by-product, and artificial. Natural obscurants are produced by nature and are uncontrollable. Natural obscurants can be advantageously used if the weather can be accurately forecasted. Some examples of natural obscurants are darkness, fog, sandstorms, and rain. By-product obscurants, produced inadvertently as a result of other activities caused during hostilities, provide concealment. Some examples of this type obscurant are smoke from burning vehicles and buildings, and dust caused by vehicular movement and artillery and/or mortar fires. Lastly, artificial obscurants are produced intentionally and for the expressed purpose of hampering hostile operations. A good example of this type of obscurant is smoke. Tables 6-6 and 6-7 show the effect obscurants have on target acquisition and guidance systems from the visible throughout the millimeter wavelengths of the electromagnetic spectrum.

Table 6-6. Spectral obscuration.



NOTE: µm = one-millionth of a meter

Table 6-7. Susceptibility of smart weapons sensors to battlefield smoke.

SENSOR WAVE-LENGTH	CURRENT INVENTORY			DEVELOPMENTAL		ADVERSE WEATHER
	Oil Smoke	HC	WP	IR Smokes	MMW Chart	Fog Rain Snow
	Generators Engine Exhaust	Pots Artillery	Projectiles Grenades	Generators Grenades	Generators Projectiles	
VISIBLE	●	●	●	●	△	●
NEAR IR	●	●	●	●	△	●
MID IR	△	△	○	●	△	○
FAR IR	△	△	○	●	△	○
MM-WAVE	△	△	△	△	●	○

△ MINIMAL PROBLEM

○ MODERATE PROBLEM

● SEVERE PROBLEM