Appendix A

Operations in Special Environments

Weather and terrain and how they affect the needs for NBC protection must receive special consideration. Certain weather conditions will greatly influence use of NBC weapons. Likewise, different types of terrain will alter the effects of NBC weapons. Also, the type of operation can directly bear on the need for NBC protection. This appendix discusses several types of operations with emphasis on NBC defense.

Cold Weather Operations

Cold weather and other severe climatic conditions create many new problems in individual protection. Such conditions may exist in the extreme northern United States, Alaska, and northern Europe. Generally, these conditions alter the planning and implementation of individual NBC defensive measures. The following paragraphs explain some of these particular situations and the procedures that soldiers should take to protect themselves.

Nuclear

Blast Effects. At subzero temperatures, the radius of damage to material targets can increase. The increase can be as much as 20 percent. These targets include such items as tanks, IFVs, APCs, artillery, and military vehicles. A precursor wave over heat-absorbing surfaces can increase the dynamic pressure wave. However, tundra, irregular terrain features, and broken ice caps break up the pressure wave. Blast effects can drastically interfere with troop movement. A blast can break up covers and cause quick thaws. The result can be avalanches in mountainous areas. In flat lands, a blast may disturb the permafrost sufficiently to restrict or disrupt movement.

Thermal Effects. Ice and snow have a high reflectivity. This may increase the minimum safe distance as much as 50 percent for unwarned troops and even warned, exposed troops. Reflectivity may also increase the number of personnel whose vision is affected by the brilliant flash, or light dazzle, especially at night.

The pale colors normally used to cover material in cold environment give an advantage. Their low absorption properties may make personnel less vulnerable to thermal effects. Cold temperatures also reduce thermal effects on materials. Snow, ice, and even frost coverings on combustible material greatly reduce the tendency of materials to catch fire. However, thermal effects will dry out exposed tundra areas, and grass fires may result.

Radiation Effects. The number of passable roadways is limited already by weather conditions, and radiological contamination on roadways may further restrict resupply and troop movement. Seasonal high winds in the arctic may present a problem in radiological contamination predictions. These winds may reduce dose rates at ground zero. At the time, they extend the area coverage and create a problem for survey/monitoring teams. Hot spots or areas of concentrated accumulation of radiological contamination may occur in areas of heavy snow and snow drifts.

Monitoring for nuclear radiation requires the use of battery-powered radiac equipment. It is imperative that these instruments be kept warm to maintain maximum efficiency in extreme cold. Radiological surveys normally are limited to those areas or routes occupied or used by large units. Aerial survey is most practical in extreme cold weather areas. Survey and monitoring procedures are covered in FM 3-3.

Protection Against Nuclear Attack

At low temperatures, troops operating in the field are particularly vulnerable to all of the effects produced by a nuclear detonation because of the difficulty in digging foxholes and underground fortifications for protection. Shelters and fortifications constructed from snow and ice provide some protection and, wherever possible, should be constructed to take maximum advantage of the additional protection provided by natural terrain features.

Tents that provide necessary warmth for living will not provide protection from radioactive fallout. Maximum use, consistent with the tactical mission, must be made of natural terrain features to provide protection against fallout. Snow and ice, although not as effective as earth in reducing radiation hazards, are readily available and can be used to provide shielding against radiation effects. Loose snow falling on a contaminated area has a half-thickness of about 60 centimeters (24 inches); that is, 60 centimeters of loose snow covering the contamination will reduce the dose rate to about half the original value. Thirty centimeters (12 inches) of hard-packed snow will reduce the dose rate by about one-half and may be of value when considering constructing radiation shield over contaminated areas or one-half and may be of value when considering around shelter.

Biological

Biological warfare in the arctic is a Possibility. Most vectors will not survive, and it is more difficult to aerosolize live biological agents in freezing temperatures. Toxins, on the other hand, are less susceptible to the cold. It has been found that the survival of microorganisms increased significantly at temperatures below freezing. Temperature inversions that exist over snowfields tend to prolong the integrity of an aerosolized biological cloud. It would thus disperse more slowly and thus remain a threat for a longer period. If an attack with these agents occurs, most likely it will be delivered by covert means It is important, therefore, to be alert at all times to the possibility of sabotage. Personnel are more susceptible to live biological agents in arctic environments. This is because of the rapid rate with which diseases will spread in the warm crowded conditions. It is more difficult to assure the requirement for food, water, rest, and cleanliness in cold weather. Troops suffering from dehydration, or from lack of nourishment or rest, will be particularly vulnerable to a biological attack.

Chemical

In arctic conditions chemical agents act differently according to whether they are blister, nerve, blood, or choking agents.

Blister Agents. Usually, blister agents are ineffective as casualty producers, because the temperature is well below their normal freezing points. Liquid mustard arent freezes and becomes solid at 14° C (58° F). However, some blister agents or combinations have very low freezing points. These can be effective as harassing agents, because their vapors produce eye irritation requiring soldiers to mask. Since troops wear additional clothing, the possibility of skin contact is greatly reduced. The greater danger is from blister agents carried inside a heated area. Hence, an attack by blister agents at low temperatures can present a real hazard.

Nerve Agents. In arctic operations, nerve agents may play an important role by forcing troops to mask. Agent evaporation takes several hours, and soldiers must remain masked for long periods. Significant contamination at low temperatures and wind speeds may remain several days. Liquid Soman (GD) freezes and becomes a solid at -42° C (-43° F). Except in severely cold conditions, nerve agents will remain liquid, and liquid agents are easily absorbed by outer garments and other porous material. Absorbed agents become a vapor hazard or even a contact hazard if transported into a heated area. and chocking agents require soldiers to mask. Blood and Blood and Chocking Agents. Vapor hazards from blood especially chocking agents remain extremely hazardous and non persistent throughout the low temperature range. These agents may be disseminated as a liquid, solid, or aerosol and require masking whenever they are used. Blood agent AC is extremely hazardous even as low as -65° F (-54° C).

Individual-Equipment Problems

Mask. Soldiers should add the M4 winterization kit to masks for cold weather use. For the M17-series and M40-series masks, pull the hood voicemitter-outlet valve assembly cover opening to below the cover. This prevents moisture from wetting inner clothing. In extreme cold, soldiers wearing masks with winterization kits installed will experience greater breathing resistance. This increases with work load, and it becomes even more pronounced with fatigue. In extreme cold environments the hood may be prone to tearing and the zipper apt to malfunction.

Soldiers should wear their mask carriers beneath their outer garments. This allows body heat to keep the masks warm and flexible. Wearing masks in this manner requires an adjustment to donning time. After each wearing, soldiers must inspect their masks for ice formation, especially in the inlet and outlet valve areas.

To prevent frostbite, soldiers should place a small piece of tape over the exposed metal rivets inside the facepiece. The tape should be just large enough to cover the metal and not so large it interferes with donning.

Fitting the mask requires care. Soldiers must adjust the head harness only tight enough to create a good seal. If the mask is too tight, it will restrict blood flow to certain areas of the face and make those areas more susceptible to frostbite. To don the protective mask in arctic conditions, soldiers should take the following eight actions:

- Stop breathing.
- Remove mask from under parka.
- Remove gloves or mittens as needed to properly don the mask.
- Lower parka hood.
- Don the mask.

NOTE: Do not clear the mask by exhaling a large amount of air into it, as is done in warm weather. A large amount of air exhaled into the mask will frost the cold eye lenses. Instead, exhale steadily and slowly. The outlet valve may stick to the seat. If this occurs, lift the outlet valve cover and rotate the disk with a finger while exhaling only. After freezing the valve, reseat the valve cover.

- Check the mask for leaks by pulling down the cheek flaps of the ice-particle prefilter and covering the inlet valves with your hands.

- Fasten the cheek flaps and resume normal breathing,
- Raise the parka hood and fasten your outer garment,

To remove the mask in arctic conditions, soldiers must take the following five actions:

- Brush snow or ice particles from your mask.
- Remove gloves or mittens as necessary to remove mask.
- Remove mask and immediately dry face and inside of mask.

NOTE: Perspiration collects around the facepiece. Take care when removing the mask to prevent perspiration from freezing on your face and causing frostbite. Use a small towel or cloth to wipe your face and inside of mask. To prevent ice formation, wipe your mask thoroughly before storing it. When possible, further dry the mask by placing it in a warm, heated environment, but avoid placing it in direct heat.

- Store mask in carrier.
- Put on gloves or mittens.

M24125-Series and M43-Series Masks. With these masks, the facepieces become brittle from the cold and can be broken. To prevent this, the mask should be carried beneath outer garments to keep warm. Along with keeping them warn, the face-form is required to prevent creasing and cracking, especially in cold weather.

Battle Dress Overgarment. The BDO is not adversely affected by cold temperatures. Commanders and leaders must be particulary sensitive to the possibilities of their soldiers receiving cold weather injuries, particularly frostbite occurring when soldiers are in MOPP3 or MOPP4. Soldiers are most susceptible to frostbite on their hands, fingers, around the elastic in the arms of the overgarment, and from the buildup of sweat that occurs while wearing the mask and rubber gloves. The chances of hypothermia will increase when the MOPP level is reduced.

The BDO is worn under environmental (cold weather parkas) clothing in keeping with the "layered principle." Overheated soldiers may need to "vent" their chemical protective clothing by opening and cooling down the body core temperature and then reestablishing the protective posture. Before doing this, though, the commander must consider the threat and degree of risk involved. The production of body heat makes the BDO breast pockets particularly well suited for carrying items requiring protection from freezing (for example, M256/M256Al kits and NAAK).

Chemical Protective Overboots and GVOS. Both covers are worn seasonally but do not fit over the vapor barrier (VB) boots required in extreme environments. During winter operations the VB boots provide adequate protection when worn in conjunction with chemical protective clothing. The VB boots are double-layered, natural rubber with an air pocket in between.

Chemical Protective Gloves. Normal procedure when donning the protective gloves is to first put on the cotton liners and then the rubber gloves. During winter operations in a chemical environment, use the wool glove liners (part of the black leather glove set) under the butyl rubber gloves to absorb and wick away perspiration from hand surfaces. Proper glove fit is required to preclude restricting blood circulation and cold weather injury. In an extreme cold environment, the arctic mittens should be worn over the rubber gloves to provide warmth. When mittens are removed, the glove surface should be decontaminated before redonning the mittens.

Nerve Agent Antidote Fit, Mark I & II. Arctic weather affects the Mark I & II kit. When the temperature is below 32° F (0° C) the kit may not function properly. When the temperature dips below 40° F (5° C), remove the kit from the carrier and store it in the shirt pocket. Keep it as close to body temperature as possible. This precludes the danger of severe muscle spasms and/or shock from injecting an extremely cold liquid into a muscle. If the kit freezes, do not use it, but acquire a replacement. In addition, protection from freezing must be provided during transit, storage, and resupply operations because freezing and thawing render the kits unserviceable. Care must be taken during the use of the NAAKs to ensure penetration through winter clothing to the muscle.

M258AI/M291 Skin Decontamination Kit. As with any cold liquid on the skin, the M258AI must be used when chemical agents contact the skin, even though there is a risk of cold injury. Warming the kit prevents possible frost bite. The M291 kit will alleviate this problem since it is a resin-based kit. Additional information relating to decon in arctic environments is in FM 3-5.

M256/M256Al Chemical Agent Detector Kit. Arctic weather affects the kit. When temperature is -15°F (-21°C) or below, the kit can give inaccurate indications. Solutions in the capsules freeze, and the solutions will not work even if reheated. Also, it is difficult or even impossible for the heat tabs to heat the enzyme window to a reaction temperature.

Take care to keep the kit at a temperature above freezing. However, do not place it directly on a source of heat, such as a vehicle heater. If possible, warm it with body heat by placing it inside the parka.

A system of identifying a sample of suspected agent

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is to collect the suspected agent and place it on M8 or M9 paper. Once collected, the M8 or M9 paper is warmed and covered in a box or can while the M256/M256A1 is inside the box or can. This will heat both the suspected agent sufficiently to enable detection by the M256/M256A1 kit. Soldiers can place samples into empty ammunition cans and apply external heat to cause agent off-gassing. The external heat source may be a small fire, heat tab, burning C-4, or trip flare.

M8 and M9 Detector Paper. Both M8 and M9 detector paper are not specifically limited in the cold but can detect only liquid that would probably be frozen. If the specific substance is thickened or frozen, a sample is collected with a stick or scraper and wiped onto a sheet of wither M8 or M9 paper. The sample is placed on a heated surface, such as an operating vehicle or a power generator, to stimulate thawing of the suspected agent so that identification is expedited. Because of the possibility of off-gassing, this procedure should not be performed inside a heated vehicle or tent.

Collective Protection

For collective protection, chemical hazards become a true challenge in the cold. Successful cold weather operations are dependent upon heated shelters. Without these, combat effectiveness is decreased. Most collective-protection systems have proven to be reliable and durable in the cold. Fluctuations in pressure may occur when the system is exposed to high winds. In cold environments, indirect vapor absorption presents the greatest problem in entry and exit. For this reason it is important to have detection capability in the shelter itself, which is currently prescribed in normal entry/exit procedures. If agent is detected, soldiers in the shelter will immediately mask. The soldiers inside the shelter will be monitored to identify who has brought in the contamination. Once identification has been made, the soldier exits and the shelter is then immediately purged. If follow-on detection proves negative, soldiers may resume entry/exit procedures.

Desert Operations

Desert operations present many varying problems. Desert daytime temperatures can vary from 90°F to 125°F (32°C to 52°C). An unstable temperature gradient results, and this is not particularly favorable to NBC attacks. However, with nightfall, the desert cools rapidly, and a stable temperature gradient results. A possibility of night or early morning attacks must be considered in all planning of desert operations

Nuclear

Nuclear defense planning is generally much the same in a desert as in other areas. There are a few exceptions, however. Lack of vegetation and permanent fixtures, such as forests and buildings, makes it necessary to plan for and construct fortifications. Construction may be difficult because of inconsistencies of the sand; but sand, in combination with sandbags, will give additional protection from radiation exposure.

Blowing winds and sands can produce widespread areas of radiological contamination. The varying terrain may make radiological survey monitoring very difficult.

Biological

Most aerosolized live biological agents are ineffective weapons in desert areas. An exception is spore-forming biological agents. This is a result of low humidity and the ultraviolet radiation of direct sunlight. Troops crossing or occupying desert terrain face little danger from long-term live biological contamination except for spore-forming agents. But, because of favorable night conditions, a covert aerosolized attack could occur. Effectiveness of the live biological agent, however, would quickly diminish with daytime heat. Toxins are resistant to this harsh environment. These can be employed in the same way as chemical agents.

Chemical

Most chemical attacks will be spot or on target attacks. This is because of rapid agent evaporation. For example, with a neutral temperature gradient, 90°F (32°C) temperature, and a light wind, mustard evaporates rapidly. The concentration will be less than 50 percent in one hour.

Desert soil may be very porous. For example, an attack with an unthickened liquid agent may occur in support of a predawn attack. Soil soaks up agent. When the sun rises, it begins to heat the surface. The agent evaporates and rapidly creates a downwind hazard, and the downwind hazard area increases because of a lack of vegetation and permanent building to alter the wind flow. Soldiers must take care to place alarm systems for the widest possible coverage.

A nonpersistent agent attack is unlikely during daylight hours. Weather conditions would rapidly blow away any agent. Night brings about a reverse of weather conditions and creates ideal conditions for an attack. At night, agents linger and settle into low areas, such as foxholes.

In planning for defense, plan any strenuous activity for night hours. This will reduce the heat stress caused by wearing MOPP gear. Take care to ensure that sleeping soldiers are masked if appropriate. Also ensure that they are checked periodically to make sure that mask seals are not broken. This is because an attack is more likely at night than in the day. A way to accomplish this is to use the buddy system or to have the guard check soldiers during rounds. The unit SOP must address this subject.

Jungle Operations

Tropical climates require the highest degree of individual discipline and conditioning to maintain effective NBC defense readiness. Dominating climatic features of jungle areas are high, constant temperature; heavy rainfall; and very high humidity. In thick jungle, there is usually little or no wind, and the canopy blocks much of the sunlight from the ground.

Commanders must expect and plan for a rapid decrease in unit efficiency. They must also expect heat casualties. In addition, they must ensure that special precautions are taken to maintain unit NBC defensive equipment in usable condition. The rapid mildew, dry rot, and rust inherent in jungle areas impose this requirement.

Nuclear

Dense vegetation has little influence on initial effects of nuclear detonations except that the heavy canopy provides some protection against thermal radiation. The blast wave creates extensive tree blowdown and missile effects. Some falling particles are retained by the jungle canopy, and reduced radiation hazards may result. Subsequent rains, however, will wash these particles to the ground. Particles will concentrate in water collection areas and produce radiation hot spots.

Biological

Jungles provide excellent conditions for threat use of live biological agents and toxins. Warm temperatures, high humidity, and protection from sunlight all aid survivability of disease-causing microorganisms. Low wind speeds and jungle growth limit downwind hazards. Strict adherence to field sanitation procedures, especially vector and rodent control, is essential in jungles. These procedures will help control the naturally occurring diseases that abound. Soldiers should mask and role down sleeves to cover exposed skin from possible contact with live biological agents and toxins. Toxins are well suited to this environment, and soldiers should defend against toxins just as they defend against chemical agents.

Chemical

Chemical agents used in jungle areas can cause extreme problems for friendly forces. Persistent agents delivered by artillery shells and aircraft bombs penetrate the canopy before dissemination. These agents can remain effective on jungle floors for long periods.

High temperatures can increase vapor hazards from liquid agents. Nonpersistent agent vapors hang in the air for extended periods because of low wind speeds. However, these wind speeds minimize downwind vapor hazards. Chemical agents employed in jungle areas make MOPP gear necessary for ground operations. However, high temperature and humidity combined with the heat-loading characteristics of MOPP gear make MOPP gear uncomfortable to operate in.

Mountain Operations

Terrain and weather in mountainous areas dictate a requirement for a high degree of NBC defense preparedness. Rugged terrain limits the employment of large forces. Adjacent units may not be able to provide mutual support. Also, there is reduced logistical support and difficult rapid maneuver. In these circumstances, small US units can impede, harass, or canalize numerically superior threat forces. The intention is to dissipate threat strength and compel threat forces to fight a decisive battle under unfavorable circumstances. Mountain warfare requires friendly units to be almost completely self-sufficient in NBC protection.

Nuclear

Nuclear targeting in mountainous areas is easier than in flat terrain. The reasons are the lack of roads and trails and the slow speed at which troops must move. Digging foxholes and building other protective shelters are difficult in rocky or frozen ground. Improvised shelters built of snow, ice, or rocks may be the only possible protection. Radiological contamination deposit may be very erratic, because of rapidly changing wind patterns. Hot spots may occur far from the point of detonation, and low intensity areas may occur very near it. Limited mobility makes radiological surveys on the ground difficult, and the difficulty of maintaining a constant flight altitude makes air surveys highly inaccurate.

Natural shelters provide some protection from nuclear effects and radiological contamination. These natural shelters include caves, ravines, and cliffs. Clear mountain air extends the range of casualty-producing thermal effects. Added clothing required by cool mountain temperatures, however, reduces casualties from these effects. Rockslides or snowslides are potential problems. Units operating under nuclear warfare conditions should carefully select positions where they will not be hit or trapped by slides.

Biological

Defense against live biological agents does not differ in principle in mountains from that in flat terrain except in extreme cold. For a detailed explanation, see cold weather operations on page 94.

Chemical

Aerial delivery will most likely be the means of chemical munitions employment in mountain warfare. This results from difficult logistic problems and increased munitions requirements for cold weather employment. Troops should be constantly alert for air strikes, and they should take protective actions immediately. Defense against chemical attacks in mountains is similar to that in flat terrain where cold temperatures prevail. Refer to cold weather operations on page 94.

Urban Terrain Operations

To plan NBC defense, commanders must be fully familiar with how urban terrain will affect their mission.

Nuclear

Without some preparation, average buildings give inadequate shelter from a nuclear blast. If used correctly, ground floors and basements of steel or reinforced concrete offer excellent protection from most effects except overpressure. Soldiers should avoid windows because of possible injuries from flying debris and glass. Soldiers also may receive severe burns through openings facing ground zero. Sewers, storm drains, and subway tunnels are readily available in most urban areas. These provide better protection than ground-level buildings. Soldiers should not use structures of wood or other flammable materials, because these could burst into flames. See Chapter 4 for preparation procedures.

Buildings do provide a measure of protection against radiological contamination. Troops who must move in or through suspected contaminated urban areas should take this into consideration. They should travel through buildings, sewers, and tunnels. However, they should consider the dangers of collapse because of blast. Soldiers also should consider hazards of debris and firestorms resulting from ruptured and ignited gas or gasoline lines.

Biological

Buildings and other urban structures can provide some immediate protection from direct spray. However, the stable environment of these structures may increase persistency of live biological agents. Toxins are very effective in an urban environment, and soldiers should take the same precautions prescribed for chemical agents.

Covert operations are particularly well suited for urban employment. Existing water and food supplies are prime targets. Soldiers' personal hygiene becomes very important. Commanders must establish and consistently enforce sanitary and personal hygiene measures, including immunizations. They must also ensure that troops drink safe water and never assume that hydrant water is safe.

Chemical

Urban structures can protect against spray attacks, but this exchange for overhead cover creates other problems. Chemical agents tend to find and stay in low areas, such as those found in urban locations. Examples are basements, sewers, and subway tunnels. Soldiers should avoid these low areas. Stay times of agents, such as GB, greatly increase when settled in these areas.

Once an attack occurs, detection of chemical contamination becomes very important. Soldiers must thoroughly check areas before attempting to occupy or traverse them. They also may have to relocate some defensive positions.

Airborne and Air-Assault Operations

Airborne and air-assault divisions launch operations into specific, limited, objective areas. This provides threat forces with an opportunity to use NBC weapons effectively as a deterrent. Commanders should avoid massing troops and aircraft in and around relatively small landing zones (LZs) and drop zones (DZs). Such massing invites disaster. If the area of operation has only a few suitable LZs or DZs, the enemy may choose to contaminate them with persistent chemical agents. Any landing operation attempted in these zones would then require troops to dress in fill MOPP gear. It could also require extensive decon of aircraft (see Chapter 8 of FM 3-5). Troops operating from bases near LZs or DZs could be subjected to further chemical attacks with both persistent and nonpersistent agents. This would require extended wear of MOPP gear.

Suppression of threat fire is critical to a successful operation. Small elements should use several LZs or DZs simultaneously. This technique helps them avoid presenting lucrative targets for nuclear weapons. After landing, these elements should use separate routes to approach the objective, and they should mass only at the last possible moment before assault. Also, commanders must give planning consideration to either of two options. They can extract the force within a short time or provide a quick linkup with a ground mobile task force. These plans allow for relief from wearing MOPP gear.