Chapter 14

Nuclear, Biological, and Chemical Defense

14001. Cold Weather Operations.

Cold weather environments create unique and diverse conditions with which to overcome and accomplish an assigned mission when coupled with NBC events. Doctrine governing nuclear, biological and chemical defense remains in tact during cold weather operations. This chapter discusses only those aspects of NBC Defense that require modifications during cold weather operations/conditions within the context of the small unit leader. Each area-specific paragraph (Nuclear, Biological, and Chemical) provides a brief overview with unique measures for Individual, Monitor/Survey and Decontamination Operations.

14002. Nuclear Defense

The winter environment influences the effects of a nuclear detonation with regard to blast, thermal effect, and radiation effects.

a. Blast Effects. At subzero temperatures, the radius of damage to material targets can increase as much as 20 percent. Tundra, irregular terrain features, and broken ice caps will break up the pressure wave and thereby reduce its effects. Blast waves can drastically interfere with troop movement, by breaking up cover and causing thaws, with possible avalanches in mountainous areas.

b. Thermal Effects. Ice and snow have a high reflectivity. This reflectivity may increase the number of personnel whose vision is affected by the brilliant flash, or light dazzle, especially at night. Cold temperatures reduce thermal effects on materials, by reducing possible heat signature. Snow, ice, and even frost coverings on combustible materials greatly reduce the tendency of materials to catch fire; however, this thermal effect will dry out exposed tundra areas and may cause grass fires.

c. 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 the prediction of radiological contamination predictions and for crossing contaminated areas.

d. Individual Protective Measures. The following conditions must be considered:

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

(2) Snow and ice, although not as effective as earth in reducing radiation hazards, is readily available and can be used to provide shielding against radiation effects. Loose snow falling on a contaminated area will have a half-thickness of about 60 centimeters (24 inches). 30 centimeters (12 inches) of hard-packed snow will reduce the value to ½ of its original value. Half-thickness is the thickness of material required to reduce the original radiation level (reading) to half its value. Example; original radiation reading equates to 120 cGy, add required thickness of material and new value is 60 cGy.

(3) Cold weather clothing (Outer shell, overwhites) provides an advantage of low absorption properties and thereby reduces the thermal effects.

e. Monitor/Survey Operations/Equipment. The following conditions must be considered:

(1) High winds will extend contamination zones, creating additional challenges for monitor/survey operations. Aerial survey is the most practical method in extreme cold weather areas dependent on operating altitude and environmental conditions.

(2) Hot spots or areas of concentrated accumulation of radiological contamination may occur in areas of heavy snow and snow drifts. These areas need special attention during survey operations.

(3) Radiac instruments (used to detect, survey and monitor radiological hazards) should be kept warm until use to ensure maximum efficiency. Refer to TM 11-6665-251-10 (Operator's manual for Radiac set AN/VDR-2) for operating within cold weather environment.

f. Decontamination Operations/Equipment. The following conditions must be considered:

(1) Decontaminate radioactive fallout on vehicles via brushing using brooms, or even tree branches, due to the freezing point of water (32 Deg F). Radioactive effects (Fallout) are being removed from the contaminated item, NOT neutralized, which equates to transferring of contamination.

(2) Refer to TM 3-4230-228-10, for operating Lightweight Decontamination System, M17 Sanator under cold weather conditions.

14003. Biological Defense

Biological warfare can be waged effectively in the arctic with few exceptions. Most vectors (infected insects) will not survive the extreme environmental conditions 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 increases significantly at temperatures below freezing. At these temperatures spore-forming bacteria and certain viruses will survive and will remain dormant within the cold. Upon warming (warming tent, sleeping bag, heated vehicle, etc) they become an active hazard to personnel. Temperature inversions that exist over snowfields tend to prolong the integrity of an aerosolized biological cloud. Accordingly, it will disperse more slowly and remain a threat for a longer period of time.

a. Individual Protective Measures. Personnel are more susceptible to live biological agents in arctic environments, due to:

(1) Rapid rate diseases will spread in the crowded warming areas (tens, vehicles, etc).

(2) Difficult to maintain required food intake due to extreme physical demand (water, rest, and cleanliness may also be in short supply.)

14004. Chemical Defense

In arctic conditions, chemical agents act differently according to type. Table 14-1 is provided as an analysis tool with regard to effectiveness of chemical agents under cold temperature conditions.

a. Blister Agents. Some forms of blister agents are ineffective casualty-producers in a CWE because the temperature is well below their normal freezing points. This is not true for all blister agents, which may still be effective as harassing or casualty producing agents.

b. Nerve Agents. Significant contamination of areas at low temperatures and wind speeds may persist for several days. In severely cold conditions, nerve agents will remain liquid, which can be absorbed through normal cold weather clothing.

c. Blood and Choking Agents. Blood and choking agents remain extremely hazardous and nonpersistent throughout the low temperature range.

Freezing points of selected chemical agents
Table 14-1

Agent	Symbol	Contact Hazard	Vapor Hazard	Freezing Point
Nerve				
Tabun	GA	Extreme	Low-Moderate	-58 F (-50 C)
Sarin	GB	Extreme	Extreme	-69 F (-57 C)

Soman	GD	Extreme	Probable	-44 F (-43 C)
	VX	Extreme	Negligible	Below 60 F (16 C)
	VR-55	Extreme	Probable	Unknown
	TGD	Extreme	Probable	Depends on Thickness
Blister				
Distilled Mustard	HD	Extreme	Negligible	+58 F (15 C)
Mustard Lewisite	HL	Extreme	Low	-13 F to –25 F (-25 C to –40 C) Depending on purity
Nitrogen Mustard	HN-1	Extreme	Low	-29 F (-34 C)
Nitrogen Mustard	HN-2	Extreme	Low	-76 F (-60 C)
Lewisite	L	Extreme	Negligible	0 F (-18 C)
Nitrogen Mustard	HN-3	Extreme	Low	+25 F (-4 C)
Phosgene Oxime	CX	Extreme	Low	-1 F (-18 C)
Blood				
Hydrogen Cyanide	AC	Low	Extreme	+8 F (-13 C)
Cyanogen Chloride	CK	Low	Extreme	+20 F (-7 C)
Arsine	SA	Low	Extreme	-176 F (-80 C)
Choking				
Phosgene	CG	Slight	Extreme	-198 F (-127 C)

d. Individual Protective Measures. The addition of Chemical Protective clothing to EWCS increases the risk of heat casualties and degrades unit performance. Leaders will need to capitalize on MOPP analysis, risk assessment, and METT-T in order to derive the best available force protection requirements with minimum readiness degradation.

(1) M40 or M40A1. Refer to TM 3-4240-339-10 (Operator's manual M40 & M40A1 mask) for operating within cold weather environments. The following are quick tips for leaders:

- Always use mask assembly with outserts installed when operating in cold climate to help prevent fogging.
- DO NOT warm up mask near heater or open flame. Mask could be damaged.
- Do not clear mask by exhaling a large amount of air into it (as done in warm weather); doing so may frost inside cold eye lenses. Instead, exhale steadily and slowly.
- The outlet value may stick to the seat. If this occurs, lift the outlet value cover and rotate the disk with a finger while exhaling only. After freeing the valve, reseat the valve cover.
- To don the protective mask in arctic conditions, Marines should take the following actions:
- Stop breathing.
- Remove mask from under parka (clod weather clothing).
- Remove gloves or mittens as needed to properly don the mask.
- Lower parka hood.
- Don and clear mask per TM.

NOTE: Perspiration collects around the facepiece. Take care when removing the mask to prevent perspiration from freezing on your face and causing frostbite. Use small towel or cloth to wipe your face and inside or 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 near direct heat.

(2) Chemical Protective Clothing.

- Cold temperatures will not adversely affect the current Marine Corps chemical protective suit (Saratoga).
- Based on METT-T and risk assessment, leaders will need to establish whether chemical protective clothing is worn as outer layer (over ECWCS) or as undergarment (under ECWCS).
- ECWCS will provide only marginal protection in a chemical environment

(3) Chemical Protective Overboots. Current bootcovers are worn seasonally, hence to do fit over cold weather vapor barrier (VB) boots. During cold weather operations the VB boots provide adequate protection when worn in conjunction with chemical protective clothing (page A-2, FMFM 11-9). The VB boots are double layered, natural rubber an air pocket in between.

(4) Chemical Protective Gloves. Follow normal procedures when donning the protective gloves. During winter operations in a chemical environment, use the wool glove liners (part of 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 contributing to a cold weather injury. In extreme cold environment, the arctic mittens should be worn over the rubber gloves to provide warmth. Decontamination of cold weather mittens (if contaminated) maybe impractical and may be discarded as a combat loss.

(5) Nerve Agent Antidote Kit (NAAK). NAAKs are subject to freezing at about the same temperature as water. At temperatures at or below 40 F (5 C), remove kit (NAAKs) from mask carrier and store in shirt pocket, in order to maintain warmth through body heat. This precludes the danger of severe muscle spasms and/or shock from injecting an extremely cold liquid into muscle. During transit, storage and resupply operations, NAAKs must be protected from freezing and then thawing in order to minimize the threat of rendering kits unserviceable.

(6) M291 Skin Decontamination Kit. This kit can operate in different climatic conditions, and is effective in a CWE to temperatures of –50 F.

e. Monitor/Survey Operations/Equipment.

(1) Operations. Toxic chemicals react differently at extremely low temperatures. Some chemicals freeze at cold temperatures, thereby reducing the vapors which current detectors collect to ascertain identification. Table 14-1 provides chemical freezing points. Refer to FMFM 11-9 (NBC Protection) for cold weather Monitor/Survey considerations and guidance.

(2) Equipment.

(a) M256 Chemical Agent Detector Kit. The kit may give inaccurate indications when the temperature drops below –15 degs F (-21 degs C). Solutions in the capsules freeze (even if thawed they may not work), and heater tabs used to heat enzyme windows to reaction temperature, will have difficulty reaching proper temperature. Refer to TM 3-6665-307-10 (Operator's manual for Detector Kit, Chemical Agent M256 and M256A1) for operating within cold weather environment.

(b) Chemical Agent Monitor (CAM). At lower temperatures, most agents become more persistent or even freeze, and the CAM will have difficulty in detecting any agent as organic solvents, thereby giving potentially false readings. Cold weather will shorten battery life. Refer to TM 3-6665-327-13&P (Operator's Unit, and Immediate Direct Support Maintenance Manual, Chemical Agent Detector) for operating in cold weather environment.

(c) M8/M9 Detection Paper. The use of M8 or M9 detection is not specifically limited in the cold, but is only capable of detecting liquids. If the specific substance is thickened or solidified, collect a sample with a stick or scraper and wipe onto a sheet of M8 paper. Place the sample onto running vehicle hood to stimulate thawing of suspected agent, then wait for reaction on paper.

f. Decontamination Operations/Equipment. Refer to MCWP 3-37.7 (NBC Decontamination) for decontamination considerations and guidance with regard to cold weather environments.

(1) Equipment Decontamination. The use of water as a decontaminate will be limited during cold weather operations due impart to its freezing point (32 degs F). An alternative low-temperature decontaminate can provide a solution. STB or HTH can be used as a dry mix (two parts STB to three parts earth or snow). This method may require several applications at low temperatures. Application can be accomplished via shoveling it onto contaminated surfaces or filling sandbags and dusting it onto surfaces. After decontaminating, remove residual elements of the dry mix by brushing, scraping

or using uncontaminated earth or snow to "wash" it off. These decontaminates are corrosive to metals and personnel must wear rubber gloves and protective masks to avoid injury.

(2) Personnel Decontamination. Increase time allowances when planning MOPP exchange or detailed personnel decontamination in a CWE, placing emphasis on training with ECWCS garments.

REFERENCE PUBLICATIONS

MCWP 3-37.7	NBC Decontamination
FMFM 11-9	NBC Protection
FMFM 11-20	NBC Reconnaissance
FMFM 7-11-H	Field Behavior of NBC Agents
TM 3-4240-329-10	Operator's manual, Chemical-Biological Mask M40 and M40A1
TM 3-6665-307-10	Operator's manual, Detector Kit, Chemical Agent M256 and M256A1
TM 3-4230-229-10	Operator's manual for Decontamination Kit Skin: M291
TM 3-6665-311-10	Operator's manual for Paper, Chemical Agent Detector: M9
TM 3-6665-327-13&P	Operator, Unit, and Immediate Direct Support Maintenance Manual Chemical Agent Monitor (CAM)
TM 11-6665-251-10	Operator's manual for Radiac Set AN/VDR-2