Chapter 6

Effects of Environmental Conditions

US forces may find themselves committed to battle anywhere in the world and in any type of weather.

Weather and terrain conditions will dictate how to fight and what equipment is most effective to support the fighting force under NBC conditions. Conditions like weather, urban areas, mountains, jungles, and deserts each have a major influence on decon operations.

Natural Elements

Weather can bean advantage when used as a natural decontaminant to lessen the hazards of nuclear, biological, and chemical contamination. However, it could also be a disadvantage if you must operate under adverse weather conditions (such as extreme cold), which will restrict detection and decon operations.

Weathering or Aging

Weathering is the easiest method of decon. It acts on chemical agents through evaporation and decomposition. The effects of weathering on biological and chemical contamination, however, are variable. They depend on the persistency of the agent, climatic conditions, and the type of surface, so, exercise care within contaminated areas until all vapor and transfer hazards are gone.

Radiological contamination is not affectedly weather. Its hazards decay at a particular rate depending upon the physical characteristics of the particles. This process is called aging, and it requires almost no labor and reduces troop exposure to radiation. Although the radiation decreases with time, in certain cases, the contamination becomes more firmly fixed to the surface. So, the lack of time or the nearness of unprotected personnel to the contamination may require the use of a faster method of decon.

Effects

Temperature. High temperature speeds the changing of liquid to vapor (evaporation) and hastens the dispersion of chemical agents in the air. The persistency of liquid chemical agent on the ground decreases as the temperature increases. Temperature has no effect on radiological contamination.

Wind. Aeration aids in decon. High winds rapidly disperse chemical agent vapors.

Humidity and rain. Moisture tends to break down chemical agents. However, most chemical agents break down very slowly. Heavy rain aids decon by removing contamination, however, runoff contamination may build up in drainage areas, creating hazards. Rates at which microorganisms dry out (dehydrate) depend on the moisture content of the air. Although some agents (spores) possibly are not affected by low humidity, periods of dry weather help reduce most types of biological contamination within an area. Rain that wets the terrain may prevent the formation of secondary chemical and biological aerosols. Rainfall may also leach contamination into the soil.

Sunlight. Sunlight can act as a decontaminant. Even in cold weather, the direct rays of the sun warm surfaces above the air temperature. This hastens the evaporation and decomposition of chemical agents. The ultraviolet and infrared radiation in sunlight will help to destroy most biological agents within one day.

Time. Radiological contamination loses its radiation danger only with time. The time required depends on decay rate of the isotope(s) present as contamination.

Procedures

Aging or weathering consists of placing or leaving a contaminated object in an out-of-the-way area, posting the area with contamination markers, and waiting for the contamination to drop to an acceptable level. Check the weathering or aging progress periodically by detection and survey procedures. Consider using aging or weathering in situations where manpower is of primary importance.

Soil

Soil is a readily available natural decontaminant. The type of soil affects the persistency of chemical agents. Sandy soil tends to absorb the agent and increases the duration of the vapor hazard. Rocky soil does not absorb the agent as fast, so it does not increase the persistency.

Effects

Soil with organic matter will seal or cover contamination and absorb liquid contamination; however, sandy soil will not absorb any.

Procedures

Cover an area with about 10 centimeters (4 inches) of earth. This offers protection against liquid chemical contamination as long as the earth is not disturbed and the

chemical agent is not exposed. Such an area may be crossed safely, but take care not to disturb the earth covering. If the layer of earth is broken, both a contact and vapor hazard may result. Extra protection may be obtained by mixing household bleach with the earth. In the absence of better absorbants, use earth to remove liquid contamination from materiel. This earth becomes contaminated and must be treated as contaminated waste.

Bury expendable materiel contaminated with chemical or biological agents or with radioactive material. Earth is only a temporary cover for radiological contamination. Terrain contaminated by radiation, such as drainage ditches or collection sumps, can be effectively sealed with at least 30 centimeters (12 inches) of earth which will reduce the dose rate by approximately one half. Use earth-moving devices to collect earth for sealing or burying. Shovels may be used if heavy equipment is not available or if the contaminated area is small.

Fire

Fire is a rapid, simple, and effective means of decontaminating chemical and biological agents. Large quantities of items that are not mission essential (contaminated covers, canvas, and uniforms) may be decontaminated and disposed. Ideal conditions for using fire are during periods of lapse temperature gradient with a moderate wind speed in a direction away from friendly forces – for example, a hot, sunny day with moderate wind. Such conditions will produce minimum downwind travel of toxic vapors. Weather, agent concentration, and the amount of combustible material to be burned determine the downwind hazard. Do not use fire if it will reveal the location of friendly forces to the enemy.

Effects

Fire destroys most of the chemical and biological contamination but may also vaporize some chemical agents, and chemical and biological contamination. Some chemical agents are combustible and convert into relatively harmless products when burned. Biological agents are killed or destroyed by fire. Fire will not destroy radioactive contamination. Although the contaminated material is destroyed by combustion, the radioactive hazard is not affected.

Procedures

Burning operations cause a downwind hazard. Use the downwind vapor hazard prediction technique given in FM 3-3 to predict how fumes travel from burning chemical agents. When using fire, post sentries wearing MOPP4 to warn personnel to stay out of the area. Get permission to use fire from the commander who controls the area (from the burning site to the maximum downwind of the hazard). Warn adjacent troops that burning will take place.

Water

Water removes fallout and biological agents but cannot remove some chemical agents. Hot water is more effective than cold water. Adding soap or detergent makes it more effective. Water used for decon poses a safety hazard. Take care that runoff water does not contaminate streams.

Water alone should not be used to decon objects contaminated with Lewisite-type blistering residue. Scrub the surface with hot, soapy water to remove the residue or apply an alkaline solution to neutralize it.

Effects

Water flushes contamination from surfaces. It hydrolyzes some chemical agents. During decon, the force of the water removes the contamination and the soluble agents or isotopes in the water. It is not as effective on porous or greasy surfaces because these surfaces tend to trap and hold contamination. So, it is always best to use a detergent water solution.

Procedures

Flushing. Flushing a surface with lots of soapy water washes away the contamination. Construct a sump to collect contaminated runoff and to limit the spread of contamination. Flushing will not remove contamination that has soaked into the surface. The effectiveness of flushing increases when using high pressure, extending contact time, raising water temperature, adding soap or detergent, or scrubbing the surface. If steam is used to flush the surfaces, the heat kills many microorganisms. Flushing with soapy water is the most economical way to flush large, smooth areas such as painted walls, sheet metal roofs, and walls.

Boiling. Boiling in hot, soapy water is an excellent method for biological decon. Boil biologically contaminated items for a minimum of 15 minutes. Boil drinking water for a minimum of 15 minutes. Double this time at high altitudes. Autoclaving (with a pressure-cooker device) at 121°C (250ºF) for 15 minutes or in a low-pressure cooker at 109ºC (228ºF) for one hour is recommended for biological contamination. Although boiling removes some radiological contamination by removing the dirt from the contaminated material, it does not reduce the radioactivity of the contamination.

Disposal. Water used for decon operations becomes contaminated. It must not be disposed of in areas where it might flow or be washed into streams or other bodies of water or into areas where it might contaminate ground water used as a water supply. When selecting a disposal area, consider its hazard to troops and civilian populations. Disposal areas should be either decontaminated or marked with standard contamination markers.

Table 6-1 shows the effectiveness of natural decontaminants on NBC decon.

Table 6-1.
Effectiveness of Natural Decontaminants.

	Nuclear	Biological	Chemical
Weathering/Aging	Fair	Fair	Fair
Earth	Fair	Fair	Good
Fire	Useless	Excellent	Excellent
Water	Excellent	Fair	Poor

Cold and Arctic Weather

Northern regions, including the arctic areas, comprise about 45 percent of the North American continent and 65 percent of the Eurasian land mass. Northern regions are characterized by extreme cold and deep snow during winter months. Spring breakup and mud restricts mobility. Whiteout and greyout cause loss of depth perception, making vehicle movement hazardous. Ice fog (clouds of ice crystals) covers troops, vehicles, bivouac areas, and permanent facilities, marking their location. Chemical agents become more persistent in low temperatures (see Table 6-2, and Appendix E). As a result, some normally nonpersistent chemicals become persistent (GB nerve agent may remain a transfer hazard for up to 30 days in arctic climates). Normally persistent agents become more persistent. Although frozen agents do not present a significant problem in a solid state, they become hazards when they warm. Decon is a problem because low temperatures also reduce the effect of decontaminants.

Such situations present unique problems when you plan and conduct decon operation. These freezing points of decontaminants will serve as guidelines for planning.

32°F (0°C)	Water freezes
0°F (-18°C)	Slurry with antiset freezes.
-25°F (-31°C)	DS2 freezes

Decontaminants

You cannot use water as a decontaminant when it freezes on contact. In such situations, use DS2. DS2 is effective down to -25°F, but becomes thickened as the temperature drops. Eventually it will become too difficult to spread or spray. An alternative low temperature decontaminant can provide a solution. STB or HTH can be used as a dry mix (two parts STB to three parts earth or snow) for decon below temperatures where DS2 is no longer effective. However, these decontaminants are corrosive to metals and personnel must wear rubber gloves and protective masks to avoid injury and may require several applications of STB or HTH dry mix at low temperatures. Methods of applying dry mix range from shoveling it onto contaminated surfaces to filling sandbags with the mix 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. Further decontaminating methods using organic solvents and fuels may be used, but observe fire safety, protect personnel from corrosives, and take precaution against super cooling effects. Because of their low freezing points, solvents such as JP-8, diesel fuel, and kerosene maybe used to physically remove contamination. These solvents only flush the agent from the surfaces similar to the way water flushes sand off vehicles in temperate climates. They generally do not deactivate agents nor do they eliminate agents that soak into surfaces. Organic solvents generally are very flammable and must be handled with care. See Appendix F for specific organic solvents.

Equipment Decon Devices

M258A1/A2 Skin Decon Kit

The decon kit must be used when chemical agents contact the skin, even when there is risk of cold injury. Leader judgement must prevail in training with the M58A1 skin decontaminating kit (trainer), during cold weather operations. Using this alcohol-based trainer on the skin during cold weather will result in frostbite. Don't sacrifice safety for realism.

M291 Personal Casualty Decon System Skin Decontamination Kit (PCDS SDK)

The M291 contains a substantial amount of resin to decontaminate the soldier's hands, face, ears, and neck. The M291 can be operated in different climatic conditions. In cold weather the M291 can be operated at temperatures of -50°F.

M11 Decontaminating Apparatus

The apparatus is designed to dispense DS2 at temperatures as low as -15°F (-26°C). DS2 is effective down to -25°F, but becomes thicker as the temperature drops. Eventually it becomes too difficult to dispense. Normally one nitrogen cylinder is used to charge the M11. In cold weather, charging the container with a

second nitrogen cylinder is permissible if inadequate pressure is developed with one cylinder. Never use more than two nitrogen cylinders. When spraying DS2, scrubbing the agent with a brush will assist in removal of thickened agent.

M13 Decontaminating Apparatus; Portable (DAP)

The apparatus consists of 3.7 gallons of DS2, a 14-liter container and a long-handled applicator with scrub brush attached. As the temperature drops, flow of decontaminants through the hose and wand becomes degraded.

Table 6-2. Freezing points of selected chemical agents.

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 the 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)
Diphosgene	DP	Slight	Extreme	-71°F (-57°C)

M17 Lightweight Decontaminating System and M12 Decon Apparatus, Power-Driven, Skid Mounted

Both apparatuses have problems in the cold similar to any other water pump. Normal engine "cold-soaking" problems that cause starting difficulties and brittle metal parts have been observed. Also, internal pumps and lines will crack and break when water freezes within this system. To avoid freeze-up problems, use the shutdown procedures described in the TMs.

Detection and Warning Devices

M8/9 Detection Paper

The use of M8 detector paper is not specifically limited in the cold, but only liquids can be detected. 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 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 of the sample, do not do this in a heated vehicle or tent. M9 detector paper should be treated similarly. This paper also will not differentiate among the various agents. Collect a sample of the suspected agent on M8 or M9 paper. Set this sample on a heat source and cover the sample with a box can, or similar item. Put a detector sampler (M256A1) inside the box or can. Heat the suspected agent enough to enable detection and allow the M256A1 sampler to detect and identify the suspected agent.

M256A1 Chemical Agent Detector Kit

At temperatures above freezing (0°C, [32ºF]), the M256A1 chemical agent detector kit is not adversely affected. However, as temperatures drop, the M256A1 takes longer to give a positive or negative indication. When temperatures reach freezing, guard the liquid components of the kit against freezing by carrying it in the breast pockets of the chemical protective clothing. It may also be necessary to put the test sampler back into the shipping bag after sampling and place on a heated surface to hasten the reaction. The instruction cards for the M256A1 indicate that the kit will not work at temperatures below -32° Celsius (-25ºF).

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 may give false readings. Nevertheless, the CAM can still be quite useful. Contaminated personnel entering a building or collective protection shelter will desorb agents as they warm up. The CAM can be utilized in a vestibule or airlock where the temperature has been raised to that of the building or shelter interior. Likewise, aircraft and vehicles requiring maintenance can pass through a warmed-up site before to entry into a hanger or maintenance bay. Cold weather operation of the CAM will also shorten battery life.

M8A1 Chemical Agent Alarm (CAA)

The CAA no longer uses a wet/liquid detection mechanism, so low temperature operation is no longer limited because of solutions freezing. However, use the M253 winterization kit (for the alarm) when operating at temperatures below -7°C (20°F). Warm-up time with this kit is 50 minutes.

Equipment Decon Stations

Place decon sites in built-up areas and near road junctions, intersections of forest lanes, or where they may be approached from several directions. Break the decon sites and approach routes into sectors, and assign units to keep them open, in spite of mud or heavy snow. With present technology, equipment decon problems in the field are difficult to overcome in an arctic climate. Commanders may seriously consider fighting dirty in arctic regions. Fresh units can be rotated into the field so that dirty units can be moved back to built-up areas to decontaminate.

Vehicles

Decon and water trucks may have to be deployed with empty tanks instead of full ones as in temperate climates. To prevent freezing, it may be necessary to preheat water when loading the water tank trucks and the tanks of the decon apparatuses and keep it heated until it is used. These vehicles may have to be enclosed and warmed so the engines will start. Decon and water tank vehicles must be drained immediately after use to prevent freeze damage. Commanders may choose to conduct minimum decon until they can get back to fixed facilities and conduct a more thorough decon.

Snow and Freeze-Thaw Cycle

Decontaminate vehicles and personnel covered with contaminated snow as soon as possible before the snow has a chance to melt and freeze. Such snow forms layers of ice that make contamination difficult to remove. Radioactive fallout that settles out with snowfall must be removed as soon as possible. Use tree branches (if available) to remove contaminated snow. You can use snow to cover contamination, but snow can blow away or contamination can resurface when tracked vehicles, troop movement, or digging disturb it. Snow cover provides some protection if left undisturbed, but this protection is too uncertain to rely upon safely.

Warmed Areas

One of the most challenging problems lies in preventing contamination from entering warmed areas. For example, if soldiers get frozen agents on their clothing, it will be hard to detect because low temperatures have slowed its effects. However, if the temperature warms or if the soldiers enter a heated area, the agents become dangerous. Because of this, it maybe necessary for you to set up a thawing station for each warmed structure. The agent can be isolated there before the soldier enters the structure and unmasks. Otherwise, all occupants may be subjected to hazardous liquids and vapors. Additional soldiers and equipment are needed for these warming stations. Therefore, in cold weather operations, your decon and detection priority must be heated support facilities. FM 3-4 discusses individual and collective protection in detail.

Urban Areas

The need for decon operations in urban areas may also exist, and it may be easier to support. Water sources are generally available and commercial chemicals may be available for use as decontaminants. Site security may be simplified because of limited observation and poor fields of fire. Decon operations in urban areas will not differ significantly from similar operations in the field; however, keep the following considerations in mind when conducting operations in urban areas.

Street and Structures

When buildings are contaminated with persistent chemicals, their value for cover, concealment, and shelter is reduced. Wood and concrete tend to absorb liquid agents, and they may give off toxic vapors for days or weeks. Building decon is very difficult and requires large quantities of decontaminants. You can reduce the hazard by covering contamination with plastic sheets, STB slurry, sodium silicate, or other substances that cover or absorb the agent.

Though you do not intend to occupy a particular part of a building, it may need to be decontaminated to prevent the contamination from spreading to other parts. For example, decon of an upper story may prevent the contamination from settling to basements, subways, and sewers which are prime defensive positions.

Streets and sidewalks also absorb liquid agents, then give off toxic vapors when heated by the sun. You may need to decontaminate such surfaces several times to reduce toxic hazards to soldiers occupying the area. Roads, sidewalks, or other porous surfaces are best decontaminated by weathering, if time and situation permit.

Civilians

Try to locate decon operations away from civilians. They may injure themselves or interfere with your work. Civilians must not be forced to prepare decon sites or to help with decon operations. However, you may accept the help of volunteers who have been cleared by the civil-military operations officer, G5.

Supplies and Ammunition

Store ammunition, as well as other supplies, under cover to protect from NBC contamination. FM 3-3 explains contamination covers in detail.

Sanitation Systems

Urban areas may have sophisticated sanitation systems. When those systems are destroyed, sanitary conditions become far worse than those in areas where sanitary systems have never existed. Sanitary systems must be maintained to avoid epidemics and to avoid overloading biological decon capabilities. Contaminated water and residue must be controlled so it will not create a hazard to the civilian population or interfere with sanitation systems. Engineer support might be necessary to construct controlled runoff areas.

Mountains

Excluding the extremely high, alpine-type mountains, most mountain systems are characterized by heavy woods or jungle, compartments and ridge systems, limited routes of contamination (usually of poor quality), and highly variable weather conditions. Of these, the two factors most likely to affect decon operations are the weather and restricted mobility.

Mobility

Because of limited roadway nets, decon units will usually operate independently. The terrain and the fact that existing routes may be blocked dictate that mountain operations be decentralized. You may need additional water-carrying vehicles to support these operations. Rugged mountain terrain may restrict the swift transfer of units from place to place. It may be difficult to concentrate forces at points of critical need. To compensate for this restriction, combat elements must be organized to be self-sufficient, and should have decon elements attached to them initially decon platoons can be attached to brigades, but attaching decon squads to battalions maybe necessary. When decon elements operate independently, their parent chemical companies may not be able to provide support. Decon elements must be

equipped with greater hauling capability – especially water hauling. Administrative and logistical support to the decon element will have to come from the combat unit it is supporting.

Planning for water resupply is a challenge in any environment that restricts ground movement. Chapter 9 provides a water consumption table for hasty and deliberate decon that may assist in the logistical planning of water transportation.

Wind

Mountains have changing weather and constant winds that promote weathering at a faster rate than winds on flat or rolling terrain. In high mountains, the ridges and passes are seldom calm; by contrast, in protected valleys strong winds are rare. Normally, wind velocity increases with altitude. Downwind contamination generally will be greater because of the more frequently high winds. However, variable winds will make predictions unreliable.

Temperature

Cool or cold temperatures have an adverse effect on decon operations. Some blister agents have high freezing points (see Table 6-2, page 6-3). With every 300-meter gain in elevation, the temperature will normally drop 3° to 5°F. The drier the air, the more pronounced this drop will be. At high altitudes, there maybe differences of 40° to 50°F between the temperature in the sun and that in the shade. Consequently, the temperature rises swiftly after sunrise and drops quickly after sunset. Low temperatures that normally exist at extremely high altitudes may demand decon procedures and precautions similar to those used in cold weather operations. Daytime operations can be scheduled to avoid some low temperature problems.

Sunlight

Sunlight destroys most biological agents. Above the timberline, there is little protection from the sun, so the effectiveness of a biological attack will be reduced.

Jungle

Jungle climates vary with location. Close to the equator all seasons are nearly alike with rains throughout the year. Farther from the equator, especially in India and southeast Asia, jungles have distinct wet (monsoon) and dry seasons. Both zones have high temperatures (averaging 78° to 98°F [25° to 36°C]), heavy rainfall (as much as 1,000 centimeters [400 inches] annually), and high humidity (90 percent) throughout the year.

Transportation is extremely difficult due to natural obstacles. So decon operations will be decentralized as much as possible. Usually decon elements should be attached and in direct support of battalion task forces. You cannot wear MOPP gear for long because of high temperatures and high humidity. Decon becomes increasingly important, but the decon crews will be more susceptible to heat stress. Staffs should plan for frequent crew rotations and provide enough decon personnel to conduct decon operations.

Rain

Contamination will be retained temporarily in the jungle canopy, reducing the immediate hazard. Later, rains will wash these particles to the ground and concentrate them in low areas. These areas are likely to become contamination "hot spots." Put your decon sites on high ground during the rainy season.

Tropical rainstorms will flood decon sites unless the sites are adequately drained. Ground that appears firm may become impassable when it rains. Rain and intense heat will speed the deterioration of many supplies. Do not break the seals on packing material until it is absolutely necessary. This will protect your supplies as well as provide protection from contamination.

Rain and high humidity (wetness) degrade the protective abilities of the overgarment. Take care to ensure the maximum length of time of the overgarments's usefulness. Additional quantities of overgarments must be maintained to replace those that have gotten "wet." Rain helps the decon process. Rain will help to actually wash away contamination on exposed surfaces. Rain can also hydrolize blister agents, if that is the source of contamination. However, runoff may contaminate the soil.

Temperature and Humidity

When temperatures rise to the 85° to 100°F (29° to 37° C) range, troops can continue medium or heavy work loads only by reducing their MOPP level. Consider these limitations when you plan decon operations. More soldiers will be needed to makeup for extra rest periods and more frequent rotation periods.

You frequently must oil exposed metal parts and grease wheel bearings to protect them from moisture. Since POL products tend to absorb chemical agents, you may need additional decon. Precautionary measures taken to protect communication-electronic equipment from jungle moisture will reduce the need for decon since these measures provide good NBC protection. Seal radios with silicone compound. Pack radios in waterproof containers when not in use (remove batteries). Protect handsets and microphones with plastic bags (batteries and rations are already packed in plastic bags). Check frequently for moisture buildup in the bags.

The high jungle humidity and temperatures increase the need for maintenance. Contact teams must operate independently as they move from site to site doing repairs. There may be no decon specialists to help them.

Biological agents thrive in the heat, humidity, and shade peculiar to jungles; therefore, weathering is not a practical means of biological decon. Use another decon technique or the agent may remain dangerous for a long time.

Solid decontaminants, such as STB, tend to cake and decompose at a faster rate than in temperate climates. Caking is no problem, but the decomposition eventually makes STB ineffective. Appendix J provides some alternate decontaminants if STB is not available or has lost its effectiveness.

Time

Leaders must consider that many tasks in the jungle take more time than the same tasks in other environments. More time must be allowed for movement and security. Begin movements earlier to accomplish missions within a specified time. This may leave less time for planning and preparation. More decon personnel will be required to do the same job or more time will be required for rest periods to protect soldiers from heat stress.

Security

Decon stations are lucrative targets under usual conditions, but they are more vulnerable to enemy attacks in the jungle. Therefore, security must be a prime consideration. Relocating a decon site may require a small security force to guard against ambush. Since increased security measures must be taken, additional personnel will be required for the preparation and conduct of decon operations.

Resupply

Because of the terrain, aerial resupply usually will be common practice. Keep this in mind when determining amounts of decontaminants to keep on hand, since decontaminants will compete with ammunition, POL, medical supplies, and food and water for priority of delivery.

Persistency

Sunlight and wind are reduced within thick jungles due to the vegetation. As a result, chemical and biological agents are less likely to disperse and will remain a hazard for an extended time. This hazard must be reduced through decon.

Desert

Desert regions are characterized by extreme temperature ranges varying between 30°F (-1°C) and 130°F (54°C) over a 24-hour period. These regions have long periods of drought, interrupted by sudden rains that bring flash floods. There are shortages of suitable ground water. Large areas suitable for tracked vehicle maneuver may sometimes have impassable ravines; wet, spongy grounds; and sand seas.

Water

The principal problem for decon in the desert is lack of water. Although decon normally takes place as far forward as possible, the lack of water may force such operations further to the rear. The use of STB slurry and DS2 will burden the logistical system because of all the water required for mixing and rinsing. Nonwater-based decontaminant alternatives (hot air, burning, and organic solvents) may have to be relied upon. Contamination avoidance becomes increasingly important in desert operations because of limited water sources. Therefore, maximum use should be made of field-expedient cover, especially at night when attack by chemical or biological agents is most likely.

Camouflage

Camouflage is another problem in desert operations. Lack of vegetation requires extensive use of camouflage and smoke to conceal decon operations.

Heat Stress

A critical problem for soldiers working in desert environment in full MOPP gear is heat stress. Operating decon stations in daytime temperatures may require short periods of work followed by long periods of rest. Operations at night to avoid heat stress may create light discipline problems.

Weathering

Weathering is a viable decon option. High daytime temperatures can increase evaporation of liquid contamination. As result, vapor concentrations will be high but may not last long. Refer to FM 3-4, Chapter 3, for MOPP opening/unmasking guidance to estimate the chemical hazards, resulting from enemy attacks. But, if liquid contamination soaks into soft, porous soil, such as loose sand, evaporation is not as quick. Strong winds also increase the evaporation rate. Low temperatures during the night have a reverse effect and tend to increase the persistency of chemical and biological contamination. The sandblasting effect of sandstorms may remove contamination from surfaces facing the storm. The desert sunlight and high temperatures will destroy many chemical and biological agents without additional decon measures. Most metals in direct sunlight become hotter than the temperature of the air. This hastens evaporation of liquid contamination. However, light-colored camouflage paints lower surface temperature and slow

the evaporation rate. These light-colored surfaces may require additional decon effort.

Maintenance

Bearings and other critical moving parts need extra lubrication in the desert. This complicates decon because lubricants tend to absorb chemical agents. After a sandstorm, maintenance must be conducted regardless of the last scheduled maintenance. Decontaminate first. If time is critical, do only those surfaces that will be touched during maintenance. Decon such as this will not eliminate vapor hazards.