INTRODUCTION

The presence of contamination generally reduces the effectiveness of our combat power. Contamination forces us into protective equipment that degrades our ability to perform individual and collective tasks. Further, understanding the behavior and characteristics of contamination can better direct our efforts in taking countermeasures to avoid or reduce the nuclear, biological, and chemical hazard. Considering these factors will assist the individual soldier, planner, and leader in the integration of NBC defense measures in tactical operations.

Forms of Contamination

Successful decon requires that you understand the forms of contamination and what makes it dangerous. The different origins and forms of contamination cause different hazards. A brief discussion on the major forms and origins of contamination will clarify the meaning of contamination as it is used in this FM.

Solids

Chemical agents, biological agents, and radiological contamination can all take solid forms. In most cases, these appear as a fine dust. The dust could take the form of radioactive dirt (fallout), a frozen chemical mist, or pollenoated with biological toxins and/or biological spores, or a powder coated with chemical/biological agents (for example, dusty mustard).

Liquid

Liquid contamination is generally delivered in a mist, vapor, or rain that falls to the ground. Liquid contamination can be made thick, like syrup or gelatin. It sticks to what it touches and evaporates slowly. Low vapor pressure and high viscosity make it difficult to decontaminate. Chemical, biological, and nuclear contamination can all mix with rain and contaminate large areas. When this "washout" evaporates, the solid or liquid contamination may remain for some time.

Gases

Chemical contaminants give off vapors. Toxic chemical agents, delivered as a gas cloud, are employed either directly on the target or upwind of the target. Depending on the weather conditions, wind currents can spread toxic gas clouds over a large area. Most toxic gases disperse or evaporate quite readily. However, liquid chemical agents contaminating surfaces may give off toxic gases for days.

Types of Contamination Hazards

If you understand the contamination hazards (transfer, spread, vapor, resorption, and radiation), you will understand contamination characteristics and how decon will help you successfully complete your mission under NBC conditions.

Transfer

Anything that touches a surface covered with liquid or solid contamination will tend to pickup that contamination, and move it from one surface to another. You must eliminate or limit contamination transfer into clean areas. For example, troops climbing in and out of a contaminated tank will transfer agent to the inside of the vehicle onto navigation, communication, and/or computer instruments, or any other compartment in the tank. This will result in two hazards: (1) inhaling the gas given off by the agent brought into the tank and (2) coming in contact with the agent brought into the tank.

Spread

Touching a surface covered with liquid chemical agent can spread contamination on the same surface, thereby, increasing the size of the contaminated area. This will require more decon kits or decontaminants, more effort, and more time spent for decon. Limit the spread of agent and keep contamination from being spread to a clean surface by decontaminating with designated and/or appropriate equipment.

Vapor

The vapor hazard includes any contamination you can breathe, no matter what form it takes – dust in the air, atomized liquids (aerosols), or true gases. Generally, vapors in an open/outdoor area disperse rapidly so you do not need to decontaminate them. Some agent vapors, however (such as atomized blister), create a transfer hazard because they settle from the air and coat the surfaces they touch. As long as solid or liquid contamination remains on a surface, it can continually generate new vapors. Liquid contamination mixed with dust can result

in a vapor hazard due to wind or movement of vehicles. Generally, when a transfer or spread hazard exists, a vapor hazard could also exists.

Desorption

Liquid chemical contamination quickly absorbs into porous surfaces. Once absorbed, it begins to desorb or give off gas; that is, low levels of vapor pass out of the contaminated surface into the air and can be transferred to any surface that contacts it, including bare skin. For example, if you were operating a vehicle that was desorbing a nerve agent, you should protect yourself by wearing, as a minimum, your protective mask and gloves. Exposure to the desorbing nerve agent might blur your vision or interfere with your ability to think clearly. Handling a steering wheel bare-handed when it is desorbing nerve agent may also cause acute nerve agent poisoning. Prevent resorption by decontaminating quickly, before any agent can be absorbed into the surface. Surfaces protected with chemical agent resistant coating (CARC), which is made of polyurethane paint coating, prevent agent absorption. The surface can be easily decontaminated with soap and hot water or DS2.

Radiation

The penetrating energy of radiation does not directly fall into any of the previous categories. Radiation is given off by radioactive dust or dirt, most of which appears as fallout. For decon purposes, radiation can be thought of as a solid. Radioactive contamination can usually be removed by brushing, wiping, or shaking. Decontaminate quickly to decrease the cumulative effects of radiation. Otherwise, small but frequent exposure to radiation may cause radiation sickness.

Persistency

The length of time a hazard remains depends on the persistency of the contamination. A full discussion of detection and hazard prediction for all types of contamination is given in FM 3-3 and FM 3-3-1, but some general guidance is given here.

Chemical

Nonpersistent contamination generally requires no decon. However, the duration and effectiveness of chemical agents employed on the battlefield will depend on a series of factors that affect agent persistency:

- Type of contamination.
- Contamination density and droplet size.
- Temperature.
- Wind speed.
- Sunlight.
- Humidity and rain.
- Composition of the contaminated surface.
- Type of soil and terrain.

Any contamination found on your skin must be decontaminated immediately, regardless of persistency, Some contamination hazards can affect you within minutes after touching your skin (an agent like CX will affect within seconds). After you conduct skin decon, use detection equipment to determine the type of contamination in order to determine whether additional decon and/or treatment is required.

The physical behavior of chemical agents changes based on weather conditions. For example, in cold weather, nonpersistent agents tend to become semi-persistent, lasting from two to ten days. See FM 3-6, Field Behavior of NBC Agents, for further information.

Biological

The many variables involved in estimating persistency of biological hazards require separate consideration for each instance of contamination. Specially trained medical personnel at division level and higher will consider specific treatment regimens only after the contamination has been specifically identified. For example, biological agents will persist longer in cold weather. Temperature inversions (stable conditions) that exist over snowfields also tend to prolong the stay of an aerosolized biological cloud.

Radiological

You can gain a general idea of the persistency of radiological hazards by taking radiation dose rate readings. Use FM 3-3-1 standard decay nomograms to predict the decay rate for radiological hazards. It assumes typical fallout will decrease in intensity according to a standard decay constant (n = 1.2). For operational purposes you can use the “7-10 rule of thumb” to estimate future radiation levels. This rule provides a general estimate and should be used for planning only. The rate of radioactive decay is proportional overtime. The 7-10 rule means that for every seven multiples of time after the burst, the radiation intensity will decrease by a factor of ten. For example, if two hours after the burst your reading is 100 cGy (rad) per hour, then fourteen hours after the burst (7 times 2 hours) you can expect a reading of about 10 cGy (100 cGy divided by 10). Radiation contamination is not affected by climatic conditions or other variables that affect chemical contamination. FM 3-3-1 describes radiation decay rates in detail.

Negligible Risk

You must consider decon if the levels of contamination exceed negligible risk levels.

Chemical

Negligible risk levels for biological and chemical contamination are those that will cause mild incapacitation among no more than 5 percent of unprotected soldiers who operate for 12 continuous hours within 1 meter of contaminated surfaces. Measurements that determine safe levels are made with detection equipment held 1 inch away from the surface. For example, a one bar reading displayed on the chemical agent monitor (CAM) indicates a reduced hazard level that should be considered as a negligible risk level.

Radiological

Negligible risk levels for radiological contamination are measurements of 0.33 centigray (cGy) or less. This level of radiation will cause no more than 2.5 percent mild incapacitation to unprotected soldiers.

Contamination Combinations

Simultaneous enemy NBC attacks will probably be part of the enemy's strategy. Risk assessments include consideration that the enemy may use combinations of nuclear, biological, and chemical weapons or may use any of these combined with conventional fire. Once NBC weapons have been introduced on the battlefield, the enemy may try to deceive you regarding the type of hazard.

The thermal effects of a nuclear blast might destroy the effects of any chemical or biological weapons used at the same time. However, chemical or biological weapons effectiveness could probably be increased if used following a nuclear attack. Nuclear blast casualties and psychologically stressed soldiers are vulnerable to a CB agent attack. Agents could enter collective protective shelters, communications facilities, and vehicles damaged by the nuclear detonation.

When NBC contamination hazards exist, decontaminate the chemical agents first. Chemical agents are normally the most lethal and fastest-acting type of contamination. The decon methods for chemical agents are also effective for neutralizing or removing biological and radiological contamination. The reverse is not true.

To cause multiple types of contamination, the enemy may use a mixture of agents in their munitions. Such mixtures could be used to achieve various purposes:

- Lower the freezing point of the agents and increase agent persistency (such as mustard-lewisite mixture).
- Create both percutaneous (through the skin) and inhalation hazards (such as thickened GD and GB).
- Complicate agent identification of mixed agents, making treatment of casualties more difficult.
- Combine agents with both immediate and long-term persistency such as anthrax with an incubation period of 1 to 5 days, and histoplasmosis (pulmonary infection disease) with an incubation period of 5 to 18 days.

There is no field detecting system capable of detecting or identifying biological agents. Therefore, combinations of biological and chemical contaminants present a different challenge. This challenge can be dealt with if standard chemical decon measures are followed at once. Use standard chemical decontaminants when combinations are known or suspected to exist. They can be used for toxins and biological agents as well as chemical agents. See Appendix A for a description of field expedient chemical decontaminants for use against these hazards.

Do not base decon measures solely upon the frost hazard identified. Make sure you check thoroughly to identify all agent hazards. When specific agents are detected, take appropriate decon measures. Otherwise, use standard decontaminants and procedures.