**Chapter 23**

## Survival In Man-Made Hazards

# THE NUCLEAR ENVIRONMENT

23-1. Prepare yourself to survive in a nuclear environment. Make sure you know what to expect and how to react to a nuclear hazard.



**EFFECTS OF NUCLEAR WEAPONS**

23-2. The effects of nuclear weapons are classified as either initial or residual. Initial effects occur in the immediate area of the explosion and are hazardous in the first minute after the explosion. Residual effects can last for days or years and cause death. The principal initial effects are blast and radiation.

**Blast**

23-3. Blast is the brief and rapid movement of air away from the explosion's center and the pressure accompanying this movement. Strong winds accompany the blast. Blast hurls debris and personnel, collapses lungs, ruptures eardrums, collapses structures and positions, and causes immediate death or injury with its crushing effect.

**Thermal Radiation**

23-4. This effect is the heat and light radiation a nuclear explosion's fireball emits. Light radiation consists of both visible light and infrared light. Thermal radiation produces extensive fires, skin burns, and flash blindness.

**Nuclear Radiation**

23-5. Nuclear radiation breaks down into two categories. The effects can be initial radiation and residual radiation.

23-6. Initial nuclear radiation consists of intense gamma rays and neutrons produced during the first minute after the explosic causes extensive damage to cells throughout the body. Radiation damage may cause headaches, nausea, vomiting, diarrhea death, depending on the radiation dose received. The major problem in protecting yourself against the initial radiation's effect may have received a lethal or incapacitating dose before taking any protective action. Personnel exposed to lethal amounts o may well have been killed or fatally injured by blast or thermal radiation.

23-7. Residual radiation consists of all radiation produced after 1 minute from the explosion. It has more effect on you than in discussion of residual radiation takes place in a subsequent paragraph.

**TYPES OF NUCLEAR BURSTS**

23-8. There are three types of nuclear bursts: subsurface burst, airburst, and surface burst. The type of burst directly affects survival. A subsurface burst occurs completely underground or underwater. Its effects remain beneath the surface or in the im where the surface collapses into a crater over the burst's location. Subsurface bursts cause you little or no radioactive hazarc enter the immediate area of the crater.

23-9. An airburst occurs in the air above its intended target. The airburst provides the maximum radiation effect on the target therefore, most dangerous to you in terms of **immediate** nuclear effects.

23-10. A surface burst occurs on the ground or water surface. Large amounts of fallout result, with serious long-term effects f of burst is your **greatest** nuclear hazard.

**NUCLEAR INJURIES**

23-11. Most injuries in the nuclear environment result from the initial nuclear effects of the detonation. These injuries are clas thermal, or radiation injuries. Further radiation injuries may occur if you do not take proper precautions against fallout. Individ near a nuclear explosion will probably suffer a combination of all three types of injuries.

**Blast Injuries**

23-12. Blast injuries produced by nuclear weapons are similar to those caused by conventional high-explosive weapons. Blas can collapse lungs and rupture internal organs. Projectile wounds occur as the explosion's force hurls debris at you. Large pi striking you will cause fractured limbs or massive internal injuries. Blast overpressure may throw you long distances, and you severe injury upon impact with the ground or other objects. Substantial cover and distance from the explosion are the best pr blast injury. Cover blast injury wounds as soon as possible to prevent the entry of radioactive dust particles.

**Thermal Injuries**

23-13. The heat and light the nuclear fireball emits cause thermal injuries. First-, second-, or third-degree burns may result. F also occurs. This blindness may be permanent or temporary depending on the degree of exposure of the eyes. Substantial c distance from the explosion can prevent thermal injuries. Clothing will provide significant protection against thermal injuries. C exposed skin as possible before a nuclear explosion. First aid for thermal injuries is the same as first aid for burns. Cover ope (second- or third-degree) to prevent the entry of radioactive particles. Wash all burns before covering.

**Radiation Injuries**

23-14. Neutrons, gamma radiation, alpha radiation, and beta radiation cause radiation injuries. Neutrons are high-speed, extr penetrating particles that actually smash cells within your body. Gamma radiation is similar to X rays and is also highly penetr During the initial fireball stage of a nuclear detonation, initial gamma radiation and neutrons are the most serious threat. Beta radiation are radioactive particles normally associated with radioactive dust from fallout. They are short-range particles. You c protect yourself against them if you take precautions. See "Bodily Reactions to Radiation," below, for the symptoms of radiati

**RESIDUAL RADIATION**

23-15. Residual radiation is all radiation emitted after 1 minute from the instant of the nuclear explosion. Residual radiation co induced radiation and fallout.

**Induced Radiation**

23-16. This term describes a relatively small, intensely radioactive area directly underneath the nuclear weapon's fireball. The in this area will remain highly radioactive for an extremely long time. You should not travel into an area of induced radiation.

**Fallout**

23-17. Fallout consists of radioactive soil and water particles, as well as weapon fragments. During a surface detonation, or if nuclear fireball touches the ground, large amounts of soil and water are vaporized along with the bomb's fragments, and forc altitudes of 25,000 meters (82,000 feet) or more. When these vaporized contents cool, they can form more than 200 different products. The vaporized bomb contents condense into tiny radioactive particles that the wind carries until they fall back to ea radioactive dust. Fallout particles emit alpha, beta, and gamma radiation. Alpha and beta radiation are relatively easy to coun residual gamma radiation is much less intense than the gamma radiation emitted during the first minute after the explosion. F most significant radiation hazard, provided you have not received a lethal radiation dose from the initial radiation.

**BODILY REACTIONS TO RADIATION**

23-18. The effects of radiation on the human body can be broadly classed as either chronic or acute. Chronic effects are thos some years after exposure to radiation. Examples are cancer and genetic defects. Chronic effects are of minor concern insof your immediate survival in a radioactive environment. On the other hand, acute effects are of primary importance to your surv acute effects occur within hours after exposure to radiation. These effects result from the radiation's direct physical damage t Radiation sickness and beta burns are examples of acute effects. Radiation sickness symptoms include nausea, diarrhea, vo weakness, and loss of hair. Penetrating beta rays cause radiation burns; the wounds are similar to fire burns.

**Recovery Capability**

23-19. The extent of body damage depends mainly on the part of the body exposed to radiation and how long it was exposed ability to recover. The brain and kidneys have little recovery capability. Other parts (skin and bone marrow) have a great abilit from damage. Usually, a dose of 600 centigrays (cGy) to the entire body will result in almost certain death. If only your hands same dose, your overall health would not suffer much, although your hands would suffer severe damage.

**External and Internal Hazards**

23-20. An external or internal hazard can cause body damage. Highly penetrating gamma radiation or the less penetrating be causes burns can cause external damage. The entry of alpha or beta radiation-emitting particles into the body can cause inte The external hazard produces overall irradiation and beta burns. The internal hazard results in irradiation of critical organs su gastrointestinal tract, thyroid gland, and bone. A very small amount of radioactive material can cause extreme damage to the internal organs. The internal hazard can enter the body either through consumption of contaminated water or food or by absc cuts or abrasions. Material that enters the body through breathing presents only a minor hazard. You can greatly reduce the i hazard by using good personal hygiene and carefully decontaminating your food and water.

**Symptoms**

23-21. The symptoms of radiation injuries include nausea, diarrhea, and vomiting. The severity of these symptoms is due to t sensitivity of the gastrointestinal tract to radiation. The severity of the symptoms and the speed of onset after exposure are g the degree of radiation damage. The gastrointestinal damage can come from either the external or the internal radiation haza

**COUNTERMEASURES AGAINST PENETRATING EXTERNAL RADIATION**

23-22. Knowledge of the radiation hazards discussed earlier is extremely important in surviving in a fallout area. It is also criti to protect yourself from the most dangerous form of residual radiation—penetrating external radiation.

23-23. The means you can use to protect yourself from penetrating external radiation are time, distance, and shielding. You c level of radiation and help increase your chance of survival by controlling the duration of exposure. You can also get as far av radiation source as possible. Finally, you can place some radiation-absorbing or shielding material between you and the radia

**Time**

23-24. Time is important, in two ways, when you are in a survival situation. First, radiation dosages are cumulative. The longe exposed to a radioactive source, the greater the dose you will receive. Obviously, spend as little time in a radioactive area as Second, radioactivity decreases or decays over time. This concept is known as radioactive *half-life.* Thus, a radioactive elem loses half of its radioactivity within a certain time. The rule of thumb for radioactivity decay is that it decreases in intensity by a every sevenfold increase in time following the peak radiation level. For example, if a nuclear fallout area had a maximum radi cGy per hour when fallout is complete, this rate would fall to 20 cGy per hour after 7 hours; it would fall still further to 2 cGy p hours. Even an untrained observer can see that the greatest hazard from fallout occurs immediately after detonation, and tha decreases quickly over a relatively short time. You should try to avoid fallout areas until the radioactivity decays to safe levels avoid fallout areas long enough for most of the radioactivity to decay, you enhance your chance of survival.

**Distance**

23-25. Distance provides very effective protection against penetrating gamma radiation because radiation intensity decrease of the distance from the source. For example, if exposed to 1,000 cGy of radiation standing 30 centimeters (12 inches) from t centimeters (24 inches), you would only receive 250 cGy. Thus, when you double the distance, radiation decreases to $(0.5)^2$ amount. While this formula is valid for concentrated sources of radiation in small areas, it becomes more complicated for larg radiation such as fallout areas.

**Shielding**

23-26. Shielding is the most important method of protection from penetrating radiation. Of the three countermeasures against radiation, shielding provides the greatest protection and is the easiest to use under survival conditions. Therefore, it is the mo method. If shielding is not possible, use the other two methods to the maximum extent practical.

23-27. Shielding actually works by absorbing or weakening the penetrating radiation, thereby reducing the amount of radiatio body. The denser the material, the better the shielding effect. Lead, iron, concrete, and water are good examples of shielding

**Special Medical Aspects**

23-28. The presence of fallout material in your area requires slight changes in first aid procedures. You must cover all wound contamination and the entry of radioactive particles. You must first wash burns of beta radiation, then treat them as ordinary b measures to prevent infection. Your body will be extremely sensitive to infections due to changes in your blood chemistry. Pa to the prevention of colds or respiratory infections. Rigorously practice personal hygiene to prevent infections. Cover your eye improvised goggles to prevent the entry of particles.

**SHELTER**

23-29. As stated earlier, the shielding material's effectiveness depends on its thickness and density. An ample thickness of sh will reduce the level of radiation to negligible amounts.

23-30. The primary reason for finding and building a shelter is to get protection against the high-intensity radiation levels of e fallout as fast as possible. Five minutes to locate the shelter is a good guide. Speed in finding shelter is absolutely essential. the dosage received in the first few hours will exceed that received during the rest of a week in a contaminated area. The dos this first week will exceed the dosage accumulated during the rest of a lifetime spent in the same contaminated area.

**Shielding Materials**

23-31. The thickness required to weaken gamma radiation from fallout is far less than that needed to shield against initial gar Fallout radiation has less energy than a nuclear detonation's initial radiation. For fallout radiation, a relatively small amount of material can provide adequate protection. Figure 23-1 shows the thickness of various materials needed to reduce residual ga transmission by 50 percent.

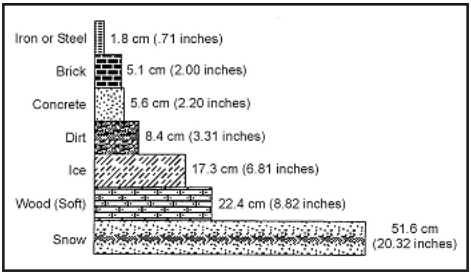


**Figure 23-1. Materials to Reduce Gamma Radiation**

23-32. The principle of **half-value layer thickness** is useful in understanding the absorption of gamma radiation by various n According to this principle, if 5 centimeters (2 inches) of brick reduce the gamma radiation level by one-half, adding another 5 inches) of brick (another half-value layer) will reduce the intensity by another half, namely, to one-fourth the original amount. I centimeters (6 inches) will reduce gamma radiation fallout levels to one-eighth its original amount, 20 centimeters (8 inches) t and so on. Thus, a shelter protected by 1 meter (3 feet) of dirt would reduce a radiation intensity of 1,000 cGy per hour on the about 0.5 cGy per hour inside the shelter.

**Natural Shelters**

23-33. Terrain that provides natural shielding and easy shelter construction is the ideal location for an emergency shelter. Go ditches, ravines, rocky outcropping, hills, and riverbanks. In level areas without natural protection, dig a fighting position or sli

**Trenches**

23-34. When digging a trench, work from inside the trench as soon as it is large enough to cover part of your body thereby nc your body to radiation. In open country, try to dig the trench from a prone position, stacking the dirt carefully and evenly arour level ground, pile the dirt around your body for additional shielding. Depending upon soil conditions, shelter construction time few minutes to a few hours. If you dig as quickly as possible, you will reduce the dosage you receive.

**Other Shelters**

23-35. While an underground shelter covered by 1 meter (3 feet) or more of earth provides the best protection against fallout following unoccupied structures (in order listed) offer the next best protection:

- Caves and tunnels covered by more than 1 meter (3 feet) of earth.
- Storm or storage cellars.
- Culverts.
- Basements or cellars of abandoned buildings.
- Abandoned buildings made of stone or mud.

**Roofs**

23-36. It is not mandatory that you build a roof on your shelter. Build one only if the materials are readily available with only a to outside contamination. If building a roof would require extended exposure to penetrating radiation, it would be wiser to leav roofless. A roof's sole function is to reduce radiation from the fallout source to your body. Unless you use a thick roof, a roof p little shielding.

23-37. You can construct a simple roof from a poncho anchored down with dirt, rocks, or other refuse from your shelter. You c large particles of dirt and debris from the top of the poncho by beating it off from the inside at frequent intervals. This cover w shielding from the radioactive particles deposited on the surface, but it will increase the distance from the fallout source and k area from further contamination.

**Shelter Site Selection and Preparation**

23-38. To reduce your exposure time and thereby reduce the dosage received, remember the following factors when selectin a shelter:

- Where possible, seek a crude, existing shelter that you can improve. If none is available, dig a trench.
- Dig the shelter deep enough to get good protection, then enlarge it as required for comfort.
- Cover the top of the fighting position or trench with any readily available material and a thick layer of earth, if you can c leaving the shelter. While a roof and camouflage are both desirable, it is probably safer to do without them than to exp radiation outside your fighting position.

- While building your shelter, keep all parts of your body covered with clothing to protect it against beta burns.
- Clean the shelter site of any surface deposit using a branch or other object that you can discard. Do this cleaning to re contaminated materials from the area you will occupy. The cleaned area should extend at least 1.5 meters (5 feet) bey shelter's area.
- Decontaminate any materials you bring into the shelter. These materials include grass or foliage that you use as insula and your outer clothing (especially footgear). If the weather permits and you have heavily contaminated outer clothing to remove it and bury it under a foot of earth at the end of your shelter. You may retrieve it later (after the radioactivity leaving the shelter. If the clothing is dry, you may decontaminate it by beating or shaking it outside the shelter's entran radioactive dust. You may use any body of water, even though contaminated, to rid materials of excess fallout particles material into the water and shake it to get rid of the excess water. Do not wring it out, this action will trap the particles.
- If possible and without leaving the shelter, wash your body thoroughly with soap and water, even if the water on hand contaminated. This washing will remove most of the harmful radioactive particles that are likely to cause beta burns or If water is not available, wipe your face and any other exposed skin surface to remove contaminated dust and dirt. You face with a clean piece of cloth or a handful of uncontaminated dirt. You get this uncontaminated dirt by scraping off th of soil and using the "clean" dirt.
- Upon completing the shelter, lie down, keep warm, and sleep and rest as much as possible while in the shelter.
- When not resting, keep busy by planning future actions, studying your maps, or making the shelter more comfortable a
- Don't panic if you experience nausea and symptoms of radiation sickness. Your main danger from radiation sickness i There is no first aid for this sickness. Resting, drinking fluids, taking any medicine that prevents vomiting, maintaining and preventing additional exposure will help avoid infection and aid recovery. Even small doses of radiation can cause symptoms, which may disappear in a short time.

**Exposure Timetable**

23-39. The following timetable provides you with the information needed to avoid receiving a serious dosage and still let you survival problems:

- Complete isolation from 4 to 6 days following delivery of the last weapon.
- A very brief exposure to get water on the third day is permissible, but exposure should not exceed 30 minutes.
- One exposure of not more than 30 minutes on the seventh day.
- One exposure of not more than 1 hour on the eighth day.
- Exposure of 2 to 4 hours from the ninth day through the twelfth day.
- Normal operation, followed by rest in a protected shelter, from the thirteenth day on.
- In all instances, make your exposures as brief as possible. Consider only mandatory requirements as valid reasons fo Decontaminate at every stop.

23-40. The times given above are conservative. If forced to move after the first or second day, you may do so. Make sure tha no longer than absolutely necessary.

**WATER PROCUREMENT**

23-41. In a fallout-contaminated area, available water sources may be contaminated. If you wait at least 48 hours before drin to allow radioactive decay to take place and select the safest possible water source, you will greatly reduce the danger of ing amounts of radioactivity.

23-42. Although many factors (wind direction, rainfall, sediment) will influence your choice in selecting water sources, conside guidelines.

**Safest Water Sources**

23-43. Water from springs, wells, or other underground sources that undergo natural filtration will be your safest sources. An the pipes or containers of abandoned houses or stores will also be free from radioactive particles. This water will be safe to d you will have to take precautions against bacteria in the water.

23-44. Snow taken from 15 centimeters (6 inches) or more below the surface during the fallout is also a safe source of water.

**Streams and Rivers**

23-45. Water from streams and rivers will be relatively free from fallout within several days after the last nuclear explosion be dilution. If possible, filter such water before drinking to get rid of radioactive particles. The best filtration method is to dig sedir seepage basins along the side of a water source. The water will seep laterally into the hole through the intervening soil that a agent and removes the contaminated fallout particles that settled on the original body of water. This method can remove up t

the radioactivity in water. You must cover the hole in some way to prevent further contamination. See Figure 6-9 for an examp filter.

**Standing Water**

23-46. Water from lakes, pools, ponds, and other standing sources is likely to be heavily contaminated; though most of the he radioactive isotopes will settle to the bottom. Use the settling technique to purify this water. First, fill a bucket or other deep co fourths full with contaminated water. Then take dirt from a depth of 10 centimeters (4 inches) or more below the ground surfa the water. Use about 2.5 centimeters (1 inch) of dirt for every 10 centimeters (4 inches) of water. Stir the water until you see r particles suspended in the water. Let the mixture settle for at least 6 hours. The settling dirt particles will carry most of the sus particles to the bottom and cover them. You can then dip out the clear water. Purify this water using a filtration device.

**Additional Precautions**

23-47. As an additional precaution against disease, treat all water with water purification tablets from your survival kit or boil i

**FOOD PROCUREMENT**

23-48. Obtaining edible food in a radiation-contaminated area is a serious but not insurmountable problem. You need to follo procedures in selecting and preparing rations and local foods for use. Since secure packaging protects your combat rations, t perfectly safe for use. Supplement your rations with any food you can find on trips outside your shelter.

Abandoned buildings may have stores of processed foods. They are safe for use after decontaminating them. Canned and pa should have containers or wrappers removed or washed free of fallout particles. These processed foods also include food sto closed container and food stored in protected areas (such as cellars). All such foods must be washed before eating or handli

23-49. If little or no processed food is available in your area, you may have to supplement your diet with local food sources. A plants are local food sources.

**Animals—A Food Source**

23-50. Assume that all animals, regardless of their habitat or living conditions, were exposed to radiation. The effects of radia are similar to those on humans. Thus, most of the wild animals living in a fallout area are likely to become sick or die from rad first month after the nuclear explosion. Although animals may not be free from harmful radioactive materials, you can and mu survival conditions as a food source if other foods are not available. With careful preparation and by following several importa animals can be safe food sources.

23-51. First, do not eat an animal that appears to be sick. It may have developed a bacterial infection because of radiation po Contaminated meat, even if thoroughly cooked, could cause severe illness or death if eaten.

23-52. Carefully skin all animals to prevent any radioactive particles on the skin or fur from entering the body. Do not eat mea bones and joints as an animal's skeleton contains over 90 percent of the radioactivity. However, the remaining animal muscle safe to eat. Before cooking it, cut the meat away from the bone, leaving at least a 3-millimeter (1/8-inch) thickness of meat on Discard all internal organs (heart, liver, and kidneys) since they tend to concentrate beta and gamma radioactivity.

23-53. Cook all meat until it is very well done. To be sure the meat is well done, cut it into less than 13-millimeter-thick (4 1/2- pieces before cooking. Such cuts will also reduce cooking time and save fuel.

23-54. The extent of contamination in fish and aquatic animals will be much greater than that of land animals. This is also true plants, especially in coastal areas. Use aquatic food sources only in conditions of extreme emergency.

23-55. All eggs, even if laid during the period of fallout, will be safe to eat. Completely avoid milk from any animals in a fallout animals absorb large amounts of radioactivity from the plants they eat.

**Plants—A Food Source**

23-56. Plant contamination occurs by the accumulation of fallout on their outer surfaces or by absorption of radioactive eleme their roots. Your first choice of plant food should be vegetables such as potatoes, turnips, carrots, and other plants whose edi grows underground. These are the safest to eat once you scrub them and remove their skins.

23-57. Second, in order of preference, are those plants with edible parts that you can decontaminate by washing and peeling surfaces. Examples are bananas, apples, tomatoes, prickly pears, and other such fruits and vegetables.

23-58. Any smooth-skinned vegetable, fruit, or plant that you cannot easily peel or effectively decontaminate by washing will choice of emergency food.

23-59. The effectiveness of decontamination by scrubbing is inversely proportional to the roughness of the fruit's surface. Sm fruits will lose 90 percent of their contamination after washing, but rough-surfaced plants will lose only about 50 percent.

23-60. Eat rough-surfaced plants (such as lettuce) only as a last resort because you cannot effectively decontaminate them b washing. Other difficult foods to decontaminate by washing with water include dried fruits (figs, prunes, peaches, apricots, pe soybeans.

23-61. In general, you can use any plant food that is ready for harvest if you can effectively decontaminate it. However, growi absorb some radioactive materials through their leaves as well as from the soil, especially if rains have occurred during or aft period. Avoid using these plants for food except in an emergency.

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