3. ALL HAZARD SHELTERING

3.01 Disaster Shelters:
Shelter designs are based on disaster threat. Disaster shelters, however, all have common requirements.

1. Clean, breathable air
2. Protection from heat and cold
3. Food and water storage
4. Protection from the perceived threat

3.02 Risk Assessment:
Every locality has potential disaster threats. A proper risk assessment must take both probability and consequence into consideration. We invite each of you to take time to fill out a threat assessment. What are the threats to you and your loved ones? What is the probability of their occurrence? What is the consequence to you and your family if these threats were to occur? During this threat assessment, consider both man-made and natural disaster. A good NBC shelter will provide protection for most all man-made and natural disaster.

3.03 NBC Targets:
When considering threat from nuclear disaster, you should also list your prime and secondary NBC target areas. Prime targets are facilities that an enemy would perceive as being 'retaliatory' in nature. Facilities of consideration would be airports with runways over 7,000 ft. (they could provide access to tankers that would refuel bombers and fighter planes), military bases, munitions storage areas and submarine pens.

An enemy would consider 'secondary targets' if their strategy was to destroy our infrastructure. Targets such as reservoirs, seaports, power plants, refineries, large cities and transportation hubs are all examples of secondary targets.

Primary and secondary targets that are within 10 miles of your locality may dictate that you consider constructing a hardened, blast resistant NBC shelter. This type shelter must provide protection from all the effects of weapons of mass destruction (blast, fallout, initial radiation and chemical/biological warfare agents).

Fallout patterns generally follow a west to east direction. If your locality is between 10 and 80 miles downwind of a prime or secondary target, you may choose to construct a shelter with only fallout and chemical/biological protection.

3.04 Sheltering in Place vs. Evacuation:
Terrorist attacks are usually localized in nature. If you have an NBC shelter at home, by all means 'shelter in place'. If you don't, it may be more prudent to evacuate in the event of a localized terrorist attack, than to prepare a 'safe room'.

FEMA has long advocated 'Sheltering in Place' by the 'duct tape and plastic' method. If you have been instructed to stay at home, retreat to an inner room with as few a number of windows and doors as possible. Turn off all heating and air conditioning vents. Seal all windows and doors with heavy mill plastic, secured with duct tape. Your 'safe room' should be on an upper floor, if possible, because biological or chemical agents are heavier than air and will settle to the lowest point.

You require 88 cubic feet per person (about 11 sq. feet of floor space) of free air space to keep your CO2 levels below the critical 3% level for a period of 4 hours. To assure your ability to stay for longer periods, you should purchase a ventilator/gas filter for the room. This should be installed well before any event. Make sure the ventilator has both electric and manual function, as you may loose power to your home. It may take longer to secure your room than it would to evacuate. Choose your options carefully.

If you are told to evacuate, take your 72-hour kit with you in your car. Your car, then, becomes your shelter. Turn off all heating and air conditioning vents. Do not travel down wind of the disaster site. If possible, travel away from the disaster and perpendicular to the wind. You may wish to purchase and store Tyvek coveralls (sold at all industrial supply stores) and a gas mask for this purpose. You can suit up faster than it would take you to secure a room with duct tape and plastic.

3.05 Sheltering against Pandemics:
In other than full scale war, it is unlikely that small pox or other contagious diseases would be spread by any other means than by person to person. Evacuation is a poor solution, as you cannot be assured there will not be others with the disease when you arrive. 'Self quarantine' may be the only solution.

Our homes will be almost as secure as our hardened NBC shelters. In order to self-quarantine, you must have the capability to become totally self sufficient with long term food and water storage, prescription medicines, and communication. *Please refer to our chapter lessons #8 and #9 on 'Food Storage' and 'Water Filtration and Purification'.

3.06 Fallout Shelter Design:
If you are more than 80 miles downwind of a nuclear blast, you may be able to survive the effects of the fallout in your basement or interior rooms. There is a natural protection factor (PF) of 5 on the main floor of one story buildings and 10 or greater in most basements. This is because of the heavy shielding provided by the ceiling of the basement and the roof of the home. You must, however, stay away from windows. If you are closer than 80 miles from a nuclear event, you should seek shelter from the fallout.

If at any time within your shelter, you are receiving more than 5 Rads per hour, you will need to seek an area with more shielding. *Please refer to our chapter lesson entitled 'Radiological Monitoring'.

3.07 Attenuation Formulas for Basement Shelters:

Every 4 inches of sand or dirt will provide a protection factor (PF) of two. Each time you add another four inches of sand to the shielding, the PF value can be multiplied by two.

All entrances to shelters should have a 90-degree turn. The 90-degree turn into the entrance will stop (attenuate) about 90% of the gamma radiation from the entering the shelter.

- **Question:**
  How much shielding is need in a basement shelter in medium fallout risk areas?

- **Answer:**
  Six layers of 4 inches (24 inches) will provide a PF of approximately 64; (2x2x2x2x2x2=64). There is already a PF of 10 in the basement. The PF of 64 from the shielding can be multiplied by the PF of 10 from the basement, resulting in a total PF of 640. This will be adequate in most areas of medium risk to fallout.

3.08 Underground Fallout Shelters:

Underground fallout shelters provide much better protection than basement shelters. Four feet of soil overhead will provide a PF greater than 1000. Good underground fallout shelter entrances should be between 30 and 48 inches in diameter and should have a total length of 22 feet or more. The best attenuation is reached if each leg of the L shaped entrance is 11 feet in length or greater.

3.09 NBC Shelters:

Blast shelters should be built with arched ceilings. Flat-topped shelters will not carry the dirt load at those depths, and could fail catastrophically under the additional load from large overpressures. Shelters in areas near heavy blast targets should be buried at twice their diameter. This depth of cover provides an 'earth arching' effect. The full earth arching effect will provide the shelter with approximately 200 psi of overpressure protection. A 10-ft. diameter shelter should be placed into a 20-ft. deep hole. A 9-ft. diameter shelter should be placed into an 18 ft. deep hole. This level of protection provides survivability at 1/2 mile from ground zero of a one-megaton yield ground burst.

The concept of building shelters from corrugated steel tanks was conceived by scientists and engineers at Oak Ridge National Laboratory (ORNL), and actually tested under blast conditions to 200 psi.

This type blast shelter would also provide protection from the 'initial radiation' which otherwise is lethal within 1 1/2 mile range of the detonation. Shielding, however, must be placed into the horizontal runs of the entrances to capture the neutrons from the initial radiation. The overhead shielding for initial radiation requires 8 ft. of cover.

Outside of the 1½-mile radius of the blast, initial radiation is not an issue. Residual radiation (fallout) is easily attenuated with as little as 4 ft. of dirt cover overhead.

3.10 NBC Shelter Entrances:

Documentation from the ORNL tests indicates that entrances must have both a vertical and a horizontal component. The entrances should be no greater than 48 inches in diameter and should be constructed in an L configuration (incorporating a 90-degree angle). The two legs should have a total minimum length of 22 feet with the 90-degree turn near the mid point. Most shelter's designed today have not considered this aspect of design and have entrance runs that are far too close to the shelter body. Basic radiation attenuation formulas demand this aspect of design for the attenuation of both fallout and initial radiation entering from entrances.

3.11 Attenuation Formulas for Entrances:

Radiation is attenuated by time, distance and shielding. The entrances pose a unique problem, because shielding cannot be placed on top of the door. Entrances, therefore, must follow the 'distance' attenuation formulas. All entrances should be kept to diameters of 48-inches or less. Small entrances such as these will follow a 'point source' formula.

- **Question:**
  What is the PF found in a proper entrance.

- **Answer:**
  The PF is found by multiplying the length squared by a factor of 8 and dividing by the diameter squared $(8L^2)/D^2$. If the length of the entrance is 22 feet and the diameter is 4 ft, the PF would be: $8x22^2/4^2$ or 8x22x22/4x4 which equals 242.

3.12 Shelter Temperatures:

Shelters placed in harsh environments stabilize their temperature with a dirt cover in the 8 to 10 ft. range. This depth of cover guarantees the temperature will not fall below 45 degrees F, or rise above 68 degrees F. Shelter supplies (nor occupants) will ever freeze or become over heated. In areas of permafrost, this temperature range may not hold true.

3.13 Concrete Shelters:

Concrete shelters are comfortable and can be designed to accommodate large numbers of people. The Swiss, almost exclusively, build concrete shelters. These shelters are placed in deep underground basements of homes, schools, hospitals, public buildings, hotels, and most all other buildings. The entire population of Switzerland can reach a shelter in a matter of minutes.

Swiss shelters for private homes must are built to a minimum code of 1 atmosphere (15 psi), and government civil defense shelters are built to a 45-psi code. Military and critical mission personnel in Switzerland are assigned to heavy blast shelters in the 200-psi plus level.

Governments that mandate a national shelter program can afford the luxury of building large population concrete shelters. They build in mass and tax their citizens accordingly. They build and install these shelters to last for long periods of time. When people move and purchase

another home, they can be assured that the shelter in the new home will be built to the same code as the shelter they have evacuated.

People in America mistakenly believe that shelter ceilings and wall slabs of an 8-inch thickness will protect them from the effects of radiation and blast. They have been miss-informed. Eight inches of concrete, with no building overhead, will give a radiation PF of less than 8. Even in low radiation risk areas, this level of protection is not adequate to save lives. The accumulated dose for one week would reach between 300 rads and 600 rads, with an expected probable death rate between 50% and 100%. The minimum blast and radiation requirement, with no building overhead, is 22 inches.

Concrete shelters built under a building, however, have an automatic PF of approximately 15, because of the mass of the home and roof above. An eight-inch slab roof under a building may be adequate for radiation protection, but that thickness will not support the home. The minimum thickness for concrete shelters under buildings is 14 inches.

3.14 Earthen Shelters (Cresson Kearney):

Earthen shelters, such as are found in the book, 'Nuclear War Survival skills', can be built very inexpensively. They would offer good tornado protection. They give fairly good radiation protection and some blast protection, but no protection from initial radiation, bio-warfare, and heavy fire.

They would be very cold in the winter and hot in the summer. They must be re-built almost every year and have dirt floors and walls. These shelters are not recommended for families with small children. They are designed for short-term survival for very hardy folks.

3.15 Expedient Shelters:

Building home shelters is not possible for all people, especially for those living in apartments. It could also be the case that after building a home shelter, a nuclear event would occur when we are not at home. There are many natural fallout and blast shelters in our neighborhoods. If we plan ahead, these shelters could be accessed quickly and easily.

A small survival kit (72 hour kit) should be placed in the trunk of every car. Supplies should also be stored at our workplaces. If early warning is taken from a loss of electrical power, we could have as much as 25 minutes warning of a possible event.

Radiation decays very quickly. Ninety percent of the gamma radiation decays after the first 7 hours. Ninety percent of the remaining 10 percent decays after two days. In most areas, after two days, we could leave our expedient shelter and go quickly to our homes. However, if possible, we should stay sheltered for two full weeks. After two weeks there is only one, one thousandth of the gamma radiation remaining.

A home basement is not adequate protection in itself, even in areas of light fallout. However, shelter could be taken in the basement under a strong table. Two feet of books or other heavy

objects should be placed on and around the table. A hose could be attached to the water heater and run to the shelter for drinking water. A 5-gallon bucket with plastic bags could be used for sanitation. These options, however, must be initiated well before hand.

If caught away from your home and shelter, other options should be considered:

- Service Garages (Service pit area)
- Churches (Pipe chases from boiler rooms)
- Banks (Basement vault or safety deposit areas)
- Hospitals (Usually have massive basements and are well built. Some hospitals have underground tunnels between buildings)
- Residential homes (Look for basements with maximum soil coverage)
- Schools (Most schools have pipe chases and some have good basements)
- Mines (Stay well back from the entrance). Possible danger from gas, falling timber, rocks, or shafts
- Caves (Stay well back from entrances)
- Tunnels (Consider rail road, car and walking tunnels)
- Subways
- Culverts (Look for long runs under highways…possible danger from rats or water runoff)
- Boiler Rooms (In churches, schools, and other large buildings)
- Underpasses (There is good blast protection (10 psi) high up under over passes, however there is no radiation protection)
- Community swim pools or equipment rooms (Possible danger from chlorine gas which is often stored in pressurized containers)
- Armories (are usually well built)
- Fire Departments
- City and County Buildings (Many have underground tunnels between buildings)
- Underground parking garages (Provide both blast & radiation protection…there is danger that the upper floors may fall and trap you)
- Boats (Covered boats in a lake provide good radiation protection, but little blast protection…must have capability to wash fallout from cover)
- State or County E.O.Cs (Usually well built and well stocked)
- Root Cellars (Offers better radiation protection than blast protection)

3.16 Shelter Supplies:

Shelter supplies are based on individual needs. This is a list of supplies for your consideration. Think in terms of basic survival. In the event of a long-term power loss (such as from an EMP Weapon or full scale war), the United States could set us back to a 19th century existence. Remember, however, that we can come back quickly because we have a knowledge base on which to build.

If we are prepared, we can continue to live full and satisfying lives. If we are not, we will suffer grave consequences.

SHELTER SUPPLIES

Food per adult person

- 8 lbs salt
- 60 lbs milk (non-fat)
- 21 lbs Oil
- 65 lbs sugar
- 375 lbs grains (wheat, rice, corn, etc.)
- 60 lbs legumes (beans, peas, lentils, etc.)
- 365 tablets multi-vitamins (with minerals)
- Leavenings (3/4 lb yeast, 1 lb baking powder)
- Seasonings
- 1 kg. Vitamin C (only in the form of crystalline ascorbic acid)

(Provides 2600 calories, 100 grams protein, and 35 grams fat pper adult for one year)

Food Preparation

- Water Purification
- Knives & Can Openers
- Eating Utensils
- Hardy plates & cups
- Paper Towels
- Paper Plates & cups
- Plastic Bags
- Zip lock bags
- Alcohol cooking stove
- Pressure cooker
- Hunting Supplies

Water & Storage

- Plastic 55 & 30 gallon drums
- Store 55 gallons per person
- Liter soda pop bottles
- Water pump for 55-gallon drums
- Amish hand pump for deep wells if necessary
- Water filter
- Iodine crystals
- Bleach

Communications

- CB Radios
- HF Amateur Radio
- Purchase material for emergency antennae
- AM/FM transistor radio with D cells

Light
- Mini 12 volt lights
- Kerosene & Lamps
- LSD lights run with D cells
- Flashlights with extra bulbs
- Matches
- Candles

Heat
- Coal & wood-burning stove
- Coal (dig pit & cover with straw)
- Foam clothing & boots

Alternative Power
- 12-volt battery system (6-volt gel-cell or golf cart in series)
- Battery charger
- Diesel (500 gallons)
- Stabilizer for Diesel
- Cooking alcohol
- Generator, 2K Brushless Diesel
- Water generator (if near stream)
- Extra parts
- Solar Panels (stored and protected from EMP)
- Batteries, (D, AA, AAA),
- Rechargeable batteries with solar charger

Transportation
- Car constructed before 1969 (without computerized ignition)
- Bicycles, wagons, carts, motor bikes
- Learn to make fuel
- Consider keeping Llamas & goats (they eat anything & pack well)
- Snow-shoes & cross-country skis

Farming
- Tools (Shovels, Hoes, Rakes, Ax, Hatchet, etc.)
- Large rolls of plastic (to cover garden spot)
- Non-Hybrid Seeds
- Rabbits (for meat)
- Chickens (for meat & eggs)
- Goats (for milk)
- Hay and feed (stored under cover)

Clothing
- Underwear & socks

- Walking shoes
- Extra Shoe laces
- Irrigation boots
- Winter boots & coats
- Foam liners

Infant Care

- Milk / Formula
- Disposable diapers
- Cloth diapers & pins
- Plastic diaper cover
- Bottles / Nipples
- Clothing
- Odorless Diaper Pail

Shelter

- Underground with min. 8 ft. dirt cover
- Low water table
- Out of flood plain
- Angled entrances
- Arched ceiling

Toilet Facilities

- Everything needed to build an 'outhouse'
- Toilet seat
- Disinfectant
- Chemical Camping toilets
- Toilet tissue (lots)
- Feminine Supplies

Medicine

- Special Prescription medicines
- Reading glasses
- Extra prescription glasses
- Over the counter medicines
- TBA tablets
- First Aid Kit

Sanitation

- Toilet Paper
- Soap
- Toothbrush & Paste
- Garbage bags
- Chemical camping toilets

- Fly poison
- Wasp poison
- Sticky spider traps
- Mouse traps
- Buckets

Bedding

- Sleeping bags, pillows
- Air mattresses
- Mattress covers
- Foam mattress pads
- Cots, hammocks

Laundry Supplies

- Detergent (lots)
- Bleach
- Clothesline & pins
- Washtub & Scrubbing board

Cleaning Supplies

- Kitty Litter
- Cleaning Supplies & bucket
- Detergent
- Liquid Bleach
- Wash Tub & Scrub board

NBC

- Rain Coat, Shower Cap
- Disposable Chem/Bio Suit
- Gas Masks
- Radiation Meter, Dosimeters & Chargers

Library

- Scriptures
- Skill books (electrical, plumbing, building, etc.)
- Schoolbooks
- Paper & pencil
- Staples & staple gun
- Pencil sharpeners
- Old style typewriter with ribbon

Important papers

- Wills

- Genealogy
- Diaries
- Family pictures
- Pictures of home & content
- Birth Certificates, licenses, diplomas, ID
- Deeds

Carpentry Tools

- Assortment of nails, screws
- Tools assortment
- Heavy plastic
- Heavy-duty stapler & staples

Electrical Supplies

- Tools
- Assortment of wire
- Connectors, receptacles, etc.

Sewing Supplies

- Needles, scissors, thread
- Treadle sewing machine
- Duct tape

Home Site or Alternate Site

- Out of flood plain
- Not too wooded
- Garden area
- Small city, rural
- Near small stream
- Near large game
- Water table below 50 ft.
- West of major targets