FEMA 131/ June 1987
(Supersedes CPG 2-1A7 dated June 1973, which may not be used.)

ATTACK ENVIRONMENT MANUAL

Chapter 7

What the planner needs to know about the Shelter Environment

FEDERAL EMERGENCY
MANAGEMENT AGENCY

FOREWORD

WHAT THE EMERGENCY PLANNER NEEDS TO KNOW ABOUT THE NATURE OF NUCLEAR WAR

No one has gone through a nuclear war. This means there isn't any practical experience upon which to build. However, emergency management officials are responsible for preparing for the possibility of nuclear war. Intelligent preparations should be based on a good understanding of what operating conditions may be like in a war that has never occurred. If the planner lacks such understanding, the emergency operations plans produced probably won't make sense if they ever have to be used.

The Attack Environment Manual has been prepared to help the emergency planner understand what such a war could be like. It contains information gathered from over four decades of study of the effects of nuclear weapons and the feasibility of nuclear defense actions, numerous operational studies and exercises, nuclear test experience, and limited experience in wartime and peacetime disasters that approximate some of the operating situations that may be experienced in a nuclear attack. In short, it summarizes what is known about the nuclear attack environment as it could affect operational readiness at the local level.

The data on the effects of nuclear weapons used in this manual have been taken from the 1977 edition of "The Effects of Nuclear Weapons" (ENW), complied and edited by S. Glasstone and P. J. Dolan and prepared and published by the United States Department of Defense and the United States Department of Energy. Copies are available for purchase from the U.S. Government Printing Office. The ENW is the most widely available authoritative source of weapon effects and is in many public libraries across the country. For these reasons it was chosen as the source data in this manual.

This Attack Environment Manual supersedes CPG 2-1A1 through 2-1A9.

PREFACE TO CHAPTER 7

This discussion of the shelter environment is aimed at the emergency planner rather than the person who has shelter management experience or training. It is assumed that the reader is familiar with the attack environment information presented in the six preceding chapters.

Information is presented in the form of "panels" each consisting of a page of text and an associated sketch, photograph, chart, or other visual image. Each panel covers a topic. This preface is like a panel, with the list of topics in chapter 7 shown opposite. If the graphic portion is converted to slides or vugraphs, the chapter or any part can be used in an illustrated lecture or briefing, if so desired.

The chapter begins with an introductory panel, followed by a series describing the basic needs that must be satisfied (in addition to protection against weapon effects) if people are to survive in shelters for an extended period of time. It then turns to the kinds of shelters that might be available. Most prevalent are shelters in existing buildings, for which several panels discuss ways of satisfying the basic needs. Lifesaving actions under attack are described next, followed by a discussion of extended shelter living under fallout conditions. The chapter closes with some points on the role of trained leadership in the shelter environment. There is a list of suggested additional reading for those who are interested.

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CHAPTER 2 What the Planner Needs to Know about Blast and Shock

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THE SHELTER ENVIRONMENT

Shelter plays the central role in protecting people from the hostile environment created by a nuclear attack. This is true whether one is remote from the scene of nuclear detonations (fallout hazard) or nearby (all-effects hazard). Shelters, however, must do more than shield from weapons effects. They must provide a habitable environment from which the survivors can later emerge in good condition to deal with the postattack world. Moreover, if people are to use shelters when warned of attack, they must believe that shelters will protect and that shelters will be livable. In earlier chapters, the best available areas for protection from weapons effects have been identified. In this chapter, the environment in shelter will be described.

Some of the conditions to be expected in shelter are the result of physical characteristics. Some are due to the behavior of people. The physical and behavioral aspects are closely related. There is much shelter experience from past wars although few, if any, Americans have had this experience. Shelters have also been used in many natural disaster situations. In both wartime and disaster situations, sheltering has been necessary for only a few hours to a few days. Fallout (see chapter 6) presents a persistent threat that might require shelter for a few days to several weeks. The potential for prolonged occupancy introduces a new dimension that past wartime shelter experience does not address.

Thus, one of the first questions asked was whether American citizens (men, women, and children) could or would endure the confinement of a shelter for a period as long as 2 weeks. The answer obtained in early experiments was an empathic "Yes." In part, this response was due to the inclusion of creature comforts, such as bunks, prepared foods, furniture, good sanitary facilities, and the like. It was not until the mid-1960's that shelter-living experiments were made sufficiently austere and uncomfortable that a significant proportion of volunteers decided to leave during the experiment.

By 1968, nearly 7,000 volunteers had participated in over 22,000 people-days of shelter living in occupancy tests ranging from family size to over 1,000 people and for periods ranging from 1 to 14 days. The results have been used in training materials for shelter manager courses, during which an additional 90,000 have gained some shelter experience. In this chapter, we will summarize the important facts that the emergency planner should know and that should be communicated to local officials and the public.

SHELTER ENVIRONMENT

SCENE IN SHELTER EXPERIMENT IN
WHICH 722 MEN, WOMEN, AND CHILDREN PARTICIPATED

Reference 24

SPACE

An elemental requirement in shelters is mere physical space for human occupancy. The approximate volume of the adult human body is 2.3 cubic feet. In history, there have been described some cases of crowding for extended periods that have approached this space allocation. Most confined situations offer much greater space per person, as shown in this table.

Prison is a common peacetime form of confinement. The minimum space allotment recommended by the American Prison Association is 38.5 square feet and 287 cubic feet per prisoner. The table is headed by a crowded version of prison confinement. This crowded jail situation is almost twice as "roomy" as the U.S. standard shelter space allotment of 10 square feet and 65 cubic feet per person.

The U.S. shelter standard is spacious, however, compared to other (and particularly wartime) experience. European nations that have had such experience currently recommend one-half square meter (about 5.4 square feet) as a minimum and have conducted occupancy tests at this allotment. World War II experience in shelter and prisoner-of-war camps was even more confining.

An implication for emergency planning is that the recommended shelter space allotment of 10 square feet of useable space per person is a desirable goal but not a practical minimum. Reduced space allotments up to one-half the standard are practical where suitable shelter space is inadequate to serve the population.

AVAILABLE SPACE IN SELECTED SITUATIONS

Situation	Area per Person (sq. ft.)	Volume per Person (cu. ft.)
Crowded jail (two inmates in one-person cell)	19.2	145
Railroad coach (60 seated passengers)	12.0	96
100-person, 2 week-Shelter Experiment, NRDL* 1959	12.0	117
U.S. shelter standard	10.0	65
30-person, 2-week Shelter Experiment, AIR** 1960	8.0	58
Civil war prison	8.0	40
Local bus filled to seating capacity only	6.3	42
160-person, 2-day Shelter Experiment, U. of GA 1966	6.0	60
West German 5-day shelter experiment	5.5	--
Swedish recommended shelter minimum	5.4	--
London WW II shelter sleeping 200 people	4.0	30
Belsen concentration camp barracks WW II	3.0	22
Black Hole of Calcutta	1.7	22

*U.S. Naval Radiological Defense Laboratory, San Francisco, CA.

**American Institute for Research, Pittsburgh, PA.

PANEL 2

AIR

Air quality in shelters is a matter of basic concern. The importance of oxygen content for breathing is well known. Fresh air contains about 21 percent oxygen. For healthy young adults, no noticeable or harmful effects occur if the oxygen content drops as low as 14 percent. At 10 percent, people experience dizziness, shortness of breath, deeper and more rapid respiration, and quickened pulse. At 7 percent, stupor sets in and about 5 percent oxygen is the minimum concentration compatible with life. However, only a small amount of fresh air is needed to keep the oxygen concentration in the safe region. For example, 0.4 cubic feet of fresh air per minute per person will maintain the oxygen concentration at 17 percent. If each person is allocated 65 cubic feet of volume (the U.S. standard), one air change in the shelter ever 2 and ½ hours would be sufficient.

A more serious problem is the increase in carbon dioxide concentration. Each person, on the average, exhales about two-thirds of a cubic foot of carbon dioxide every hour while at rest. If ventilation is inadequate, the carbon dioxide can increase markedly over the 0.04 percent present in fresh air. The consequences of higher concentrations are shown in this table.

Many years ago, 3 percent carbon dioxide was considered a permissible limit. However, experience on submarines and experiments under prolonged exposure have indicated the desirability of keeping the carbon dioxide concentration below 1 percent. For civil defense purposes, the goal has been to limit the buildup of carbon dioxide in shelters to not more than 0.5 percent of inhaled air. This limit requires about 3 cubic feet of fresh air per minute per person. Again, if each person is allocated 65 cubic feet of air space, this would require a change of air every 22 minutes. In other words, the mount of fresh air needed to limit the carbon dioxide concentration will also keep the oxygen supply at normal levels.

An alternative to supplying sufficient fresh air is to provide other means for assuring air quality, such as bottled oxygen and materials for removing the excess carbon dioxide from the air. Such means, which are used on submarines, spacecraft, and the like, are quite costly. Ventilation with fresh air will be the usual practice in shelters. No special filters are necessary to exclude fallout as the particles are too large to be inhaled or to be drawn in and deposited in sufficient quantity to alter the fallout protection afforded by the shelter area. The regular filters normally used in building ventilation are adequate to protect the ventilation equipment.

EFFECT OF CARBON DIOXIDE*

(Oxygen Content Normal)

Carbon Dioxide Content of Inhaled Air (percent)	Effects
0.04	Normal air; no effects.
2.0	Breathing deeper, volume increased 30 percent.
4.0	Breathing much deeper; rate quickened; considerable discomfort.
4.5 – 5	Breathing extremely labored; almost unbearable for many; nausea may occur.
7 – 9	Limit of tolerance.
10 – 11	Inability to coordinate; unconsciousness in 10 minutes.
15 – 30	Diminished respiration; fall of blood pressure; coma; gradual death after some hours.

* From Reference 35

PANEL 3

TEMPERATURE CONTROL

In addition to using up oxygen and exhaling carbon dioxide, each shelter occupant give off heat--averaging about 500 BTU per hour. (A BTU [British Thermal Unit] is the amount of heat necessary to raise the temperature of a pound of water 1 degree Fahrenheit.) Several hundred people congregated in a shelter produce the heat output of the heating system of an average home.

Part of the heat given off by the body is "sensible" heat--warmth as would be measured by a thermometer. Part is water vapor or evaporated moisture. This is call "latent" heat in that sensible heat is produced only when the water vapor condenses on a cool surface. Actually, a person's sensation of heat or cold is related not only to the air temperature, as measured by a thermometer, but also to air moisture (humidity) and air movement. As long as the air temperature is well below skin temperature, the body can radiate heat to maintain normal temperature. At higher temperatures, the body must rely on evaporative cooling by perspiration. If the air is humid and air movement low, evaporative cooing loses its effectiveness, and the body temperature will rise. The upper limit of body temperature for survival is 108° F. For example, the loss of life in the Black Hole of Calcutta incident (panel 2) was not caused by lack of space but by overheating.

The most widely used measure of the effects of heat and moisture on the human body is "effective temperature." It combines the effects of air temperature, air moisture, and air movement to yield equal sensations of warmth or cold and approximately equal amounts of heat strain. The effects on people of temperature and humidity conditions represented by effective temperature (ET) are shown in the table.

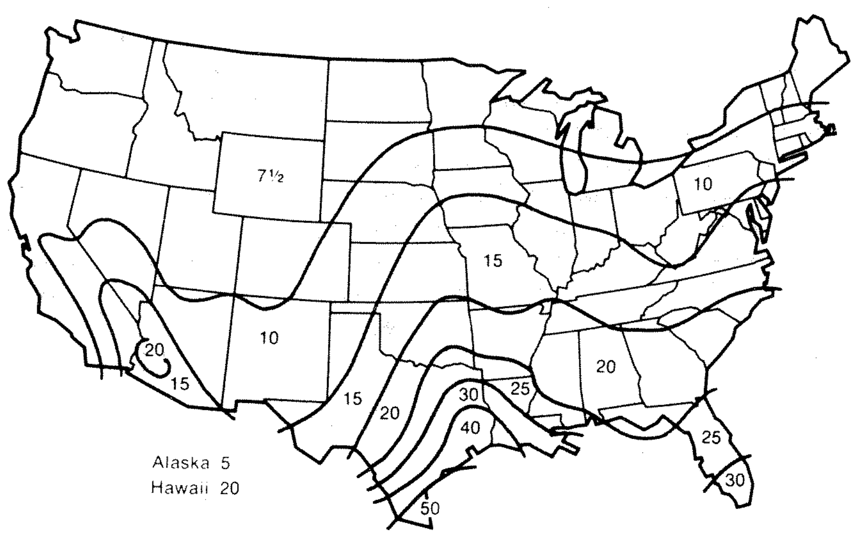
The numerical value of ET is the reading on an ordinary thermometer when the air is completely saturated with moisture (100% relative humidity). At lesser humidities, the thermometer reading would be higher than the equivalent effective temperature. For a relative humidity of more than 50 percent, which is a common summertime climatic condition, an effective temperature of 82 degrees would correspond to air temperatures in the mid-90's. An effective temperature of 82 degrees approximates the condition under which the Federal government sends people home who work in unair-conditioned offices. It is also the design limit established for the shelter environment.

Even where buildings offering shelter protection are air-conditioned, prospective crowding of people and probable lack of electric power indicate that temperature and humidity control must be accomplished by ventilation with fresh air. The map shown here defines the zones of required ventilation (in cubic feet per minute per person) to provide 90 percent reliability of maintaining the shelter effective temperature at 82 degrees or less. It can be seen that the required ventilation rates are all greater than the 3 cubic feet per minute per person needed to control the buildup of carbon dioxide.

EFFECTS OF HEAT AND HUMIDITY
(for low air movement)

Effective Temperature	Sensation	Reaction	Consequences
50-60	Uncomfortably cold	Shivering	Muscular pain; impairment of circulation
60-70	Cool	Urge for more clothing or exercise	Normal health
70-75	Comfortable	Normal heat regulation	Normal health
75-82	Warm	Regulation by sweating	Normal health
82-85	Uncomfortably hot	Increasing stress and dehydration	Cardio-vascular strain
85-90	Very uncomfortable; Very hot	Increasing stress	Danger of heat stroke
90-95	Limited tolerance	Failure of regulation; body heating	Circulatory collapse

ZONES OF REQUIRED VENTILATION RATES
IN CFM PER PERSON FOR 90% ANNUAL PROBABILITY
OF NOT EXCEEDING 82° ET



WATER

If people are to be confined in shelter more than a few days, drinking water is an essential requirement. Water is a major component of the body, accounting for about 60 percent of a person's weight. But water is by no means a static component; it moves in and out of the body at the rate of more than 5 pounds a day normally. It is the fluid vehicle for body waste, which is filtered from the blood by the kidney. Water is also evaporated from the skin as a means of regulating body heat.

When water intake is restricted or negligible, the bodies of healthy people compensate by reducing the amount of urine excretion by about half, from about 3 pounds (pints) in adults to about 1 ½ pounds. Unless people are required to perspire to lose body heat, about 1 quart of water suffices to maintain the water balance. If the shelter temperature is warm, however, the amount of water needed to avoid dehydration increases rapidly, as shown in the chart. This is another reason to be concerned about temperature control in shelters.

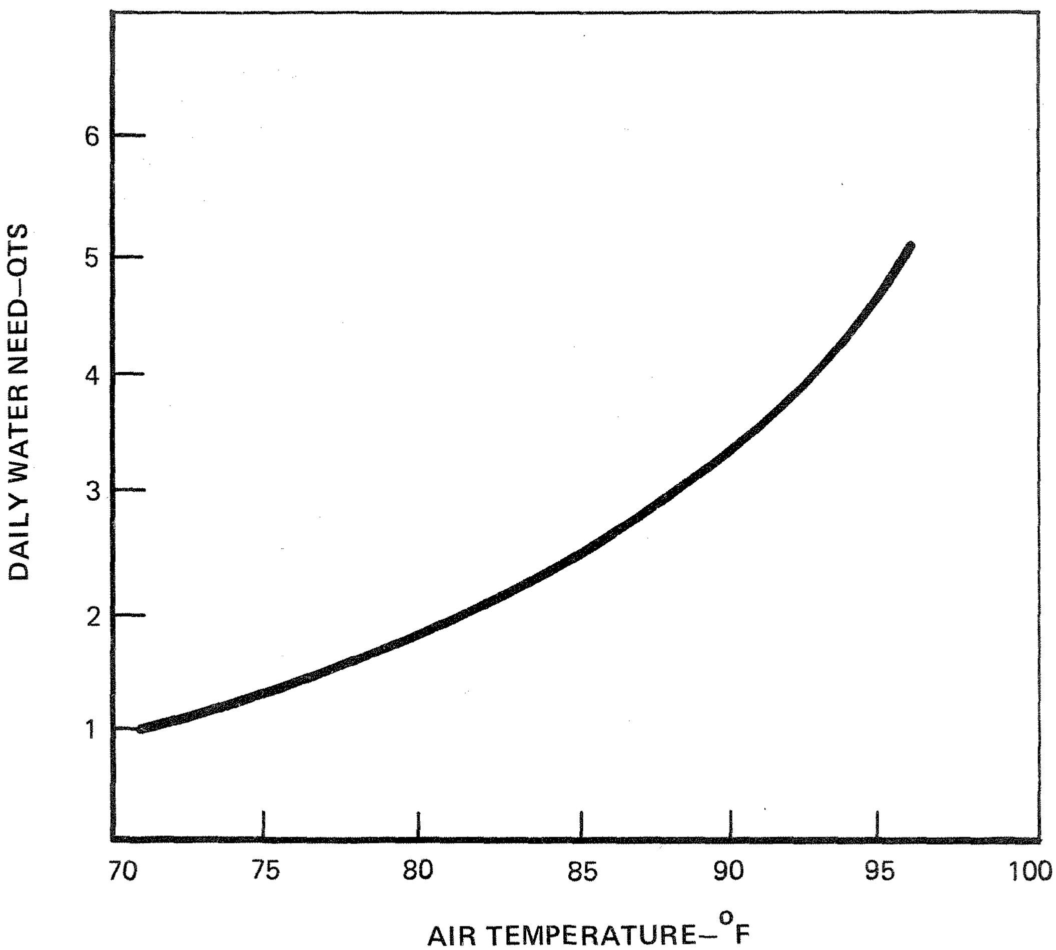
Water deficiency begins to cause trouble as soon as 1 or 2 percent of the body weight is lost. Thirst, the earliest symptom, is followed by behavioral changes--a sense of oppression, impatience, and emotional instability, and, in some, weariness and apathy. Severe symptoms such as heat exhaustion, headache, labored breathing, and increasing weakness occur when 6 to 10 percent of body weight has been lost. Delirium and death result from greater dehydration.

Experiments have shown that the consequences of dehydration vary widely among individuals, with the very young, very old, and ill being especially vulnerable. Pregnant women, for example, require more water than usual and must avoid dehydration if injury to the unborn child is to be avoided. Experiments also have shown that there is nothing to be gained by stretching out an inadequate water supply to cover a presumed shelter stay. Health is best maintained by delaying any dehydration as long as possible. Therefore, water management in shelters <u>should be aimed at ensuring adequate intake and preventing waste rather than at rationing the available supply</u>, particularly since there is not way to determine a "fair share" for each man, woman, and child except by satisfying thirst.

Water for washing has been shown to be an amenity and not a necessity, even for extended shelter stays.

MINIMUM WATER REQUIRED FOR NEGLIGIBLE DEHYDRATION

(APPROXIMATE AVERAGE FOR MEN, WOMEN, and CHILDREN)



PANEL 5

SLEEP

Sleep is essential to the well-being of people confined for more than a day or two. Indeed, sleeping is a favorite way to pass the time. And, fortunately, most people are able to nap or sleep under the most austere circumstances.

Early shelter occupancy experiments were conducted when shelters were largely thought of as structures that were to be built for that purpose. It was clearly important from a cost standpoint to get as many sleeping spaces into a shelter as possible. This consideration led to provision for tiered bunks, demountable ones in most instances, so that all the available space might be used to the maximum for both day and night activities.

When emphasis shifted to dual-use shelters, largely in existing buildings, sleeping on the floor became the most likely situation. The standard shelter space of 10 square feet per person approximates the space required by the recumbent adult person. The shelter function requiring the greatest amount of floor space is sleep. Many experiments have now been conducted successfully in which people sleep upon the floor. Sleeping on a bare concrete floor has been found feasible but uncomfortable. A major improvement occurs when carpeting exists or when fiberboard box material is laid down. Blankets or outer clothing brought in by the shelterees also can be used as sleeping pads. Even so, sleeping difficulty usually has ranked high on the "discomfort index."

The most compact and hygienic sleeping arrangement is head-to-foot sleeping as shown in this photograph. A recommended practice is to locate single men on one side of the shelter and single women on the other, with the family groups in between.

Noise is a shelter characteristic that is closely related to sleeping difficulty. Noise levels during waking hours in shelter experiments have been found to range from 50 to 85 decibels; that is, from the noise level associated with a business office to that inside an automobile. The psychological pressure of noise is such that shelterees welcome occasional "quiet periods" during the day. Therefore, if only a single open space is available, all people should observe the same sleeping hours. When separate rooms are included in the same shelter area, shift sleeping can be considered. This usually results in more individual sleeping space and less crowded areas for nonsleeping activities.

HEAD-TO-FOOT SLEEPING

(NOTE USE OF FIBERBOARD FOR SLEEPING PAD.)

HEALTH AND SANITATION

The medical problems in a shelter are: (1) the chronic illnesses, such as diabetes or heart ailments, with which some proportion of the population is afflicted; (2) the possible spread of communicable diseases, respiratory infections, and other illnesses; and (3) the injuries and illnesses that may be caused by the attack environment.

Natural disaster experience has demonstrated that many chronically ill persons, who are dependent on continued specialized medication, enter shelters established for evacuated flood or hurricane victims without these essential medical supplies. In natural disasters, alternative sources are usually available, but in the nuclear attack situation, the lack of on-hand drugs could have serious consequences. Educational materials for the public should emphasize the importance of brining such supplies to the shelter and plans should be made for crisis information to reinforce this need.

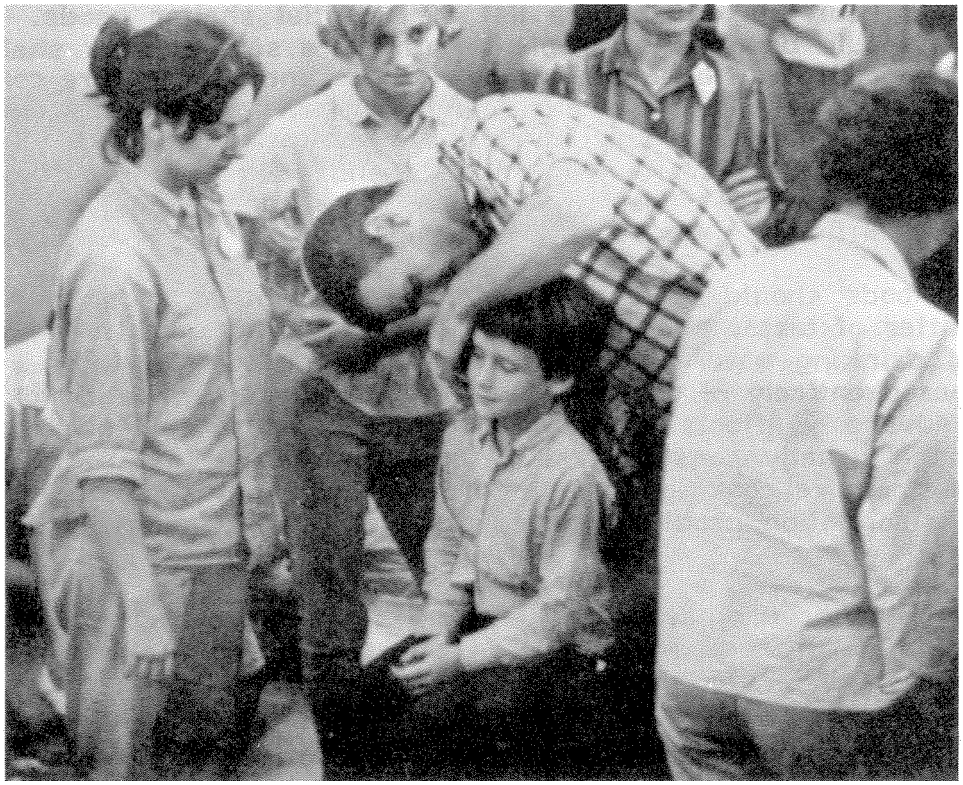
Minimizing the spread of disease or infection requires constant attention to sanitation measures, cleanliness of toilet areas, careful handling of water and food, and establishment of an isolation area for persons who are ill. These are management problems. In addition, minimal medical supplies to treat headaches, respiratory symptoms, and waste elimination difficulties should be available. It would be ideal if every shelter had a doctor or nurse assigned to it; and, to the extent possible, emergency plans should attempt such assignments.

Minimal sanitary arrangements are necessary in a shelter. At the very least, some sort of toilet facility must be available. If continued operation of conventional flush toilets cannot be assured, containers for collecting and storing human wastes must be provided. As a rough rule of thumb, waste storage capacity must be able to handle about 1/2 gallon of sewage per person per day.

In many shelter occupancy tests, no water was provided for washing. While bathing is not a necessity, the lack of water for personal hygiene has invariably ranked No. 1 or No. 2 in the list of shelter discomforts. Moreover, some provisions of this sort are essential for food handling and sanitation.

Another aspect of shelter living that ranks high on the "discomfort index" is dirt. Substantial amounts of litter and trash tend to accumulate in a crowded shelter. Lack of janitorial supplies can contribute significantly to this sanitation problem.

Prospective shelterees anticipate that odors would cause great discomfort. Yet odors have never ranked very high among the discomforts. The reason is that the olfactory organs quickly become dulled and the odors are not noticed except by persons entering the shelter from the fresh air. One exception is stale tobacco smoke, which is unpleasant even to smokers.



MEDICAL CARE

SICK CALL IN A SHLETER OCCUPANY TEST

FOOD

Food is near the end of the list of essential shelter needs. Healthy individuals should be physically able to survive a several-week shelter stay without any food given adequate water supplies and temperature conditions. If shelterees are expected to participate in postshelter recover operations, however, they will require food during the confinement period. Moreover, food has tremendous emotional significance and failure to provide what is commonly perceived as a basic need can make the keeping of people in shelter very difficult.

What foods should be provided in, or brought to, a shelter is more than a matter of taste. Foods high in protein and fat greatly increase the amount of drinking water required to eliminate wastes. At the same time a diet composed entirely of carbohydrates is undesirable. Heating or cooking of foods adversely affects temperature control, requires an assured source of heat, and usually constitutes a potential hazard in a crowded shelter. Food that require cooking or eating utensils or that produce garbage or trash offer sanitation problems unless disposal facilities exist in the shelter area.

The unlikelihood of prepositioned food supplies in most public shelters necessitates the procurement of food from local sources. Determination of the types of food to stock in shelters will be dependent on what is locally available. Increased readiness planning for food stocking should take into account the points discussed above. Perishables are not recommended. If brought to the shelter, they should be consumed first. The most desirable way to stock is with crackers and canned goods, which are easy to transport, store, and prepare, as well as whole-grain cereal products and dried fruits. Augmentation by food products that are mostly liquid is desirable, provided plastic containers are chosen. Broken glass is a hazard in crowded shelters. If glass containers are used, people should be warned to handle them with care.

Shelter occupants should be encouraged to bring ready-to-eat food from home to supplement any supplies that may have been stocked.

Suitable Shelter Rations

LIGHTING

Some lighting is essential for effective shelter operations. Providing light is assuming greater importance in view of the increased emphasis on use of basement areas and the recognition that attack effects, such as EMP (chapter 4), make widespread loss of commercial electric power a possibility.

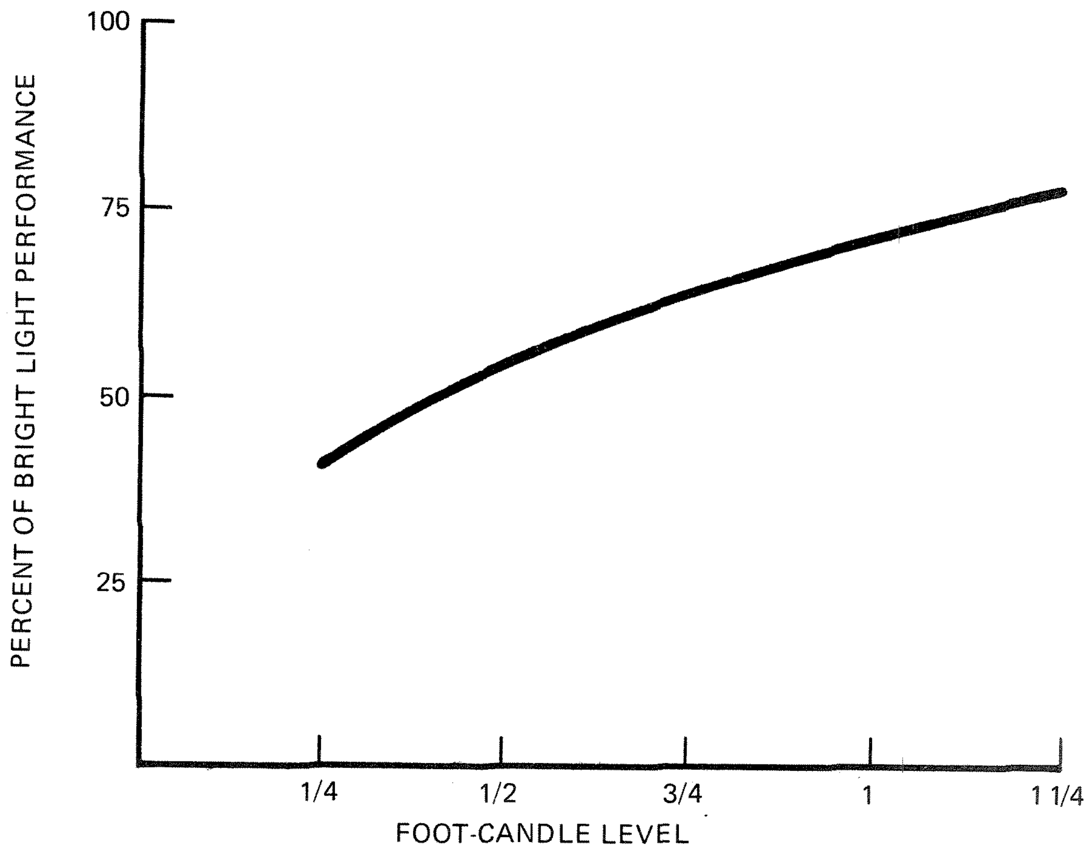
General lighting should provide a sufficient level of illumination for movement about the shelter and performance of shelter tasks. A higher level of illumination may be necessary for special functions, such as medical treatment, reading instructions, and equipment maintenance. The measure of illumination is the foot-candle. Recommended emergency lighting levels range from 2 foot-candles in sleeping areas to 5 foot-candles for general lighting to 20 foot-candles for medical treatment and equipment maintenance.

Shelter experiments have been performed, however, at very much lower lighting levels. Tests of visual acuity and performance tests, such as needle threading; nut, washer, and bolt assembling; and newspaper reading, showed that ordinary tasks, such as food preparation, reading, and sewing, could be performed at lighting levels as low as 1/4 foot candle. Depth perception was one faculty most reduced by low levels of light. Shown here is the average performance under low-light conditions as compared with performance in bright (45 foot-candles) light.

One example of low illumination levels commonly encountered is moon-light, which provides about 0.02 foot-candle. A dark motion picture theater provides about 0.2 foot-candle while the picture is being shown. A well-lighted business street provided about 2.5 foot-candles.

One shelter test involving 15 people has been conducted without any light whatsoever. The volunteers realized that they would be spending a 24-hour period in total darkness and apparently adjusted very well. None requested to leave before completion of the experiment. Food and water preparation was done quite adequately by inexperienced people although they often needed "hints" from more experienced members of the group. The shelterees, expecting darkness, found shelter existence in the dark to be less uncomfortable than they had anticipated. Entering the dark shelter initially was the most upsetting experience. Light of some kind would seem desirable upon entering the shelter and during the initial setting up of shelter supplies, particularly in the absence of training leadership.

AVERAGE PERFORMANCE UNDER LOW LEVELS OF LIGHTING
(compared to 45 foot-candle level)



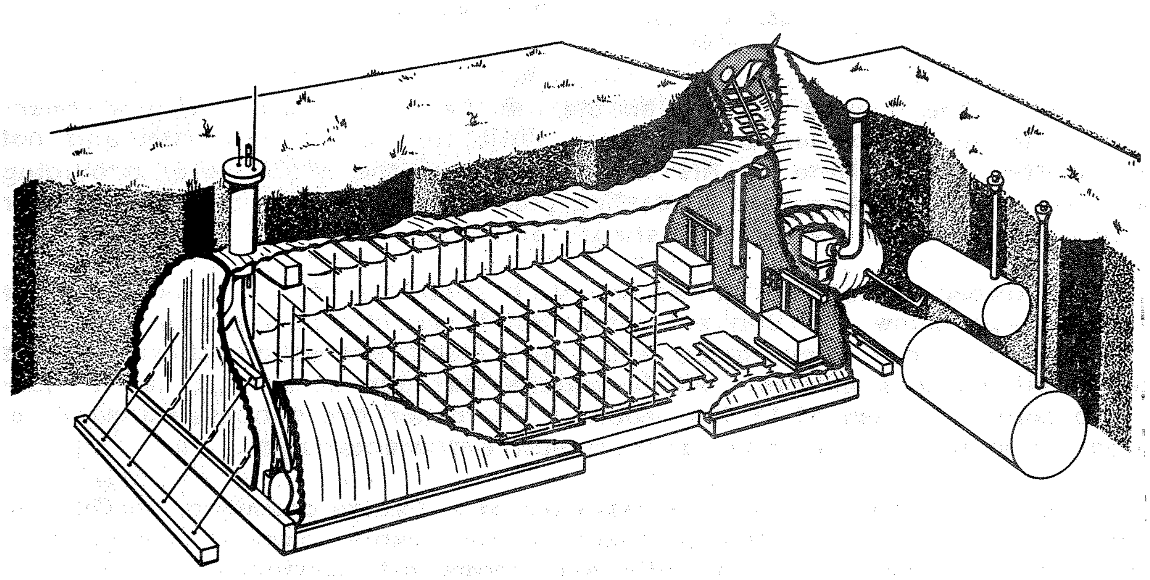
SINGLE-PURPOSE SHELTERS

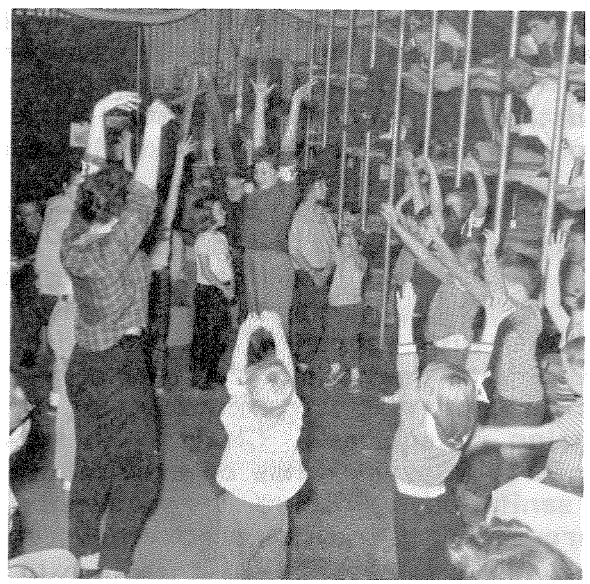
If shelters are built for the purpose, it is relatively easy to provide not only protection against attack effects but also the essential elements of a habitable shelter environment. Many such single-purpose shelters have been designed, and a few have been built and tested. The designs cover a variety of sizes, construction materials, and degrees of protection.

One example of a single-purpose shelter is shown here. It uses a corrugated-steel-arch building buried below ground. Space is available for at least 100 persons. Buried tanks along side the shelter provide an ample water supply and a fuel supply for the emergency generator, which provides an assured power supply for ventilation and lighting. Tank-type toilet facilities are provided at the rear of the shelter area near the combination air exhaust and emergency escape hatch. Demountable stretcher-type bunks are provided for the whole shelter population, as well as tables and benches in the food preparation area. The photograph shows the shelter occupied by 100 men, women, and children. The shelterees have decided to leave half the bunks in place during the daytime.

Although a number of single-purpose shelters have been constructed for operational use as emergency control centers, almost none have been constructed to shelter the population. Most emergency planners will need to rely on protection provided by structures built for some peacetime purpose. Where such space is insufficient, plans must be laid to upgrade the inherent protection of existing structures or to construct "expedient" shelters during a crisis period.

A SINGLE-PURPOSE SHELTER





DUAL-USE SHELTER SPACE

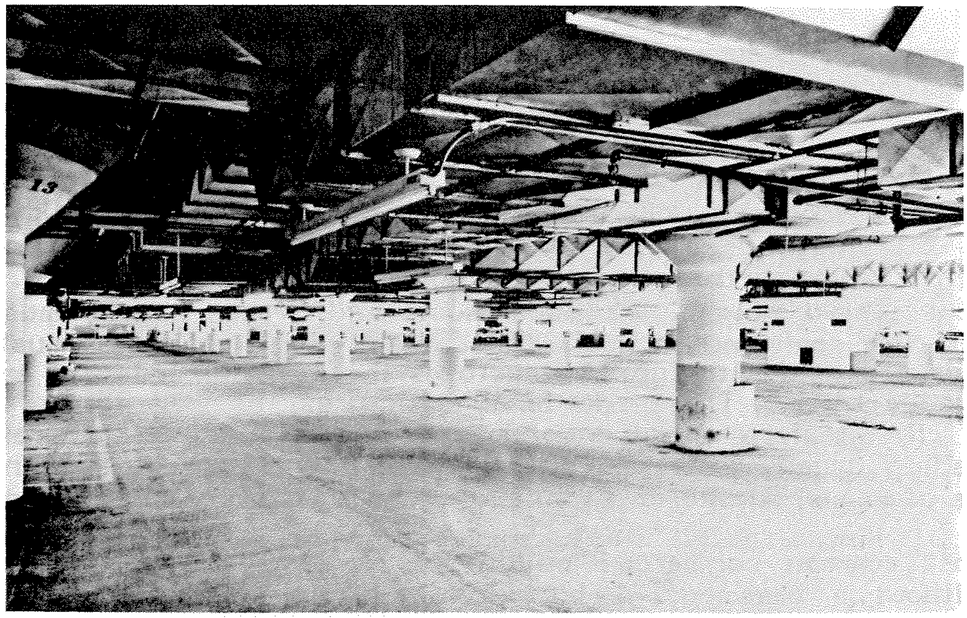
Most of the shelter space available for the consideration of local emergency planners is located in buildings built for normal purposes and not with shelter use in mind. This fact complicates the problems of providing the essential needs described in earlier panels. For one thing, this shelter space comes in a wide variety of shapes and sizes.

The upper photograph shows on such shelter area. It is one of three subbasements below the Denver Hilton Hotel serving as a parking garage. It is a very large open space with very good protection characteristics against all weapons effects. At 10 square feet per person, it has a capacity to hold in excess of 12,000 people. The other two subbasements are of similar construction, capacity, and protective characteristics.

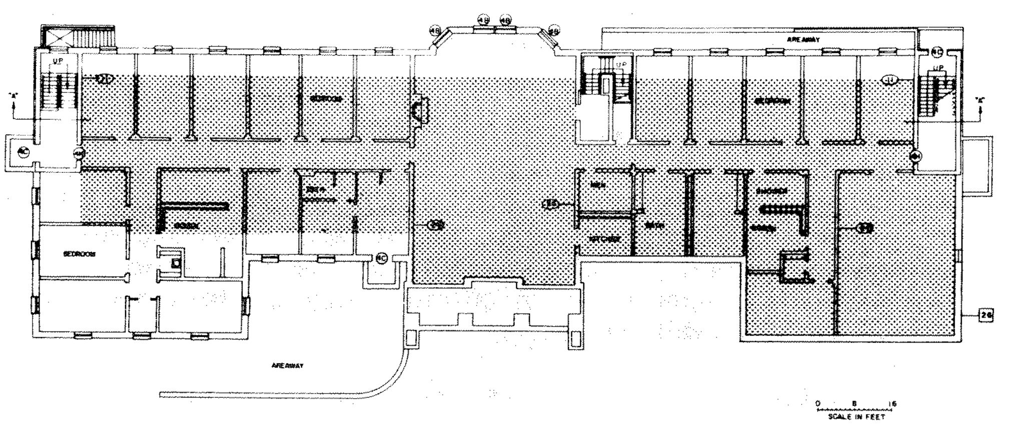
The lower sketch shows the basement of a college dormitory in Greensboro, North Carolina. Although there is one sizable common room, most of the space is broken up into individual rooms off corridors. Because of the areaways and exposed basement walls with windows, not all of the basement provides good fallout protection. The area offering at least PF 40, according to the shelter survey, is shown as shaded area. These boundaries will not be marked in the building but, as we saw in chapter 6, this is unlikely to be important since the best-protected parts should be determined by a radiation detection instrument, if fallout actually occurs. Based on the survey, however, protected space is available for 800 persons.

It has been found that the wide variety of shelter spaces in the NFS inventory fall into a limited number of categories. They are: (1) the basic single room, of which the Denver Hilton garage is an example; (2) a large area with small adjoining rooms; (3) areas partitioned into rooms of comparable size; (4) corridors with rooms off the corridor; and (5) corridors joining two large areas with rooms off the corridors. Finally, there are those of complex configuration with large numbers of rooms that form combinations of the foregoing categories. Clearly, these configurations offer both problems and opportunities in terms of providing air and temperature control, water and sanitation, sleeping arrangements and noise control, health and medical care, feeding and other activities, and lighting.

The use to which the space is put in peacetime is another important consideration. Depending on circumstances, the Denver Hilton garage is filled to greater or lesser degree with automobiles. The Bennett College dormitory basement contains bedroom and sitting room furniture there. Other occupancies will have office furniture, merchandise, or stored supplies. Many of these items will find a shelter use. Others will interfere with use of the protected spaces as a shelter.



A VIEW OF THE SECOND BASEMENT OF THE DENVER HILTON GARAGE



A COLLEGE DORMITORY BASEMENT

UPGRADED SHELTER

Where good shelter is in short supply, as is often the case, protection can be upgraded by adding more mass or more strength or both. Upgrading existing buildings to provide a high degree of fallout protection is accomplished by piling earth against the exposed walls and on the roof. To support the increased weight, additional posts and braces usually must be placed under the roof and against walls. Windows and doors must be boarded up or provided with tunnel structures through the mound of earth, which is called a berm. These additional structures, as well as the berm itself, often will interfere with the normal use of the building. Therefore, fallout upgrading usually is treated as an emergency measure to be undertaken in time of crisis, similar to sandbagging to protect against a flood.

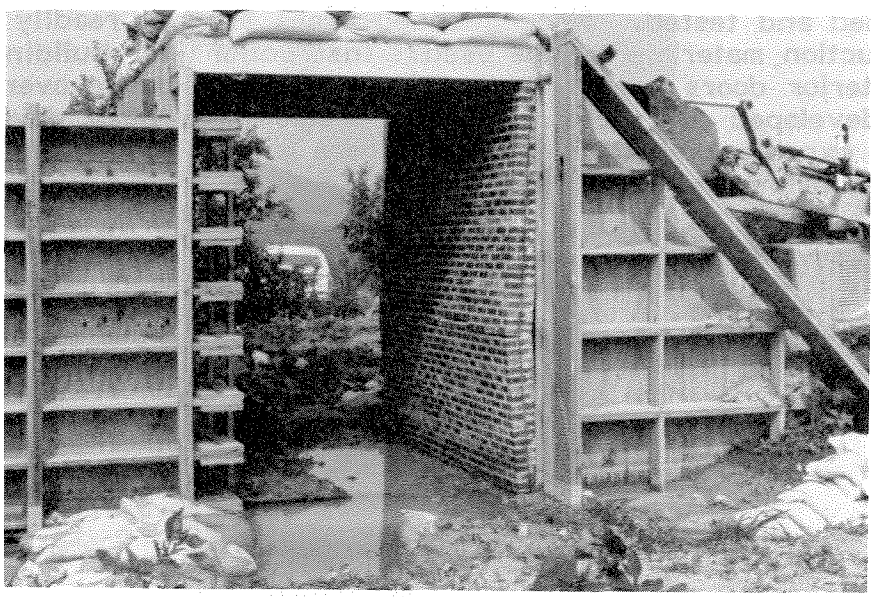
The most common commercial building is a single-story, flat-roofed structure without a basement. This kind of building offers very little fallout protection as it stands but is among the easiest to upgrade in a crisis. Single-story residences built on a concrete slab offer similar opportunities. Shown in the upper photograph is a view of the experimental upgrading of an ordinary ranch-style home to provide fallout protection not only for the occupants but for the neighbors as well. In this experiment, no interior supports were used nor were they needed. Entrance was through a kitchen door. As completed, the upgraded house would have provided shelter for 80 people at 10 square feet per person.

The lower photograph illustrates the type of wall failure that can occur due to the berm loading. In this experiment, earth was piled against a test section of an 8 inch brick wall. The wall, 10 feet high, is representative of some manufacturing facilities or perhaps a supermarket. In this case failure occurred when the berm reached a height of 7 feet. Clearly such walls require internal support. Such support can be furnished either by installing diagonal timer supports or by piling earth on the inside of the wall to perhaps one-half the wall height.

As noted in chapter 2, the basement areas of many larger buildings could be upgraded to provide improved protection against the direct effects of nuclear weapons as well. Timber posts can be used to provide increased strength to the reinforced concrete slab over the basement. The most difficult task is to provide blast resistant entrance doors and ventilation closures. Research is continuing on means to upgrade building basements to protect against all nuclear weapons effects.

Source: Reference 27

Upgrading of a typical ranch style house



Source T. Carroll Associates

Failure of a brick wall due to berm loading

PANEL 12

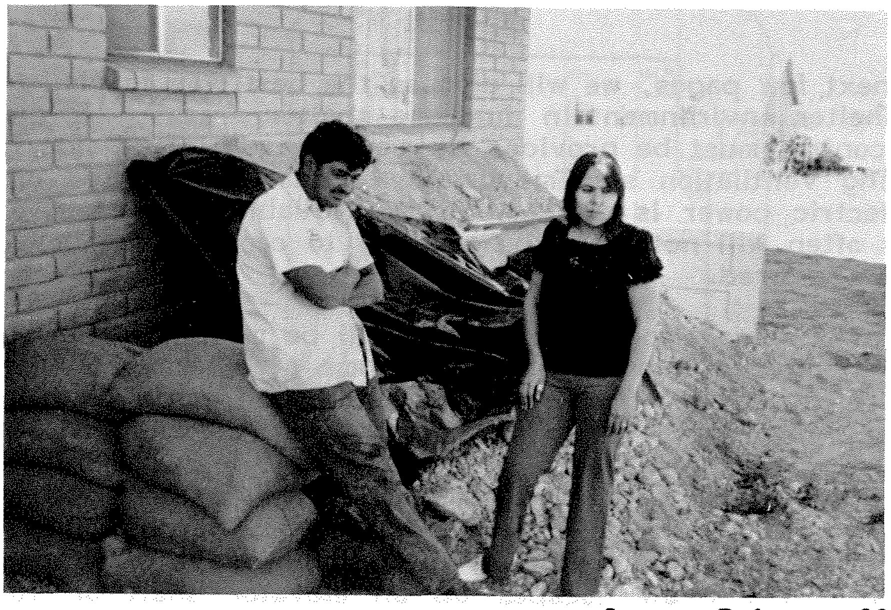
EXPEDIENT SHELTERS

Where upgradable buildings are insufficient for the population, plans can be made to create good shelter during a crisis period. Single-purpose shelters of this type are called "expedient shelters." They are necessarily crude since they must be constructed of whatever is readily at hand. They can, however, be designed as a shelter, and most offer substantial direct-effects protection as well as fallout protection.

The upper photograph shows a lean to type of fallout shelter built by the couple with 17 work-hours of effort. The shelter was constructed by tilting interior doors against the side of the house and covering them with earth.

The lower photograph shows the interior of a larger 30-person shelter built with about 100 work-hours of effort, aided by power excavating equipment widely available in rural areas. The design uses logs and scrap lumber. Air comes in the entranceway and exhausts through a small wooden ventilating box located above the girl lying on the upper bunk. Water is provided in a water barrel. A covered pail serves as a toilet. Food and other essential supplies are brought to the shelter by the people who will use it.

Instructions to permit untrained people to build these shelters have been developed and tested. Where wooded areas are not readily available, other construction materials can be used. Instructions for building shelters using the interior doors from houses or using an automobile over a trench have been developed and tested. Designs also have been developed for aboveground expedient shelters for use where a high water table or rock would prevent belowground construction.



Source: Reference 29

Expedient lean-to shelter

Source: Reference 28

Expedient lumber and log shelter

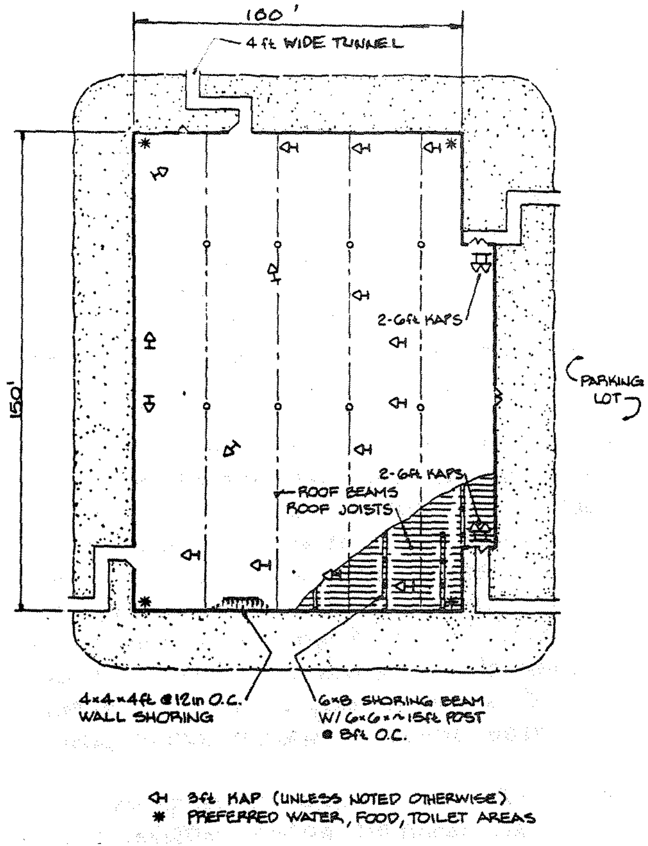
VENTILATION

In the next few pages, we will discuss the best way to plan to provide a habitable shelter environment in dual-use shelter areas. Air quality and temperature control must be provided by ventilation with outside fresh air. Normal building ventilation systems usually cannot be counted on because commercial electric power is unlikely to be available (see chapter 4), and such systems often will not have the capacity to cool the number of people that might be sheltered.

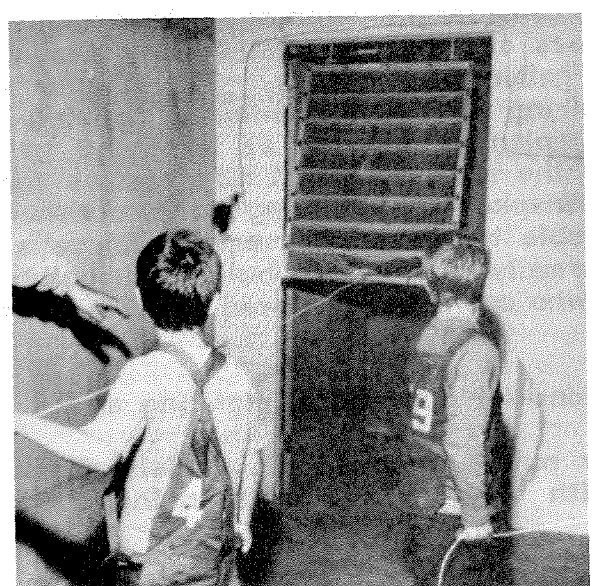
As we have seen, temperature control will be most important in crowded shelters during the summer. In wintertime or where shelter areas are not crowded, 3 cubic feet per minute per person of fresh air will be needed to prevent buildup of carbon dioxide. We believe that "natural ventilation" will be adequate in aboveground shelter areas if a sufficient number of windows are opened. Natural ventilation occurs because of wind forces and also because warm air tends to rise. In basements, ventilation is improved if cooler air can be allowed to flow in through doorways or windows at one end while warm shelter air escapes up an elevator shaft or stairwell to higher windows at the other end. Often, however, natural ventilation will be insufficient to maintain a habitable environment.

The upgrading plan for a supermarket shown in the upper sketch is an example where natural ventilation will not suffice to provide fresh air for the 700 people who could be sheltered. The best solution is to provide an emergency power generator and fuel supply sufficient to operate either the store's normal ventilation system or a number of floor- or pedestal-based 20-inch ventilation fans brought in for the purpose. Some markets already have emergency generators to preserve their frozen foods in event of a power outage. Nationwide, about one-quarter of government and industrial buildings have emergency power. Portable engine-generators used by construction contractors usually are sufficiently powerful to provide ventilation and lighting for a building sheltering no more than 1,000 persons. Plans, however, must specify the source of the fans and generators for each shelter in a crisis.

If the shelter lacks electric power, ventilation can be provided by a simple air pump developed by C. H. Kearny. Such pumps can be constructed from locally available materials by volunteers during a crisis. The lower photograph shows one version of the Kearny air pump (KAP) being used in a shelter occupancy test. The upper sketch shows the planned placement of KAP's at the entrances and at various points in the shelter area. The KAP consists of a wooden frame covered with wire netting on which overlapping horizontal strips of plastic are attached at their upper edges. Hung in a doorway or on a stand and set swinging by pulling on a long cord, the plastic flaps press against the netting when swung in one direction, pushing the air like a fan. On the back swing, the flaps open up so that air is pumped in only one direction.



UPGRADING SKETCH FOR A SUPERMARKET



KEARNEY AIR PUMP HUNG IN DOORWAY OF SHELTER ROOM

PANEL 14

WATER SUPPLY

An assured water supply is very important if the shelter is to be occupied for an extended period. In winter weather or in an uncrowded shelter, 3.5 gallons per person will last for a 2-week period. In hot weather, this amount may be sufficient for as little as 3 days, according to the information in panel 5. Moreover, an abundance of drinking water can compensate for many deficiencies in temperature control. Therefore, plan to provide as much water as possible.

If a shelter building has its own well, availability of an emergency engine-generator with ample fuel can assure an abundance of water. Most buildings to be used as shelter are served by the local water company. In areas potentially subject to blast effects, continued water service should not be expected because breaks anywhere in the system may cause loss of pressure. Outside of urbanized areas, however, water pressure in smaller cities and towns usually is provided by elevated tanks of ample capacity. The emergency planner should consul with the operators of the local water service to determine if an assured, abundant water supply is in prospect despite the potential widespread loss of electric power.

In blast-prone areas and where water pressure is dependent on electric power, providing an assured water supply is largely a container problem. Many years ago, the Federal Government provided metal water drums for water storage such as those seen along the shelter wall in the photograph. Few, if any, remain in shelter stocks. Today, there are a number of crisis options to consider in planning. Plastic and metal trash cans with plastic bags as liners are suitable and readily available. So are 1-gallon plastic jugs and 5-gallon plastic cans. The planner's task is to establish the means of acquiring sufficient containers during a crisis period. To minimize the need, plan to provide at least 3.5 gallons for each person expected to occupy the shelter, which may be less than the maximum shelter capacity, and inspect the building to establish the amount of stored water already available to the shelter area. Surveys have found that the amount of water normally stored in a building usually is insufficient for the numbers of people who could be sheltered, but the water available could be significant.

Other implications for operational planning are:

(1) Emergency public information materials should stress the need for people to bring with them to shelter drinking cups and plastic jugs of water.

(2) No matter how good the water supply is, plan for organized resupply by municipal forces in the early postattack period.

WATER DRUMS

WATER DRUMS STORED ALONG WALL IN SHELTER OCCUPANCY TEST
(For best blast protection, the drums should be placed in the center of the space with shelterees long the walls.)

SANITARY ARRANGEMENTS

The disposal of human waste is the highest priority sanitation need. Whether a dual-use shelter area has toilet facilities depends very much on its peacetime use. The two examples in panel 11 both have conventional toilet facilities. There are four toilets on the second basement level of the Denver Hilton and about the same number in the dormitory basement. On the other hand, the shelter capacities are 12,000 and 800 people respectively. The emergency standard is one commode per 50 people. With few exceptions, dual-use shelter areas will have few, if any, conventional commodes; and flushing water will be limited.

The existence of minimal toilet facilities is still useful. Quantities of toilet paper and paper towels are likely in the building, for one thing. Containers used as toilets can be dumped into the sewer system through the conventional toilet. If water is abundant, the toilet can be flushed periodically. Otherwise, emptied water containers, plastic bags, or some other containers must be available to store the wastes.

The portable chemical commode is the best solution to the lack of sufficient conventional toilet facilities. These are, however, not widely available. Makeshift chemical commodes can be made by lining suitable large cans or pails with heavy-duty plastic bags and improvising some sort of seat with a pair of boards or by cutting a hole in a piece of plywood, fiberboard, plastic sheet, or rug. In use, disinfectant (chlorine bleach, etc.) should be poured in periodically to fight germs and odors. If you must store human waste until safe to dispose of it outside, plastic bags from the chemical commodes can be tied off when nearly full and placed in large covered garbage cans.

Keeping the toilets and toilet areas clean is an important part of preventive medicine in a crowded shelter. Unless the shelter space is not occupied by people in its peacetime use, janitorial supplies, such as trash cans, brooms, mops, and the like, are usually available. Even if the shelter space does not have such supplies, they may be found in other parts of the building for relocation to the shelter area. Additional supplies of plastic bags will be invaluable for collecting and storing the quantities of solid waste produced in shelter living.

THE CHEMICAL COMMODE

THE CHEMICAL TOILET PROVIDED IN THE FEDERAL STOCKING PROGRAM*

* The Federal Stocking Program has been discontinued and the chemical commode is no longer supplied for shelter stocking.

PROVISIONS FOR MEDICAL CARE

Medical care needs in public shelter were described in panel 7. It does not seem desirable or feasible to provide treatment of chronic medical conditions in shelter, since the medications should be prescribed for each patient by a doctor. But as noted earlier, chronically ill persons must be advised to bring their own medications with them. As shown in this table, the number of such persons in a "typical" group shelter could be quite substantial.

Medical care provisions for the illnesses likely to exist in the normal "healthy" population are important to the continued well-being of a confined shelter population. As shown in the lower part of the table, the incidence of acute (short term) illnesses is much higher in winter than in summer. In other words, respiratory and infective illnesses are at their low ebb during the period when hot, humid shelter conditions may place additional strain on the body.

Emergency public information should encourage the population to bring to shelter nonprescription as well as prescription medications and other basic first aid items such as bandages, antiseptics, thermometer, baking soda, petroleum jelly, and medications for headaches, waste elimination problems, and respiratory symptoms. As a general policy, shelters should not be stocked with items that could be used effectively and safely only by physicians or highly-trained paramedical personnel.

On the other hand, it is good planning to arrange for assignment of local physicians to major shelters. This would greatly increase the prospects for adequate in-shelter medical care and, presumably, would improve the chances of survival of medical personnel needed postattack. Where this is done, reasonable plans can be made to cope with treatment of attack casualties that might occur. Such treatment requires the availability of medical supplies, the attendance of persons possessing surgical skills, and adequate space and lighting. Only where these criteria can be met should formal casualty treatment be considered. Otherwise, the treatment taught in first aid courses must suffice. Courses in first aid skills (cardiopulmonary resuscitation techniques and treatment of cuts, burns, and shock) are currently being given by many hospitals, volunteer ambulance corps, the Red Cross, and various other community organizations. A reasonable readiness goal is to train one person in each family through these courses.

INCIDENCE OF ILLNESS IN THE POPULATION

CHRONIC CONDITIONS*	Percent Affected
Arthritis and Rheumatism	13
Asthma and Hay Fever	12
High Blood Pressure	11
Heart Conditions	7
Chronic Bronchitis	3
Peptic Ulcer	2
Diabetes	2
Epilepsy	0.5
Pregnancy	2

ACUTE ILLNESSES IN 3-MONTH PERIOD**	
Respiratory Ailments, Winter	47
Respiratory Ailments, Summer	15
Infective and Parasitic Diseases, Winter	7
Infective and Parasitic Diseases, Summer	5
Digestive Ailments	3
Other	16

*From Reference 6.
** From Reference 5.

PRIORITY INITIAL ACTIONS IN HIGH-HAZARD AREAS

If an international crisis should worsen and the threat of nuclear attack appear imminent, residents in areas potentially subject to direct effects may evacuate to safer locations. Time and circumstances, however, may preclude evacuation. Since people are most likely to be advised to seek shelter upon warning that an attack on the country has been detected (ATTACK WARNING), not more than 15 to 30 minutes may be available before detonations occur. Therefore, not only must the shelter be close at hand but also certain initial in-shelter actions must be accomplished very quickly.

The most important initial action upon loading a shelter in response to attack warning is to place the occupants in the best locations to survive direct weapons effects. As discussed in chapter 2, such areas are mainly in basements, although core areas above ground may be used when they offer the best protection available. Review panel 20 of chapter 2 for suggestions on the best protective positions for people to take in the shelter area. Since this "maximum protective posture" generally involves sitting around the periphery of the shelter area, shelter supplies should be moved to the central area.

After locating people where they are least vulnerable to direct effects, the next most important initial action is to organize and instruct fire guard teams. These teams, formed from able-bodied adult shelterees, must be prepared to carry out a rapid reconnaissance of aboveground parts of the shelter building if a close-by detonation should occur, locating and suppressing any smoldering ignitions found (see panels 29 and 31 of chapter 3).

People can adapt to crowding in the best protective locations for several hours at least. Our best estimate is about 6 hours. Since this period of time is likely to be the period of maximum threat from detonations in the vicinity, crowding into basements is a viable option for increased lifesaving. The main limiting factor on the practicability of staying in the maximum protective posture is the adequacy of ventilation to maintain temperature control. This will be a more serious problem in hot summer weather than in cooler seasons. A team should be organized to monitor the shelter environment and promote natural ventilation (panel 14) as necessary. As long as electric power is available, the building ventilation system should contribute. If manual ventilation devices, such as Kearny pumps, have been provided, the ventilation team should be charged with setting these up, if a need exists.

Maintaining order is essential to the survival of the shelter occupants. People will generally follow the instructions of visible and trained shelter leaders under stress conditions. The only concession to "creature comforts" should be provision of minimum toilet facilities, preferably in or adjacent to the best protected areas. Except for safety tasks (fire, police, medical, radiological, and ventilation) and minimal sanitary arrangements, it is best to defer other life-support activities for several hours until the protective posture can be relaxed.

PRIORITY PROTECTIVE ACTIONS (DIRECT EFFECTS)

1. Place the people in the maximum protective posture to survive direct weapons effects.

2. Organize shelter fire guard teams.

3. Organize a ventilation team.

4. Maintain order.

5. Provide minimal sanitation facilities.

6. Information people on what to expect if a detonation occurs in the vicinity.

INITIAL ACTIONS IN FALLOUT HAZARD AREAS

In rural and small city areas where the occurrence of direct attack effects is unlikely, much more time is available for shelter taking and initial in-shelter organization. Fallout, if it should occur, will begin to arrive several hours or more after distant weapon detonations are observed (see chapter 6). It is still desirable to send people to fallout shelter upon ATTACK WARNING since loss of electric power, communications, and transportation due to EMP effects (see chapter 4) may make fallout warning and travel difficult.

Maintaining order is necessary to promote the survival of the shelterees and should be the first priority for shelter management. One or more Fire, Safety, and Security teams should be recruited immediately from early arrivals by a law enforcement officer, if available, or other person experienced in handling movement of large numbers of people. This team should prevent the bringing of pets, bulky items, and other unneeded materials into the shelter and should distribute the arriving people throughout the building. Later, this team can dispose of flammables that could create a fire hazard, move equipment that might be a safety hazard, and open windows to improve ventilation.

Organizing the shelter occupants into manageable groups should be accomplished next. Depending upon the size of the shelter and its configuration, this may require recruitment of temporary group leaders to carry the work throughout the facility. Leaders should be visible; a uniform is best, no matter what kind; an arm band is next best; and lacking that, a handkerchief should be tied around the left arm. Through these leaders, the shelterees should be given early "orientation" concerning the existing situation as best as it can be determined; the plan for organization of the shelter; and the critical safety, health, sanitation, and other rules that must be observed.

The population of the shelter is best organized into units of about 10 persons, based on kinship, friendship, and common interests. In small shelters (less than 100 persons), the elected unit leaders are the only formal organization required except for task teams. In larger shelters, five or six units should be grouped into a section, sections into divisions, etc., letting the size of the community groups conform to the separate rooms and floors of the shelter building.

Except for safety tasks (fire, police, medical, ventilation, and radiological protection) and minimal sanitary and water arrangements, it is best to defer life support activities until several hours after shelter occupancy, unless it proves desirable to proceed further. If and when the fallout threat becomes actual, shelterees should be crowded in those sections of the facility having the best fallout protection, preferably based on measurement of radiation levels. Whether or not fallout occurs, people would remain in shelter under organized control and support at least until notified that further attack is unlikely.

PANEL 19

PRIORITY ACTIONS (FALLOUT ONLY)

1. Organize Fire, Safety, and Security Teams.

2. Distribute the people throughout the shelter building as necessary and maintain order.

3. Organize the occupants into manageable groups.

4. Provide minimal sanitary and water arrangements.

5. When fallout occurs, crowd people into best protected areas, based on radiation measurement or best judgment.

EMERGENCY RESPONSE TO DAMAGE

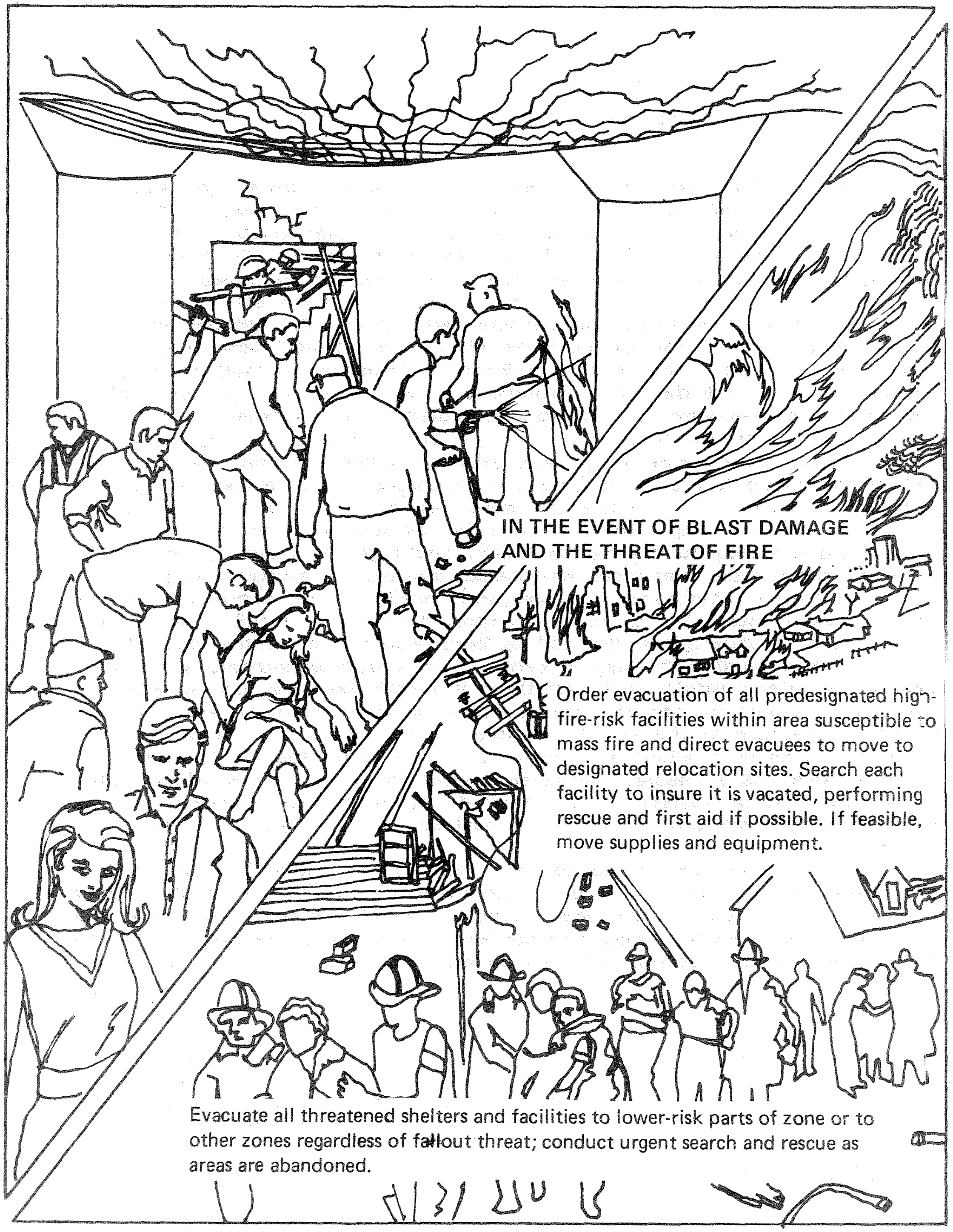
Shelters are intended to provide substantially better prospects of survival in an attack than otherwise might be the case. But no shelters, even specially-built shelters, are proof against a "direct hit." In areas of moderate to severe damage, dual-use shelter areas will experience some degree of damage, with possible injuries and entrapment.

Where damage is minor, the shock and sounds of breaking glass and displacement of furniture outside the shelter area will be impressive. If the shelter area is dusty, a cloud of dust may be raised. At somewhat higher overpressures, light fixtures and false ceilings, if they exist, may fall to the floor. These may cause injuries, mostly minor in nature. Exterior doors may be blown in and interior partitions damaged. Stairways and other access routes may become blocked. Review chapter 2 to become familiar with the kinds of damage that can occur in areas where survival may remain high.

If damage occurs, fire guard teams should emerge to assess the situation and to suppress any incipient fires in and around the shelter building. Those remaining should render aid to the injured. The shelter area should not be abandoned unless it is obviously untenable or unless a reconnaissance indicates that an uncontrollable fire situation is in prospect. If the suggestions of panel 24, chapter 3, have been incorporated into local emergency plans, the leadership in so-called high fire risk shelter facilities will be aware of the need for prompt evacuation and will have a designated low fire risk shelter facility to which the survivors should go.

In many cases, egress may be blocked by debris. Therefore, basic rescue tools, such as shovels, wrecking bars, saws, ropes, and jacks, are desirable supplementary shelter equipment in hazard areas. Dual-use shelters will vary widely in their susceptibility to damage. Hence, those in shelters that suffer only minor damage should be aware of the existence of other shelters in the immediate vicinity and should take the initiate to examine the condition of their neighbors and to aid in rescue to the extent necessary. In particular, task teams from low fire risk facilities should go out to meet those abandoning high fire risk facilities when advised that relocation is required. As shown in chapter 6, fallout radiation should not restrict these early life-saving operations in most of the damaged areas.

A special problem may be presented to occupants of basements of residences and other lightly constructed buildings. As noted in chapters 2 and 6, the building may be blown clear of the basement, greatly reducing the protection from subsequent fallout. Emergency actions must be directed toward improving the fallout protection, using the nearby debris as a source of materials.


IN THE EVENT OF BLAST DAMAGE AND THE THREAT OF FIRE
Order evacuation of all predesignated high-fire-risk facilities within area susceptible to mass fire and direct evacuees to move to designated relocation sites. Search each facility to insure it is vacated, performing rescue and first aid if possible. If feasible, move supplies and equipment.
Evacuate all threatened shelters and facilities to lower-risk parts of zone or to other zones regardless of fallout threat; conduct urgent search and rescue as areas are abandoned.

PANEL 20

EMERGENCY RESPONSE TO FALLOUT

Just as in the case of blast and fire, dual-use shelters vary widely in the protection afforded against fallout radiation. If fallout occurs, the basic objective should be to keep the average radiation exposure of the shelterees as low as possible. As discussed in chapter 5, there is no completely safe exposure, however low. People should be crowded into the areas showing the lowest exposure rates as measure by a CD V-715 survey meter. Additional shielding can be achieved by crowding people together. People in the most exposed locations should be rotated periodically with people less exposed, except that children and women of child-baring age should be given preferential protection. If ventilation is inadequate, groups of shelterees may be rotated into cooler areas for relief.

In heavy fallout areas, the most intense period of fallout radiation will persist for the better part of a day. See chapter 6 for rules of thumb on radiological decay. If, despite the measure described above, substantial exposures are received, these should be evident by the occurrence of nausea and vomiting during the first day. As noted in panel 3, chapter 5, these symptoms occur at doses will below those that result in severe sickness and death. Moreover, nausea and vomiting are symptoms also of simple anxiety, stress, and fear. If exposures of 70 to 100 R or more have indeed been received, this fact will be confirmed by temporary loss of hair from the head during the second week. Confirming measurements by dosimeters are also helpful. Identification of overly exposed groups while in shelters is important because these people must be shielded from further radiation exposure to the extent possible. They are of no use as workers at urgent tasks in a fallout environment. There is no specific treatment for radiation sickness available. However, since one aspect of radiation injury is the lowering of resistance to infection, preventative measures such as rest and good sanitation should be emphasized.

People should not be led to fear radiation exposure blindly, as this may immobilize any attempts to deal with other threats to life safety. They should be reassured that radiation sickness is not contagious and that the occurrence of symptoms does not portend inevitable death. Respect and caution, not fear, is appropriate in a fallout environment.

PANEL 21

GETTING FAMILIAR WITH RADIOLOGICAL
MONITORING EQUIPMENT
(Note: Shelter stocks in background no longer available)

INITIAL ACTIONS IN RESIDENTIAL BASEMENTS

In emergency plans for in-place protection in high-hazard areas, the use of residential basements for shelter has become increasingly important. Chapter 2 demonstrated that just getting people below ground level in a basement had major lifesaving potential. Moreover, people are generally less vulnerable at home as compared to being at work where they are more concentrated in commercial and industrial areas. On the other hand, there are fewer large building basements in residential areas, and not every home has a basement. Thus, sharing of those basements that exist may be the best sheltering plan.

The average residential basement has about 1,200 square feet of area. Some of this space is occupied by furnace, hot water heater, laundry tub, and the like; but generally as many as 100 people could be sheltered readily. Only in some parts of the South and Southwest would such intensive use seem necessary. In most cases, the use by several families rather than just one family would be sufficient. There is considerable merit, however, in encouraging 5 to 10 families to use the best basement, even if several are available. People seem to weather crises better as a group rather than separately. A wider range of skills, including leadership, can be found in the group of 20 to 50; and the young and elderly can receive better care. The chance of having trained people in the shelter and of being able to communicate with local authorities is also greater. The list of emergency actions suggested here is an indication of why group use of residential basements makes sense.

Upon ATTACK WARNING, neighbors would go to the selected basement, bringing with them the agreed-upon supplies. The supplies would be stacked in the center of the basement along with movable furniture and equipment. As one can see from the middle sketch of panel 12, chapter 2, placing a heavy table or work bench beneath the center of the span of floor joist would prevent the joists from being pushed all of the way into the basement, if broken by a blast wave.

As soon as the basement walls are cleared, people should sit along and facing the basement wall, the best protective position. If blankets or mattresses have been brought, they should be placed over the body to shield against flying bits of debris. Then an emergency team should be organized, whose first task would be to break out the basement windows to remove the possibility of flying glass. As this is being done, water can be drawn and the utilities turned off at main service connections to minimize secondary fires. Then the emergency team should be ready to perform the tasks described in the previous panels if an attack occurs.

PRIORITY ACTIONS IN RESIDENTIAL BASEMENTS

1. Send everyone to the basement.

2. Move all furniture, shop benches, and equipment to central part of basement and deposit supplies with them.

3. Have people sit facing basement wall.

4. Organize an emergency team to:

   (a) break out any basement windows, sweeping up glass pieces,

   (b) draw water in laundry tubs and other containers,

   (c) shut off electric, gas, and water utilities,

   (d) prepare to suppress fires and rebuild fallout protection.

5. Provide pail or other toilet facility.

6. Maintain protective posture for at least 6 hours.

7. Listen to the Emergency Broadcast Station on a portable radio.

SOME POINTS ON HUMAN BEHAVIOR

The popular image of how people behave in disaster is filled with lurid scenes of society and human nature in the process of disintegration. According to this image, people trample one another and lose all sense of concern for their fellows. Many people, so it is believed, become hysterical or are so stunned as to be helpless. Others turn to looting and other forms of antisocial behavior. The aftermath is widespread immorality, social conflict, and mental derangement. This grim picture is continually reinforced in popular fiction, movies, television dramas, and journalistic accounts.

Scientific disaster field studies have demonstrated that these popular images are false. In contrast, they show that under disaster conditions people have a heightened sense of concern for others and that mutual aid and acts of unselfishness are much more common than under normal conditions. The sharing of a common threat to survival and widespread public suffering produce a dramatic increase in social solidarity that helps people to overcome the usual disorganizing effects of trauma and stress. In general, the scientific studies show that communities and nations typically demonstrate amazing toughness and resiliency in coping with the destructive effects of disaster and unusual speed in restoring and revitalizing their social institutions.

When the threat becomes clearly defined and danger is imminent and personal, people usually take actions to protect themselves and others rather than engage in irrational acts that increase the danger. The notion that people typically "panic," become "hysterical," or "go to pieces" in the presence of danger is not supported by disaster research findings. Of course, whether their behavior is appropriate depends to a great extent on the information and training they receive in the period preceding the warning of danger.

Disasters do not render people a dazed and helpless mass, completely dependent on outside help. To the contrary, the immediate and pressing tasks of rescue and aid are usually accomplished by the survivors themselves; and if a group is isolated for some time, it will develop the necessary emergency organization to cope with the problems at hand.

Finally, people directly affected respond to purposeful leadership. They rapidly shift from self-interest to motivation for common survival. Injured disaster victims are almost invariably quiet, calm, undemanding, and concerned for the welfare of others. Uninjured survivors will aid the injured and helpless, almost without regard to self, if they are in a position to do so and have the necessary equipment and training. (Peacetime disaster field studies show that disaster victims have been able to cope with all immediate disaster problems except those that require special equipment or advanced medical skills.)

PANEL 23

PEOPLE IN DISASTER

1. DO NOT "go to pieces."

2. DO take actions to protect themselves and others.

3. ARE NOT rendered dazed and helpless.

4. DO accomplish essential rescue and relief tasks.

5. DO develop ways to cope with pressing needs.

6. RESPOND to purposeful leadership.

7. ARE motivated for the common survival and speedy recovery.

8. ARE quiet, calm, and undemanding, of injured.

9. WILLINGLY aid the injured and helpless, if they are capable of doing so.

10. Do need information and direction and the necessary predisaster training in specialized survival, rescue, and medical treatment skills.

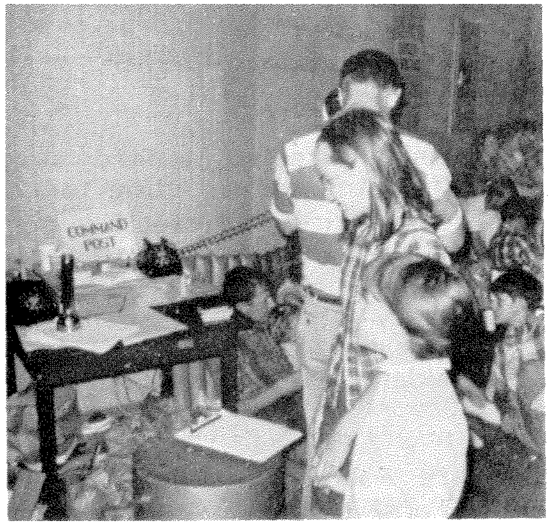
DIRECTION AND CONTROL

People under stress need direction and control. They tend to follow the instructions of anyone having a symbol of authority, if the instructions appear sensible. Maintaining order to promote the survival of the shelterees (through proper positioning, for example) is the first priority upon taking shelter. Maintaining social standards may also become important if the degree of threat from weapons effects remains low for an extended period.

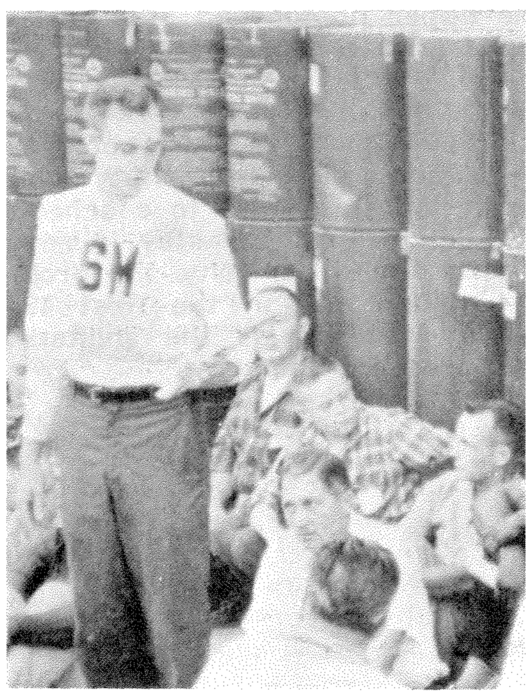
If the people in a particular shelter area are completely isolated from contact with the "outside," the organization and functions within the shelter must cover the whole gamut of emergency functions discussed in chapter 1: police, fire, medical, welfare, and resource control, all organized through direction and control. Successful sheltering is greatly aided by external communications. The status of shelter occupants, facility conditions, and supplies can be reported to the local Emergency Operating Center (EOC) throughout the shelter occupancy. It is preferable that shelters short of drinking water, for example, be resupplied by organized public works teams--with foraging by teams of shelterees used only in event communications fail or damage, debris, or fire preclude resupply. If the shelter becomes untenable, the EOC can organize aid for relocation to an alternate facility. Guidance on fallout conditions and probable shelter stay time can be given. Information on general conditions and what is being done about it will be important for shelteree morale.

Management of public shelter facilities, including groups in residential basements, should not depend entirely on one-way information heard on commercial radio (the Emergency Broadcast System--EBS). Two independent means of two-way communications are desirable--telephone and Citizens Band radio, for example. Where many public shelters exist in a local jurisdiction, plans should designate a more limited group of shelters as "Shelter Complex Headquarters," with which other shelters in the vicinity communicate.

Internal communications also are necessary for direction and control. Sometimes, operable public address systems are available in dual-use shelter facilities. More likely, internal communications will be by announcement of information and instructions. In large shelters, organization of the population into management groups and selection of group leaders are necessary for this purpose.



EXTERNAL COMMUNICATIONS



INTERNAL COMMUNICATIONS

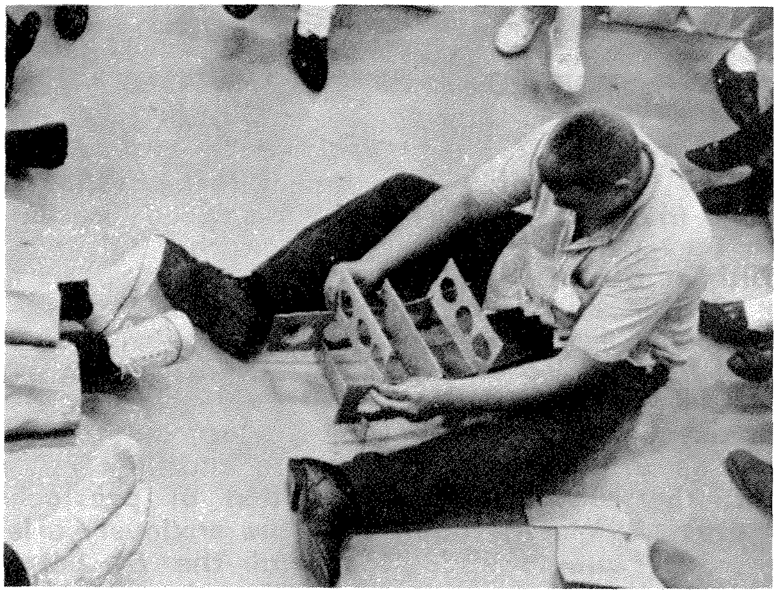
PANEL 24

LIFE SUPPORT TASKS

Once the emergency tasks directed toward survival of the shelter occupants are no longer critical, the more routine functions of shelter living can be organized. When the maximum protective posture in high-hazard areas and heavy fallout areas can be relaxed, the occupants can be organized into units, sections, etc., if not already accomplished, and task teams formed to perform the necessary functions. Shelter occupancy tests have shown the importance of giving all shelterees jobs to call their own. This applies to children and the elderly as well, except for the very young and the disabled.

"Life support" tasks are among the most essential: food and water distribution, sleep, health, and sanitation. Continued ventilation of the shelter area also must be accomplished. Specific arrangements must be adapted to the shelter configuration and the available facilities and equipment. In small shelters, occupants can go to pick up food and water at a distribution point; in larger shelters, food and water are best delivered to groups of shelterees where they "live." There are many detailed chores to be accomplished. In the upper photograph, for example, a rack for water cups is being constructed from a cardboard carton.

Toilet facilities must be set up and kept clean. Trash and litter must be disposed of. A sick bay should be designated and a daily sick call scheduled. A 24-hour communication and safety watch should be established (lower photograph). All this leads to a schedule of daily activities that becomes routine if a lengthy shelter stay is required. Shelter occupancy tests have shown that shelterees solve the problems of shelter living and make the necessary adjustments in the first 48 hours. Thereafter, they can remain indefinitely so long as the shelter environment remains habitable and essential supplies are adequate.



MAKING A CUP RACK

COMMUNICATION AND SAFETY TEAM

MORALE SUPPORT ACTIVITIES

In addition to the essential life-support tasks, other organized activities are desirable in shelters. These may be called "morale support activities," although they usually contribute to the physical well-being as well as the mental health of the shelterees, and often are directed at preparing the occupants for shelter emergence. The period of shelter stay should be viewed as a period of active and productive preparation for the postshelter environment, not as a period of listless "waiting-it-out."

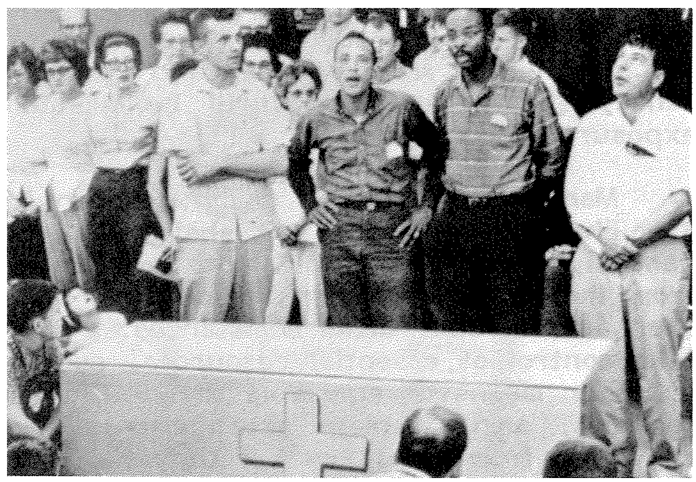
It is both psychologically and practically unrealistic to view the period of shelter stay as one of soothing "hearts and flowers" music, leisurely recreation, and the conspicuous consumption of prestocked fruits of a beneficent society. People in shelters will be anxiously oriented toward the future. The more realistic and meaningful the fit between the shelter activity and their future needs and those of society, the greater the likelihood will be of channeling this anxiety into socially useful form.

Organized nurseries or "day-care" arrangements are useful to provide parents with relief from child care and to allow attendance at adult activities. Special arrangements may be needed to care for any unaccompanied children. Adults take turns supervising the children, organizing their games, and providing informal entertaining. Sometimes, small school classes are instituted.

One form of adult activity of importance is training sessions on subjects relating to shelter confinement and postattack conditions. Information of the type covered in chapter 8 but based on the real situation in the locality, State, and Nation should be presented to the shelterees in preparation for participation in postwar reconstruction and recovery. Even in peacetime shelter experiments, participants have been found eager to learn of these matters. The motivation in an actual emergency should be even higher.

EXERCISE SESSION

RELIGIOUS SERVICE



TRAINING SESSION

SHELTER EMERGENCE

Even in areas that experience no attack effects, the population should remain in shelter until notified by the authorities that the danger of further attack and fallout has abated. This period may be several days or more, during which time the shelterees can be informed as to what to expect in the postshelter period. Because a particular locality escapes damage or significant fallout does not mean that the population can scatter from the shelters and resume their prewar way of life. A disrupted economic system elsewhere will mean that normal means of livelihood may be vanished; food, fuel, medical supplies, and other necessities may not be available in the market; and not too far away there will be fellow citizens in need of help.

Where fallout radiation persists, shelter emergency may be delayed, and people may need to sleep and live in shelters when not at work. In a sense, shelter emergence will be gradual so that unnecessary radiation exposure is avoided.

Many details of the postshelter environment are described in chapter 8. These will dictate how shelter emergence should be planned for. In general, shelterees should not be released until instructions are received from the local authorities to do so. Much preparatory activity is required, even in the best of circumstances. The local government would need to take control of essential resources, conduct an inventory, set up rationing or other means of equitable distribution, resume public safety and utility services, and complete arrangements for support of the population and survivors from other areas if they should be under the responsibility of the local government.

LEAVING THE SHELTER

TRAINED LEADERSHIP

The description in this chapter of the probable shelter environment and the ways of coping with it should leave no doubt about the value of trained leadership--shelter managers, as they are called. Of course, leaders will emerge in response to pressing needs, and groups can muddle through very difficult situations. There will be many situations, however, in which trained leadership will make the difference between life and death for substantial numbers of citizens.

The ideal preparedness goal would be to train in peacetime sufficient numbers of shelter managers to staff all public shelters scheduled for use according to the community's Emergency Operations Plan, including group shelters in residential basements. Although unlikely to be achieved in most localities, the training program should have this goal. The next best target is to training enough shelter manager instructors and stockpile the necessary training materials so that the needed shelter leaders can be trained rapidly during a crisis period. Even if this is done, some shelters are likely to be occupied without benefit of trained leadership. Therefore, each shelter should contain a copy of the Shelter Management Handbook (FEMA-59) or similar instructions and guidance for the use of emergent leaders.

Who should be recruited as shelter managers? It appears virtually impossible to take people without management experience and turn them into managers through exposure to a short course of training. It is, however, quite feasible to take people with strong management backgrounds and in a short time give them the technical information required to manage shelters effectively. This suggests that upper-level executives from organizations housed in structures designated as shelter facilities are potential candidates. The ideal manager appears to be one who is capable of working in ill-defined situations; one who can provide structure and direction and then proceed with the tasks at hand; a person who is creative in the face of unique, unprecedented problems; an effective communicator who has practice in dealing with people. As shown on this chart, these desirable characteristics may be associated with certain types of positions within the average business organizations.

RELATIONSHIP OF MANAGERIAL SKILLS

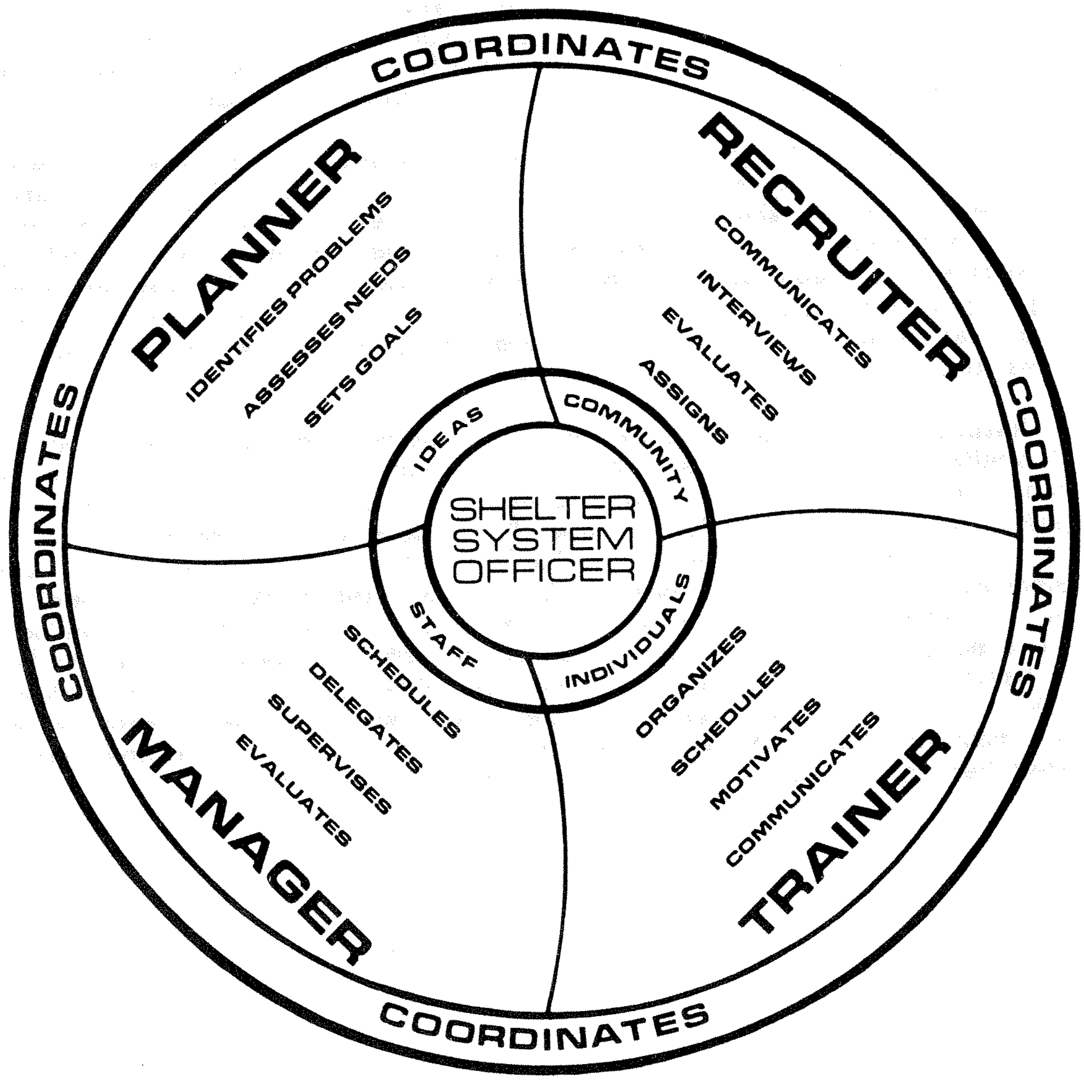
Skills/Knowledges/Conditions Relevant to Shelter Management	**Implications for Desired Management Positions**	**Some Likely Job Titles**
Must manage a situation that is unprecedented in the manager's experience.	Must show ability to react to problems in innovative creative fashion.	SALES MANAGER
Must make a great number of critical decisions in a relatively short period of time.	Must demonstrate competence in managing situations requiring response to daily emergencies.	LABOR RELATIONS MANAGER
Must deal with trade-offs and compromises in decision making.	Must have had experience in decision making where results of decision have impact on more than one factor.	PRODUCTION MANAGER
Must be an effective communicator, to forestall the development of rumors and to motivate the shelter populace.	Must have experience involving frequent verbal interaction with peers and subordinates, must be an effective public speaker.	PLANT MANAGER
May be temporary lack of a formal functioning sub-organization.	Must have experience in dealing with highly ambiguous situations, must show ability to impose structure and direction in confused situations.	DIRECTOR OF PUBLIC RELATIONS

THE SHELTER SYSTEM OFFICER

Shelter protection is a critical functional area that is not readily related to the day-to-day functions of local government. For this reason, city and county officials usually encounter difficulty in assigning responsibly for the planning and operating of a system of shelters. To fill this need, the position of Shelter System Officer has been developed. The responsibilities of the Shelter System Officer comprise two distinct skill areas. One covers planning and managing the shelter system. The other involves the recruitment and training of shelter managers. The Shelter System Officer can be a key member of the staff of the local emergency management coordinator, either as a volunteer or by assignment of the position to a regular employee.

The action diagram shown opposite is drawn from the Shelter System Officer Training Course, a 32-hour course consisting of two parts. Part A contains such topics as shelter system operations and management, recruiting and managing shelter system volunteers, and communications. Part B includes preparation for teaching the shelter managers using the instructor guide, Management of a Congregate Lodging Facility or Fallout Shelter (IG-11). This latter course is 8 hours in length and is aimed at training individuals locally to serve as shelter managers. Contact your State Office of Emergency Management for the dates and locations of these courses.

MANAGEMENT ACTIONS
OF THE
SHELTER SYSTEM OFFICER



THE SHELTER USE PLAN

Since any shelter can be used more effectively with a plan, every major shelter facility should have a use plan prepared for it. Both shelter use plans and trained leadership are needed for proper sheltering of the population. For example, a definite ventilation plan should be available before occupancy. The best protective locations for occupants should be identified. Potential destinations for relocation should be planned in advance in the event the shelter area must be abandoned as untenable.

In smaller shelters, merely filling in the blanks in the Immediate Action Instructions of the Shelter Management Handbook (FEMA-59), will satisfy most of the need for a shelter use plan. In larger shelters or those having special characteristics, a more detailed plan is desirable. An integral part of the shelter use plan should be a detailed sketch of the shelter areas, showing significant features, including location of supplies and equipment. The use plan should also contain information on the location of survival resources and other shelters in the vicinity.

A listing of the essential elements of information that should be in a typical shelter use plan are shown on this chart. Why these elements are important has been outlined in this chapter. The ordering is intentional. The last five elements are "operational." If the shelter were to be used without prior preparation (the "surprise attack" situation), one would start with element 6. Why aren't these last elements listed first? In panel 22, chapter 1, some planning assumptions are listed. The first is "A period of crisis will most likely precede a nuclear conflict." It seems prudent to plan on the basis that trained leadership may be able to staff shelters prior to ATTACK WARNING, that familiarization can occur, that furniture and supplies may be acquired or moved about, and that preparations may be completed before the population begins to move to the shelters.

WHAT'S IN A SHELTER USE PLAN

1. Where the best protected areas are.

2. What needs to be done to shift from peacetime use to shelter use.

3. Essential supplies and equipment, where they are, and how to use them.

4. What professionals (doctors, nurses, policemen, firemen, building engineers, etc.), if any, are assigned and who they are.

5. Suggested organization for THIS shelter, including how many fireguard teams to form, and the like.

6. Specific initial action schedule upon loading the shelter, preferably a checklist.

7. Who NEXTUP* is, the phone/call number, and reporting instructions.

8. What to do if the shelter must be abandoned for any reason.

9. Resupply resources in the environs, in event NEXTUP* cannot help.

10. Location of nearby shelters and mutual aid arrangements.

*NEXTUP = Shelter Complex Headquarters of local Emergency Operating Center

SUGGESTED ADDITIONAL READING

Sheltering is so vital a protective measure that emergency planners should try to learn everything they can about the shelter environment. The very best way of improving your understanding is to experience the realities of shelter living for a few days or a week. The next best approach is to read more deeply into the rather rich literature bearing on the shelter environment. The sources listed provide additional background on the topics in this chapter. Those references having an AD number are available from the National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia, 22161 for a small charge.

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