# PLANNING GUIDES FOR DUAL-PURPOSE SHELTERS

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# PLANNING GUIDES FOR DUAL-PURPOSE SHELTERS

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# TABLE OF CONTENTS


| | Page |
|---|---|
| **CHAPTER I. INTRODUCTION** | |
| THE NATIONAL SHELTER PROGRAM | 1 |
| Need for Planning Guidance | 2 |
| REFERENCES | 3 |
| **CHAPTER II. GENERAL INFORMATION** | |
| PURPOSE OF THE GUIDE | 4 |
| NATURE OF THE GUIDE | 4 |
| REFERENCES | 11 |
| **CHAPTER III. RADIOLOGICAL PROTECTION** | |
| BACKGROUND | 12 |
| Nature of the Threat | 12 |
| MAJOR PLANNING FACTORS | 14 |
| Assessment of Available Shielding | 15 |
| Providing Additional Protection | 18 |
| Radiological Monitoring | 20 |
| Decontamination | 23 |
| REFERENCES | 26 |
| **CHAPTER IV. OTHER WEAPON EFFECTS** | |
| MAJOR NEEDS | 27 |
| BLAST PROTECTION | 27 |
| Background | 27 |
| Major Planning Factors | 28 |
| THERMAL RADIATION PROTECTION | 29 |
| Background | 29 |
| Major Planning Factors | 29 |
| REFERENCES | 31 |
| **CHAPTER V. MAINTENANCE AND AUXILIARY POWER** | |
| MAINTENANCE REQUIREMENTS | 32 |
| Background | 32 |
| Major Planning Factors | 33 |

TABLE OF CONTENTS (Continued)


| | Page |
|---|---|
| AUXILIARY POWER | 34 |
| Uses | 34 |
| Planning Implications | 35 |
| Procurement | 35 |
| REFERENCES | 37 |

CHAPTER VI. TEMPERATURE AND ATMOSPHERE CONTROL

| | |
|---|---|
| BACKGROUND INFORMATION | 38 |
| MAJOR PLANNING FACTORS | 40 |
| Air Exchange | 40 |
| Control of Air Temperature | 44 |
| Purification | 46 |
| REFERENCES | 49 |

CHAPTER VII. WATER SUPPLY

| | |
|---|---|
| BACKGROUND | 50 |
| MAJOR PLANNING FACTORS | 50 |
| Amount | 51 |
| Provision and Storage | 51 |
| Purification | 54 |
| Distribution | 55 |
| REFERENCES | 58 |

CHAPTER VIII. FOOD

| | |
|---|---|
| BACKGROUND | 59 |
| Need for Food | 59 |
| Relationship of Food to Drinking Water | 59 |
| MAJOR PLANNING FACTORS | 59 |
| Procurement | 60 |
| Storage | 63 |
| Preparation | 65 |
| Distribution | 69 |
| Provision of Eating Facilities | 72 |
| REFERENCES | 73 |

CHAPTER IX. LIGHTING

| | |
|---|---|
| BACKGROUND | 74 |
| MAJOR PLANNING FACTORS | 74 |
| REFERENCES | 79 |

TABLE OF CONTENTS (Continued)

CHAPTER X. FIRE PROTECTION


| | Page |
|---|---|
| BACKGROUND | 80 |
| MAJOR PLANNING FACTORS | 81 |
| Prevention | 81 |
| Detection | 83 |
| Suppression | 83 |
| REFERENCES | 85 |


CHAPTER XI. MEDICAL


| | |
|---|---|
| BACKGROUND | 86 |
| Primary Objectives | 86 |
| MAJOR PLANNING FACTORS | 89 |
| General Medical Area | 90 |
| Medical Facilities | 91 |
| REFERENCES | 95 |


CHAPTER XII. SANITATION


| | |
|---|---|
| BACKGROUND | 96 |
| The Problem | 96 |
| Implications for Shelter Operation | 96 |
| MAJOR PLANNING FACTORS | 97 |
| Human Waste Disposal | 97 |
| Need | 97 |
| Methods of Waste Disposal | 98 |
| Garbage and Trash Disposal | 99 |
| General Shelter Cleanliness | 99 |
| Personal Hygiene | 100 |
| Body Disposal | 100 |
| REFERENCES | 104 |


CHAPTER XIII. COMMUNICATIONS


| | |
|---|---|
| BACKGROUND | 105 |
| Requirements | 105 |
| Communication Area | 107 |
| Equipment | 107 |
| General Requirements | 108 |
| REFERENCES | 109 |

TABLE OF CONTENTS (Continued)


CHAPTER XIV. SLEEPING FACILITIES — Page

BACKGROUND. . . . . 110
MAJOR PLANNING FACTORS. . . . . 110
General Strategy. . . . . 110
Provision of Sleeping Facilities. . . . . 115

CHAPTER XV. WARNING AND SHELTER ENTRY

BACKGROUND. . . . . 120
Need for In-House Warning in Dual-Purpose Shelters. 120
Need for Rapid and Smooth Shelter Entry . . . . . 120
MAJOR PLANNING FACTORS. . . . . 121
Warning Systems . . . . . 121
Access Routes . . . . . 123
Shelter Opening . . . . . 124
Shelter Entrances . . . . . 125
Shelter Loading . . . . . 126
Closure Capability. . . . . 128
REFERENCES. . . . . 129

CHAPTER XVI. ORGANIZATION AND MANAGEMENT

BACKGROUND. . . . . 130
MAJOR PLANNING FACTORS. . . . . 130
Development of an Organizational Structure. . . . . 130
Staffing of Management Cadre. . . . . 134
Pre-Shelter Training and Orientation. . . . . 136
Planning for Shelter Activities . . . . . 139
REFERENCES. . . . . 145

BIBLIOGRAPHY. . . . . 146

# LIST OF TABLES


| | | Page |
|---|---|---|
| Table I. | Shelter Planning Areas and Associated Factors | 6 |
| Table II. | Techniques for Heating or Cooking Shelter Food | 68 |
| Table III. | General Recommendations for Shelter Illumination | 77 |
| Table IV. | Incandescent Versus Fluorescent Shelter Lighting | 78 |
| Table V. | Nature and Source of Potential Shelter Medical Problems | 87 |
| Table VI. | Government Supplied Medical Facilities | 92 |
| Table VII. | On the Floor Sleep Space Required for 100 Sleepers | 112 |


# LIST OF FIGURES


| | | Page |
|---|---|---|
| Figure 1. | Baffle Shielding | 21 |
| Figure 2. | Post-Warning Window Shielding | 21 |
| Figure 3. | Required Rates of Air Exchange | 42 |
| Figure 4. | Grouping and Relative Placement of Sleeping Shelterees | 114 |
| Figure 5. | Sample Shelter Organization | 132 |

# ABSTRACT

This document provides general planning information relative to the principal factors which must be considered in the development of group fallout shelter facilities. It discusses a number of possible methods for dealing with each factor. Emphasis is placed upon the potential dual-purpose use of facilities usually available within existing structures. The information which is provided is designed to permit the shelter planner to select specific methods for meeting each shelter requirement according to the needs and opportunities dictated by his particular situation. The planning areas discussed in the report include: Radiological Protection, Other Weapon Effects, Temperature and Atmosphere Control, Water Supply, Food, Lighting, Fire Protection, Medical, Sanitation, Communications, Sleeping Facilities, Warning and Shelter Entry, and Organization and Management.

# INTRODUCTION AND GENERAL INFORMATION

INTRODUCTION

GENERAL INFORMATION

# I. INTRODUCTION

## The National Shelter Program

The President of the United States, in May of 1961, declared that civil defense is a "major element of the national security," and took steps to initiate a new and revitalized civil defense program. A major and essential part of this program has been the development of group fallout shelters. The reason for this is clear. The annual report of the Office of Civil Defense states that all studies and analyses of possible nuclear attack patterns on this nation indicate that fallout shelters can save more lives than any other feasible protective measure (DOD, 1962).

Current efforts in the development of group fallout shelters follow two main courses:

1. A government program for the designation of adequate shelter areas in existing structures and stocking of these areas with essential shelter supplies and provisions at Federal expense.
2. Shelter programs sponsored by civic organizations, business, industry, and other private groups. These efforts include the design and construction of shelters as completely new structures, as well as the development of shelter facilities within existing buildings.

It is significant to note that both of these approaches involve the utilization of existing structures as fallout shelters. Such an emphasis is appropriate due to both the great amount of potential shelter space in existing buildings and underground facilities, and the relative economy of shelter development within such structures.

In line with this economy, it should be noted that once satisfactory shelter areas have been designated, there is much to be gained by the use of material in and around these areas to support essential shelter functions. Protecting against fallout alone is not sufficient to assure survival.

Survival as human beings demands that certain basic needs, such as air, food, and water be adequately met. Survival as a nation requires sustenance of such things as communications, good physical and mental health, and orientation to the post-shelter world.

## Need for Planning Guidance

Shelter planning is a complex task. Provision must be made for all of the needs outlined above, and many more. These needs must be met within the isolated bounds of a shelter community which may have no access to outside resources for several days, or even weeks. Man's resourcefulness will play an important role in his survival during and following a nuclear attack. Careful planning, along with this same resourcefulness, can play an even more important role now, during the preparation of shelter facilities.

The United States government, in its program for stocking Federally designated shelter areas and the training of shelter managers, has taken steps to meet the most basic requirements for shelter survival. Supplemental use of additional material could greatly increase the effectiveness of this shelter program. Independent shelter planners, in addition, are faced with the development of an entire shelter, often within the economy of a narrow budget.

There is a need for guidance material which outlines the factors that must be considered in shelter planning, and reviews possible approaches for dealing with these factors. In order to meet the present need for economical planning, these guidance materials should emphasize the potential dual-purpose use of facilities usually available within existing structures.

# References

Department of Defense. Annual report of the office of civil defense. Washington D. C.: Author, 1962.

# II. GENERAL INFORMATION

## Purpose of the Guide

The purpose of this Guide is to:

1. Specify all of the principal factors which must be considered in planning and developing a shelter area within an existing structure, or in designing a building which is to serve the purpose of providing shelter facilities as well as another primary purpose.
2. Identify possible methods for meeting the various requirements associated with each of these factors.
3. Present sufficient information to permit selection of specific methods for meeting each shelter requirement according to the needs and opportunities dictated by a particular situation.

The actual employment of methods decided upon on the basis of information in this document may require additional guidance, often in the form of manuals or other publications referred to in the Guide.

## Nature of the Guide

### General Organization

The remaining sections of this report deal with four major goals of a shelter system:

1. Providing protection from weapon effects
2. Sustaining the life and health of those in the shelter.
3. Meeting auxiliary needs of those in the shelter.
4. Providing personnel and management support for the entire system.

The chapters within each section are concerned with the planning areas, such as radiological protection or shelter sanitation, which must be considered to achieve these goals.

Usually, a number of factors must be considered for complete coverage of each planning area. For example, the factors associated with radiological protection include the assessment of available shielding, the provision of additional shielding, radiological monitoring, and decontamination. The major factors associated with each area of shelter planning are presented in Table 1. These factors, to a great extent, comprise the basic units of shelter planning. Each factor must be adequately accounted for in shelter planning to assure the effective, independent operation of the shelter during and following a nuclear attack.

In general, each chapter in the remainder of this report provides certain background information concerning a particular planning area, and then presents the essential information regarding each planning factor. Background information includes both the nature and origin of the problems within a given area, and the implications which they pose for shelter operations.

The major planning factors within each area are identified and defined. General planning guidance then will be provided for each factor. This information is independent of the specific methods available for dealing with a particular factor. For example, the general requirements for radiation shielding are specified prior to discussion of methods for providing the necessary shielding.

Once the general requirements have been discussed, specific methods are presented for dealing with the planning factor under consideration. Information will be provided which will facilitate decisions regarding the method or methods best suited to any particular shelter situation. This information includes such data as:

1. Required equipment and facilities, including description, cost, and peacetime use.
2. Conversion procedures, including procurement and installation or modification.
3. Maintenance requirements.
4. Personnel and training requirements.

Table I.

Shelter Planning Areas and Associated Factors

| Planning Area | Major Planning Factors |
|---|---|
| Radiological Protection | Assessment of Available Shielding<br>Provision of Additional Shielding<br>Radiological Monitoring<br>Decontamination |
| Other Weapon Effects | Blast Protection<br>Thermal Radiation Protection |
| Temperature and Atmosphere Control | Air Exchange<br>Control of Air Temperature<br>Air Purification |
| Water Supply | Amount<br>Provision and Storage<br>Purification<br>Distribution |
| Food | Procurement<br>Storage<br>Preparation<br>Distribution<br>Provision of Eating Facilities |
| Lighting | General Shelter Lighting<br>High Intensity Lighting<br>Back-up Lighting |

Table 1.

Shelter Planning Areas and Associated Factors (Continued)

| Planning Area | Major Planning Factors |
|---|---|
| Fire Protection | Prevention<br>Detection<br>Suppression |
| Medical | General Medical Area<br>Medical Facilities |
| Sanitation | Human Waste Disposal<br>Garbage and Trash Disposal<br>General Shelter Cleanliness<br>Personal Hygiene<br>Body Disposal |
| Communications | Communication Area<br>Equipment<br>General Requirements |
| Sleeping Facilities | General Strategy<br>Provision of Sleeping Facilities |
| Warning and Shelter Entry | Warning Systems<br>Access Routes<br>Shelter Entrances<br>Shelter Loading |
| Organization and Management | Organizational Structure<br>Management Staffing<br>Pre-Shelter Training and Orientation<br>Shelter Activities |

5. General effectiveness of the method.

6. Potential user acceptance and necessary orientation.

7. Technical references.

Some of these data may, under certain situations, apply to all methods for dealing with a particular factor. For example, specific training requirements exist for those involved in radiological monitoring, regardless of the method used. In such cases, this information is presented as general information prior to the presentation of specific methods.

Emphasis Upon Available Facilities

For almost every factor involved in shelter planning, a number of possible methods are available which will satisfy the requirements through the use of existing facilities. These available resources include:

1. The general structure in which a shelter may be housed.

2. The equipment, tools, and other "hardware" available within or near the structure.

3. The food, water, medical supplies and other provisions available within or near the structure.

4. The people within the structure during its peacetime use, and/or those who will use the structure as a shelter.

A major goal of this Guide is to provide the planner with as many potential shelter uses of these facilities as possible.

Certain government supplied resources also are available at little or no cost. These resources include technical consultation and training, as well as materials such as shelter provisions, radiological monitoring instruments, etc. Shelter planners will want to seriously consider the advantages of participation in the Federal Marking and Stocking Program if their particular structure qualifies for this opportunity. Shelters with a protection factor* of 40 or better, and a capacity of more than 50 persons,

* See page 15.

may obtain their basic supplies through this program (DOD, 1962). Specific material and services available through OCD are pointed out where relevant to a particular planning factor.

Finally, it is recognized that peacetime or government-supplied facilities will not always be available to meet every shelter need. Therefore, some methods are discussed which involve the use of equipment which can be purchased or constructed specifically for shelter use. Recommendations and references are provided regarding where to obtain advice concerning the selection and procurement of these items.

Scope of the Guidance

The procedures related to any method for dealing with a particular planning factor can be divided into three major phases:

1. Peacetime procedures for developing and maintaining shelter capability.
2. Post-warning procedures for complete conversion to shelter capability.
3. In-shelter procedures associated with the method involved.

This planning document broadly describes the peacetime and, usually, the post-warning procedures associated with each method which is discussed. In some cases the peacetime procedures will provide complete conversion to shelter capability. In other situations, the maintenance of peacetime functions will necessitate certain last-minute steps for complete conversion. In-shelter procedures will be referred to indirectly in the discussion of such planning considerations as material, personnel and training requirements, general effectiveness of a particular method, and acceptance by the shelterees. Information relevant only to shelter planning, then, and not to shelter operation, are provided by the guidelines. Other documents, referenced in this report, are available for further guidance once specific methods have been selected for the development of a dual-purpose shelter capability. The references at the end of each chapter frequently

are prepared to support technical statements made within the text. Their primary purpose, however, is to indicate sources of detailed information useful to the planner. For information regarding the characteristics, selection, operation, and maintenance of equipment, shelter planners should refer to a document prepared in 1963 by the IIT Research Institute under an OCD shelter operations contract.

# References

Department of Defense. Annual report of the Office of Civil Defense. Washington D. C.: Author, 1962.

# PROTECTION FROM WEAPON EFFECTS

RADIOLOGICAL PROTECTION

OTHER WEAPON EFFECTS

# III. RADIOLOGICAL PROTECTION

## Background

A primary purpose of a fallout shelter program is to provide protection against radiological hazards. Radiological protection is therefore fundamental to shelter planning. Without the assurance of such protection the other areas of shelter development are of little practical value.

### Nature of the Threat

Certain basic characteristics of fallout and radiation must be considered in shelter planning. These characteristics are reviewed briefly on the pages which follow. A number of documents are available which provide a more detailed, technical discussion of the problem, if desired. (Glasstone, 1962; Joint Committee on Atomic Energy, 1959).

Fallout

When a nuclear explosion occurs close to the ground, tons of earth and debris are vaporized and sucked up into the mushroom cloud. As the particles condense and solidify during the cooling, they collect radioactive isotopes, which, in turn, make the fallout particles emit radiation. It is estimated that one-half of this material will fall back to earth within the general area of the blast within 12 hours. The remainder, which is finer, will descend more slowly, depending upon particle size, wind, rain, and other atmospheric conditions.

Fallout will, in general, unevenly cover an elongated area extending downwind from the burst. The earliest fallout may not arrive until 30 minutes after blast, (even next to a totally devastated area), and it may take up to 24 hours before severe contamination will reach areas well downwind.

Fallout generally looks and behaves like dust, and in heavily contaminated areas, it will appear as fine white powder or sand. It can be carried by the wind and will drift around corners much as any household dust.

## Radiation

Types. Three types of radiation are given off by radioactive fallout: alpha and beta particles and gamma rays. Since alpha and beta particles are stopped by clothing and skin, they are not as serious a threat as gamma radiation unless materials containing them are taken internally into the body through mouth or nose.

Gamma rays can pass through matter, damaging or destroying living cells. However, they do not make the persons or objects they strike radioactive.

Decay of radioactivity. Radioactivity diminishes or "decays" at a specific rate with time. This natural process cannot be altered. This decay rate is expressed by "half-life" which means that half of the radioactivity is lost within a specific period of time ranging from seconds to years. For instance, iodine 131, with a half-life of eight days, loses one-half of its' activity in this time, and half again of the remaining activity in the succeeding eight days. The radiation hazard will decrease rapidly at first because early fallout contains many radioisotopes with short half-lives. According to Glasstone in The Effects of Nuclear Weapons,

> "As a rough rule-of-thumb, it may be stated that for every sevenfold increase in time, the radiation level will decrease by a factor of 10, provided the fallout is complete. For example, the radiation level at the end of seven days will have fallen to roughly one-tenth of that at the end of one day. At the end of 49 days, it will have decreased by a factor of 100, etc. The rule is applicable to any unit of time; thus at seven hours the residual radiation level will be one-tenth of that at one hour, at fourteen hours it will be one-tenth of that at two hours, and so on, provided the fallout is complete at both times." (Glasstone, 1962).

Barrier shielding. Gamma rays can travel many feet through air and can be most effectively reduced in intensity by placing enough mass between the source of radioactivity and the person being shielded to absorb the rays. Generally, the denser the shielding material, the greater the protection offered. When radiation strikes a barrier, it may be absorbed and reduced in intensity. However, if the barrier is not sufficient to absorb it all, radiation may pass through the barrier in the same direction or be scattered in other directions. Consequently, to be protected from the threat of radiation by barrier shielding, a person must be completely surrounded by that shielding. The degree of protection which a material offers is the result of two factors: density and thickness or mass. For example, 20 inches of concrete will provide shielding equivalent to 30 inches of earth.

Geometric shielding. Another type of natural protection is provided by distance, or geometric shielding. Exposure is decreased with an increased distance between the fallout and the individual. A person will receive less exposure from fallout 20 feet away than fallout five feet away.

Effects of radiation. The major threat to the shelterees will be external whole-body radiation. The nature and severity of its effects will depend upon the dose received. Any degreee of radiation sickness occuring in the shelter will be deterimental to effective operation of the shelter organization. Mild doses of radiation will serve to reduce the efficiency and capability of the shelterees in performing shelter tasks. Other symptoms such as vomiting will cause medical and sanitation problems and will generally demoralize the shelterees. Deaths from radiation sickness may cause emotional problems great enough to disrupt normal functioning of the shelter organization.

## Major Planning Factors

Four major factors which should be considered in planning for radiological protection are:

1. Assessment of the shielding already available in the dual-purpose structure.
2. Provision of additional shielding as necessary or desired.
3. Provision of radiological monitoring capability within the shelter.
4. Provision for decontamination in and around the shelter.

## Assessment of Available Shielding

Nature of Available Protection

The whole concept of dual-purpose shelters is based upon the fact that existing structures usually provide some radiation shielding as an inherent part of their design. The degree of protection may vary greatly from one part of the structure to another. This variation, and the specific level of protection afforded at any point in the building, will depend on such things as:

1. Basement areas and/or heavy walls and ceilings of sufficient density to provide barrier shielding against direct penetration of radiation from fallout outside the structure.
2. A structural configuration which would provide geometric shielding by placing the shelterees in an area distant from the source of radiation.

Protection Factor

The detailed and systematic appraisal of all such relevant variables will permit computation of the minimum protection factor afforded by a potential shelter area. This protection factor is a ratio based upon the radiation dose a person would receive without protection as compared to the dose he would receive with protection. This is: $PF = \frac{\text{Dose without protection}}{\text{Dose with protection}}$. For example, if the radiation dose in the absence of a shelter is 1200 roentgens, and the radiation dose inside the shelter is 30 roentgents, the protection factor is 40.

Approaches to Assessment

The complexity involved in computation of a protection factor, and the importance of this factor to shelter planning, necessitate a careful and, if possible, professional assessment of available protection. When several potential shelter areas are available, shelter planners may wish to roughly appraise the protection afforded by each of these areas in order to determine whether a more formal survey and other steps toward development of a shelter are appropriate. With the use of guidance materials available through local, state or Federal Civil Defense organizations, individuals with some training in engineering or architectual design should be able to estimate the radiation protection available within an existing structure. Such estimates cannot be expected to be as accurate as those by professionally trained individuals. However, they can be useful at least in determining general shielding potential and whether or not a structure should be surveyed more formally as a possible dual-purpose shelter.

Professional assessment of available radiation protection may be obtained through request for participation in the national survey, use of professional consultants, and participation in formal training.

Requests for participation in the national survey. Shelter planners who feel that a particular structure will qualify for the National Marking and Stocking Program may request that it be surveyed as part of the Fallout Shelter Updating Program. This program, which is contingent upon future appropriations, will assess the protection of structures missed during the initial survey, or those which have been newly constructed or modified since that time. Requests for consideration in this program should be directed to local civil defense officials. The survey, conducted by government-trained architects and engineers, will indicate:

1. Those areas within the dual-purpose structure which provide adequate radiation protection. (A protection factor of at least 40 is being used as a basis for designating shelter areas in the current Federal program.)

2. The capacity of the designated shelter areas.

3. Steps which can be taken to provide adequate protection in other parts of the structure.

Those who request the government survey, should, of course, be prepared to sign a license permitting public marking and stocking of all adequately protected shelter areas with a capacity of more than 50 persons.

Use of professional consultants. An increasing number of architect/engineering firms are becoming familiar with techniques for assessing radiation shielding through participation in government-sponsored courses and in the shelter marking program. These organizations may be available for the development of private structures on a consulting basis. Many of these firms were involved in the Federal marking program, and may be contacted through the local Civil Defense office. Colleges and universities also often are good sources of highly-qualified individual consultants. In all cases care should be taken to assure that the consultant is trained and, preferably, experienced in the specific and unique problems associated with radiation shielding. A reliable consulting firm or individual consultant should produce an appraisal or potential radiation shielding equivalent to that provided by participation in the Federal Marking and Stocking Program.

Participation in formal training. Those responsible for shelter planning may send architect/engineering personnel to government-sponsored courses and develop their own capability for the assessment of radiation protection. The availability of such courses should be determined through the local Civil Defense office. Identification of shelter areas in this manner does not necessarily involve participation in the marking and stocking program, but the assessment of radiation protection should be quite accurate.

## Providing Additional Protection

### Need

If adequate radiation shielding is not available in the potential shelter area it is very important to provide additional protection to an extent which raises the protection factor to a satisfactory level.

A protection factor of better than 40 will be useful for shelters in a geographical area for which particularily large amounts of highly radioactive fallout may be anticipated, such as areas downwind and relatively close to potential targets. Except for "hardened" shelters constructed to withstand blast effects in areas which also may be extremely "hot" in terms of radiation, protection factors probably need not exceed 1,000.

### Methods

In some cases additional complete-cover shielding may be required to achieve the desired protection for a shelter area. That is, entire walls may have to be constructed to provide adequate shielding (Suggs, 1962). Most potential dual-purpose structures, however, will require additional shielding only at certain points around the shelter area. Windows, doors, and the other openings may reduce the protection factor of an area which is otherwise well protected by the thickness of its walls and ceiling. Such openings must be blocked or baffled with concrete or other dense materials to provide adequate shielding.

These steps for providing additional protection may be taken long before an attack by constructing permanent baffle walls, or by solidly blocking up wall openings. Another approach is to quickly form the additional shielding following an attack warning, using blocks or other building materials which have been set aside for that purpose, or which are always available for some peacetime use.

The first approach, that of permanent modification in advance of an attack warning, has many advantages. As was pointed out earlier, adequate

radiation shielding is fundamental to shelter effectiveness. This protection must be available when fallout first decends following an attack. The construction of protective barriers following an attack warning could be quite time consuming due to:

1. The substantial weight of building materials dense enough to provide adequate shielding.
2. The necessity for relatively precise construction to assure against "leaks" in the shielding barriers.
3. The congestion of personnel which can be anticipated in and around the shelter following an attack warning.

The need for haste following a warning usually will necessitate "dry wall" construction of the barriers; that is, placing the building materials side-by-side and on top of one another without the use of mortar or other adhesive substance. The inherent instability of such construction makes the erection of free-standing walls over four feet high extremely difficult. Such barriers also would be extremely susceptible to collapse in a crowded shelter, and normally non-fatal blast pressures could convert loosely-laid building materials into dangerous missiles within the shelter. In contrast, shielding provided during peacetime can be sturdily constructed by professional contractors, and the protection factor of the shelter area formally re-assessed when the modifications are complete.

In most dual-purpose structures, certain wall openings must be retained to meet ventilation requirements or permit personnel movement. In such cases, baffles can be constructed which permit personnel and air movement but effectively block radiation. This principle is illustrated in Figure 1.

Peacetime users of a dual-purpose structure may object to having windows and other openings blocked or even baffled prior to an attack. Attractive murals of outdoor scenes can be used to meet this problem in

windowless shelter areas. If such an alternative is not possible or acceptable, post-warning shielding may be used. Techniques for facilitating this approach include:

1. Use of floor markings, which can be decorative in nature, to indicate where barriers should be erected.
2. Installation of "L" beams at windows sills to support shielding material (Suggs, 1962). These braces can be used to support window boxes during peacetime. Figure 2 illustrates this technique.

## Radiological Monitoring

Definition and Application

Radiological monitoring is the means by which the current and accumlated amount of radioactivity at a given location may be observed by shelter personnel. This monitoring is useful in:

1. Assessing levels of radiation at various locations within the shelter.
2. Appraising the extent of contamination of objects and personnel entering the structure following an attack.
3. Determining when the outside radiation level has diminished enought to permit exit from the shelter.

Basic Instruments

Instruments of use in radiological monitoring are of two types: ratemeters and dosimeters. The amount of radiation in a given area may be measured in roentgens, just as distance may be measured in miles. The ratemeters indicate the number of roentgens per hour being received by the instrument; it is analogous to a car's speedometer. It indicates the "dose rate" at one point in time at the location of the instrument. The dosimeter is analogous to the mileage indicator; it shows the total amount of

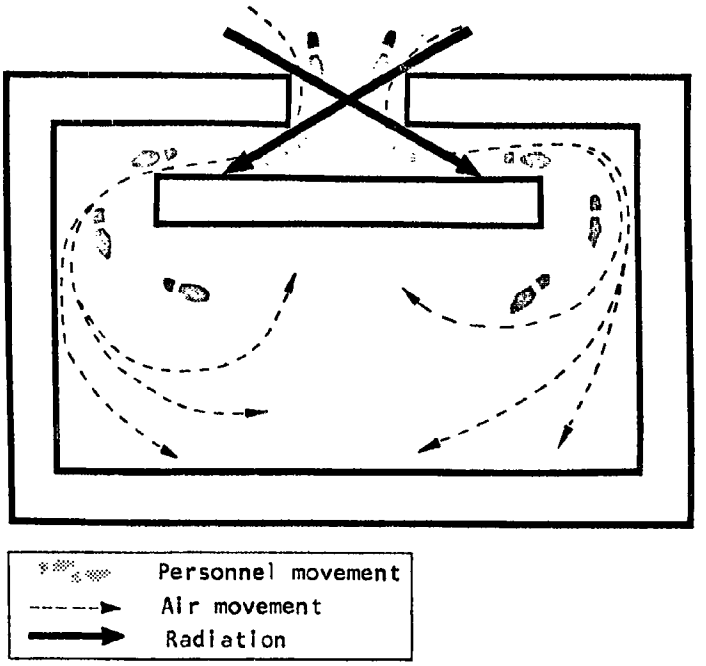
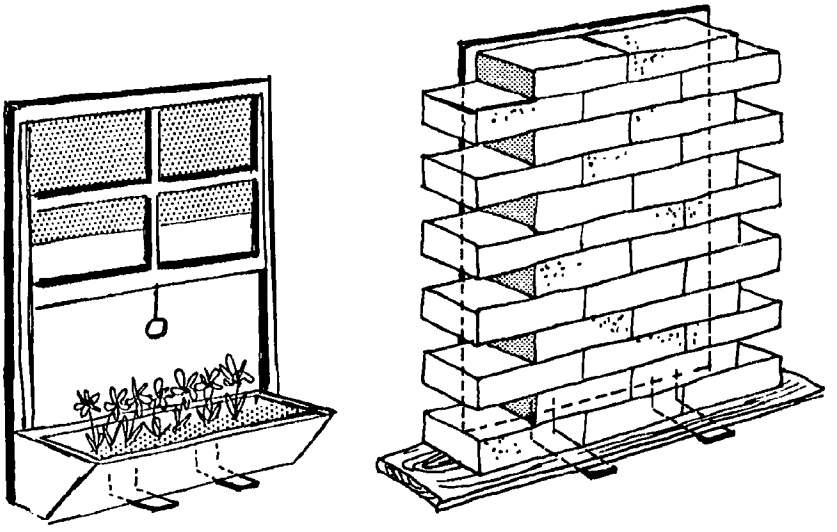



Figure 1. Baffle Shielding



Pre-warning

Post-warning

Figure 2. Post-Warning Window Shielding

radiation, in roentgens, which as been received from the time the instrument has been put into operation. Both instruments have important uses in such important shelter activities as decontamination where, for example, ratemeters would be used to indicate the radiation level of contaminated objects, and the dosimeter used to determine the total amount of radiation which has been accumulated by the decontamination team.

Due to the critical nature of their tasks, radiological monitoring instruments must be both accurate and reliable. Both instruments should be operable after storage for several years. Remember also, that these instruments could be needed during the reconstruction stage following an attack, as well as during the shelter stay. For this reason, they should perform reliably throughout many weeks of continuous use. Ratemeters with a range of 0 - 500 r/hr, such as the CD V-715 instrument provided by the Federal government (DOD, 1962) are quite adequate for shelter use. Dosimeters should have a reading range of 0 - 200 roentgens in order to provide information within the range which is critical to man's health and safety (Glasstone, 1962).

Procurement of Instruments

Some dual-purpose shelter structures may house industrial or research functions during peacetime which require the use of radiological instruments; in the few cases where the opportunity exists, these instruments may be considered for shelter use, but only when their range and other characteristics are compatible with emergency needs, and their availability upon an attack warning can be assured.

In most cases, radiological instruments for shelter use will have to be obtained from the government or purchased on the open market. Structures which qualify for the National Marking and Stocking Program will, of course, be provided with a community shelter radiation kit (CD V-777-1) along with the rest of their shelter provisions. Some dual-purpose shelters will qualify for appointment as Federal, state or local monitoring stations. Peacetime occupants of these structures must accept the responsibility of

daily readings as part of the national monitoring network. At least four trained monitors are required for each site by present OCD standards (DOD, 1962). Each monitoring station is provided with a radiological defense monitoring kit (CD V-777) suitable for general monitoring and shelter use.

A number of radiological monitoring instruments are also available commercially. A complete kit, including at least one ratemeter, dosimeter and battery-operated charger, can be purchased for as little as $25. Local civil defense authorities should be consulted to confirm the adequacy of any instruments with which the shelter planner is unfamiliar.

### Personnel Requirements

Shelter planners must take into consideration the importance of the qualified personnel, as well as adequate equipment, needed for radiological monitoring. Unlike certain other shelter equipment, radiological monitoring instruments should be used by pre-trained operators to assure maximum effectiveness in the shelter situation. Current OCD plans call for three radiological monitors in each shelter of 50 - 100 spaces, and five monitors in larger shelters (DOD, 1962).

As a minimum requirement, shelter monitors should study the operating and maintenance manuals provided with each radiological instrument. An actual demonstation by someone familiar with the equipment is desirable. Optimum training would involve at least one person's participation in the two-week course for Radiological Defense Officers, and subsequent training (four to five hours) of additional radiological monitors by the RDO.

## Decontamination

### Nature of Decontamination

Decontamination is the process of removing radioactive fallout from personnel, clothing, water, food and other contaminated surfaces. Removing

fallout from surfaces, is similar to removing dirt. "Dry" decontamination involves brushing, dusting, sweeping, etc., and is considered extremely practical for shelter use, (RCA Service Company, 1960; Suggs, 1962). "Wet" decontamination is accomplished by washing or scrubbing the decontaminated area. This approach, as in removing dirt, is very effective but requires large amounts of water.

There should be little need for extensive decontamination within most dual-purpose shelters. Pre-shelter planning, therefore, need not be extensive, particularly when simple "dry" procedures are to be employed. More elaborate provisions, possibly involving wet decontamination, will be appropriate in such situations as:

1. "Core" shelters which plan to expand following an attack, thereby necessitating some decontamination of peripheral areas of the structures.
2. Shelters which anticipate many late arrivals, or which will house radiological monitors, rescue teams, or other personnel subjected to exposure to fallout.

Even in these situations, dry decontamination usually will be satisfactory if the shelter water supply is limited. The approach to decontamination chosen also may depend upon the requirements and plans for fire protection. If hoses, or other fire fighting equipment are planned for the shelter, consideration should be given to the possibility of using this equipment for decontamination. Dry decontamination eliminates the need for the installation of expensive facilities that may be required for wet decontamination. Although dry decontamination may be less thorough, the fact that it also will take less time may pose a decisive advantage in some shelter situation.

Support Equipment

Almost any approach to decontamination within a shelter will require some type of support. Personnel engaged in any type of decontamination

may need to wear protective clothing such as gloves, face masks, etc. If some method of wet decontamination is planned for the shelter, personnel will also require special clothing such as boots and raincoats.

Monitoring

Radiological monitoring may be helpful in decontamination through the identification of contaminated areas, follow-up monitoring of objects and areas which have been decontaminated, tracing contaminated waste, and personnel monitoring.

Personnel Requirements

Persons selected as decontamination personnel for the shelter should preferably have some experience in the control of individuals or groups who may be frightened and possibly hurt. These people should, if possible, receive several hours instruction in decontamination procedures by a Radiological Defense Officer or other qualified individuals. If desired, they may also be trained for radiological monitoring.

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# IV. OTHER WEAPON EFFECTS

## Major Needs

Protection from radiological effects should be of prime importance in shelter planning. However, consideration should be given to protection from other potential threats such as blast and the thermal effects of nuclear weapons. Some protection from these threats may be provided at little cost beyond that involved in meeting other shelter needs.

## Blast Protection

### Background

Effects from blast occur as a result of a wave of hot, compressed air which travels away from the fireball of a nuclear detonation a little faster than the speed of sound. These effects include a shock front, over-pressure, high-velocity winds, and earth tremors.

Damage to structures and material may occur from these effects in the form of cave-ins, broken windows and doors, and possibly fires caused by overturning furnaces or combustible equipment.

Over-pressure may cause personnel injuries--such things as broken eardrums, internal hemorrhages, and damaged organs. People also can be injured by flying debris such as glass, loose equipment, and furnishings; or they may actually be thrown through the air as a result of shock and high winds.

At present, there are three reasons why stress is not being placed on blast protection to the extent that it is on radiological defense:

1. The effects of fallout radiation extend over a much larger area than the effects of blast.

2. Some low-grade blast protection is inherently provided along with radiation protection.

3. Blast protection is more costly.

If blast protection is desired by the shelter planners, it will be necessary to go beyond this Guide for the possible methods. Appreciable blast protection usually cannot be found within the capabilities of existing structures alone, and special facilities which would be required are expensive.

However, shelter planners should give some consideration to blast protection, since many steps can be taken in dual-purpose shelter planning to reduce the danger of blast. As a result of these steps, shelters situated on the fringe of a blast area may be provided with enough protection to insure their structural integrity as fallout shelters.

## Major Planning Factors

A low order of blast protection may be provided through radiation shielding. Blast effects may be reduced through properly designed barrier shielding provided for protection against radiation.

There are a number of methods using available materials which may be used to increase protection against blast. To prevent all shelter furnishings and portable equipment from becoming flying debris, they should be located out of the line of possible blast. Sand bags or other material may be stacked around immovable equipment, such as a generator, to buffer the shocks of the blast.

It is not advised that shelter planners depend on drapes, venetian blinds, or other regular window coverings to stop flying glass, since the glass will probably cut right through. Venetian blinds may, in themselves, become dangerous missiles.

Some special equipment is also available which may increase blast protection. Anti-blast valves and doors may be purchased to reinforce shelter openings from effects of blast. Also, some provision should be made for protecting the ventilating equipment when forced ventilation is used (Department of the Army, 1958). To obtain more information about these facilities, local, state, and Federal civil defense agencies should be contacted (Covert, 1961).

# Thermal Radiation Protection

## Background

A nuclear explosion radiates a tremendous amount of heat within the first minute or less following the detonation. Since thermal radiation is released within such a short time span, its effects are limited to the surface of exposed objects. The high concentration of heat, however, causes the temperature of the object to rise rapidly. Thermal radiation, therefore, will char or burn exposed surfaces, but some protection may be provided by even a light-weight, reflective covering--such as a white sheet. The instantaneous effects of thermal radiation will cause burns to exposed personnel and may damage equipment which is not shielded. Fires started by this initial effect may spread and cause further damage.

## Major Planning Factors

Radiological protection provided for a shelter inherently affords protection against the effects of thermal radiation. Materials used in radiation shielding will provide an insulating shield for those within the shelter against initial thermal effects. Further, the external surface of the shelter usually will be composed of concrete or other dense material which is unlikely to be kindled by the heat flash.

Fires near the shelter area resulting from thermal radiation may ultimately pose a threat to the shelter. Standard prevention of fires around the shelter, employing such methods as removal of rubbish, etc., will provide protection against this threat of thermal radiation. However, following the blast and before the descent of fallout, a fire inspection should be made of the area surrounding the shelter. Other methods of fire protection for the shelter are more fully discussed in Chapter X.

# References

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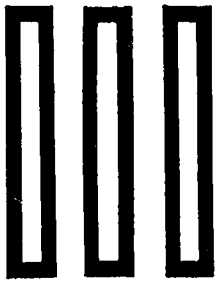
# SUSTENANCE
# OF
# LIFE AND HEALTH



MAINTENANCE AND AUXILIARY POWER

TEMPERATURE AND ATMOSPHERE CONTROL

WATER SUPPLY

FOOD

LIGHTING

FIRE PROTECTION

MEDICAL

SANITATION

# V. MAINTENANCE AND AUXILIARY POWER

## Maintenance Requirements

### Background

In order to fulfill the functions discussed in the remainder of this report, some group fallout shelters will contain equipment which requires maintenance support. Much of the equipment which may be provided, such as ventilation systems, must perform adequately during the entire shelter stay to assure the health, and often the survival, of the shelter inhabitants. At the same time, under conditions of a nuclear attack, the resources commonly available to maintain and repair many critical items will not be available on casual demand. Thus, shelter planners should provide some capability for essential in-shelter maintenance and repair.

A primary concern in shelter planning, of course, will be to achieve the highest possible degree of reliability in shelter equipment and, thus, keep the need for maintenance and repair to a minimum. Many equipment items, however, require some preventive maintenance, such as oiling, adjusting, etc., in order to keep them functioning properly. In addition, even the most reliable equipment is subject to some chance of failure, particularly when operated continuously for as long as two weeks following a storage period of perhaps several years. Finally, all shelter facilities run the risk of being damaged, either by weapon effects or accidents within the shelter itself. Shelter planners must take all three of these possibilities into consideration when developing some capability for in-shelter maintenance and repair.

## Major Planning Factors

The steps involved in planning for shelter maintenance are:

1. Identify specific maintenance requirements. The variety of tools, test equipment, and other items available for various maintenance tasks is virtually endless. Planning for a general and somewhat nebulous shelter maintenance need would be expensive and inefficient. Shelter planners should carefully identify the maintenance requirements associated with each item of shelter equipment. These data should be used not only in deciding upon the procurement of various shelter facilities, but also to identify the specific maintenance support required for each shelter item.

2. Identify special requirements to support unskilled personnel. The probable lack of highly skilled maintenance personnel within a shelter should be reflected by shelter planners in simplified maintenance procedures, detailed instructions, and the stocking of simple, standard tools.

3. Stock and post maintenance instructions. Clear instructions for both preventive and corrective maintenance should be provided for shelter use. Basic operating and maintenance instructions should be posted in plain view on or near the associated equipment. Diagrams, charts, and other aids should be provided to reduce the probability of error on the part of maintenance personnel (Altman, Marchese, & Marchiando, 1961).

4. Stock essential maintenance tools. The tools needed for shelter maintenance should be procured and stored in a safe location within the shelter. Many of the necessary tools may be available among the maintenance resources of the dual-purpose structure housing the shelter. The every-day use of many of these tools, however, may make it advisable to stock extra items especially for shelter use. This will be particularly true if only a small number of relatively inexpensive tools are required.

5. Consider structural repair and rescue. Shelter planners may wish to provide some capability for general repair and rescue in the event of blast damage to their dual-purpose structure. The materials which should be provided for such operations are discussed in Rescue Skills and Techniques (OCDM, 1959).

6. Provide skilled personnel. In a few cases, the use of complex shelter equipment will require skilled personnel for adequate performance of in-shelter maintenance. Shelter planners must identify this need and see that it is met (see Chapter XVI).

Additional information regarding the maintenance of shelter equipment may be found in the document prepared in 1963 by the IIT Research Institute under an OCD shelter operations contract.

# Auxiliary Power

## Uses

Certain shelter equipment may require the support of some power source. It is almost never reasonable to assume that municipal power serving a dual-purpose structure will remain intact following a nuclear attack. All essential equipment can be operated on self-contained batteries or powered manually to meet minimum shelter needs. The effectiveness of many shelter systems can be significantly increased, however, by the support of a relatively large central power supply.

A major advantage of auxiliary power is the increase in shelter capacity which can be achieved through the use of electrically-powered forced ventilation, or even air-conditioning systems. Another use of auxiliary power is for shelter lighting. It also may be used for support of communications and, if necessary, water pumping. In addition, auxiliary power may be useful for heating elements used in the preparation of food, or even refrigeration for food preservation. Waste disposal facilities, such as a sump-pump, also may use auxiliary power. Where completely adequate power facilities are available, this power may serve other uses, such as support of special medical facilities or consoles used in radiological monitoring.

## Planning Implications

The use of auxiliary power to support any or all of these shelter functions must be traded off against other planning considerations. Two of the most important factors to consider are cost and fuel storage. Cost estimates must include the man-hours required for peacetime maintenance, as well as the expense of the equipment itself. Provision of auxiliary power could be the most expensive item in the shelter budget, but it could also be the biggest bargain when one considers the advantages discussed above. The hazards associated with storage of fuel for power equipment give rise to legal, as well as technical, problems which must be considered during shelter planning.

The installation of auxiliary power equipment will be an efficient use of shelter space if the capacity of the shelter can be increased by the use of electrically-powered ventilation. The equipment must be housed in an area which permits control of the heat, noise, fumes, and other undesirable elements associated with its operation. Shelter planning must also provide for the qualified personnel and support equipment which may be needed for the operation and maintenance of an auxiliary power unit.

## Procurement

Auxiliary power may be provided through use of existing facilities or by direct purchase of power equipment. Many buildings have auxiliary power units for use during peacetime emergencies. In this case, shelter planners should see that this equipment is located within a shielded area and within access of the shelterees. In addition, this equipment must be tied into the shelter system. Some firms which use large vehicles have spare batteries which provide a limited source of auxiliary power. Under other circumstances, it may be appropriate to purchase power equipment. In this case, an engineering expert usually should be consulted because of: (1) the key role which auxiliary power may play in shelter operations, (2) complexity of most auxiliary power systems, and (3) the unique needs of any particular shelter.

Information on the characteristics, selection, operation, and maintenance of auxiliary power equipment is provided in the report referred to on page 34.

# REFERENCES

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Office of Civil Defense Mobilization. Rescue skills and techniques. Washington, D. C.: Government Printing Office, June 1959. (Revised)

# VI. TEMPERATURE AND ATMOSPHERE CONTROL

## Background Information

Control of the shelter temperature and atmospheric composition can be as vital to survival as protection from weapon effects. Lack of adequate control could result in objectionable or dangerous changes in shelter temperature or atmospheric quality. Atmospheric changes might include an increase in carbon dioxide and carbon monoxide and a decrease in oxygen content. Temperatures and humidity will tend to increase if not controlled.

Radical situations of this type could cause deaths in the shelter or might force shelterees to move to less protected areas. Less severe changes may result in increasingly serious physiological and psychological effects upon the shelterees which could be detrimental to shelter operation.

### High Temperature

A dangerously high effective temperature is probably the biggest environmental threat posed by crowded conditions of shelter living. Effective temperature relates dry-bulb temperature, humidity, and air movement to physiological comfort or discomfort. Effective temperatures from $50^{\circ}$ in cold weather to $78^{\circ}$ in warm weather cover the range of relative comfort (National Research Council, 1960).

A shelter's effective temperature will rise sharply immediately following shelter entry because of the body heat and moisture generated by the shelterees. Other causes of high temperatures include factors both internal and external to the shelter. Heat in the shelter can be generated from heating appliances used in the preparation of food or purification of water, from lights, and from shelter machinery. Chemicals for absorbing $CO_2$, if used in the shelter, will give off heat in proportion to the amount of $CO_2$ absorbed. High temperatures can also be a result of such external causes as seasonal temperature. An excessive increase in temperature and humidity will encourage upper respiratory ailments and generally demoralize the shelter. Extreme

shelter temperatures will result in lassitude and eventual collapse of the shelterees. High temperatures will also cause shelterees to perspire more and, as a result, will increase their need for water.

Low Temperature

Effective temperatures which are low enough to cause some discomfort may be expected in above-ground shelters when outside temperatures are low. If effective temperatures get below 50° F., medical and psychological problems will increase, work efficiency may suffer, and the shelteree will require more food and oxygen.

Atmospheric Imbalance

A decrease in oxygen and an increase in carbon dioxide and carbon monoxide can create a dangerous situation in the shelter.

Shelter planning should assure that the oxygen level of shelter air can be maintained at a minimum of 19 per cent, and that the carbon dioxide level can be kept below two per cent. No amount of carbon monoxide should be tolerated in the shelter air (National Research Council, 1960).

The three major causes of oxygen and carbon dioxide problems in the shelter are:

1. Inadequate air exchange which causes the oxygen to be burned up faster by the shelterees than it can be replaced and increases carbon dioxide beyond healthy limits.
2. Fires which consume oxygen and give off carbon dioxide.
3. Carbon dioxide added to the air from engine exhaust and cigarette smoke.

An increase in carbon monoxide may be the result of engine exhaust fumes, tobacco smoke, or open flames.

An increase in carbon dioxide may cause labored breathing, uncooperativeness, and apathy; while an increase in carbon monoxide may result in poor balance, dizziness, and mental confusion. A decrease in oxygen will have certain effects on the shelterees, such as reduced reaction time, poor memory, and irritability.

# Major Planning Factors

The atmospheric composition and temperature within a shelter may be controlled by one or more of the following:

1. Air exchange which can usually be quite effective in controlling both the atmospheric composition and the temperature in the shelter.
2. Control of air temperature and humidity which can keep the effective temperature of shelter air at a safe level.
3. Air purification which can be effective for controlling composition of the shelter air.

Consideration should be given to each of these factors during shelter planning.

## Air Exchange

The removal of stale air from the shelter and introduction of fresh air from the outside is a fundamental, and probably the most promising, technique for control of both effective temperature and atmospheric composition. Generally speaking, air exchange may be accomplished through: (1) natural ventilation, and (2) forced ventilation.

### Natural Ventilation

Natural draft ventilation relys solely on air circulating through open doors and windows, cracks, and other natural openings in the shelter. The extent and effectiveness of natural ventilation in any particular structure will be a function of many things, such as structural characteristics of the building, prevailing winds, and even orientation of the structure in relation to the sun's most direct rays (National Safety Council, 1955). Natural ventilation is, of course, much more effective in the upper stories of a building than in a closed basement. A ventilation specialist probably should be

consulted to determine the potential natural ventilation of any dual-purpose shelter. Shelter planning might include procedures such as opening doors or windows for enhancing the natural ventilation of a structure following an attack warning. These procedures, however, must be compatible with other shelter requirements, such as protection from fallout.

The exclusive use of natural ventilation will greatly limit the number of shelterees that can be adequately provided for in a shelter. In general, naturally-ventilated, above-ground shelter areas should allow 500 cubic feet of space per person in planning shelter capacity, to provide for satisfactory atmospheric composition during the shelter stay (OCD, 1962). This principle, however, assumes the availability of completely adequate natural ventilation. If there were no air replacement, 500 cubic feet of space per person would provide only for about one day of shelter occupancy.

Forced Ventilation

Basement shelters and above-ground facilities which wish to approach the ten square feet per person standard for shelter capacity (OCD, 1962) probably will have to employ some mechanical equipment, such as fans or blowers, to provide adequate air exchange. In planning for forced ventilation of a shelter, consideration should be given to: (1) the required rate of air exchange, (2) the need for an auxiliary power source, and (3) specific methods for providing forced ventilation.

Rate of air exchange. An air exchange rate of three cubic feet per minute per person has been suggested as a minimum requirement for maintaining the atmospheric composition of the shelter (OCD, 1962). It is important to note, however, that in many cases this rate of air exchange will prove inadequate for the control of effective temperature in the shelter. Figure 3 indicates the rate of air exchange required to maintain a safe effective temperature under various conditions of outside air temperature and humidity.

Other factors, such as the temperature of the earth around the shelter, also are related to the required rate of air exchange. The complexity of this problem will, in most cases, require consultation with a ventilation specialist to determine the rate of air exchange and/or capacity of a particular shelter.

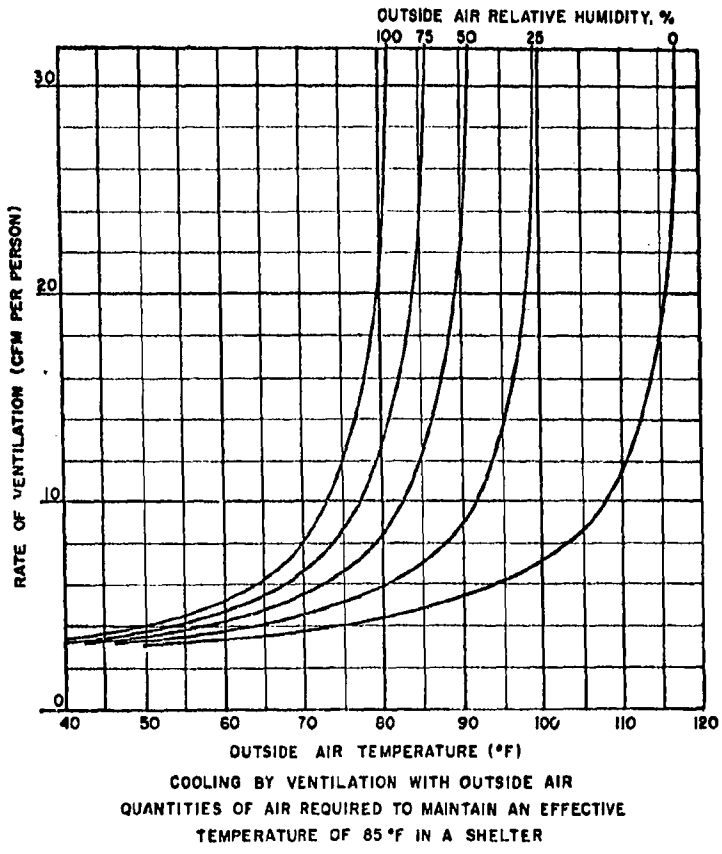


Figure 3. Required Rates of Air Exchange*

Need for auxiliary power. Forced ventilation systems can be powered by hand cranks, "bicycle" chain drives, and other manual means. Such techniques are limited, however, by the work output required, the body heat generated by that work, and limited air volume which can be exchanged per

* Allen, F. C. From Mechanical equipment requirements. In Symposium on survival shelters. Miami Beach, Florida: American Society of Heating, Refrigerating, and Air-Conditioning Engineers, 25-27 June 1962. Reproduced with permission of the author.

unit of effort. Large, fairly crowded shelters, and other situations requiring the rapid exchange of large volumes of air, usually will require the support of an auxiliary power source. The power requirements of the ventilating equipment must be carefully assessed in relation to other demands which might be made upon the shelter's electrical system. Consideration may be given to the use of blowers (fans) with alternative manual/motor drives. Then, if the power fails, the blower can be hand operated.

Methods for providing forced ventilation. Again, professional specialists probably should be consulted to determine the particular method for forced ventilation of a shelter, as well as the power requirements for support of that method.

In some cases, available peacetime facilities may be useful for shelter ventilation. Portable fans or air-conditioning units may be installed at pre-designated openings of the shelter upon receipt of an attack warning and plugged into an auxiliary power source. Also, permanent ventilation systems in large dual-purpose structures may be modified to permit operation on auxiliary power and the by-pass of non-shelter areas, with a resulting high-volume air flow to the shelter facilities.

Such uses of peacetime facilities could reduce shelter costs, but may prove to be inefficient or inadequate. In dual-purpose structures which inherently provide an adequate amount of radiation shielding, the installation of ventilation facilities often may be the most fruitful way to spend a large portion of any funds which are available for shelter development. These facilities could be useful during peacetime for the ventilation of offices, laboratories, storage rooms, or other dual-purpose areas.

General technical requirements for shelter ventilation are continually being generated by the Office of Civil Defense and other agencies (Allen, 1962). Ventilation specialists serving as consultants to shelter planning should make every effort to become familiar with the latest requirements.

## Control of Air Temperature

### Requirements

The need for adequate control of shelter temperature has been pointed out earlier in the chapter (p. 38). Control of high temperatures appears as the major problem. The effective temperature in a shelter should be kept below 85°, if possible. An effective temperature of 78° is fairly comfortable for the shelterees. Temperatures below 60° could cause extreme discomfort.

### Facilities for Temperature Control

Air exchange can usually be very effective in maintaining acceptable low temperatures when sufficiently large volumes of air can be circulated through the shelter. However, as indicated in Figure 3 (p. 42), the rate of air exchange required for temperature control becomes exhorbitantly high under certain conditions of outside temperature and/or humidity. Plans for reducing the temperature of incoming air may, therefore, pose a more expedient solution to the control of temperature in shelters located in normally warm climates.

Air may be cooled by the use of conventional air-conditioning units, which also may be used to facilitate air exchange (p. 43). An adequate power supply must be available if this method is to be used. Another technique which could be applied is to pass air through cool water by means of an air washer. The air is cooled and also cleaned by this method, but the humidity will be increased.

Since the temperature of well water in most parts of the country usually is relatively low (45° - 55° F.), it may be used for cooling the air in shelters where a well is available. This could be done by passing air around a surface coil through which well water is being pumped. Ground or shallow well water temperatures in the South may be as high as 75° F., but even water at this temperature can be helpful if plentiful, and a high volume of air flow and large coil surface areas are available. However, an increase in humidity could also be a problem with this method.

If some provision for heating the shelter is desired, conventional heaters may be used where power is available. If diesel or gasoline engines are used in the shelter, waste heat may be drawn from this machinery and used to heat water for coil heaters. This would not involve use of any electric power.

A number of these methods for shelter temperature control involve use of materials available in dual-purpose structures, thereby increasing the feasibility of their use in the shelter system. Of major importance in shelter planning, however, are the relationships of various techniques for temperature control to air exchange and shelter humidity, along with the requirements for auxiliary power associated with many of these methods. All of these factors should be taken into consideration, probably by a professional consultant, during shelter planning.

Management of Activities

Management of shelter activities which might affect shelter temperature also should be considered in shelter planning. Careful management of certain activities will contribute significantly to the control of temperature. Some examples of shelter activities which might produce a rise in temperature are:

1. Physical activity on the part of the shelterees.
2. Utilization of heat-producing appliances.
3. Excess humidity raised by evaporation of moisture from uncovered water containers, wet garbage, human waste, or food preparation.

Careful control of these activities can be utilized to either increase or decrease shelter temperature significantly. Current studies being done on management of shelter activities should be consulted for further planning information (Bend, Griffard, Schaner, & Shively, 1963; Siroky & Eninger, 1963).

## Purification

### Requirements

A fresh-air intake of three cfm per person usually will be adequate to maintain the proper balance of oxygen and carbon dioxide in a shelter (see p. 41). A much greater volume of air often may be required, however, to sustain tolerably low shelter temperatures (see Figure 3). It follows that most shelters with sufficient air exchange to maintain temperature control will not require air purification to retain adequate atmospheric composition.

Shelters with provisions for air conditioning or other air temperature control, or those located in relatively cool climates, may be naturally ventilated or may utilize forced ventilation at a rate of less than three cfm of fresh air per person. These shelters could require some means of purifying the shelter atmosphere. Shelters which are capable of being sealed for fire protection also may require facilities for air purification.

### Facilities for Purification

Maintenance of a safe shelter atmosphere may be accomplished through:

Filtration. The purpose of filtration is to remove dangerous particulates from shelter air. Commercial air filters may serve the purpose of removing particulates, but will require a forced ventilation system to overcome the resistance which incoming air will meet from the filter. Filters which are already installed in good ventilating systems for peacetime use are usually adequate for removing particulate matter such as fallout. Filters will need to be shielded against damage from blast and thermal radiation and should be kept from moisture. If filters are clean at the start of occupancy, they probably will not require servicing or replacement during the anticipated stay time. Since the material accumulated by the filters may be radioactive, it should be shielded from the general shelter area to protect the shelterees (Department of the Army, 1958).

Sand or gravel filters may also be used for air purification. This type of filter will remove heat and most particulate matter from the air, but is

not capable of removing such toxic elements as carbon monoxide. In most cases, sand or gravel filters will not be available in existing structures, and will need to be specially constructed. These filters are quite large and heavy, and will require a high-powered fan in order to pull the air through and into the shelter (National Safety Council, 1955).

Adsorption. The purpose of adsorption is to remove toxic or noxious elements from incoming air. This may be done by using charcoal filters and charcoal elements or such adsorbents as lime. Charcoal elements are especially good for removing foul odors and smoke from the shelter air. Charcoal should be kept from moisture to maintain its adsorbancy. If charcoal filters are not located in the shelter, they should be located in a shielded area to protect both maintenance personnel and the general shelter population.

Such elements as soda lime, baralime, and lithium hydroxide are capable of removing carbon dioxide from shelter air. These materials will produce a chemical burn in contact with the skin, and are highly irritating to the lungs and eyes, so care must be taken in their use. Lime also must be kept dry to be useful.

Oxygen regeneration. The purpose of oxygen regeneration is to periodically replace oxygen in the air. Oxygen regeneration can be accomplished by bleeding oxygen from large tanks into the shelter. Trained personnel will probably be needed to operate such equipment. Also, precautions must be taken against possible fire hazards. Chlorate candles, which give off oxygen when burned, may be used as a possible method for oxygen regeneration. This method is generally not desirable, since it may cause the shelter temperature to rise considerably. This method also requires special facilities in its use, and is quite expensive. Precautions also must be taken here to protect against fire hazards.

Most of the techniques for air purification involve a certain amount of technical complexity and some inherent danger. In addition, there may be some questions as to the actual need of purification facilities as opposed to such alternatives as: (1) increasing the volume of air exchange, if the source of contamination comes from within the shelter; or (2) sealing the

shelter against contamination in the outside air. Both the need for air purification and the specific techniques for meeting this need should be considered by a trained ventilation specialist. Such specialists should be aware of the unique problems associated with shelter design, and familiar with the latest literature in this area (i.e., National Research Council, 1960).

Management of Activities

Careful management of activities which might reduce the need for air purification in the shelter should be considered in shelter planning. Some of these activities include:

1. Physical activity on the part of the shelterees.
2. Running of shelter machinery, which gives off exhaust fumes.
3. Using open flames for cooking, which gives off carbon monoxide.
4. Removal of waste, garbage, and corpses, which cause foul odors.

The latest studies on management of shelter activities should be consulted for further planning information (Bend, et al, 1963; Siroky & Eninger, 1963).

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# VII. WATER SUPPLY

## Background

Water is necessary to sustain the life of the shelterees. Although a human being may survive for two weeks with no food, it will not be possible to survive in the shelter for more than a few days without water or liquids. Even limitation of fluid intake to the minimum requirements for survival has been shown to cause considerable discomfort and could seriously impair an individual's ability to perform certain critical shelter tasks.

Water may be useful for other shelter functions such as fire suppression, decontamination and sanitation. These functions may be satisfactorily provided for without the use of water. However, if water is to be used, large quantities may be required.

Water which is procured and stored for these other purposes should be drinkable.

## Major Planning Factors

Planning for a shelter water supply should consider the following major factors:

1. Amount
2. Provision and Storage
3. Purification
4. Distribution

Methods for the distribution and use of water for non-drinking purposes are discussed in other chapters of this report. The following pages consider amount, procurement and storage of the entire water supply, and possible techniques for the purification and distribution of drinking water.

## Amount

The Federal government is stocking all licensed shelters with water containers holding 17.5 gallons of water, which provide 3.5 gallons for each shelter space.

The amount of drinking water required to maintain human efficiency in a shelter, however, will depend upon the shelter temperature, the length of the shelter stay, the nature of the shelter diet, and other factors. High shelter temperatures, particularly, will greatly increase the amount of water required by the shelterees.

The amount of water required for other shelter functions depends primarily on the other provisions which are available for meeting these requirements. If water is to be the sole means of meeting other requirements such as fire suppression and decontamination, the amount required for each function should be carefully assessed. For example, the use of showers for decontamination may require large quantities of water.

## Provision and Storage

Need

It is almost never reasonable to assume that the public water system serving a dual-purpose shelter structure will remain intact during or following a nuclear attack. A nuclear weapon exploded at a great distance from a shelter can destroy the water mains or pumping facilities which support that structure. Loss of power or maintenance personnel may also result in the eventual breakdown of the municipal water supply to an extent which makes decontamination temporarily inadequate. For these reasons, a sufficient supply of water must be maintained within access of the shelterees.

## Approach

The three basic approaches to provision and storage of water for shelter use are:

1. Stocking of water containers
2. Use of storage tanks
3. Use of wells

Sufficient water for a dual-purpose shelter also may be available in the structure's water system. Water may be trapped in the piping by shutting off all valves leading to and from the building's water system. Shelter planners should obtain a professional appraisal of the capacity of their buildings water system before designating this resource as a primary source of shelter water. Attention should be given to the correct procedures for tapping this source in the event of an emergency, and to the possible need for purification of the water (Bend, et al, 1963).

There are several other ways of providing water for the shelter. Some of these include use of: water from flush tanks of toilets; liquid from water-packed foods such as canned fruit; ice from undamaged refrigerators; and water collected in bathtubs, sinks, buckets, wastebaskets and other containers. Such approaches should be utilized as auxiliary sources, however, and rarely considered within the shelter plan as a primary source of water.

The three basic approaches to provision and storage of the shelter water supply should be considered in terms of their availability in a particular planning situation and the extent to which water purity is maintained.

## Containers

Availability. If water filled containers are to be used to store the shelter water supply, the shelter planner should decide whether they will be commercially filled (i. e. hermetically sealed cans) or self-filled (i.e. containers filled with tap water just prior to being placed in the shelter). Commerically filled containers are generally more costly because of the cost of the filling and sealing operation and because water is

heavy and bulky, and shipping cost will be high. Containers which can be self-filled may be procured in one of three ways: (1) through the Federal Marking and Stocking Program, (2) containers already available in existing structures, or (3) by direct purchase.

Maintenance of purity. Containers which are to be self-filled should preferably be those which have tight-fitting covers, such as the containers provided by the Federal Marking and Stocking Program. At the time of storage, containers should be marked with the date. A periodic inspection should be made of the water supply to determine its purity and any damage which might cause leaks and would necessitate replacement. Water in hermetically-sealed containers should maintain its purity for at least five years. Self-filled containers with a good seal, such as those provided by OCD, also provide long storage life.

The area in which containers are stored is also important in shelter planning. This area should be away from latrines and the sick-bay. It should be dry and cool, but caution should be taken to see that the water is not stored in a place where it might freeze.

Tanks

Availability. Storage tanks may be appropriate for storing water in relatively large shelters, particularly where a tank is available to meet fire suppression and other peacetime needs within the existing structure. If it is desired, a storage tank may be bought and installed especially for shelter use, but this would be quite expensive. In any case, storage tanks should be located as near to the shelter as possible. Also, precautions should be taken against possible flooding of the shelter if a tank ruptures due to blast damage during an attack.

Other types of tanks which may be considered for provision of a primary water supply are available furnace boilers or hot water tanks. However, these tanks would probably not provide enough water for the whole shelter population.

Maintenance of purity. Water stored in tanks will need to be tested periodically for purity. The tank itself should be inspected regularly for leaks, rusting, or other damage. If possible, to assure purity the peacetime water supply may be circulated through the storage tank. If furnace boilers or a hot water tank is to be used as part of the primary water supply, it should be flushed every three months until the tank runs clean to keep it free from rust and sediment.

Wells

Availability. If a well is available, it will be a good means of providing a water supply. An existing well may be used, or a well may be sunk especially for shelter use. It should be located as near to the shelter as possible.

Maintenance of purity. Water stored in wells should be checked periodically for purity. The well also should be checked for standing capacity and flow. A regular maintenance check of the well's pumping system should be made for possible damage or deterioration.

## Purification

Purification of the primary shelter water supply should almost never be necessary since this water should be checked and possibly rotated periodically. As mentioned earlier, even such water sources as hot water tanks, boilers etc., if part of the primary shelter water supply, should be periodically checked to assure purity. However, some situations such as damage to the primary water supply, an extended shelter stay, or environmental conditions such as high temperatures, may create a need for more water than was originally planned for the shelter. Boilers, hot water tanks, flush tanks of toilets etc., if not part of the primary shelter supply, may be used as auxiliary water sources and should, as a matter of course, be purified. If not previously checked, water from furnace boilers and hot water heating systems might contain rust and other sedimentary material.

Generally, the three types of contaminants to be considered are:

1. Bacteria
2. Foreign Bodies
3. Toxics

Resources for coping with toxics such as anti-rust chemicals, etc., will be very limited in a shelter situation. However, the likelihood of encountering such elements is very small. Bacteria may be combated with water purification tablets, which are provided in federally stocked shelters. Several drops of chlorine household bleach or tincture of iodine added to each quart of water also can be quite effective, as will boiling the water hard for at least one minute (OCDM, 1961; Cannel, 1962).

Foreign bodies may be removed by filtering the water through filter paper, gauge, fiberglass, or finely woven fabric; or by allowing the water to stand until the sediment settles, and pouring off the "clean" water.

## Distribution

Water should be apportioned and distributed to the shelterees in the most efficient manner possible. Distribution is important because of the problems which may arise out of haphazard, poorly-organized handling of the shelter water supply. Two main considerations which hinge on the distribution procedure used are equitableness and waste. Wasteful or inequitable water distribution could result in generally poor morale, hostility and resentment toward shelter management, hoarding, and possibly even overt aggression among the shelterees.

### Methods of Distribution

Water may be distributed to the shelterees either by having them come to a fixed point of distribution or by taking it to them (moving-point distribution).

Fixed-point distribution. In small shelters or in shelters where crowding is not anticipated, a fixed-distribution point is desirable. The advantages of this method include:

1. facilitating management supervision of the distribution process.
2. optimizing equitable distribution.
3. minimizing waste.

Techniques for dispensing water at fixed-distribution points include:

1. water fountains
2. regular water spigots
3. hoses
4. dipping from water containers

Moving-point distribution. Water stored in containers can be transported to areas throughout a large shelter through use of various carts, trays, wagons and other vehicles available in existing structures. These carts may also be used for food distribution and movement of other heavy objects.

This type of distribution should be used only in large shelters where a traffic problem or a ventilation problem might arise from many people moving around the shelter area. This method will limit movement to a few people responsible for distribution.

If this method is to be part of a shelter plan, the shelter layout must provide room for the movement of these carts. Again, the risk of spillage is so great when using this method, that it should be employed only when no other feasible alternatives are available.

Combination. These two general approaches may be combined in planning for a very large shelter. Water may be taken from the shelter source and moved to several locations for fixed-point distribution. This water may be moved to fixed points by using equipment discussed under moving-point distribution. The water supply may also be piped to various parts of the shelter for distribution. Two ways in which this can be done are:

1. Use existing plumbing in the shelter by installing a by-pass which permits disconnection from the municipal system and a tie-in with the shelter water supply.

2. Install a special plumbing system throughout the shelter. This may be done with standard plumbing equipment, or simply by running flexible hose from the water supply to various points in the shelter, even following an attack warning.

Drinking Containers

Regardless of the distribution approach used in most cases each shelter inhabitant will require a container to hold his water ration. Each shelteree should have his own container to reduce the threat of contagious disease in the shelter. Federally stocked shelters contain plastic cups as part of their provisions. Many existing facilities have cup dispensers located at the water fountains throughout the building. Extra supplies of these paper cups can be stored in or near shelter areas for use in an emergency. In other cases, shelter planners can ask peacetime users of a structure to bring the cups which they retain for use during "coffee break" to the shelter following an attack warning. When cups are purchased especially for shelter use they should be of a durable and easily cleaned material which does not shatter to sharp edges if broken. Plastic picnic utensils may be appropriate for this purpose.

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# VIII. FOOD

## Background

### Need for Food

The food provided as part of shelter provisions need not be elaborate. Work output is not impaired by limiting food intake to less than 1,000 calories per day. Indeed, most of the relatively inactive shelter population could survive for two weeks with no food. Nevertheless, shelterees receiving too little food may become pre-occupied and uncooperative. Anxiety may become widespread, and lack of food may have a detrimental effect on the ability of shelterees to perform critical shelter tasks.

### Relationship of Food to Drinking Water

Any plan to provide food to shelterees must consider the relationship of food requirements to the provisions which have been made for drinking water. Food which provokes thirst, high protein diets, and vitamin supplements which require large quantities of drinking water should be kept to a minimum in shelters where the water supply is limited. Foods which require an abundance of water in their preparation also should be avoided in order to conserve the shelter water supply.

## Major Planning Factors

Planning for a shelter food program should center around five major factors:

1. Procurement
2. Storage

3. Preparation
4. Distribution
5. Provision of an Eating Area

An important consideration in planning for each of these factors is the general type of food selected for shelter use. The shelter menu may be comprised primarily of survival rations, such as biscuits, crackers, and a carbohydrate (hard candy) supplement, or it may utilize relatively standard foods, ranging from basic canned dishes such as chili or stew to complete meals. A third approach is the use of survival rations augmented by different "toppings" (jelly, spaghetti sauce, etc.), or by a supplemental supply of standard foods, ranging from candy bars to provisions sufficient for an occasional complete meal. The implications, such as cost, space requirements, etc., posed by use of a particular type of food will be pointed out, where appropriate, for each factor involved in food planning.

## Procurement

### Calories and Nutrients

Two primary considerations in the procurement of a shelter food supply are the number of calories desired for each shelteree, and the vitamins, minerals and other nutritional characteristics which are appropriate.

The Federal government, in its Marking and Stocking Program, is providing 10,000 calories of food per shelter space (DOD, 1962). Planning of food procurement for use in any particular shelter should consider the characteristics of the shelter population. Additional amounts or kinds of food may be desirable if a great many infants, young children, adolescents, the sick and aged, or pregnant or lactating women are expected in the shelter (Wells, 1962).

Also, stocking amounts of food beyond caloric minimums may help to offset feeding problems created by possible overloading, and alleviate low morale and other problems associated with reduced food intake.

Survival of the shelter population depends more on an adequate supply of calories than an adequate balance of nutrients. Primarily, foods that provide an adequate supply of calories and provision for some variety should be stocked in the shelter. Foods which are particularly high in protein content generally should be avoided since they create a need for a large supply of drinking water. It is desirable to include in diets for infants and pregnant or lactating women, and other special cases, more protein (along with more water), as well as vitamin C, calcium, and other nutrients.

Methods of Procurement

Three primary approaches may be followed in the procurement of a shelter food supply:

Federal stocking of emergency rations will be available to shelter areas which qualify for and accept licensing under the Federal Marking and Stocking Program. The general implications of participation in the Federal Program are discussed earlier in this document. A biscuit, or cracker, and carbohydrate supplement totaling 10,000 calories per shelter space will be provided according to the government-designated capacity of the shelter. The ration provides the essential dietary elements for energy and nutrients and daily calories sufficient for an adult during a short and relatively inactive period. It is also considered sufficient to maintain shelterees in condition to resume an active and productive life upon emergence. It is expected to be usable for at least five years and will be replaced periodically by fresh supplies when determined not to be usable any longer.

Back-stocking and rotation of foods used during peacetime may be a useful way to stock shelters in buildings which normally distribute food through vending machines, snack bars, cafeterias or restaurants. Depending upon the nature and volume of foods normally used in the building, storage of extra quantities for rotation through the peacetime facilities could provide an augmented or complete shelter menu. Such back-stocks, of course, must be stored within the shelter area for access following an attack. Candy bars and other snack foods

will be very useful in supplementing basic shelter foods. Plans for utilizing large back-stocks of meats and fresh vegetables normally available for restaurant or cafeteria use must take into consideration the refrigeration and cooking facilities required for preserving and preparing these foods during the shelter stay. An initial outlay of funds will be necessary to acquire the necessary back-log of provisions. Replacement of rotated foods would, of course, cost no more than that normally required to support the peacetime food distribution facilities. There may be some additional cost for storage and the administrative tasks associated with maintenance and surveillance of the larger food supply.

Direct purchase may be an appropriate method for obtaining survival rations, supplemental foods, or a relatively standard shelter menu. Emergency rations, identical or similar to those distributed by OCD, may be purchased from private manufacturers, their distributors or dealers. Although specific prices vary considerably, the per person cost of such rations, particularly when purchased in large lots, is relatively low (approximately two to six dollars per person for a 10 to 14 day food supply).* Adjuncts to these or Federally provided rations can be purchased quite cheaply. Several servings of such toppings as jelly, gravy or pudding can be purchased for just a few cents per person (Shephard, Nury, Ferrel, & Hale, 1962). Canned foods, including stews, soups, fruits, and vegetables, can be purchased either to augment survival rations or as a complete shelter menu. If funds are available for an elaborate food supply, a professional dietician should be consulted to plan their purchase.

Two additional ways of obtaining food for a shelter are to request individuals to bring provisions to the shelter with them and/or to utilize the inventories of retail food stores near the shelter as soon as it is safe to venture from the shelter for short periods of time. While both of these approaches may be useful for supplementing a shelter food supply, they rarely should be relied upon as the sole source of shelter food. Provisioning by

*Based upon experiences in stocking actual shelter systems of various size.

individuals prior to an attack assumes that those who will occupy the shelter can be identified and that they can be contacted and convinced to bring certain specific provisions to the shelter. Plans for bringing food to the shelter following an attack warning pose similar problems and, in addition, must assume that individuals will have time to acquire the food and bring it to the shelter after a warning is received. A recent government survey (Callahan, Rosenblum, & Coombe, 1961) indicated that more than ten days supply of food was available in retail food store inventories. The accessability of such supplies under the radiation hazards following an attack is very unpredictable, however, and these provisions may be valuable during the post-shelter recovery phase.

## Storage

Plans for storage of the shelter food supply should aim toward:

1. Maximizing the shelf life of the provisions.
2. Assuring the security of the food stocks.
3. Placing the provisions as close as possible to food processing areas.
4. Meeting safety requirements.

Planning to achieve these goals should consider packaging, environmental control, physical location, provision of special facilities, and inventory and marking.

### Packaging

Shelter planners may have little to say about the way in which food provisions are packaged. Survival rations usually will be adequately packaged in moisture-proof, and often airtight, containers. Problems may be encountered with use of standard foods, since most containers in present commercial use are not fully insect-proof, with the exception of tin cans and steel drums, which are susceptable to rust if the humidity is much above 45 per cent (Tressler, 1959). If shelter planners have the opportunity to package their

own shelter foods, civil defense officials or professional consultants should be contacted to determine the best techniques which have been developed through recent research.

## Environmental Control

Environmental control of the food storage area can do much to increase the shelf life of foods packaged in a variety of ways. For example, the lower the temperature in the storage area, the longer metal containers will remain free from corrosion, and the more slowly they will corrode. Further, if food is held below 45° F. it will not be attacked by insects, nor will insects grow in it (Tressler, 1959). On the other hand, care must be taken to see that food stocks are not damaged by freezing. The relative humidity in the food storage area should be kept below 60-70 per cent to eliminate external corrosion of metal containers (Olson, Ferrell, Jullly, Kaufman, & Taylor, 1960). Shelter food supplies also should be stored in an area free from moisture, and one which provides good air circulation to reduce the danger of mold growth on fiberboard or paperboard packages.

## Location

In addition to storing food within the general shelter area, an effort should be made to locate these provisions close to anticipated food preparation and distribution areas. Other considerations in planning the location of shelter food stocks include:

1. Dispersion of provisions in large dual-purpose shelters which anticipate possible blast damage in some areas.
2. Stacking of large containers to form partitions between various functional areas of the shelter.
3. Arrangement of food stocks to permit effective movement of personnel from one part of the shelter to another.
4. Dispersion of provisions to prevent weight overloads on upper floors of dual-purpose structures.

### Special Facilities

The most simple way to store shelter food supplies is to pile the containers up, one on top of each other. The use of storage shelves, however, will keep food cartons away from damp floors, provide a safer technique than simply stacking large containers, and improve the accessability of individual items. The use of large cabinets or bins will provide even more secure storage facilities. Storage cabinets, or at least the general storage area, should be capable of being locked.

Other special facilities, such as ladders for access to provisions stacked or shelved in high locations, should be utilized if available in dual-purpose structures, or should be purchased if essential to the storage system.

### Inventory and Marking

Shelter foods should be marked with the date and shelf-life at their time of storage. An inventory of these foods should be taken periodically to determine any additional needs as well as what foods should be rotated or replaced.

## Preparation

### Deciding Upon the Extent of Preparation

A plan for shelter food preparation may involve one or more of the following tasks:

Unpackaging will be the first step in preparing any shelter food. Standard foods must be unpackaged carefully to facilitate rationing and keep waste at a minimum. Crackers, biscuits, and other survival rations will require little preparation other than unpackaging prior to distribution to the shelter population.

Mixing could be part of the preparation of many standard foods, as well as for the use of toppings and other supplements with basic survival rations.

Heating of shelter rations is not essential, but a hot food or drink has been found to be effective in reducing stress (Olson et.al., 1960). Some shelter provisions which can be eaten cold will be greatly enhanced by heating.

Cooking will be necessary only for certain foods in the most elaborate shelter menus. Most standard foods may be cooked, heated or even served cold, depending upon the specific food and the preparation facilities which are provided as part of shelter planning.

Special treatments, such as the preparation of babies' formula would be a desirable part of food planning when infants, the aged, or infirm are anticipated as part of the shelter population.

It is clear that the extent of food preparation will depend upon the nature of the shelter diet and the facilities for food preparation which are available. Factors which must be considered in planning for the provision of these facilities include:

Shelter temperature control, which will have to be highly sophisticated to keep the temperature at a reasonable low level if heating units are used to cook or warm food in the shelter.

Auxiliary power requirements, which will be increased tremendously by the use of electrical heating elements to warm or cook food.

Fire and other hazards, which may be associated with the use of open flames and combustible fuels to heat or cook food.

Support equipment, such as the pots and pans and other utensils required for cooking and other relatively elaborate food preparation.

Personnel required for any extensive food preparation. A number of well-trained individuals should be available for any elaborate food preparation in large shelters in order to minimize waste and maintain general efficiency.

As the extent of food preparation proceeds from the simple unpackaging of rations to heating or even cooking elaborate meals, the palatability of the menu will increase; but shelter planning must meet correspondingly increasing demands upon power and environmental control systems, and provide substantial support in both equipment and personnel.

The most straightforward and economical approach to shelter food preparation appears to be simply unpackaging the provisions, and, perhaps after some mixing, readying the proper locations for distribution. If at all possible,

however, some provision should be made for at least heating certain shelter foods, particularly for infants or the infirm. Facilities for such food preparation are available from a number of sources.

## Kinds of Preparation Facilities

Generally speaking, facilities useful in food preparation include (1) containers and other utensils, and (2) heating units.

Utensils useful in food preparation, such as knives, spoons, pots and pans are often available in structures serving as dual-purpose shelters. In many cases such items are kept available for "coffee breaks" or other social functions. Some buildings contain complete kitchen units. In any dual-purpose structure where utensils useful for food preparation are available, these materials should be stored in the shelter area, or plans made for their removal to the shelter in the event of an attack warning. Certain special items or entire sets of utensils may be purchased especially for shelter use at relatively little cost. Care should be taken to procure utensils which are compatible with the heating or cooking facilities which will be available in the shelter.

Heating or cooking facilities also are available in many dual-purpose shelter structures. Heat generated by certain equipment items in the shelter also can be utilized for warming foods or beverages. Small, low-cost heating units can, of course, be purchased especially for shelter use. A number of techniques for heating or cooking food in the shelter are presented in Table II. Except for their use in large kitchen units, flame burners are not recommended for shelter use because of the hazards involved.

## Planning the Food Preparation Area

Regardless of the extent of food preparation, a specific area or areas in the shelter should be designated as the location for this critical function. Major considerations in planning these areas will be their size and configuration, number, and location within the shelter.

Table II.

Techniques for Heating or Cooking Shelter Food

| Technique | Considerations |
|---|---|
| Hot plates and small immersion units | Often are available in dual-purpose structures.<br>Hot plates may be purchased for approximately $20 - $40.<br>Can heat small amounts of food at any one time with each unit.<br>Each heating coil will draw approximately 8 watts of electric power. |
| Large coffee urns | Often are available in dual-purpose structures.<br>May be purchased for approximately $30 - $50.<br>Can heat large quantities of liquid (6 - 8 gal.) and cans of food immersed in this liquid in a short period of time.<br>Will draw approximately 10 watts of electric power. |
| Hot water from cooling system of diesel engines or other machinery | Can warm various quantities of food depending upon amount and temperature of the water.<br>Assumes the availability of a diesel engine or other machinery in the shelter, but heating the water for warming food does not require additional power. |
| Vending machines which heat canned foods. | Probably should be used only if already available within the dual-purpose structure.<br>Can heat moderate quantities of canned foods (200 cans simultaneously).<br>Will draw approximately 10 watts of electric power. |
| Stoves, ovens, and other large kitchen units | Occasionally available in dual-purpose structures.<br>Purchase would be quite expensive.<br>Can cook moderate to large quantities of food, depending on the size of the unit.<br>Will require at least 50 watts of electric power or a source of natural gas. |

Size and configuration. The size and specific configuration of these areas will depend to a large extent upon the nature of the food preparation. A relatively small area is required for unpackaging food rations. Some counter space is necessary for mixing and other more extensive preparation. Areas used for heating or cooking probably will require facilities for temperature control and for removal of grease and odors.

The number of preparation areas. In general it will be best to confine food preparation to a single area in the shelter. Such an approach will:

1. Optimize rationing control.
2. Minimize waste.
3. Facilitate the organization and management of complex food preparation procedures.
4. Minimize the need for both support equipment and personnel.
5. Restrict the need for extra temperature control and ventilation to a single area in the shelter.

In especially large shelters, or when the shelter consists of a number of separate areas, several food preparation facilities may be more appropriate.

Location of the preparation area(s). Preparation facilities should be within easy reach of food storage areas, and as far away as possible from the sick-bay and toilet areas. If there are exhaust fans in the shelter, heating or cooking facilities should be located next to one of them. Also, this area should be physically separated from the rest of the shelter with a barrier, if possible, in order to permit sanitary and efficient food preparation.

## Distribution

### Major Goals

Once prepared, each shelter meal must be transferred from the preparation area to each individual shelteree in the most effective manner possible. This effectiveness is largely a function of:

Speed of distribution. Many critical shelter tasks must be performed which will demand a closely coordinated shelter schedule. The distribution

of food must fall within this schedule. When serving hot foods to a large number of people, it will be necessary to keep the heating units on until all are fed. This could raise the shelter temperature. For this reason, it is necessary for food distribution to be as fast as possible.

Equality of distribution. Equal portions of food should be distributed to all healthy adults in the shelter. Careful control also should be kept over the rations provided for children, the aged or infirm. Unequal portions could give shelterees fears that favoritism exists, and result in serious management problems.

Minimizing waste. Waste of food could result from spillage during distribution or from providing excessive individual portions at any one serving. Such waste must be kept to a minimum to preserve the shelter food supply, in-shelter sanitation, and to maintain the morale of the shelterees.

General Approach

Food may be distributed to the shelterees either by taking it to them (moving-point distribution), or by serving from a single, fixed-point distribution area.

Moving-point distribution. The chief advantage of taking food to the shelterees is that it reduces traffic problems in the shelter by limiting necessary movement to the few people responsible for distribution. In planning an approach to food distribution, then, both the size of the shelter and anticipated crowding should be carefully considered. A plan to take food to the shelterees may be advantageous when:

1. The shelter is large and many of the shelterees will be a significant distance from the food preparation area.
2. Ventilation, and other factors will permit fairly high-density crowding, and the resulting limited movement of large numbers of people within the shelter.

Fixed-point distribution. In small or moderately sized shelters, and where extreme crowding is not anticipated, a fixed-point approach to food distribution seems most advantageous. The advantages include:

1. Facilitating management supervision of the distribution process.
2. Optimizing equitable distribution.
3. Minimizing waste.
4. Controlling sanitary conditions.
5. Minimizing the need for support equipment and personnel.

All of these factors assume greater importance when the shelter diet is in the form of standard bulk foods or other items which require serving utensils, individual plates, and other materials for their distribution.

These two general approaches may, of course, be combined in planning for a very large shelter, when food is taken from a central preparation area and moved to several locations for fixed-point distribution.

Support Equipment

Support equipment will be needed in order to distribute the food with minimum waste and in the shortest time possible. Generally, the two major considerations when deciding on support equipment for distribution are:

1. The elaborateness of the food which is to be served.
2. The method of distribution.

In situations where the shelterees will come to a fixed-distribution point, the necessary equipment might include such things as counters or trays.

In shelters where the food is to be taken to the shelterees, support equipment for distribution is also needed. This equipment may include:

1. Existing facilities in the building such as trays, baskets, and service carts.
2. Facilities improvised from large cans and lids, bushel baskets, boxes, or any table with wheels such as typewriter tables or those used in libraries and mailrooms.
3. Facilities especially purchased for distribution.

## Provision of Eating Facilities

### Eating Area

In order to maintain sanitary conditions within the shelter and reduce the movement of personnel carrying hot or easily-spilled foods, an eating area should be designed within the shelter. This is particularly true if food is to be distributed at a single fixed-point in the shelter. The eating area, of course, should be as close to the distribution point as possible, and away from the latrines and sick-bay. Providing such an area should increase management efficiency as well as making the shelterees more comfortable both physically and psychologically. This area will serve to prevent garbage and food spillage from being spread throughout the shelter. Tables and chairs or benches should be provided for this area. If regular furniture is not provided, tables may be improvised from large cans or boxes as well as collapsable bunks which can be moved easily. Seating will be discussed in a later chapter. When not in use for eating purposes, this area might be used for other things such as shelter meetings or recreation. In deciding whether a formal eating area should be provided, shelter planners should take into consideration the many other potential uses of such an area and its facilities.

### Eating Utensils

Eating utensils such as dishes, knives, forks, etc., should be provided when anything more than simple survival rations, which may be eaten from their own containers, are stocked. Some of these utensils may be part of an existing supply kept for "coffee breaks" or other social functions. Regular dishes may be purchased or paper plates and plastic knives, forks and spoons may be stocked. In deciding on the eating utensils to be provided, the shelter planner should:

1. Assess what utensils will be needed for the diet stocked in the shelter.
2. Determine what methods of sanitation will be available to keep these utensils clean or what method of disposal will be available if paper plates, etc., are used.

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# IX. LIGHTING

## Background

Minimum lighting is essential to shelter operation. Peacetime lighting facilities which rely upon municipal power probably may not be operable during or following a nuclear attack. (See Maintenance and Auxiliary Power.) In addition, barrier shielding which is effective in stopping radiation also will prevent natural light from penetrating a shelter.

Insufficient lighting could have serious implications for the performance of critical tasks within the shelters. Medical personnel will suffer severe handicaps if they are forced to perform their duties in poorly lit areas. Accidents within the shelter resulting from poor lighting would add to the burden of this team and place unnecessary strain on the medical supplies. Conservation of food and water could be threatened by spillage, and shelter sanitation would be difficult. Well-organized procedures for shelter organization and management will be of little use if sufficient lighting is not provided for putting them into operation.

## Major Planning Factors

### Types of Shelter Lighting

The types of lighting which should be included in a shelter system are:

General shelter lighting. A general lighting system, which is independent of commercial power, should be installed in the shelter to provide sufficient light for the performance of general shelter tasks, reading, and movement about in the shelter. It should be possible to dim at least some portion of the general lighting system sufficiently to permit sleeping by the shelter occupants.

High-intensity spot lighting. The general level of illumination within a shelter may be inadequate for certain critical tasks, such as medical treatment, reading of instruments, and equipment maintenance. To meet these needs, facilities should be available to provide relatively high-intensity lighting within at least a limited area of the shelter. Such lighting facilities should be portable if possible, to provide the necessary illumination wherever it may be needed in the shelter.

Back-up lighting. The primary lighting system within a shelter will be subject to failure, through blast damage, loss of auxiliary power, or other factors. Such failures may be partial or total; temporary or permanent. A back-up lighting system should be available to provide illumination in any of these instances. This lighting may be minimal, but sufficient to support repair work, and it should be available to all areas of the shelter.

## Methods

Three general methods are available for providing lighting in dual-purpose shelters. Some may meet the requirements of both general and high-intensity lighting. Others are sufficient for back-up and/or high-intensity lighting.

Use of existing lights. When connected to an auxiliary power source, all or part of the existing lights in a dual-purpose shelter area may be utilized for general shelter lighting. This method should provide adequate over-all coverage in the shelter, and may even meet the requirements for high-intensity lighting in some areas. To make the most effective use of the auxiliary power system, a planner may wish to connect only part of the peacetime lighting system to it in some areas.

Supplementary facilities. Extra lights may be installed in potential shelter areas not covered by the normal lighting system. Additional lights also may be installed in the shelter medical area, and other areas requiring high illumination.

Use of portable, battery-powered lights. Battery-powered lights which may be moved around the shelter are an excellent source of high-intensity

lighting. Such equipment also would provide back-up facilities in the event of a failure of the general shelter lighting. Portable lighting equipment includes large emergency floodlights, and smaller lighting units such as flashlights. Fuel-fed lamps or lanterns are not recommended because of the hazards which are involved in their use such as burns and fires, oxygen depletion, and carbon dioxide and possible carbon monoxide generation.

Other Considerations

Facilities available for any of the general methods discussed above may be evaluated according to several factors. The level of illumination is, of course, a major consideration. The implications of darkness and insufficient lighting have already been discussed. Excessive glare also can be a disadvantage to shelter living. It causes nervous muscular tension and inefficiency. The type of fixture used in a lighting system also is important. This characteristic may influence the shelter heat level, demands upon the shelter power supply, and other factors.

Level of Illumination. As indicated earlier, illumination level requirements vary with different activities. Normal lighting recommendations as reported by Murray (Disaster Research Group, 1960) are:

| | |
|---|---|
| 1 - 5 ft. candles | Sufficient for seeing larger objects, illuminating hallways and stairs. |
| 5 - 10 ft. candles | Needed for casual visual work that is not continuous. |
| 10 - 15 ft. candles | Needed for reading large size print. |
| 15 - 20 ft. candles | Should be used where handwriting and moderately fine details must be discriminated--satisfactory for general office work, mail rooms, and file rooms. |
| 20 - 50 ft. candles | Are needed for various kinds of visual tasks, including reading and drafting. |
| 50 - 100 ft. candles | And more are needed for severe visual tasks such as stitching on black cloth. |

Similarly, studies of shelter lighting specify different levels for different areas. For example, Panero specifies two to three foot candles in the bunking areas and ten to twenty-five foot candles elsewhere. Ferguson specifies twenty-five foot candles for work and medical areas and five to ten foot candles elsewhere. The Office of Civil Defense's Minimum Technical Requirements for Group Shelters (OCD,1962) mentions two foot candles for sleeping areas, five foot candles for activity areas, and twenty foot candles for administrative and medical areas.

Table III summarizes the latest recommendations for illumination of major shelter areas.

Table III.

General Recommendations for Shelter Illumination

| Shelter Area | Recommended Illumination |
|---|---|
| Bunking area | 2 - 5 foot candles |
| Corridors for personnel movement | 5 foot candles |
| General activity areas, including eating, recreation training, etc. | 5 - 10 foot candles |
| Administrative and general work areas | 20 foot candles |
| Close work areas, including medical and decontamination areas, equipment maintenance, etc. | 20 - 25 foot candles |

Light fixture. When auxiliary power is available, the shelter planner may have the opportunity of choosing between incandescent and fluorescent fixtures for shelter lighting. There are advantages and disadvantages to each type of fixture. These are presented in Table IV. The type of fixture which is most appropriate usually will depend upon the particular shelter situation. Smith and Wendel (1963) report that fluorescent lighting is most acceptable for large shelters from the cost-effectiveness standpoint.

Table IV.

Incandescent Versus Fluorescent Shelter Lighting

| Type of Fixture | Advantages | Disadvantages |
|---|---|---|
| INCANDESCENT | 1. Cheaper installation | 1. More expensive operation |
| | 2. Less sensitive to voltage fluctuation and more rapid recovery from temporary power failures. | 2. More heat generated<br>3. Higher burnout rate<br>4. Uneven illumination and glare |
| | 3. Subject to rheostat dimming | 5. More power required for same light level |
| FLUORESCENT | 1. Much lower power required for same light level | 1. Odd quality of light |
| | 2. Lower heat generation | 2. Not subject to rheostat dimming |
| | 3. Less expensive to operate | 3. Possible health hazards from broken tubes |
| | 4. Reduced glare and shadows | 4. More complex (starters, etc., required) |

# References


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# X. FIRE PROTECTION

## Background

### Potential Hazards

A number of fire hazards may exist within crowded group shelters. Some of these hazards include:

1. Smoking by the shelterees.
2. Heating elements used for food preparation, etc.
3. Sparks given off by generators and other machinery.
4. Highly flammable elements such as volatile medical supplies used in the shelter.
5. Spontaneous combustion of peacetime supplies stored in the shelter and present at the time of occupancy.

Thermal weapon effects are unlikely to start fires within shelters beyond the range of major devastation. Spot fires may be started elsewhere in the building, however. These small fires should be extinguished prior to the descent of fallout. A broader discussion of thermal weapon effects is presented in Chapter IV.

### Implications

Serious threats may be posed by fires either in or near to the shelter area. Fires may cause injury to the shelterees and ruin shelter equipment and provisions. Indirect threats posed by fire include:

1. Ventilation problems caused by a decrease in oxygen and an increase in carbon dioxide.
2. Undesirable effects of fire extinguishing agents, such as toxic fumes given off by chemical extinguishers, or water damage from hoses.

Fire in the shelter can have serious effects on shelter functioning. Even fires that hurt only a few people, or which may not be dangerous at all in themselves, are still capable of causing anxiety and panic among the shelterees. In extreme cases, evacuation of the shelter may be necessary.

Need for Fire Protection Program

The shelter planner should consider a fire protection program for two major reasons:

1. There is a real need for protection, because of the fire hazards present in shelter living and the serious effects which an outbreak of fire may cause.
2. Psychologically, it is important for individuals confined to a shelter to have the assurance of a fire protection program.

## Major Planning Factors

A fire protection program should include plans for:

1. Prevention
2. Detection
3. Suppression

### Prevention

A major aspect of fire protection is prevention. Steps taken prior to an attack should prevent the outbreak of fire during peacetime as well as after shelter occupancy. These steps will involve the practice of general fire safety measures as part of:

1. Storage of fuel and other materials in or near the shelter. Shelter planners should see that all combustibles, such as paper

and wood, are stored at safe distances from possible ignition sources. Fuel storage tanks should be checked periodically for leaks and other damage. Other volatile material, such as medical supplies, should be stored in air-tight containers.

2. Installation of vital equipment. Electric equipment should always be installed by authorized persons, since electrical defects are often a source of fires. Also, where electrical equipment is exposed to flammable vapors, dusts or gases, it must be of a special type to prevent explosions (National Safety Council, 1955).

3. General design of the shelter. Precautionary measures may be taken in the shelter to prevent the outbreak and/or spread of fires. Such measures include painting with non-flammable paint as well as avoiding the use of combustible wall boards, acoustical ceilings, etc. (National Safety Council, 1955).

4. Peacetime uses of the shelter. If possible, the shelter should not be used in peacetime for any work which might entail the use of flammable goods such as dry cleaning fluid or some industrial materials. Also, peacetime materials such as gasoline, paints, and varnishes should not be stored in the shelter area.

In-shelter methods for fire prevention are primarily procedural. These procedures involve such things as the establishment of and adherence to certain rules and regulations, periodic inspection for fire hazards, and in-shelter discussions of fire prevention.

General procedures for fire safety can be found in general safety manuals such as those published by the National Fire Protection Association. Those specific to shelter living can be found in OCD reports on shelter management (Bend et al. 1963; American National Red Cross, 1950). Because of this procedural emphasis, management and training are particularly important to fire prevention in the shelter.

## Detection

Fire detection is important in limiting damage both in shelters and around the shelter area. Quick detection will also facilitate preservation of available fire suppression resources.

### Approaches

Personal observation. A very practical plan for fire detection in shelters is the use of personal observation. Shelters are relatively confined, and fires may be spotted almost immediately by alert personnel. Fire watches should be planned to assure that someone is awake at all times in all areas of the shelter. Shelterees may also be sent elsewhere in a structure prior to the occurrence of fallout to detect spot fires.

Use of Instruments. A number of special instruments are available for fire detection in unprotected areas or remote locations in the shelter (Tyron, 1962). These instruments include:

1. Gas analysers
2. Smoke detectors
3. Heat sensors

In some instances, fire detection instruments will be available in existing structures. In most cases, however, it will be necessary to procure such instruments when they are desired for shelter use. The potentially high cost of these instruments makes it desirable to plan for other methods of detection, where possible.

## Suppression

### Criteria

Facilities used for shelter fire suppression must be able to effectively extinguish many different types of fires. Because water is essential to

survival of the shelterees, fire fighting equipment should use a minimum amount of this shelter resource. Fire fighting facilities must also be safe. It is particularly important that shelter facilities and personnel are not adversely affected by such things as toxic fumes from chemical extinguishers, or extensive water damage to vital shelter stocks.

Facilities

Almost all buildings contain some type of fire fighting equipment. Shelter fire fighting facilities may be increased by moving some of the portable equipment available in other parts of the structure to the shelter following an attack warning. Peacetime facilities not ordinarily used for fire fighting should also be considered in planning. Some of these facilities include sand, and buckets or other containers which may be filled with water.

In some cases, it may be necessary to purchase fire fighting equipment, such as fire extinguishers, especially for shelter use. In addition, sprinklers, hydrants or other devices for fire suppression may be installed in the plumbing network which serves the dual-purpose shelter area. This would be practical, of course, only when ample water is available to support the piping system in the event of an attack. Before buying this equipment, shelter planners should consult with a local fire department or fire protection engineering consultant. Planners should be sure, however, to make the individuals who are consulted aware of the problems which are unique to shelter fire suppression.

A fire fighting team, trained prior to shelter entry, should be considered in planning for fire suppression. Plans should also be made to orient all shelterees, following shelter entry, concerning fire fighting procedures. This will not only aid in extinguishing fires, but may also serve to reduce panic and anxiety caused by the fear and fire.

As discussed above, a planner should contact a local fire department or fire protection engineering consultant concerning the problems of shelter fire suppression. These individuals are usually available for consultation, and can provide valuable information on the technical aspects of this problem.

# References

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Ferguson Company. Draft of study and report of fallout radiation protection in underground garages. Cleveland: Author, February 1960.

National Research Council. Proceedings of the meeting on environmental engineering in protective shelters. Washington, D. C.: Author, 1960.

National Safety Council. Accident prevention manual for industrial operations. Chicago: Author, 1955.

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# XI. MEDICAL

## Background

The variety of medical problems which could arise in a shelter may have important implications for shelter functioning. Some medical problems may keep people from performing shelter tasks necessary for survival. Also, sick shelterees, as well as those around them, may become demoralized. The sick and injured may also be unable to perform tasks necessary for effective control of sanitation problems. Finally, illnesses involving such things as diarrhea and vomiting will create their own sanitation problems.

Due to the isolation of the shelter group from peacetime medical facilities after an attack, even minor ailments could become problems in the shelter environment. Therefore, shelter planners should be prepared to cope with minor ailments, as well as more complicated illnesses.

Table V lists the medical problems which may arise as a direct result of the shelter stay. Shelter planners must, in addition, consider the normal medical problems which would occur in any population during a two-week period. A toothache which requires only a brief trip to the dentist during peacetime, for example, could become a major problem in the shelter, if adequate facilities are not available for its treatment. Similarly, childhood communicable diseases, such as measles, will demand stringent control in the shelter situation.

### Primary Objectives

The primary objectives in planning for medical treatment in the shelter are:

1. To effectively treat the symptoms of illnesses or injuries. In many cases, it will be virtually impossible to stock drugs

Table V

Nature and Source of Potential Shelter Medical Problems

| Nature | Source |
|---|---|
| Nausea | Radiation sickness<br>Poor atmospheric control<br>Food poisoning<br>Unsafe drinking water<br>Odors from other illnesses<br>Infectious diseases |
| Upper respiratory illnesses | Poor atmosphere control<br>Radiation sickness<br>Over-crowded, austere living conditions in the shelter<br>Infectious diseases |
| Diarrhea | Unsafe drinking water<br>Food poisoning<br>Poor shelter sanitation<br>Various common ailments and infectious diseases |
| Constipation | Lack of physical activity<br>Low-residual shelter diet<br>Decreased water intake<br>Infectious diseases |
| Headaches | Poor atmosphere control<br>Radiation sickness<br>Food poisoning<br>Over-crowding in the shelter<br>High temperatures<br>Any common illness or disease that may occur in the shelter or may be brought into the shelter<br>Infectious diseases |

Table V (continued)

| Nature | Source |
|---|---|
| Psychological problems | Fear of radiation sickness and other weapon effects<br>Over-crowding in the shelter<br>Pain<br>Discomfort<br>High effective temperatures<br>Concern for relatives and friends |
| Skin ailments | Poor atmosphere control<br>High effective temperatures<br>General unsanitary living conditions<br>Infectious diseases |
| Shock | Could accompany:<br>Injury from direct exposure to bomb damage<br>Injuries from conventional accidents resulting from over-crowded conditions in the shelter |
| Hemorrhaging | External:<br>Deep wounds and cuts from flying glass and falling debris during blast<br>Accidents resulting from over-crowded conditions<br>Internal:<br>Internal injuries from blast<br>Terminal cases of radiation sickness<br>Extreme cases of diarrhea |
| Burns | Exposure to radiation<br>Fires from blast damage<br>Cigarettes<br>Spilled hot liquids<br>Open heating elements |
| Broken bones, puncture wounds, abrasions, sprains | Blast effects<br>Accident in the shelter (falls, etc.) |

to cure illnesses and injuries. Thus, effective symptomatic treatment should be a major consideration in medical planning. For example, as in the case of radiation sickness, a person can live or die, depending on the treatment of symptoms. Other ailments for which symptomatic treatment should be emphasized include skin ailments, psychological problems, gastro-intestinal illnesses, first-degree burns, shock, puncture wounds, and infectious diseases.

2. To reduce pain. It is important to have pain-killing drugs on hand to reduce the suffering of the patients and to prevent other shelterees from becoming demoralized. The need to reduce pain may arise in such situations as terminal cases of radiation sickness, serious first-degree burns, and complex illnesses which the shelter medical supply is not capable of handling.

3. To prevent contagion. The control of communicable disease is of particular importance in a confined and crowded shelter environment with limited medical resources. Much can be achieved toward this goal through well-planned shelter sanitation (see Chapter XII). When communicable disease becomes a threat in the shelter, however, medical planning should provide procedures and materials for control of feeding and medical operations, and, if necessary, for isolation of infected individuals.

## Major Planning Factors

The major factors to consider in planning for shelter medicine are the development of the medical area and procurement and storage of medical facilities.

## General Medical Area

In shelter planning, some consideration should be given to a general medical area. This area may be used for treatment of sick and injured shelterees. It may also be used for the retention of bed-ridden shelterees. This will provide easy access to medical supplies required by these patients. It may also be appropriate to retain certain individuals in this area to control communicable diseases. Regardless of the extent to which this area is to be used, it should, if possible, have some physical segregation from the rest of the shelter. This is to permit the unimpeded treatment of the sick and injured, and to avoid undesirable psychological effects on other shelterees. Ideally, one segment of the medical area should be designed to permit isolation of people with infectious diseases. Space also should be allotted for the confinement of mentally disturbed people who may be dangerous to themselves or others.

It will be extremely difficult to predict the number of sick and injured which may be present in the shelter. For this reason, the medical area should be usable for some other purpose if there are few medical problems. Similarly, plans should allow for the expansion of medical facilities if medical needs are great.

The need for high-intensity lighting in the medical area has been emphasized in Chapter IX. Consideration must also be given to bunking facilities and the storage of medical supplies in this area. Bunks should be provided in the medical area, if at all possible, even when no provision is made for them elsewhere in the shelter. The medical area should also contain space which has been allotted for the storage of medical supplies. The body disposal area (see p.105) should be located as near to the medical area as possible, both to make transfer as easy as possible, and to minimize demoralization of the shelterees in the event of deaths.

## Medical Facilities

Two major factors in planning for medical facilities are (1) procurement and (2) storage.

### Procurement

Medical facilities may be procured through the use of existing facilities, government-supplied facilities, or by direct purchase.

Use of existing facilities. A number of buildings contain dispensaries and other medical areas. Where it is possible, shelter planners should include these areas in the shelter during peacetime use.

If these facilities are not already stored in the shelter area, plans should be made to identify existing facilities and see that they are transported to the shelter upon receipt of an attack warning. Preferably, these materials should be stored in the shelter and possibly rotated through dispensaries used in peacetime. Medical supplies in pharmacies located in existing structures also should be utilized. This may be done by rotating pharmaceutical supplies with those stored in the shelter, or providing for the transportation of these supplies to the shelter immediately after an attack warning.

Government-supplied facilities. Shelter medical supplies may be procured through participation in the Federal Marking and Stocking Program. These kits contain items selected to provide austere medical treatment for a wide variety of people in terms of age, sex, status of health, etc. (OCD, 1962). Table VI lists the items available in these kits.

Also, some large shelters which meet specific requirements may qualify for Federal contributions toward a 200-bed hospital unit (OCDM, 1959).

Direct purchase. Medical facilities may also be procured for shelter use by direct purchase. These facilities include medications, bandages, and other consumables; as well as stretchers, flashlights, and such medical instruments as thermometers. The following list of medical supplies provided by the Federal government (see Table VI) may serve as a checklist for those

Table VI

Government Supplied Medical Facilities*

| MEDICATION | |
|---|---|
| Acetylsalicylic Acid, Tablets, USP | Petrolatum, White, USP |
| Cascara Sagrada Ext., Tablets, (Laxative) N.F. | Phenobarbital Tablets, USP |
| Eugenol, USP | Soap, Surgical |
| Eye, Ear, and Nose Drops | Sodium Bicarbonate |
| Isopropyl Alcohol, N.F. | Sodium Chloride, USP |
| Kaolin and Pectin | Sulfadiazine Tablets |
| Penicillin G, Tablets, USP | Tablets, Water Purification |
| **DRESSINGS** | |
| Bandage, Gauze, Roller | Cotton, Purified |
| Bandage, Muslin, Triangular | Pads, Gauze, Surgical |
| **OTHER** | |
| Applicator, Wood, Cotton, Tipped End | Scissors, Pocket, Straight |
| Depressor, Tongue, Wood | Syringe, Fountain, Plastic, and Attachment |
| Forceps, Splinter, Tweezer | Thermometer, Human, Clinical, Oral, Stubby Bulb, with Case |
| Pin, Safety | |

* Derived from: Office of Civil Defense. Description, care, and handling of supplies for public fallout shelters. Washington, D. C.: Department of Defense, 1962.

planners desiring to purchase special facilities. If possible, professional medical personnel familiar with possible shelter medical problems and the characteristics of the potential shelter population should participate in this planning effort.

Some critically needed drugs, such as insulin, are extremely difficult to store in proper quantities for extended periods of time. If rotation of such drugs is not economically feasible, individuals who require such drugs should be informed that they should bring an adequate supply with them to the shelter in the event of an attack warning. Refrigeration for perishable drugs should be provided if at all possible.

## Storage

Two major requirements for the storage of medical facilities are preservation and protection.

Preservation. Medical supplies stored for shelter use should not be packaged in glass containers, due to the danger of breakage from blast tremors. The area in which medical supplies are stored should be dry, cool, and free from rodents and other pests. Due to the nature of these supplies, this area should also be as aseptic as possible. Good air circulation is also necessary to reduce the danger of mold growth in containers or boxes. Refrigeration may be required for preservation of some medical supplies.

Protection. Protection of vital drugs and other medical supplies is of major importance in shelter planning. This may even present a greater problem than protection of shelter food. Protection from theft from sources outside the shelter should be provided for these supplies in peacetime as well as during the shelter stay. This may be accomplished by providing locked cabinets for supplies. A monitor may also be required for these supplies during the shelter stay.

## Medical Personnel

It will be extremely desirable to have trained medical personnel in the shelter. Planners may want to contact local medical people concerning

their availability to serve as part of the shelter medical staff. Medical supplies should coincide with the level of medical personnel expected in the shelter. For example, there will be no need to stock elaborate surgical equipment if qualified medical people are not available.

# References

Office of Civil Defense. Description, care, and handling of supplies for public fallout shelters. Washington, D. C.: Department of Defense, 1962.

Office of Civil Defense Mobilization. Federal contributions for civil defense equipment. Battle Creek, Mich.: Author, 1959.

# XII. SANITATION

## Background

### The Problem

A major reason for sanitation problems in the shelter will be the lack of facilities ordinarily taken for granted in peacetime.

In most cases, waste will have to be retained in the shelter until the outside radiation level decreases. Also, sewage facilities ordinarily used in peacetime may not be available, due to blast damage. It will probably not be reasonable to burn waste material in the shelter. Installation of chimneys may present shielding problems. Also, burning such material may cause an undesirable rise in temperature. Further, the equipment and facilities which would permit the burning of waste safely in the shelter will be quite expensive.

A limited supply of water also may give rise to sanitation problems in the shelter. Water is a necessity for survival, and only very small amounts, if any, will generally be available for washing and cleaning. There may, in addition, be a problem in disposing of water used for sanitation purposes. Cleaning materials, pesticides, and other antiseptic resources also will be limited to those which can be stored in the shelter prior to an attack.

Planners must remember, too, that all sanitation problems in the shelter will be magnified due to personnel concentration and confinement.

### Implications for Shelter Operation

Inadequate sanitation can create a number of problems, both physical and psychological, within the shelter population. Unclean conditions often

lead to illness, which in turn promotes additional sanitation problems. A number of fatal illnesses thrive in unsanitary conditions. Due to the normally high standards of cleanliness practiced by the American culture, shelterees will be particularly susceptible to many of these illnesses. Similarly, unsanitary living conditions can be expected to affect American shelter populations psychologically to a greater extent than would be the case in other cultures.

Both the physical and psychological effects of unsanitary conditions can in turn create functional problems in the shelter. These may range from poor task performance, due to low morale or minor illness, to a complete breakdown of the shelter system as a result of epidemic diseases.

## Major Planning Factors

Planning for shelter sanitation must focus on five major factors:

1. Human Waste Disposal
2. Garbage and Trash Disposal
3. General Shelter Cleanliness
4. Personal Hygiene
5. Body Disposal

### Human Waste Disposal

Need

Disposal of human waste, if not adequately provided for, will be a major source of sanitation problems in the shelter. Even when low residue diets are provided, possible diarrhea and other gastro-intestinal problems caused by a change in diet or illness will continue to make human waste disposal a problem. Also, individual tolerance is much less for human waste than it is for other garbage. Shelterees may become particularly anxious

or irritable, or exhibit other psychological effects, if human waste is not disposed of adequately.

Finally, human waste should not be disposed of in the same container as garbage and other trash. Mixture of these materials increases the generation of gas (Vernon, 1959).

Methods of Waste Disposal

Waste may be disposed of by removal from the shelter or storage in the shelter.

Removal. Waste may be pumped out of the shelter by means of the public sewage system. However, shelter planners usually cannot assume that this system will remain operable following an attack. Waste also might be pumped out of the shelter to a nearby storage tank. Grinding up the waste through the use of a grinding mill might be considered for increasing the capacity of such a storage tank (Dorsey, 1962).

Liquid waste may be disposed of by channeling it through pipes to foundation drains outside of the shelter (Department of the Army, 1959).

Planners must remember that the use of facilities other than the public sewer system for waste disposal in peacetime is restricted by law. Installation of these systems is also very expensive.

Storage. A variety of methods are available for storing human waste in the shelter.

Sanitary kits consisting of a 17.5 gallon drum, polyethylene liner, toilet seat, toilet paper, and commode chemicals may be obtained through participation in the Federal Marking and Stocking Program (DOD, 1962). This method allows the storage of waste in the same container used as a toilet. This eliminates the transfer of waste from one container to another.

Existing facilities may be used which also eliminate the need for transferring waste for disposal. Large garbage cans or metal drums fitted with toilet seats may be adequate. Wastebaskets or other such containers may be used as make-shift toilets (Federal Civil Defense Administration, 1956).

However, waste will probably have to be transferred from these smaller containers for disposal.

All containers used for storing waste should be equipped with tight-fitting lids. Disinfectant should also be stocked for application to waste containers. If adequate funds are available, chemical toilets may be stocked for the collection and storage of human waste. Individual toilet units are relatively expensive. However, several seats may be installed on large storage tanks to which chemicals for waste treatment have been added.

## Garbage and Trash Disposal

Wasted food probably will be kept to a minimum in shelters where food preparation and distribution are carefully organized. No food should be thrown away unless there is a threat of spreading communicable diseases from leftovers.

Empty food containers may be cleaned out and used for other things in the shelter, such as drinking cups, butt cans in smoking areas, ladles or scoops, pots for heating food, and disposal cans for toothbrushing.

Planners should consider using some of the large empty food containers for storing garbage and trash. These cans should be covered, preferably with tight-fitting lids. If the number of large food containers is limited, large garbage cans may be provided for other garbage and trash in the shelter, such as used tissues and paper towels. Disinfectant should be provided for application to stored garbage and trash.

## General Shelter Cleanliness

Dirt and filth can breed disease and depress shelter personnel. This may affect the health and attitude of the shelterees, and could increase medical problems. Garbage and trash can present obstacles to personnel responsible for performing critical tasks in the shelter. An unclean shelter may also cause safety hazards, since shelterees may slip and fall on debris.

The task efficiency of personnel may be impaired by unclean shelter conditions. For example, personnel concerned with food preparation and medical services would be seriously affected if unsanitary conditions persisted.

The practice of shelter cleanliness may be affected by the attitude of the general shelter population. Planners may enhance shelter cleanliness by emphasizing cleaning procedures and by providing cleaning equipment.

Equipment necessary for cleaning the shelter is usually available in most buildings. If possible, this equipment should be stored in the shelter during peacetime. Cleaning equipment should include brushes, brooms, rags, mops (if water is available), dust pans, and buckets.

Cleaning agents should also be provided. These include soap powder, cleanser, and disinfectant.

If the floor of the shelter is constructed from concrete or another porous material, it should be painted or sealed. This will prevent the absorption of spilled food and other waste which could cause the growth of bacteria. A smooth surface will also prevent production of dust and facilitate cleaning.

## Personal Hygiene

Personal cleanliness, like shelter cleanliness, is important in preventing the spread of disease. It is also important for the physical comfort of the shelterees, and may prevent psychological effects, such as depression and irritability.

General personal cleanliness is not essential for survival. Because of adaptation to body odors by the shelterees, this factor seems to be no real problem (Altman, Smith, Meyers, McKenna, & Bryson, 1960). Hand cleaning, however, is particularly important, especially for personnel connected with food and medical operations.

In warm and humid shelters, rashes may develop in body areas where chafing occurs. Cleanliness may also help to reduce this problem.

There are a number of methods available for personal cleanliness in the shelter. Where water is available, standard methods involving the use of soap and other common materials may be used. Waterless hand cleaners may be used when the water supply is limited. Chemically treated towelettes, such as "Wet 'n Drys," are commercially available. These may be substituted for soap and water, and can be used for washing both hands and face (Altman, et al, 1960).

Body powder should also be stocked in the shelters. This is especially important for babies. It will also help to reduce rashes in warm and humid shelters.

Supplies which are stocked for rest rooms in most buildings can be utilized in the shelter. A sizable backlogging of these supplies will be required, however, since large quantities will be needed for shelter use. If possible, these supplies should be stored in the shelter during peacetime.

Two other important aspects of personal hygiene are: (1) use of toilet facilities, and (2) feminine hygiene. Adequate facilities for coping with these problems are essential for both health and cleanliness in the shelter. Inadequate planning in this area also could create serious morale problems among the shelterees.

Almost all structures which house dual-purpose fallout shelters will contain a limited supply of both toilet tissue and sanitary napkins for use in rest rooms. Only rarely, however, will these peacetime resources be adequate to meet the shelter needs for large numbers of people for a two-week period.

OCD shelter stocks contain a minimum quantity of both toilet tissue and sanitary napkins. In shelters which are not part of the Federal Marking and Stocking Program, shelter planners should assure an adequate supply of these items by:

1. Carefully assessing the probable needs of the shelter situation.
2. Procuring and storing an adequate supply of these materials, which can be rotated through the peacetime facilities. The extra items should, of course, be stored in the shelter area if possible.

Because sanitary napkins can be used as medical dressings, shelter planners may wish to stock an extra supply of these items to augment other medical facilities.

## Body Disposal

If a shelter system operates effectively, there should be no more deaths than would ordinarily occur in a population of its size. In the event that deaths do occur, however, the bodies should be removed from the shelter as soon as radiation levels permit, and buried if and when conditions permit. Consideration also must be given to retaining bodies in the shelter until radiation levels permit temporary opening of the structure. This will aid health and sanitation procedures and reduce psychological effects on the shelterees.

Planning for body disposal is important to assure that this operation is carried out smoothly during shelter occupancy. Shelter inhabitants will be extremely sensitive about the disposal of bodies. For this reason, plans should be made to meet cultural standards commensurate with health and sanitation requirements necessary for body disposal. Religious materials for memorial services for all faiths, or at least for a single, non-denominational service, should be provided in the shelter.

Shovels and other items required for burial procedures also should be included in the shelter stocks. In addition, room should be designated for the retention of bodies until burial or removal from the shelter is possible. This room should be located as far from the shelter living area as possible.

Most dual-purpose structures should have such a room available. This room need not be shielded as well as the general shelter area, but shielding should be adequate enough to permit occasional access by personnel. Preferably, this room should be in the coolest part of the structure and as close to the medical area as possible. The area should be sealed as adequately as possible from the rest of the shelter to prevent odors and gases from leaking into the rest of the shelter. An exhaust vent should also be provided.

Bodies retained in the shelter area may be placed in large plastic bags, or the body orifices closed with cotton or some other material to stop the escape of fluids. Medical or mortuary personnel should be consulted for further information concerning the procedures and equipment needed to support body disposal.

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# PROVISION OF AUXILIARY NEEDS

# IV

COMMUNICATIONS

SLEEPING FACILITIES

WARNING AND SHELTER ENTRY

# XIII. COMMUNICATIONS

## Background

### Requirements

Shelter planners should consider facilities for both in-shelter and beyond-shelter communications.

In-Shelter

To facilitiate shelter functioning through the cooperation of shelter management and the general shelter population, some form of communication is necessary. The following kinds of information will need to be transmitted to the shelter population:

1. Messages from outside the shelter dealing with such information as radiation level, local damage, state of the nation, survival instructions, etc.
2. Orientation of the shelterees to the immediate situation, in-shelter life, and provision of information they will use for post-shelter life.
3. General announcements concerning such things as conditions of the shelter, and shelter needs in terms of people, ability, etc.
4. Emergency announcements such as shelter evacuation instructions.

Shelterees may also wish to transmit information concerning such things as illness or other problems to management. This may be done by word-of-mouth through the shelter staff. Other facilities, i.e., telephones, if available, would also be useful for this purpose.

Whatever system is chosen should have the following characteristics:

1. Coverage. Provision should be made to see that all of the appropriate shelterees receive necessary information.

2. Clarity. Announcements must be clear, distinguishable, and understandable to all individuals.

3. Reliability. The system should have 100 per cent guarantee of working when it is needed. Careful attention should be paid to design features and frequent operability tests should be made.

Beyond Shelter

Since people will be confined to the shelter, communication facilities will be useful in keeping them informed of outside happenings. This may aid in such things as planning for shelter exit and the best evacuation routes, or will inform shelterees of danger from large fires or other threats. News of general outside conditions, especially of areas where friends or relatives of the shelterees are located, may also be helpful.

Two-way communication to the outside from the shelter will be valuable for reporting emergencies and requesting aid or advice from other sources such as civil defense communication centers.

The fundamental requirements for beyond-shelter communications may be expressed in terms of the number of stations the shelter can contact and the range of these communications. Shelterees may want to keep in touch with outside groups such as radiological monitoring stations, fire and rescue organizations, local government, and other agencies.

However, the expense of facilities for beyond-shelter communication will increase according to the number of stations the shelter has the capability to contact. For this reason, it may be more desirable for shelters to communicate with civil defense communications centers alone. These civil defense centers will in turn be in touch with other emergency agencies, government, and other agencies.

The range of communications facilities in the shelter also need not be as extensive if contact is to be limited to a local civil defense center.

## Communication Area

Communication equipment should be located in a relatively quiet area of the shelter. This will aid communications personnel in hearing incoming messages as well as in transmitting information. These facilities also should be located so as not to disturb those outside the communications area. The communications area should be lighted well enough to permit messages to be written and read. Locating this area adjacent to shelter management will be helpful. Access to communication facilities should be controlled to prevent unauthorized personnel who may disrupt communications from entering the area.

## Equipment

Communications facilities for the shelter may simply consist of runners who operate from the communications center where messages originate (Jones and Laughlin Steel Corporation, 1960). Many existing structures have public address systems available which may be utilized for in-shelter communication (Petzinger, 1960). Also, loud speakers may be mounted in one or two central areas of the shelter. Hand-carried megaphones can be purchased for between six and seven dollars. Battery-powered telephones or walkie-talkies may also be useful. However, these are not usually available within existing structures, and probably will have to be purchased for use in the shelter. When auxiliary power is available, standard telephone lines, within structures containing their own switchboards, can be used for in-shelter communications.

When choosing facilities for the shelter, planners may consider a combination of two or more methods. For example, messages may be transmitted by telephone to members of the shelter staff and relayed to other personnel by means of runners. Similarly, walkie-talkies may be used for both in-shelter and beyond-shelter communications. Use of the conventional radios

seems to be the most practical method for receiving civil defense information from locations outside the shelter. A planner also may wish to have other radio receivers to receive information from civil defense organizations (Jones and Laughlin Steel Corporation, 1960).

Shelter planners may desire two-way communication facilities for the shelter. This may be done through the use of two-way radio or by wire.

The expense of radios for the shelter will depend on range, number of frequencies and the general complexity of the equipment. Depending on these factors, some equipment may be purchased for as little as 100 to 150 dollars.

If telephones are being considered for the shelter, planners should not rely on the use of city telephones because of blast damage. However, there are protected underground telephone lines available for this purpose.

## General Requirements

Shielding, which is effective in impeding radiation also will inhibit the passage of radio waves. For this reason, shelters planning to use radio communication systems, should consider the need for an outside antenna to support this equipment. Protection from blast damage should be assured by use of "whip" antennas or stabilization with guy lines. For short-range communication, a simple ground wire may suffice.

In cases where the auxiliary power supply is limited, or stand-by power is desired for communications equipment, batteries should be stocked in the shelter. These batteries should be checked periodically to see that they are in proper working condition. They should also be rotated if they can be used in peacetime.

Complex communications equipment will probably require skilled operators. Planners who have such equipment should consider ham operators or identify qualified radio operators among their potential shelter population. The Radio Amateur Civil Emergency Radio Service (RACES), which was set up for providing communications in all types of disasters, may also be contacted for this purpose (Gautney & Jones, 1962).

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# XIV. SLEEPING FACILITIES

## Background

Sleeping is a vital human activity that requires careful consideration during shelter planning. Although sleep deprivation is less a threat to physical survival than, for example, water deprivation, long term and widespread disturbances in sleeping can contribute to serious shelter problems. Shelteree reaction to extended periods of sleeplessness may be either apathy and listlessness, or, on the other hand, irritability, or a combination of the two. This may be accompanied by physical symptoms, such as headaches and nausea. Performance of tasks requiring concentration also may be impaired.

The plans made for sleeping will affect most other shelter activities. Sleeping will take up more time and space than any other activity. The amount of space required for sleeping will influence the physical organization of the shelter. Also, the time required for sleeping will affect the scheduling of other activities.

## Major Planning Factors

Planning for shelter sleeping facilities involves two major considerations. These are: (1) the general strategy of shelter sleeping arrangements, and (2) the provision of sleeping facilities.

### General Strategy

There are several basic decisions that shelter planners must make concerning shelter sleeping arrangements that will greatly affect shelter operation. One

such decision is whether plans should be made to have all shelterees sleep at once, or in two or more shifts. Another important consideration involves locating the sleeping area in the shelter. In order to optimize social control, shelter planners also should make preliminary decisions regarding the grouping and relative positioning of sleepers.

Simultaneous vs. Shift Sleeping

If adequate space is available, it is better to plan to sleep the entire shelter population at one time, rather than in shifts. Simultaneous sleeping offers fewer problems in such areas as noise control, shelter movement within the shelter, and scheduling of activities.

Also, from the health and sanitation point of view, it is desirable that only one person use a particular sleeping space. "Hot bunking" (assigning more than one person to the same sleeping space in shifts) increases the possibility of transmission of infectious diseases.

Finally, if only one person occupies a bunk which does not have to be dismantled daily, the bunk becomes a place of relative shelter privacy, where an individual can relax during the day and store his non-valuable personal effects.

Sleep space, of course, is the major consideration involved in deciding upon simultaneous vs. shift bunking. If bunks are available, there must be enough space to house them in the shelter. Sleeping facilities which can be dismantled during the day will greatly enhance the possibility of simultaneous bunking. When no bunks are available, general sleeping space must be considered in deciding upon a sleeping arrangement. Table VII indicates the adequacy of various sleeping areas. Aisle space, which was not taken into account in the table, should be allotted wherever possible. A two-foot aisle around the perimeter of the sleeping area, plus at least one aisle and preferably more within the sleeping area, will make entry and egress in the sleep area easier, and thereby increase management control during sleep hours.

The major advantage of shift sleeping is that it saves space, which is a very important consideration in-shelter. However, the uses to which this space can be put might be limited by the requirement to lower noise and illumination levels, so as not to disturb those on the sleep shift.

Table VII.

On the Floor Sleep Space Required for 100 Sleepers

| SQUARE FEET AVAILABLE | CONDITIONS FOR SLEEPING 100 SHELTEREES |
|---|---|
| 650 | 1. All except children have to sleep with legs bent.<br>2. Situation may be uncomfortable enough to consider "shift sleeping." |
| 900 | 1. Almost all shelterees will be able to sleep on their sides with legs extended.<br>2. Some will be able to sleep on their backs. |
| 1500 | 1. Almost all shelterees will be able to sleep on their backs with legs extended.<br>2. There will be sufficient room to extend arms and move body slightly without interfering with other shelterees. |

It is recommend that the number of sleeping shifts be kept to two, if at all possible. This will permit a large period of time daily when all shelterees are awake for activities in which the entire shelter population should participate. Two-shift sleeping will also allow time for daytime naps and rest periods for children and others requiring them.

Location of the Sleeping Area

The principal considerations involved in locating the shelter sleeping area during shelter planning are:

Shelter size and layout. In a small single-area shelter, there will often be no choice in locating a sleeping area. The sleeping area will consist of all or most of the usable floor space, unless many-tiered bunks are available.

Ventilation. Sleeping areas, particularly those utilizing tiered bunking, probably will contain more people per cubic foot than any other area in the shelter. Particular attention should be paid to the ventilation facilities for this area to assure adequate temperature and atmospheric control. While in many shelters the problem will be one of excessive temperatures, due to high density occupancy, shelters in cold climates may have a requirement to provide some heat for the sleeping area.

Noise and light. When shift sleeping is to be used, the sleeping area must be separated from the activity area, either by a barrier or by physical distance. This has a two-fold purpose: to insure that sleepers are not affected by on-going activities in the day area, and that activities are not constrained by the requirement to keep light and noise at levels so that people can sleep. The quieter and darker the location, the greater the opportunity for sleep.

Toilet facilities. In a shift-sleeping shelter, relative location of the toilet facilities and the sleeping area should be such that those in the day area can use the facilities without disturbing sleepers.

## Grouping of Sleepers

Shelter planners should recommend that shelterees be separated in the sleeping area on the basis of sex, age, and marital status. Single men and single women should be segregated in the sleeping area. This includes unmarried men and women, and also those who are married but unaccompanied in shelter by their spouses or children. It also is advisable that infants and preteenage children sleep in close proximity to their parents.

The most effective plan for grouping is to use physically separate areas for a dormitory or dormitories for single men, and one or more for single women. Family groups should sleep together in a third location.

If the shelter consists of a single area, single men can be assigned sleep positions at one end of the shelter, and single women at the other end. Family groups should be assigned sleep positions between the two single groups. This approach is based on the assumption that married couples, especially in the presence of their children will be more likely to accept a shelter regulation against sexual behavior, and thus not only provide a space barrier between unmarried men and women, but also be a model of appropriate behavior for the young unmarrieds.

When tiered bunks are available, separation of the sexes may be accomplished by assigning single men and women to bunks in tiers that are separated by level or grouping.

Relative Positioning of Sleepers

If shelterees are arranged in certain standardized sleep positions, the spread of respiratory ailments may be decreased. Shelter planners should prepare a plan for the arrangement of shelterees within the sleeping area, and provide a basis for assigning shelterees to their positions.

It is frequently recommended that shelterees and their neighbors sleep in a "head-to-foot" arrangement, as illustrated in Figure 4. Two small children may be fit into the floor space allocated for one adult.

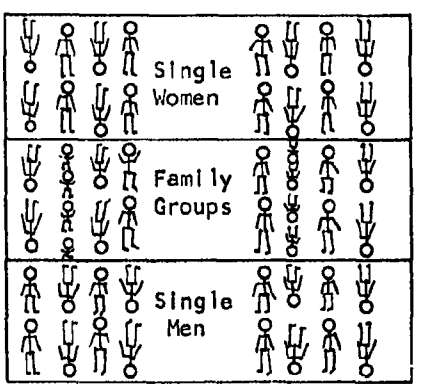


Figure 4. Grouping and Relative Placement of Sleeping Shelterees

If bunks are available, it would be advisable for safety reasons not to put children in the top bunks of tiers. Elderly and infirm shelterees should not be assigned to bunks that are either too high or too low to reach with safety and relative ease.

## Provision of Sleeping Facilities

Plans for shelter sleeping facilities can involve one or three basic approaches:

1. Improvising without major modification of existing facilities.
2. Improvising involving extensive modification of existing facilities.
3. Installation of a shelter bunking system.

In addition to the bunks themselves, various other items may be provided to enhance sleeping in the shelter.

### Improvising Without Modification

If necessary, shelterees can sleep on the floor of the shelter with no particular ill effects. If shelter planning calls for such an approach to the sleep problem, any of the more comfortable facilities such as cots, or even tables and desks, probably should be set aside for special use (for example, in the sick bay). This should reduce conflict within the general shelter population.

Rugs available within dual-purpose structures can be laid in the sleeping area and rolled up during daylight hours. This should contribute to both the comfort and cleanliness of the sleeping area.

Some shelters will have special facilities that can be used without modification for sleep purposes. In a shelter with an auditorium, the auditorium seats can serve as sleeping facilities. In a filled parking garage, the cars may well provide sleeping facilities for many shelterees. If shelterees can sleep on the tops of desks, tables, etc., as well as under them, more sleepers can be accommodated at one time.

Improvising Through Modification

The most effective sleeping facilities for shelter use are tiered bunks. The capability to "stack" sleeping shelterees will greatly increase the amount of shelter floor space available for other purposes. Many of the peacetime facilities available within dual-purpose structures can be modified to form tiered bunks for shelter use. The development of such sleeping facilities is largely a matter of individual ingenuity. One method which has been demonstrated as feasible is to fasten together six or seven multi-tiered, open-backed, metal bookcases or stock shelves.* Depending upon the width of the shelves, one or two persons can sleep on each tier. Five tiers of sleepers will very often be possible, using normal metal bookcases or stock shelves. Another way of constructing a tiered sleeping arrangement is to carefully place tables on top of one another.

Plans for any such improvision of bunking facilities should be worked out in great detail by shelter planners prior to shelter entry to assure that:

1. Sufficient facilities are available to assure the planned sleeping arrangements.
2. The planned modifications will provide tiers which are strong and sufficiently stable.
3. Higher tiers will be arranged in a manner which will reduce the probability of someone toppling from them which asleep.

The necessity for careful pre-planning cannot be overstressed. For example, while stacking tables atop of one another may seem quite simple, an actual attempt to stack only a few tables will quickly reveal the many factors which must be considered to meet the three basic requirements stated above.

Very adequate non-tiered bunks for infants and small children also may be made from cardboard cartons. If possible, the carton should be lined with a waterproof material. It should be recognized that waterproof materials, if not properly installed, may become a suffocation threat to infants. Children should be assigned to a specific cardboard bunk for the entire shelter stay, to the extent possible.

*Members of the Institute's staff converted available storage shelves to tiered bunks and slept in them for one night.

Installation of a Bunking System

When the planning budget permits, a complete bunking system can be installed in the shelter. Tiered bunks, of course, are highly recommended. Such sleeping facilities may be purchased from a number of commercial sources, including military surplus outlets and retailers of camping and dormitory equipment.

Under such circumstances, it will be beneficial to have some bunks erected at the time of shelter entry. Among the advantages of such an arrangement are:

1. It provides a place where sick and injured can rest immediately upon entry.
2. By directing incoming shelterees to specific locations in bunks, crowding and milling about is cut down.
3. Assignment to bunks represents an immediate first step in shelter organization, and it can be the basis for later assignment to shelter sub-groups.

These bunks ought to be set at a distance from the shelter entrance to prevent congestion at the point of ingress. If blast effects are expected in-shelter, it may be advisable to keep bunks dismantled and stored in a way that keeps them from injuring shelterees at the time of blast.

In some shelters, bunks will have to be dismantled and erected daily, for maximum use of shelter space. In such cases, the shelter planner should establish a set of procedures and a schedule for erecting and dismantling bunks.

Bunking systems may be designed to provide a variety of daytime uses. For example:

1. Bunks may be left in place for daytime naps.
2. Bunks may be used as chairs for eating, recreation, etc. To accomplish this, some modification is usually necessary, e.g., removing or raising the middle bunk on a tier.

3. Removable bunks may be used as tables or desks, when placed on water drums, cartons, camp stools, etc.

Additional Items

Other items which may be provided in planning for shelter sleeping facilities include:

Sleep area partitions. Partitioning the sleep area serves two basic purposes. First, partitions serve to separate the sleeping area from the daytime area. This is a requirement for carrying out shift sleeping successfully. Secondly, partitions can be used to segregate the sexes during sleeping hours, which will help maintain social control in the shelter.

The natural configuration of the dual-purpose shelter can be used to provide separate sleeping areas. A natural partition is any structural feature of the structure that insulates one part from sight or sound of another. This includes separate rooms, walls, room dividers, etc.

Temporary partiions for separating sleeping areas can be erected from folding screens, portable blackboards, map racks, bulletin boards, signs. Tables and desks also can be used as temporary partitions. Curtains or blankets can be hung or draped to separate areas. In parking garages, cars may be moved to form partitions. Whatever is used as a partition should not take up too much floor space in-shelter.

Blankets. In the warm environment of many shelters, blankets will not be necessary as a covering. However, in all shelters, blankets may still be needed by the infirm and aged. In addition, blankets have a number of other uses. A blanket may be folded over as a mattress or mattress cover, rolled up as a pillow, or hung up as a partition. Blankets which are quite adequate for sheiter use can be purchased for as little as three to five dollars. However, those resonsible for developing shelter sleeping facilities in dual-purpose structures can plan to use a variety of available items to serve this purpose. Blankets may be improvised, for example, from clothing

(coats, jackets, shirts, sweaters); furniture (slip covers, drapes, curtains, rugs); towels, laundry bags, and newspaper, and other paper.

If two or more shelterees share a common bunk, table top, or even spot on the floor, it would be advantageous if each had his own blanket to provide something between the sleeper and the sleep surface. From both a psychological and a medical point of view, an individual's own private blanket or other form of bedding would be valuable in overcoming some of the disadvantages of "hot bunking," (more than one person using the same bunk).

Mattresses and pillows. While there seems to be little justification for stocking such an item in any but the most elaborate shelter, sleeping on the floor, table, or shelf may be made more comfortable through the use of an improvised mattress. Even one layer of corregated cardboard between a sleeper and the sleeping surface may aid shelterees comfort. Shelter plans may specify the use of the cardboard containers of various shelter supplies for this purpose, if this seems desirable.

Pillows, while not a likely item for shelter stocking, may be improvised from articles of clothing, books, or other materials.

# XV. WARNING AND SHELTER ENTRY

## Background

### Need for In-House Warning in Dual-Purpose Shelters

The major shelter goals can only be achieved through getting the greatest number of potential shelterees to the shelter on time. A great many people probably will be in buildings when an attack warning is sounded. Several factors may prevent individuals within large buildings from hearing outside warnings of impending atomic attack. Some of these factors include:

1. Excessive noise within the building from people or machinery.
2. Architectural features such as thick walls or soundproofing which prevent penetration of external sounds.
3. Working in areas in the central parts of the building which are isolated from external exposure.
4. Excessive distance of the external warning device from the building which prevents overcoming the above factors.

In addition, the outside warnings may be mistaken or ignored as a result of such factors as lack of knowledge about meaning of warning signals, or refusal to accept the reality of the situation. Delays in starting people to the shelter or total ignorance of impending attack may result in unnecessary exposure of shelterees to weapon effects. This suggests that some form of in-house warning system be developed within dual-purpose structures which will overcome the danger of failure in hearing outside warnings.

### Need for Rapid and Smooth Shelter Entry

Once potential shelterees receive an attack warning, they must approach and enter the shelter as quickly and smoothly as possible. The positioning

of personnel within the shelter or shelter loading is another important factor, which can affect both the approach to the shelter and passage through the entranceways.

With the short warning time (10 - 15 minutes) provided by modern weapon-delivery systems, speed becomes of critical importance to effective shelter entry. Confusion and compression of frightened crowds at shelter entrances can be major problems. Such factors can reduce the speed of shelter entry, cause extensive injury, and divert some individuals completely from the safety of the shelter area.

## Major Planning Factors

A shelter warning and entry program should include plans for:

1. Warning Systems
2. Access Routes
3. Entry Design and Procedures
4. Shelter Loading

### Warning Systems

Requirements

Factors which must be considered in the design of an effective in-house warning system are coverage, clarity, and reliability.

1. Coverage. Provision must be made so that all persons within the building are able to hear the warning no matter what conditions of man or machine noise or architectural features such as soundproofing exist.
2. Clarity. The addition of one sound to others may lead to the individual's ignoring the warning. The warning must be clear, distinguishable, and understandable to

all individuals. The signal should be used only for disaster warning.

3. Reliability. The system must have a one-hundred per cent gurantee of working when it is needed. This suggests that careful attention be paid to design features and that frequent tests of operability of the system be made.

Methods

There are several different types of warning systems which may be used for alerting personnel in dual-purpose structures of an imminent attack. Some of these include:

Public-warning system. Warning sirens have been installed by many cities and states through the help of the Federal government. These sirens are strategically placed throughout the area to provide widespread warning prior to an attack. Signals are transmitted by these sirens to indicate "attack warning" and "take over." These general-warning systems have proven effective in notifying much of the population of an impending attack. They do, however, have limitations for warning people inside buildings, as discussed on page 120.

Bell-and-light system. This warning system is available to the public through the Bell Telephone Company. The system can be installed through most switchboards, and located almost anywhere within a building. Warnings originating from Air Defense Control Centers are transmitted over private lines and telephone netwcrks to Civil Air Defense Warning stations. Special dials are installed at these points and when the code is dialed, warnings are relayed simultaneously to "bell-and-light" stations.

NEAR system. The NEAR system is another indoor warning device, now under development by OCD. It consists of a small electronic element that can be plugged into any electrical wall outlet. This box is designed to pick up signals that will be sent over regular commercial powerlines from the National Attack Warning System.

All of the systems described above provide maximum warning time in the event of an impending attack. The installation of the bell-and-light, NEAR, or another individual warning device in every room of a structure beyond the range of public sirens could be expensive, however. Furthermore, it would not necessarily be disadvantagous for shelter management personnel to receive a warning through such devices slightly prior to the rest of the shelterees. For these reasons, it may be desirable to develop a general warning system within a structure, which can be activated by shelter management personnel. In such a case, the individual warning device would be placed at strategic locations throughout a structure, so that responsible persons could always hear them.

In some cases, existing facilities may be used as warning systems. Some of these facilities include in-house fire alarms, public address systems, telephones, and signal bells or buzzers. Some planners may wish to install a special in-house warning system. The can be accomplished through the utilization of door-bell devices, sirens, whistles or other relatively inexpensive equipment.

## Access Routes

In developing access routes to the shelter from all possible locations in the building, shelter planning should include:

Review of available routes. Every building has peculiar characteristics which make it necessary for planners to review these features before the determination of desirable routes to the shelter. Such review would include consideration of: (1) widths of passages, (2) distance to shelter, (3) location of people. On the basis of review of available routes to the shelters, planners must determine the most desirable passageways.

Orientation of potential shelterees. It is necessary that planners devise some system of informing the potential shelterees of the routes they are expected to take to insure that they will be appropriately used. Whether to implement such orientation through meetings, personal contact, memos, or

other methods is a decision which will ultimately depend on the particular situation. Such factors as size of building, number of diverse organizations, number of people in and around the building, effectiveness of present communications systems, would be important in the design of an orientation plan.

Route and shelter marking. Orientation efforts may not prove successful, as a result of being ignored, forgotten, or passed off lightly. Also, individuals will probably be in the building as visitors and, therefore, not be familiar with the access plans of the particular building. This suggests that planners must consider some form of visible marking of both routes and shelters for each building. Such an approach is rather simple in both cost and effort but planners must consider possible objections to posted directions from peacetime users of the structure.

Establish a system for traffic control. To effectively get all individuals to the shelter quickly and smoothly, it will be necessary for planners to establish a system of traffic control for the building. Required control points must be determined. The procedures of control must be established. The type of personnel needed to control movement must be defined. The type of training these individuals require also must be defined. Finally, specific individuals must be designated for control positions.

## Shelter Opening

The dual-purpose use of some shelter facilities may necessitate their being locked during peacetime. Shelter planners should assure that these areas can be opened immediately upon receipt of an attack warning. A number of individuals should be given the responsibility of seeing that the shelter is opened and the necessary support equipment (lights, ventilation, etc.) be put into operation. Enough people should be designated to assure prompt response at any time of the day or night. The responsible individuals should be provided with keys and given the necessary instruction by those responsible for shelter planning.

## Shelter Entrances

Close attention must be given to shelter entrances since this may have serious effects on the flow of individuals into the shelter. Among the factors of importance are: (1) the number of entrances to the shelter, (2) the location of these entrances, (3) the design of these entrances, and (4) procedures for opening and closing the shelter.

Number. Several factors must be considered to determine how many entrances will be required to permit the passing of a particular number of people into the shelter in the given period of time. Ultimately this problem is solvable through a combined consideration of theoretical flow movements and analysis of design characteristics. The following are important factors in considering the number of entrances to the shelter:

1. More individuals can move through several entrances than a single entrance.
2. The more entrances, the greater the difficulty of providing for blast and radiation protection.
3. The more entrances, the greater the chance of having streams of people running into each other at certain places in the shelter. This would tend to lead to confusion and perhaps dangerous compaction of crowds, and in turn, would tend to impede the effective performance of important shelter tasks.

Location. The location of entrances can be an important factor in the effective handling of incoming shelterees. Entrances should be located so that they most directly face the direction from which the greatest flow of people will come. However, consideration must also be given to architectural features such as hallways and natural barriers. For example, an entrance which is in the middle of a corridor will be more effective than one which is at the end of a corridor, because it will be capable of handling flows from two directions rather than one.

Design. Design of entrances can play an important part in getting people into the shelter. Among planning considerations for design are

capacity vs. protection tradeoffs, lighting and other characteristics, and closure capability.

1. Capacity vs. Protection. Decisions must be made as to whether increased entrance width will seriously affect the protection afforded by entry doors. The wider the entrances, the more difficult it becomes to provide the necessary shielding. Some reasonable compromise must be made which will permit passage of the required number of people and also permit maximum protection under the given conditions.

2. Lighting and Other Characteristics. Lighting is an important factor at the entrance to the shelter as well as inside the shelter. People will be reluctant to pass into a darkened room and this in turn will cause slowdowns in the rate of loading the shelter. Darkness may also contribute to confusion and anxiety among the shelterees, as well as inhibiting effective performance of shelter tasks. Other physical configurations may inhibit the flow of individuals into the shelter. If baffle walls are built inside the shelter entrances to shield the shelterees from radiation, these walls could seriously impede flows. Consideration must be given to the side effects of such protective devices in designing the shelter. Similarily, more minute details of entrance design could be important. Door sills could trip individuals who are rushing through the entrance causing injury and slowing of the rate of entrance. Door latches, knobs, plates, etc. could injure entering shelterees. Should the door for the entrance open outwards, it may affect the flow of people who must pass around such an obstruction.

## Shelter Loading

Under conditions of an actual attack, personnel will tend to slow up once they have reached the safety of the shelter area. If shelterees enter

the shelter and merely stand around near the entrance, a serious back-up effect will take place, impeding the entrance of subsequent shelterees. Provision must be made to keep individuals moving into the shelter and to their designated places. People entering will naturally feel overawed by the small size of the room(s) and the large number of people who are supposed to enter. Such perception will decrease their willingness to proceed further. This phenomenon would be compounded by inadequate lighting arrangements. Therefore, there is a need to consider: (1) implications for shelter configurations and procedures at the time of shelter entry, (2) the need for a loading procedure, and (3) the need for crowd control.

Implications for shelter configuration. Possible effects of the entry phase indicate that certain possible design features are crucial in minimizing chances for such a slowdown in loading. The room may be made to look bigger than it is through the use of certain colors. Other techniques include not having all the bunks set up, and having supplies stored in the most efficient fashion.

Need for a loading procedure. The effects of the "back-up" phenomenon can be minimized not only through modification of design features, but also through effective definition of loading procedures. This means that each individual must know his assigned place in the shelter, and must proceed to it immediately upon entry. To accomplish such a task, an extensive education program must be carried out with the potential shelterees giving such procedural information.

Need for crowd control. Whether or not the above measures are effective in preventing the "back-up" effect, there is a definite need to select, train, and use control personnel in the loading phase. Such personnel would help those who had forgotten their place or who did not happen to work in the building to find appropriate places in the shelter. Also, such individuals would help to prevent confusion and panic once the shelterees were in the actual shelter.

## Closure Capability

Closing the shelter at the proper time is an essential aspect of the capabilities of shelters. In some cases it may be necessary to close the main doors before all the people have entered, because the blast may be imminent or fallout of radioactive materials may be starting. This would suggest that alternate entrances which would be designed to permit entrance without ill effects on people already inside, be used for latecomers. Such possibilities require planners to consider door design features such as sliding vs. hinged doors, as well as closure procedures. Such procedures, while tailored to the particular shelter situation, should:

1. Provide for rapid closure when danger is imminent.
2. Minimize personnel injury.
3. Minimize the possibility of confusion and fear of failure to gain entrance on the part of individuals still outside the shelter.

Again, at least one entrance should be provided which permits shelter ingress once fallout descends. Knowledge of this provision on the part of potential shelterees will do much to reduce the confusion and fear.

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# ORGANIZATION AND MANAGEMENT

# XVI. ORGANIZATION AND MANAGEMENT

## Background

The preceding chapters of this report have indicated the importance of personnel support both within and across all shelter operations. Effective organization of the entire shelter population, from the shelter management staff to individual work teams will contribute significantly to shelter functioning (Strope, Etter, Goldbeck, Heiskell, & Sheard, 1960; Altman, et al, 1961). The management and organization of a shelter system must not only support operational activities, but also should establish and maintain a shelter society which:

1. Develops and maintains group structure.
2. Establishes social standards.
3. Maintains law and order.
4. Sustains morale and group cohesiveness.

Much of the organization and management of a shelter system may be developed following shelter entry. Certain aspects of organization and management, however, are essential to assure effective system operation during and immediately following an attack warning. A great deal can and should be done during shelter planning to assure effective shelter operation and social control throughout the shelter stay.

## Major Planning Factors

Pre-shelter planning for organization and management should include: (1) development of an organizational structure, (2) staffing of "core" management, (3) pre-shelter training and orientation, and (4) general planning of shelter activities.

### Development of an Organizational Structure

Shelter organization should involve two types of groups, functional and community.

## Functional Organization

Functional organization involves the development of a shelter management staff and the designation of task teams to support the management structure. A management staff must be developed with key jobs in the areas of shelter operations, administration, and training. Task teams also must be evolved, comprised of small groups of individuals, often with specific skills, which are assigned to carry out particular shelter tasks.

One major purpose of functional organization is to apply the shelter group's resources toward the achievement of shelter goals in a rational and efficient manner. Another purpose is to give as many shelterees as possible a useful task to perform, with the result, perhaps, of lowered efficiency in some tasks, but an increase in shelteree motivation and morale.

Planning of a functional organization for any shelter is a complex procedure, which must reflect the unique characteristics of the particular shelter situation. Documents are available which provide a detailed and extensive treatment of this problem (Bend, et al, 1963; Eninger, & Fetter, 1963). A sample organization for shelter management is presented in Figure 5. Each box in the functional organization represents an area of responsibility, but not necessarily a particular individual on the management staff. A single area of responsibility may be managed by more than one manager, or a single individual may be responsible for several areas, depending upon the size of the shelter organization.

## Community Organization

Community organization involves development of population units of the shelter citizenry for the purpose of increased manageability by shelter leadership, and increased motivation and morale on the part of the shelterees. The major functions of this organization are: (1) psychological, (2) operational, and (3) managerial.

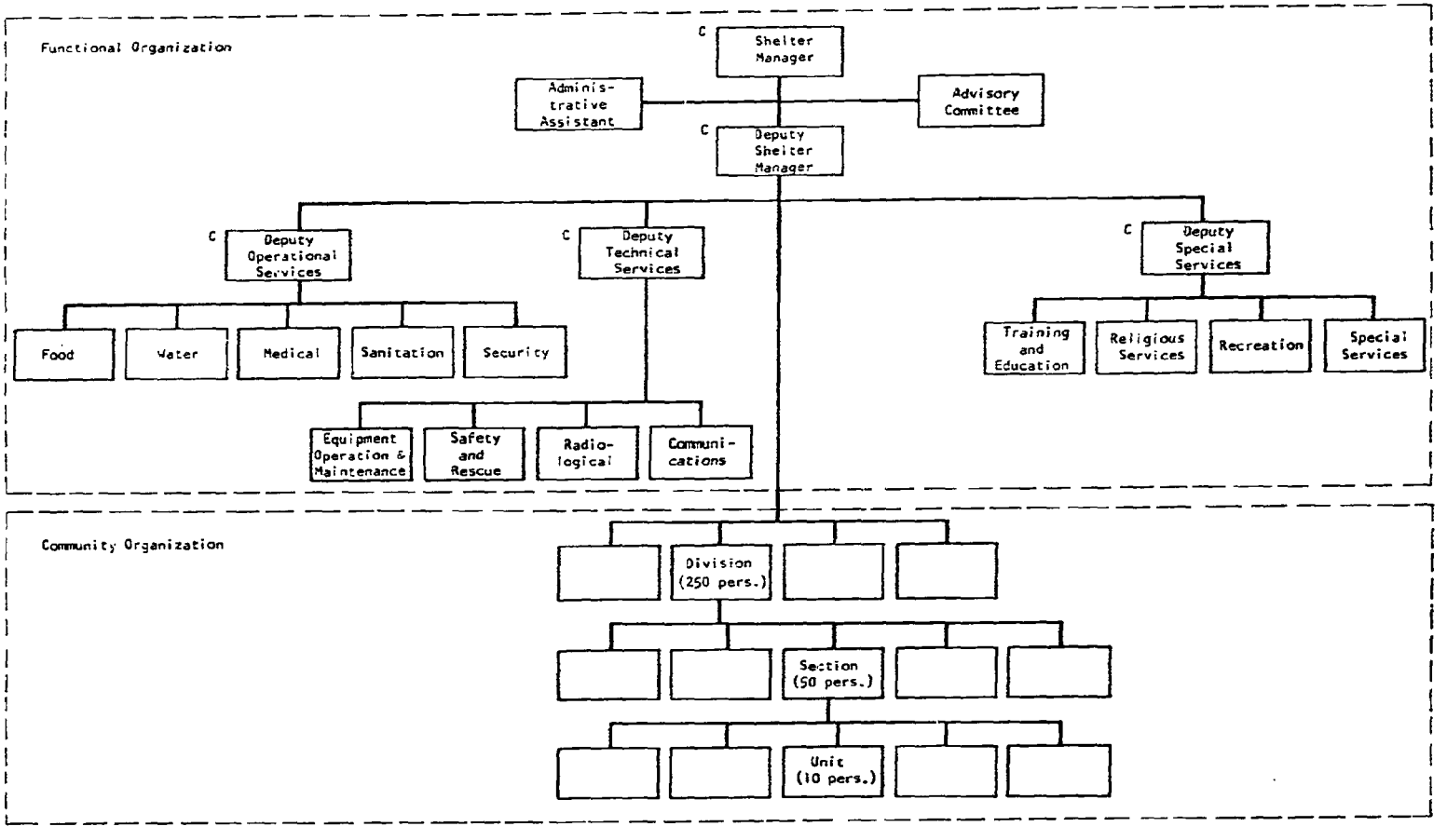


Figure 5. Sample Shelter Organization

The specific structure of community organization will depend upon certain basic characteristics of the particular shelter system under consideration. These characteristics include:

1. Shelter Size. The variable with the overriding effect upon shelter grouping is the size of the shelter, that is, the number of people in a given shelter.

2. Shelter Configuration. Shelter configuration means the physical layout of the shelter. The shelter can consist of a single space or multiple areas; the multiple areas may be contiguous or physically separated.

3. Level of Shelter Facilities. The shelter that has an extremely low level of survival supplies and equipment face a set of management problems that may call for a different mode of community grouping than the shelter that has a less austere level of facilities. The level of supplies may be affected by several possibilities. The original stocks may be at a minimal level. Overcrowding or an extended shelter stay may also deplete shelter supplies.

4. Population Characteristics. The distribution of the population as to age, sex, social class, and ethnic background has an impact on shelter grouping, A shelter with a heterogeneous mixture of these characteristics is a different shelter from the point of view of manageable group size and structure, than a shelter with a homogeneous population. Similarly, a shelter with many children may require different grouping patterns than an all-adult shelter.

5. Pre-Trained Management. The extent to which a pre-trained, and perhaps, pre-organized management staff is available in a shelter will be an important consideration in establishing shelter groups.

6. Pre-Organized Shelterees. The degree to which the shelterees are part of a common pre-shelter organization (an office or plant, school, perhaps even a neighborhood) will have implications for community grouping in-shelter.

7. Pre-Knowledges of Other Shelterees. A shelter in which a large part of the population are acquaintances, friends, relatives, or perhaps just know of each other, will tend to have a different grouping pattern than the shelter in which strangers are the rule and friends the exception.

The structure of community grouping in a shelter system is obviously complex and dependent upon many variable conditions. A detailed and extensive treatment of this problem is available in the document, Manageable Group Sizes In Large Shelters, (Bend, et al, 1963). The chart is, of course, exemplatory in nature, since the number of divisions, sections, and units in the community organization will vary with the size of the shelter.

## Staffing of Management Cadre

### Need for a Cadre

Staffing of key positions in the management structure should be one of the first steps in shelter planning. Members of the management staff should actively participate in planning for all of the shelter functions discussed in this report. In addition, these individuals should have major responsibility for maintaining the shelter system in a state of

operational readiness. Finally, the appointment of management personnel prior to shelter habitations will provide a valuable opportunity for their training and orientation prior to an actual emergency.

## Size of the Cadre

The number of persons needed to function as a management cadre will depend upon the size and complexity of the shelter system. A small shelter, i.e., less than 100 shelter spaces, may require a cadre of as few as two or three persons. A multi-thousand capacity shelter will require a substantially larger cadre because of the more complex planning and management problems.

The boxes marked C in the sample management organization (Figure 5, p. 132) are those positions which would constitute a minimum cadre. The five positions as indicated would be required to assure the planning and management support of every shelter function. Naturally, if additional cadre could be recruited, shelter planning and management could be more effectively implemented. A detailed account of cadre responsibilities is presented in the document, The Recruitment, Selection, and Training of Shelter Managers and Core Staff (Eninger, & Fetter, 1963).

## Recruitment and Selection

The overwhelming majority of public fallout shelters are peacetime facilities which are occupied by relatively large numbers of people for eight hours or more at least five days a week. It seems desirable to recruit a shelter management cadre from the people who regularly occupy such facilities (Eninger, & Fetter, 1963). Most such established facilities have one or more management organizations to support their peacetime operations. It is highly probable, therefore, that the kind of basically qualified persons needed for shelter management cadres are already normal occupants of the facilities which house fallout shelters. It is recommended that the cadre for such shelters be recruited from the basically

qualified, regular occupants by working through the influence of those who head the normal, peacetime management organizations. It should be necessary beyond the building to recruit only when: (1) the regular occupants fail to volunteer their services, or (2) there is a lack of qualified persons among the regular occupants. For those facilities not characterized by management organization, or in the situation where the heads of such organizations are reluctant to participate, it is recommended that an alternative stategy, recruitment through the community influence structure, be used (Eninger, & Fetter, 1963). Within any community there are those individuals or groups who have more power or influence than others. This power or influence can be based on money, social prestige, military rank, political office, religious prestige, etc., or some combination of these depending on the local situation. In any case, the overt existence of such influence structures should be apparent to the local citizenry and should be used in persuading other community citizens to assume management positions. Detailed recommendations concerning the recruitment and selection of a shelter management cadre are presented in Eninger and Fetter (1963).

### Expansion of Management Cadre

The immediate task of the shelter management cadre, once the shelter has been occupied by shelterees, is to expand itself to fulfill the organization plan. This will require the recruitment, selection, and training of additional personnel from the shelterees. Shelter registration form should be prepared and stocked for use in the selection of qualified persons from among the shelterees to expand the management staff (Siroky, & Eninger, 1963).

## Pre-Shelter Training and Orientation

### Training of Shelter Managers

Leadership abilities will presumably be natural characteristics of personnel recruited as shelter managers. However, the specific problems

which must be faced in civil defense differ greatly from those encountered in the manager's normal occupation. This suggests that a training and education program be established to familiarize each of these individuals with: (1) the procedures of managing a dual-purpose shelter, (2) the stocking requirements of shelters, (3) the pecular characteristics of the particular shelter involved, (4) methods for recruiting lower level personnel, and (5) procedures for maintaining operational readiness.

The training and education programs should be undertaken in such a fashion as not to interfere with the manager's ordinary occupation. The managers, being recruited from the influence structure of the community, will hold important and time-consuming positions. Therefore, the amount of time required for training purposes should be minimal.

A five-day shelter management training course is now being offered at OCD training centers in Battle Creek, Michigan; Brooklyn, New York; and Alameda, California (DOD, 1963). Shelter managers who attend this course will be qualified to instruct their deputies and other management cadre, using reading materials, lectures, discussions, self-instructional techniques, and actual sessions, if possible. Eninger and Fetter (1963) provides specific recommendations for this training.

Shelteree Orientation

One of the greatest impediments to effective shelter operation could be confusion, or even panic, on the part of shelterees unfamiliar not only with the threat of nuclear disaster, but also with the facilities which have been established for their protection. Orientation of the shelterees to both of these factors prior to an actual emergency should greatly facilitate operation of the shelter. This orientation can be accomplished through an initial briefing, periodic exercises, and the dissemination of literature of potential shelter users.

Once a shelter system has been developed to a state of operational readiness the potential shelterees should, if possible, be assembled in the shelter area for a brief general orientation. This initial orientation should include:

1. A brief explanation of the nature of nuclear war and the concept of fallout shelter protection.
2. Inspection of the shelter area and its facilities.
3. A brief discussion by the shelter manager of procedures for shelter entry, habitation, and exit.
4. An introduction to the group of other shelter management personnel.
5. Registration of the potential shelterees to determine available skills.
6. Distribution of literature and a general question and answer period.

Periodic meetings of all or some of the potential shelter population should be conducted in succeeding months to both maintain and increase operational readiness. These meetings should be held in the shelter area, if possible, and should involve such things as discussions of potential shelter problems and exercises in the use of facilities, i.e., setting up bunks, waste disposal, etc.

The distribution of literature can be used as either an alternative or supplemental technique for shelteree orientation. When the addresses of potential shelterees are available, pamphlets can be distributed which discuss such things as:

1. The physical aspects of the shelter.
2. Procedures for entering the shelter.

3. Shelter activities.

4. The structure and responsibilities of shelter management.

Again, the potential shelterees may be asked to register in order to assess the skills which may be available during an emergency.

## Planning for Shelter Activities

Planning for the management and organization of a shelter system should include a general program for the maximum utilization of its major resource, the shelterees themselves. The primary advantages of programming the activities of the shelter population are:

1. Maximum utilization of available manpower, skills and knowledges to support shelter operations.

2. Enhancement of morale and group cohesiveness.

Certain shelter activities, such as caring for the ill and infirm, or food preparation, are directly related to the operational goals of the shelter. On the other hand, activities of a more non-operational nature, such as recreational or religious programs, engender morale; and "esprit de corps," thus, facilitating social control in the shelter. The two types of activities interact, of course, participation in a useful activity such as food preparation enhances an individual's morale, and morale-producing recreational activities make the individual more willing to participate in vital operational tasks.

The general planning of such activities prior to shelter entry will do much to promote confidence in shelter management on the part of the shelter population.

The three major areas for activities planning are: (1) operational, (2) non-operational, and (3) training. Although training is technically

a non-operational activity, it contributes directly to both in-shelter and post-shelter operations, and, as a major shelter activity, should be considered separately.

## Operational Activities

These activities, of course, are of prime consideration. They involve, essentially, direct support of each of the shelter functions discussed in this report. Regular teams of shelterees will be designated, following shelter entry, to perform specific tasks in such areas as fire protection, communications, and shelter sanitation. The formation and responsibilities of these teams are discussed in detail in a number of reports prepared for OCD (Bend, et al, 1963; Eninger, & Fetter, 1963; Levy, et al, 1963).

The shelterees also will participate as a group in many operational activities, including fire drills, food distribution, erection of bunking facilities, etc. A well-planned program of such activities may be developed through reference to reports prepared for OCD (Bend, et al, 1963).

## Non-Operational Activities

The types of non-operational activities which should be considered during shelter planning include physical fitness exercises, religious activities, arts and crafts, small group social activities, spectator entertainment, and individual solitary activities (e.g., reading). The potential benefits to be derived from these types of activities vary somewhat according to the type of activity. In general, they are:

1. Reduction in negative emotional states.
2. Breakdown of interpersonal barriers.
3. Readiness of shelterees to respond to shelter leadership.
4. Better control over shelteree behavior.
5. A sense of faster time passage.
6. A sense of contributing to the common good.

7. A general increase of useful or necessary information.
8. A restoration of "inner strength" or spiritual resources.

Since the physical characteristics of the shelter facility would have some bearing on the kinds of activities planned for shelterees, the activity planner should assess the physical characteristics of his shelter fairly early in the planning phase. He should consider:

Personnel capacity of the shelter. This will provide the activity planner with a basis for estimating the magnitude of the activity program, and for recognizing the implications of space, personnel and perhaps, stocked materials.

Physical division of shelter facility. Preparing a floor plan of the shelter facility will provide a basis for allocating specific activities to specific locations so that the required tasks of the shelter may best be fulfilled, and insure that activities do not become a nuisance to non-participants.

Adequacy of shelter ventilation. Obviously, where there is minimally adequate natural ventilation activities likely to generate heat should be held to a minimum or eliminated all together. Thus, adequacy of shelter ventilation, which is also a function of climate and other shelter conditions, has direct bearing on the kinds or types of activities permissible.

Availability of materials for activities. The equipment, materials, and supplies normally found in the shelter area should be assessed for potential use in a program of planned activities. For example, a shelter located in a school or community center probably would contain maximal activity-inducing materials for its potential shelterees. The kinds and quantity of activity items should be inventoried and listed, since this list can be the basis for determining if needed materials are likely to be available, or whether additional local stocking may be desired.

The activity planner also should attempt to forecast the kind of shelterees who are likely to occupy his shelter, since they have bearing on the kinds of activities which may be planned. Mainly, characteristics of shelterees may be forecast from the nature of the area surrounding the shelter,

as this is where the shelterees are likely to have come from. The neighborhood, type of companies and buildings adjacent to the shelter, the presence of schools, hospitals, etc., all can be used as predictors of potential shelterees.

The following characteristics of a shelter population may influence activity planning:

1. Ratio of adult males to females.
2. Ratio of non-adults to adults.
3. Number and type of special problem cases (aged, infirm, hospitalized, etc.).
4. Racial composition of shelterees.
5. Religious composition.
6. Predominant socio-economic level.

Identifying specific individuals in his area who have experience with many kinds of activities will aid the activity leader in selecting assistants and advisors.

Special materials may be stocked in the shelter to be used for recreational purposes. However, most dual-purpose structures contain sufficient resources to support these activities. A more complete discussion of shelter activity planning may be found in Planning and Organizing Shelter Activity Programs (Siroky, & Eninger, 1963).

## In-Shelter Training

In-shelter training, education, and orientation activities should be engaged in by most, if not all, shelterees. They will be among the most important of the shelter activities for two reasons. They will not only provide a realistic, highly meaningful, and useful way to absorb shelterees idle time, but also increase the capability of shelterees for in- and post-shelter living.

Shelter activity planners should emphasize the following five kinds of training and education activities:

Management staff training. This refers to training individuals selected from the general shelter population in the duties and responsibilities of various shelter management positions. This type of training activity would be offered to only a minority of shelterees.

Training shelterees for shelter emergencies. All shelterees should know what to do when contingencies such as outbreak of fire, breakdown of ventilation, infiltration of radiation, shelter flooding, outbreaks of group panic, and other threatening emergencies occur. This training should be be given fairly early in the shelter occcupancy, and all shelterees should participate. It should be given on a group basis by knowledgeable members of the shelter staff.

Orientation and news transmittal sessions. As soon after entry, and periodically thereafter, shelterees should be kept informed and oriented to the shelter conditions as well as about developments outside of the shelter. This would probably take the form of relatively short general shelter meetings once a day, or as new developments warrant.

Post-shelter living training. Training shelterees on how to cope with the problems likely to be encountered in the first several weeks after leaving the shelter, e.g., rationing of food supplies, purification of water, first aid and medical care, and similar topics, will be one of the most important of the shelter activities. It should reach all shelterees.

On-going education for children. As a means of forging a bridge between pre- and post-shelter society, on-going education of school-age children will be important. The amount and kind of academic information transmitted will be of secondary importance next to the effect this activity has in terms of increasing shelteree morale and providing parents with some free time to rest or perform shelter jobs.

Planners of training activities should be aware of several kinds of information, including: (1) the local civil defnese plan, (2) guidelines for training for post-shelter survival, (3) specific course contents of post-shelter survival training, e.g., special sanitation procedures, decontamination procedures, procedures for obtaining food, water, etc.

Course materials should be developed and stocked in the shelter. Many of the pamphlets and other materials now in use for civil defense training would be useful for in-shelter training (i.e., Federal Civil Defense Administration, 1956). These may be acquired by shelter planners at little or no cost from local civil defense agencies. Paper, pencils, and other tools useful for training sessions will be available in most buildings which serve as dual-purpose shelters. If not, these items can, of course, be purchased quite cheaply.

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