Appendix 1

(Annex 10—National Shelter Plan)

Fallout Shelter Surveys:

GUIDE FOR EXECUTIVES

NP–10–1

NATIONAL PLAN APPENDIX SERIES

Executive Office of the President

OFFICE OF CIVIL AND DEFENSE MOBILIZATION

October 1959

CONTENTS

INTRODUCTION

Ten years ago terms such as "nuclear radiation" and "roentgen" were pretty much confined to the scientist's laboratory.

Today they are on the executive's desk.

They are there by necessity because they are tied in with the promises and the problems of the new nuclear age—an age which demands informed leadership.

You will find these and other like terms in this manual because the manual deals with an important problem—radioactive fallout from nuclear attack—as it concerns a key executive: the man responsible for directing civil defense preparedness measures in government, industry, or other large facility.

The job this man faces is sometimes discouraging because of its size and newness. But it is far from an impossible job. There are more answers today, for example, to the problem of radiological defense than there were even as recently as 6 months ago.

The purpose of this manual is to describe one of today's answers—a fallout shelter survey.

Fallout shelter surveys are an essential part of the National Policy on Shelters issued by direction of the President on May 7, 1958. Since the policy announcement, there has been a growing recognition of the importance of these surveys. State Governors, for example, at their 51st annual meeting in August 1959, unanimously approved a resolution: "That each State initiate a survey of all State owned or operated facilities to determine both their adequacy as fallout shelters, and what steps are needed to provide fallout protection for their users, both regular and transient."

A fallout shelter survey has two immediate goals: (1) To discover what facilities already exist in a community in the way of fallout shelter, and (2) to determine the best ways of improving these facilities from the standpoint of fallout protection and shelter habitability. This information is vital to the development of any plan for shelter use.

Many methods could be used to achieve these goals in a given survey—some of them very expensive and time-consuming. The Office of Civil and Defense Mobilization, with the assistance of other governmental and private agencies, has developed survey methods that take into account these important matters of time and expense as well as other factors in shelter surveying. The methods are based upon considerable research, including pilot shelter surveys conducted in the spring of 1959 in Contra Costa County, Calif.; Milwaukee, Wis.; Montgomery, Ala.; and Tulsa, Okla.

This manual, prepared as background guidance for the executive responsible for planning and directing a fallout shelter survey, contains a brief description of the characteristics of radioactive fallout, radiation shielding, and shelter habitability, followed by a discussion of suggested survey planning, administrative, and field work procedures.

Architects or engineers who actually conduct fallout shelter surveys should be fully acquainted not only with the material in this manual but also with the technical procedures described in another OCDM manual, *Fallout Shelter Surveys: Guide for Architects and Engineers.*

THE PROBLEM—RADIOACTIVE FALLOUT

The detonation of a nuclear weapon near the ground causes large quantities of earth and debris to be forced up into the fireball and the resulting mushroom-shaped cloud—a cloud which may reach an altitude of 15 miles or more before leveling off. The earth and debris particles in the cloud vary in size from fine powder to large grains, and it is these particles which act as the sources of radiation that can damage living cells.

Most of the particles fall back to the earth's surface within 2 days—"early fallout"—but some remain aloft far longer—"delayed fallout." (See fig. 1.) In a nuclear attack the immediate and most serious danger would be from early fallout. Therefore, the term fallout as used in this manual refers to early fallout only.

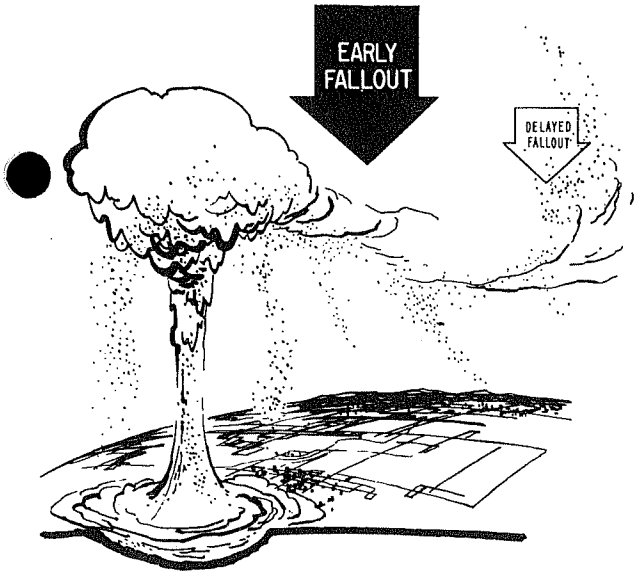


FIGURE 1.—*Formation of fallout.*

Significant amounts of fallout do not arrive outside a blast area earlier than about 30 minutes after an explosion. From then on the fallout begins to cover an increasingly larger area, and may eventually blanket thousands of square miles.

The fallout pattern depends largely on the type, size, and detonation of the weapon involved, and the meteorological conditions for the first day or so after the explosion. Some idea of the effect that wind conditions have on fallout patterns from a single nuclear burst is illustrated in figure 2. In areas where the fallout patterns from two or more weapons overlap the hazard increases, and in a massive nuclear attack on the United States much of the country could be covered by dangerous radioactive contamination (fig. 3).

There are three different kinds of radiation associated with fallout—alpha and beta particles, and gamma rays. Alpha and beta emitters may be dangerous if they are ingested through contaminated food, water, or air, but from the shelter standpoint they present no problem. Alpha particles cannot penetrate the external layer of skin, and beta particles cannot penetrate heavy clothing. However, *gamma rays, like X-rays, are*

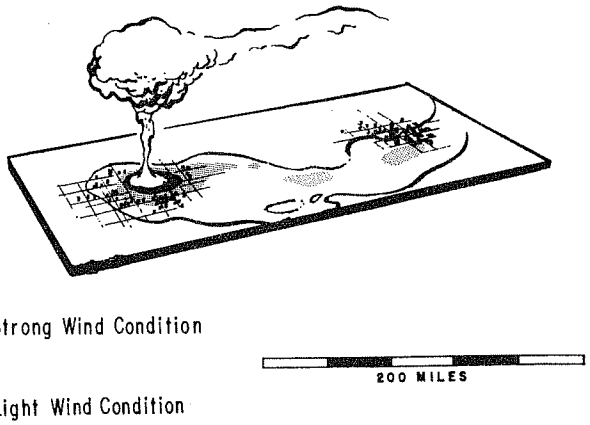


FIGURE 2.—*How wind conditions affect fallout distribution.*

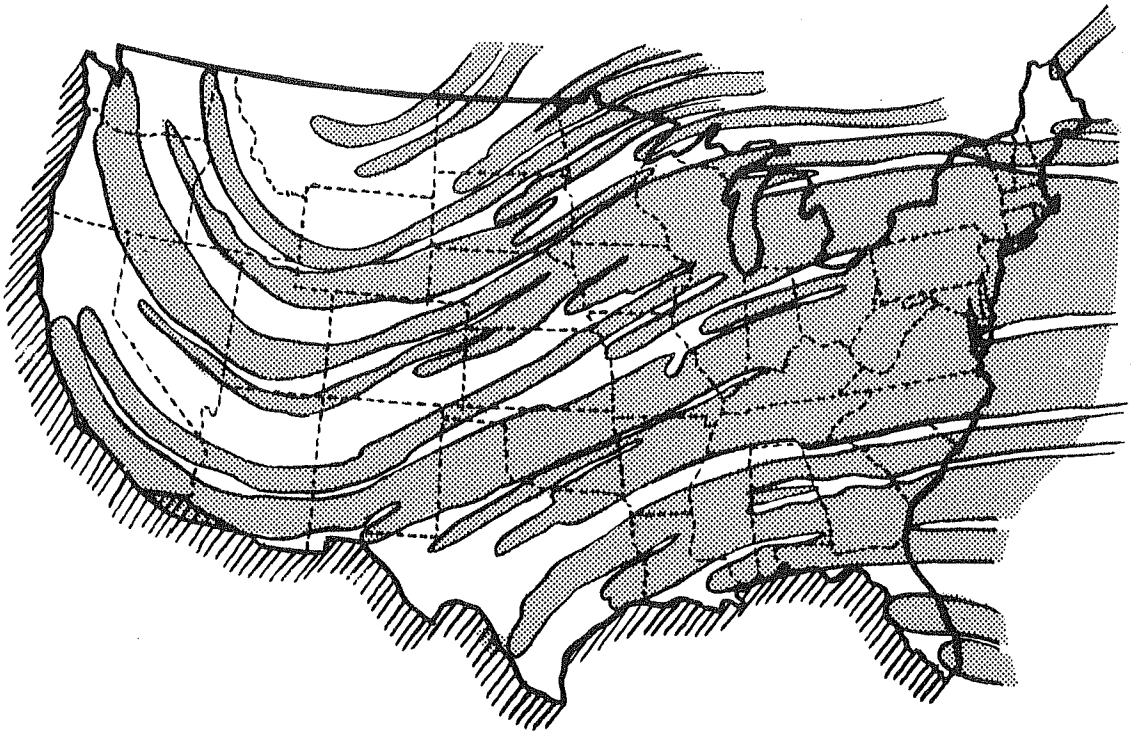


FIGURE 3.—*How fallout could cover the Nation following a massive nuclear attack.*

highly penetrating, and can cause serious damage to living tissue. *The primary aim of fallout shelter is to provide a shield against gamma radiation.*

The intensity of gamma fallout radiation decreases in time through a process known as radioactive decay. A significant decrease in radioactivity comes during the first 24 hours of its existence. For example, if the gamma radiation is measured as 800 roentgens per hour [1] 3½ hours after an explosion, it would be only about 80 roentgens per hour 24 hours after the explosion.

Some idea of the effects of gamma radiation on humans may be found in figure 4. These examples are related to *short-term* exposure doses. An exposure dose received over a long period of time may be less harmful than the same dose received in a few hours or days.

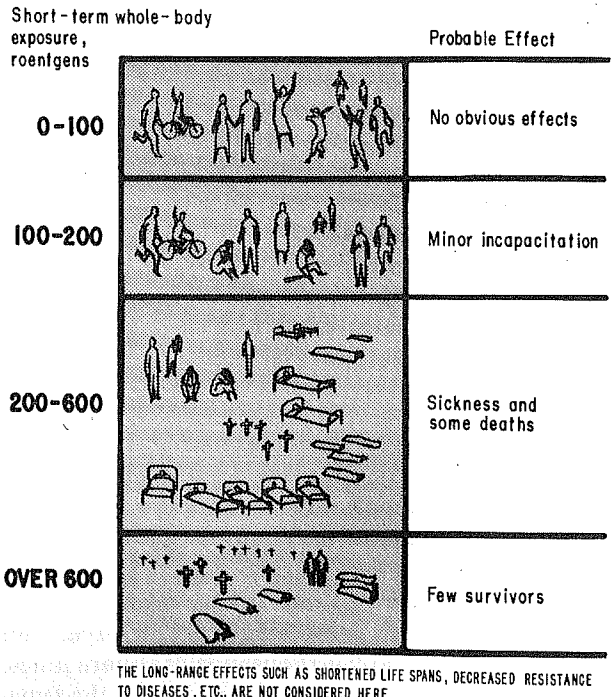


FIGURE 4.—*Probable acute effects of gamma radiation on humans.*

[1] A roentgen is the unit used to measure exposure dose of gamma radiation, and exposure dose rate is expressed in roentgens per hour (r/hr).

KEY SHELTER FACTORS

SHIELDING

There are two methods of shielding from fallout radiation: barrier shielding and geometry shielding.

In the first method, a barrier is placed between the fallout field and the individual. The heavier the protective barrier, the greater the barrier shielding effect. Examples of barriers in structures are walls, floors, and ceilings. (See fig. 5.)

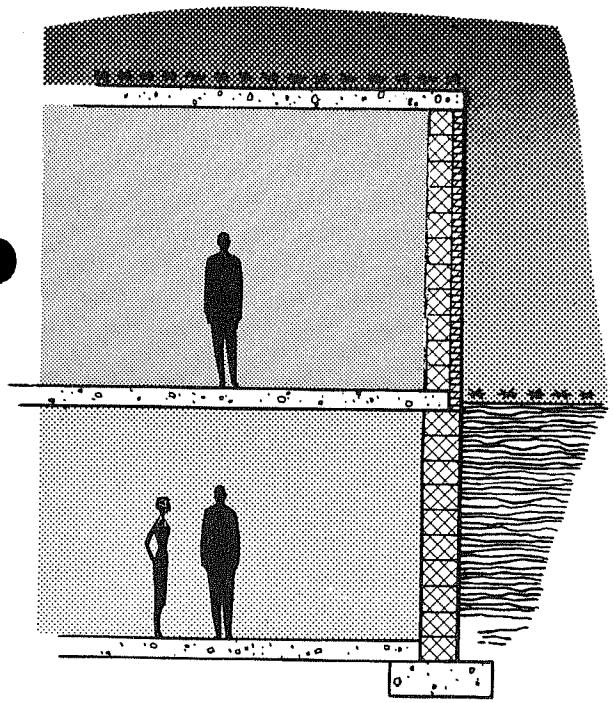


FIGURE 5.—*Barrier shielding.*

Geometry shielding is determined by the extent of the fallout field affecting an individual, and/or his distance from it.

Here is an example of the geometry shielding effect:

If two buildings are of the same height and similar construction, but of different area, the protection from ground contamination would be greater on the first floor in the building with the larger area.

On the other hand, if two buildings are of equal area and similar construction, but differ in height, protection from roof contamination would be greater on the first floor of the higher building. (See fig. 6.)

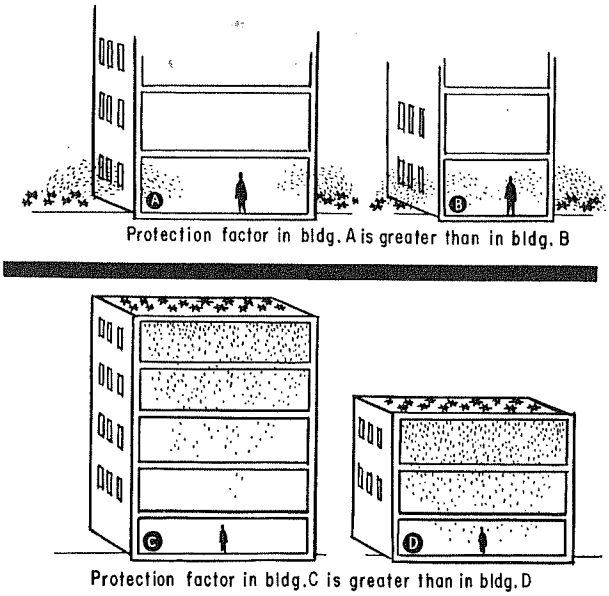


FIGURE 6.—*Geometry shielding.*

The combined effects of barrier shielding and geometry shielding result in a shelter "protection factor." This term is used by technicians to express the relative reduction in the amount of radiation that would be received by a person in a protected location, compared to the amount he would receive if he were unprotected. For example, if a shelter has a protection factor of 500, an unprotected person would be exposed to 500 times more radiation than someone inside the shelter.

For shelter survey purposes, structures should be classified according to their protection factor. Six categories of protection factors, "A" through "F," together with some examples of potential shelter areas to which they may be applied, are listed in table 1.

TABLE 1.—*Description of shelter categories*

Shelter category	Protection factor [1]	Shelter examples [2]
A	1,000 or greater.	OCDM underground shelters. Subbasements of multistory buildings. Underground installations (mines, tunnels, etc.).
B	250 to 1,000.	OCDM basement fallout shelters (heavy masonry residences). Basements (without exposed walls of multistory buildings).
C	50 to 250	OCDM basement fallout shelters (frame and brick veneer residences). Central areas of basements (with partially exposed walls) of multistory buildings. Central areas of upper floors (excluding top floor) of large multistory buildings with heavy exterior walls and floors.
D	10 to 50	Basements (without exposed walls) of small 1- or 2-story buildings. Central areas of upper floors (excluding top floor) of large multistory buildings with light exterior walls and floors.
E	2 to 10	Basements (partially exposed) of small 1- or 2-story buildings. Central areas on ground floors in 1- or 2-story buildings with heavy masonry walls.
F	1½ to 2	Aboveground areas of low buildings, in general, including residences, stores, light industrial buildings.

[1] This term expresses the relative reduction in the amount of radiation that would be received by a person in a protected location, compared to the amount he would receive if he were unprotected.

[2] These examples refer to isolated structures only. The presence of other structures nearby could increase the protection factor of a given shelter area, perhaps enough to raise its category.

Some indication of the likelihood of survival from the effects of fallout radiation, as related to category of shelter, is given in table 2. It is important to note that even "E" category shelters afford "fair" protection from light fallout, and could save many lives.

TABLE 2.—*Chances of survival without severe illness from exposure to fallout radiation*

Shelter category	Fallout deposition		
	Heavy	Medium	Light
A	Excellent	Excellent	Excellent.
B	Good	Excellent	Excellent.
C	Fair	Good	Excellent.
D	Poor	Fair	Good.
E	Nil	Poor	Fair.
F	Nil	Nil	Poor.

HABITABILITY

Although a potential shelter area may provide excellent shielding from fallout radiation, its worth as a shelter is limited if it is poorly ventilated, deficient in sanitary facilities, or too small for the number of occupants. (See fig. 7.)

The term "capacity," as used in shelter surveys, refers to the number of persons that can be accommodated in a shelter.

At least 12 square feet per person is recommended as a basis for determining capacity of a well-ventilated potential shelter area. The best plan of action during the first 24 hours—which is the critical period for fallout—may be to crowd people into somewhat less space to protect them from the high levels of outside radiation. After

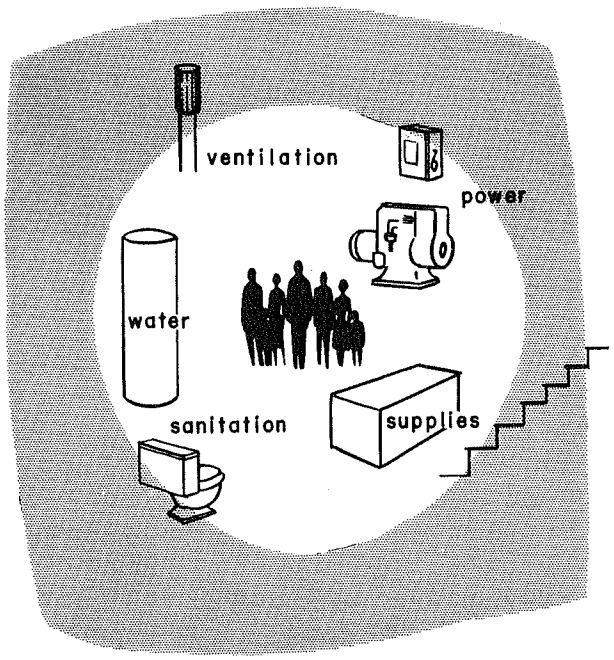


FIGURE 7.—*Shelter habitability.*

this time it may be feasible to transfer them to areas with lower protection factors but more space per person.

Adequate shelter ventilation is most important. A forced-air system with a fresh-air intake of at least 3 cubic feet per minute per person would allow full use of a shelter.

Many existing buildings have well-shielded rooms that are unventilated or poorly ventilated. In these cases, capacity is limited by the volume of the room, not its floor area. A rule of thumb for estimating capacity of unventilated basement shelter is that each occupant requires 500 cubic feet of volume.

Water available to a shelter area should not be less than one-half gallon of potable water per person per day. At least a 2-week supply should be assured. A dependable well in or supplying the shelter is preferred, but stored water is a suitable alternative—and could be less expensive if a well is not already in place.

Unsanitary conditions may develop in a relatively short time after a shelter is occupied unless proper provisions are made. Building codes normally require at least 1 toilet for every 35 occupants in barracks, dormitories, and similar structures. In shelter planning, this requirement may be lowered to as much as 1 toilet for every 70 occupants.

Garbage and trash disposal probably will not be a serious problem because it can be deposited outside the shelter area soon after it collects.

Each public shelter area should have electric power. Unless there is reasonable assurance that normal power supplies will be available during the emergency, engine-generator sets may be required.

IMPROVEMENT OF SHELTER AREAS

Two types of improvements should be considered for potential shelter areas. First, improvements to increase the protection factor, and second, to provide a tolerable environment.

Obviously, if enough money is available, any area can be improved to the highest shelter category, with a satisfactory environment. For shelter survey purposes, however, it is necessary to distinguish between a "reasonable improvement" of an existing area and virtual reconstruction.

The suggested approach in evaluating fallout shelter improvement potential is to define the limits of reasonable improvements by a fixed cost per occupant, excluding costs of bunks, bedding, food, and other supplies. Then match the per capita cost with the highest practicable category to which the structure can be improved.

As a general rule, the fixed cost selected should not be greater than the per capita cost of a new fallout shelter nor less than that required to meet minimum habitability standards.

PROGRAMING AND PLANNING

GENERAL

A fallout shelter survey should be considered an essential part, but not the only part, of a total shelter program for a community. The total program would consist ideally of at least five major projects:

1. Establishment of a working organization with the authority to develop a comprehensive community shelter program that is carefully integrated with the overall civil defense program.
2. Completion of a community fallout shelter survey.
3. Designation of temporary shelters in existing buildings for use if an emergency occurs before the shelter program is completed.
4. Modifying existing buildings and incorporating shelter areas into new buildings.
5. Construction of new shelters which can serve such dual purposes as youth centers, community halls, schools, hospitals, etc.

PROGRAMING THE SHELTER SURVEY

Fallout shelter survey programing may be divided into five major phases: (1) Initial funding and organizing; (2) collection and analysis of data on existing fallout shelter areas; (3) preparation of estimated costs for improving fallout shelter areas; (4) collection of data on population distribution; and (5) integration of phases 2, 3, and 4 into a report that shows the fallout shelter potential of the community.

Perhaps most important to the man responsible for managing the survey is the first phase, particularly the initial funding. He has to be able to answer the obvious question: "How much is it going to cost?"

Based on experience gained in its pilot shelter surveys, OCDM suggests the following cost-estimate formula:

Multiply the number of people in the community (daily peak population) by 10 cents. Multiply the number of structures in the community by 50 cents. The higher of the two figures will give a good indication of the minimum cost.

As an example of a specific case, the pilot shelter survey conducted in Montgomery, Ala., cost $33,100. However, Montgomery officials believe that with the procedures and techniques now available—many of them developed through the pilot study—they could do the same job today for about $21,000. The survey involved a total of about 8,000 man-hours. Survey officials believe that the total man-hours required for a similar survey could be reduced by about 50 percent, cutting about $12,000 off the cost.

This survey covered Montgomery County (population 177,000; 805 square miles), which includes the city of Montgomery (population 132,000; 30 square miles). There are a total of 43,185 structures in the County.

The cost breakdown for the Montgomery pilot survey was as follows:

Professional services	$27,200
Consultant service	475
Travel expense	1,800
Communication	375
Taxes and licenses	600
Insurance	200
Supplies	400
Office rent	700
Equipment rent	550
Reproduction of reports	800
Total	$33,100

As a general rule survey costs will be kept to a minimum if (1) the architect or engineer conducting the survey thoroughly understands the nature of fallout radiation and how shielding factors relate to the problem, and has an efficient survey organization; (2) local records on existing buildings are complete, up-to-date, and readily available; and (3) a cooperative spirit exists within local government, among civic associations, and on the part of the public.

SHELTER SURVEY PLANNING

The overall management of a community shelter survey is the responsibility of the chief executive of the community or his designee, such as his civil defense director. However, it is desirable to have an experienced architect or engineer direct the details of the actual survey. Such a professional should be hired on a full-time basis. A model "General Scope of Work for Fallout Shelter Survey Contracts" is presented in supplement A, p. 11.

Although planning is largely determined by local conditions, some generalizations may be made. First, a cursory preliminary study may be worthwhile because it will indicate the variety of buildings to be analyzed and which buildings may be considered typical of a particular class. For example, every residence in a given subdivision may be so similar that a shelter analysis of one could be assumed to apply to all.

Second, shelter survey "districts" should be chosen to coincide with well-established areas such as census tracts, political precincts, or land utilization areas as determined by local planning commissions.

Third, it is important to collect information on critical structures, such as electrical power stations and waterworks, during the early phases of the survey. Also, information on public structures, such as schools and hospitals, may be collected as separate groups in addition to considering the structures as part of a given shelter district.

Finally, good public relations is essential to a successful survey. The survey will be "news" and local news media should be kept fully informed on the purpose of the survey, the manner in which it is to be conducted, and the results.

GENERAL GUIDANCE ON MAKING THE SURVEY

ORGANIZATION

The organizational setup required for a shelter survey project will depend upon time and money available, and size and nature of the area to be surveyed.

One example of organization is shown in figure 8.

In the pilot survey conducted in Montgomery, Ala., the survey team consisted of 11 persons, as follows: 3 supervisors, a secretary, and 7 others who functioned as clerks, computers, and inspectors.

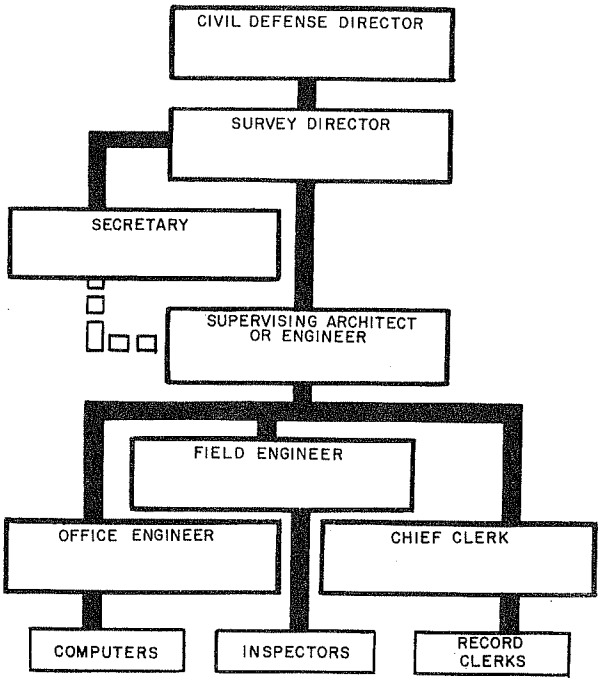


FIGURE 8.—*Shelter survey organization.*

"Task force" members must be versatile. For example, during the early stages of the project, computers may be required to work as field inspectors. Later, the reverse may be necessary.

OFFICE OPERATIONS

Principal office tasks will be calculations to determine category and capacity of existing shelter areas, preliminary cost estimates of modifications, and preparation of maps, tables, and summaries.

Sample data forms prepared by OCDM to expedite this work are shown in figure 9. Their use is detailed in the OCDM manual, *Fallout Shelter Surveys: Guide for Architects and Engineers.* Through use of six graphs included in that publication, simple arithmetic will provide all the answers necessary to fill in these forms.

Equipment and supplies ordinarily available in the office of an architect or engineer are required for office operations. In addition, use of a punch-card system for machine analysis would be particularly helpful in metropolitan areas where data is already on cards. Otherwise it may be too expensive. In some cases, however, information entered could be used later by local government on other projects, such as long-range urban planning.

Before extensive field work is started, a check should be made for pertinent records and other informational sources of local government, business, and industry. Table 3 lists some of the more important of these sources.

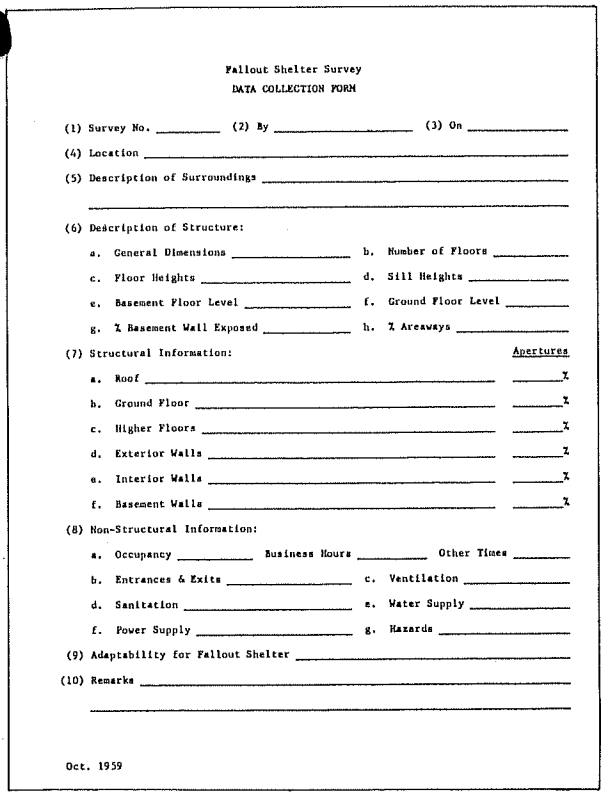
If good records are available, it may be advisable to have a separate group of clerical personnel spend full time transferring information from files to the data collection forms. If available records are poor, the need for higher salaried personnel will be greater because more care will be required in extracting desired information, and more field work will be necessary.

FIELD OPERATIONS

Full-scale field operations should be preceded by a "cruising" or "windshield" survey. This will familiarize inspectors with assigned territories, and will also provide valuable planning information.

As an example, visual inspection from a moving automobile often is sufficient basis for quickly designating an entire subdivision as "F" category for shelter purposes.

A cruising team is a driver and an inspector. As the team drives down a street, the inspector looks at the various structures and enters on



Fallout Shelter Survey
DATA COLLECTION FORM

(1) Survey No. _____ (2) By _____ (3) On _____
(4) Location _____
(5) Description of Surroundings _____
(6) Description of Structure:
a. General Dimensions _____ b. Number of Floors _____
c. Floor Heights _____ d. Sill Heights _____
e. Basement Floor Level _____ f. Ground Floor Level _____
g. % Basement Wall Exposed _____ h. % Areaways _____
(7) Structural Information: Apertures
a. Roof _____ ____%
b. Ground Floor _____ ____%
c. Higher Floors _____ ____%
d. Exterior Walls _____ ____%
e. Interior Walls _____ ____%
f. Basement Walls _____ ____%
(8) Non-Structural Information:
a. Occupancy _____ Business Hours _____ Other Times _____
b. Entrances & Exits _____ c. Ventilation _____
d. Sanitation _____ e. Water Supply _____
f. Power Supply _____ g. Hazards _____
(9) Adaptability for Fallout Shelter _____
(10) Remarks _____
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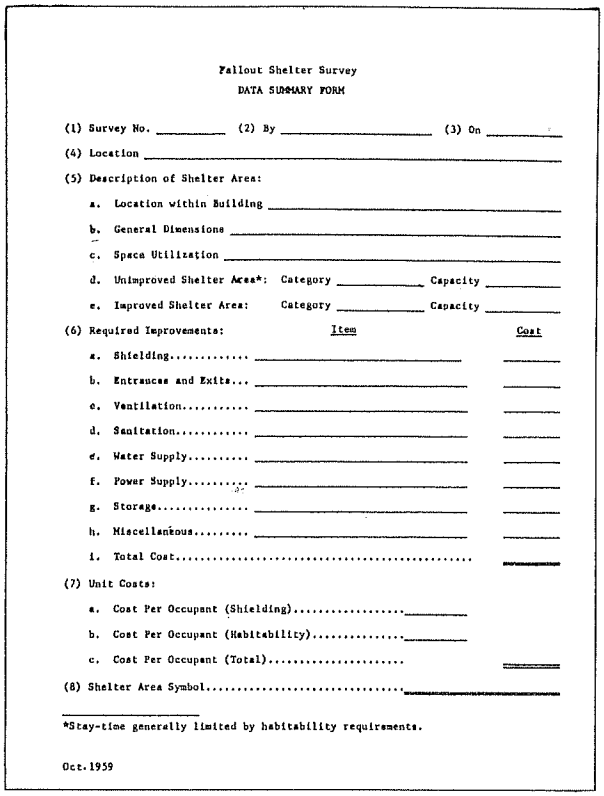

Fallout Shelter Survey
DATA SUMMARY FORM

(1) Survey No. _____ (2) By _____ (3) On _____
(4) Location _____
(5) Description of Shelter Area:
a. Location within Building _____
b. General Dimensions _____
c. Space Utilization _____
d. Unimproved Shelter Area*: Category _____ Capacity _____
e. Improved Shelter Area: Category _____ Capacity _____
(6) Required Improvements: Item Cost
a. Shielding..... _____ _____
b. Entrances and Exits... _____ _____
c. Ventilation..... _____ _____
d. Sanitation..... _____ _____
e. Water Supply..... _____ _____
f. Power Supply..... _____ _____
g. Storage..... _____ _____
h. Miscellaneous..... _____ _____
i. Total Cost..... _____
(7) Unit Costs:
a. Cost Per Occupant (Shielding)..... _____
b. Cost Per Occupant (Habitability)..... _____
c. Cost Per Occupant (Total)..... _____
(8) Shelter Area Symbol..... _____
*Stay-time generally limited by habitability requirements.
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FIGURE 9.—*Shelter survey forms.*

TABLE 3.—*Sources of information useful in fallout shelter surveys*

Sources	Remarks
Publications	
Operational Survival Plans	These plans have been completed for every State in the United States and contain much useful information for shelter surveys.
Sanborn maps	These maps can be obtained for almost every urban area in the United States with a population of 2,000 or more. They show location and construction characteristics of every building in a given area. Information on basements, type of occupancy, etc., is included.
Bureau of Census publications	Statistical abstracts, county and city data books, etc., contain detailed population information.
Topographic and geologic maps and air photos	Location of underground installations such as mines, tunnels, caves, etc.
Local government offices	
Building Department	Plans may be on file for each public building and most private buildings.
Tax Assessor's Office	Records may give summaries of construction type, size, and location of all types of buildings.
Planning Commission	Land-use maps, population studies, and general information on building types for certain areas may be available.
Department of Education	Information on schools, including student populations and possibly building plans.
Police and Fire Departments	Location and possibly building plans of all stations in the area.
Department of Public Health	Location and possibly building plans of medical facilities in the area.
Electric power, telephone, and gas companies	Location and possibly building plans of their office buildings, generating stations, etc.
Private business and associations	
Chamber of Commerce	Location and description of commercial and industrial establishments.
Architects, engineers, and building contractors	As-built drawings of buildings designed by their firms.
Building materials suppliers	Information on materials used in local building construction.
Trade associations	Information on buildings constructed using their products.
Individual building owners or managers	As-built drawings and up-to-date information on alterations.

previously prepared data sheets his estimate of a shelter category and capacity, according to street address.

Table 1 may be helpful for a quick estimate of shelter category.

Information obtained in full-scale field operations should be entered on a Fallout Shelter Survey Data Collection Form. (See example, fig. 9.)

The best way to get the facts about the fallout shelter potential of existing buildings is by specific examination of the individual structures. However, it may be possible to complete some of the survey form through use of "as-built" plans, Sanborn maps, and other pertinent records. (See table 3.)

Field personnel should carry identity cards and explanatory letters signed by the executive of local government. The letters should introduce the bearer, briefly explain the purpose of his work, and urge cooperation on the part of building owners or tenants.

D	[illegible]	SHELTER DISTRICT IX				
	SHELTER SPACES FOUND IN SHELTER CATEGORIES					
	EXISTING SPACES		IMPROVED SPACES BY COST OF IMPROVEMENT			
CATEGORY	NUMBER	%	a	b	c	d	TOTAL
A	276	4.4	416				416
B	298	4.6	400	8		368	776
C	191	2.9	232	140	236		608
D	385	5.9	516	232	586	20	1,354
E	5,340	82.2	8,846	44			8,890
TOTAL	6,490	100	10,410	424	822	388	12,044
	POPULATION - NIGHT TIME						28,831
	SURPLUS OR DEFICIENCY						-16,787
	DAY TIME						19,438
	SURPLUS OR DEFICIENCY						- 7,394

Tabulation of Survey District

Map of Survey District

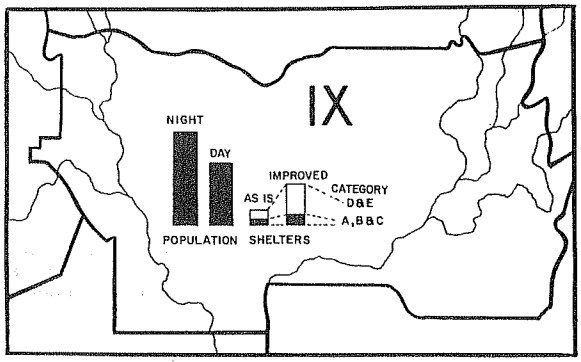

FIGURE 10.—*Sample fallout shelter survey.*

If an inspector finds no one available to admit him to a building, he should leave a "call-back" card. The card should give the inspector's name and survey office address and telephone number, tell the purpose of the visit, and ask that the inspector be called to arrange a convenient time for his return.

Although the primary duty of field inspectors is data collection, they are also responsible for maintaining their own files of information collected.

REPORTS

The following outline may be useful in preparing the final fallout shelter survey report:

1. Description of survey area.
2. Procedures used in the survey.
3. Summary of survey results.
4. Discussion of survey results.
5. Conclusions and recommendations.

The detailed tabulation sheets and supplementary maps should be included as appendixes or as companion publications.

Because of the voluminous nature of collated shelter survey information, concise methods of presentation must be used. One method is a three-part sequence of symbols that denote shelter category, shelter capacity, and cost per person for required improvements. Shelter category letter symbols are given in Table 1. For cost-of-improvement symbols see Table 4.

As an example, in the concise, three-part presentation "C75b," "C" denotes shelter category (with a protection factor of 50 to 250); "75" indicates a shelter capacity of 75 persons; and "b" relates to a per capita cost estimate of $25 to $50 for improvement of category, habitability, or both.

These same symbols may also be used for entry of data on tabulation sheets or maps. (See fig. 10.)

TABLE 4.—*Cost symbols for improvement of shelters*

Symbol	Estimated cost per shelter occupant
	Dollars
a	Less than 25.
b	25 to 50.
c	50 to 75.
d	75 to 100.
e	More than 100.

GENERAL SCOPE OF WORK FOR FALLOUT SHELTER SURVEY CONTRACTS

A. The contractor, in consultation with the contracting authority, shall furnish the necessary personnel, services of others, facilities, and materials and shall use his best efforts to evaluate thoroughly the fallout shelter resources located in the _____, hereinafter referred to
(Name of city or county)
as the "area," and shall prepare a report on this evaluation as well as the methods and procedures used in performing the work and services under this contract.

B. The specific studies to be undertaken will include, but will not necessarily be limited to, the following:

1. Making a complete inventory, by individual buildings, of existing and potential fallout shelters located within the area in accordance with the OCDM manual, *Fallout Shelter Surveys: Guide for Architects and Engineers.*

2. Summarizing in tables and on maps the aforesaid inventory.

3. Using the latest data available, preparing separate maps and tables to show distribution of daytime and nighttime populations of the area.

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