Civil Defense Research
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A SUMMARY OF THE

FINAL REPORT

SHELTER OCCUPANCY STUDIES AT THE UNIVERSITY OF GEORGIA

1964

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Abstract

From 1962-1964 the University of Georgia conducted six simulated community fallout shelter occupancy tests for the Office of Civil Defense. Investigated variables included organizational and environmental factors. Men, women, and children, aged 3-70 years, participated. Recent test results and overall implications for the National Shelter Program are presented in this report.

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Chapter 1 - The Research Mission

I. Introduction

The National Shelter Survey, Marking and Stocking Program has identified a sufficient number of public fallout shelter spaces in existing structures and other facilities to accommodate over 127 million persons. Approximately 29 million of these spaces have been stocked with survival supplies. By the early 1970's, it is hoped that 240 million spaces will be readied.

In early 1962 the operability of shelters so created and provisioned had never been tested. This task was assigned to the Civil Defense Research effort at the University of Georgia.

The general research mission, therefore, was to appraise minimal survival conditions in public fallout shelters as presently equipped and stocked with emergency supplies. Specifically, the project was to evaluate the interactive effects of such variables as overloading, limited bunks and bedding, emergency sanitation equipment, marginal ventilation conditions, and minimal food and water supplies. Films depicting results were also part of the research mission. Following preliminary pilot studies, four main experimental studies (Experimental Studies I-IV) were conducted during the spring and summer of 1963. During 1964 two additional studies were conducted (Experimental Studies V and VI). The results of these tests, as well as implications for the National Shelter Program, are presented in the main body of this report.

II. Outline of Studies

The six main experimental studies completed to date are outlined in Table 1. The detailed results of Experimental Studies I-IV and the description of shelter facilities have been presented in the 1963 Final Report. Therefore, discussion in Chapter 2 will be restricted to Experimental Studies V and VI.

Experimental Study	Date	Shelterees N	Sex	Age	Defections	Net Space/Pe sq.ft.	cu
ES I	14-18 Dec. 1962	30	Men, women, children	15-50	8	8	
ES II	16 Feb.- 1 Mar., 1963	30	Men, women, children	9-67	5	8	
ES III	27 Apr.-10 May, 1963	30	Men, women, children	7-66	2	8	
ES IV	20-27 July 1963	30	Children, two adults	7-12	11	6	
ES V	8-21Feb. 1964	30	Men, women, children	7-70	8	8	
ES VI	31 July-2 August 1964	300	Men, women, children	3-66	0	10	

*Ss requested to consume as few rations as possible

Shelter Environment						S
Person cu.ft.	Temp.	Hur.	Ventilation cfm/person	Water qt/person/day Consumed	Food cal/person/day Consumed	Sanitation
52	opt.	opt.	15 (20% fresh air)	1.3*	315 cal.* Bulgur wafer	chemical toilet
52	opt.	opt.	Day: 40 (20% fresh air) Night: 15 (20% fresh air)	1.4*	787 cal.* Bulgur wafer	chemical toilet
52	opt.	opt.	Day: 40 (20% fresh air) Night: 15 (20% fresh air)	1.0*	814 cal.* Nabisco biscuit	chemical toilet
39	opt.	opt.	Day: 40 (20% fresh air) Night: 15 (20% fresh air)	1.0	552 cal. Nebraska cracker + 296 cal. carbo suppl.= 848 cal.	chemical toilet
52	opt.	opt.	Day: 40 (20% fresh air) Night: 15 (20% fresh air)	1.0	808 cal. (Bulgur wafer, Nabisco biscuit, Nebraska cracker, carbc suppl.)	chemical toilet
--	opt.	opt.	MRD Ventilation Tests	1.0	306 cal. Nebraska cracker + 208 cal. carbo suppl.= 514 cal.	chemical toilet

Table 1

Experimental Shelter Occupancy Variables

	Shelter Supplies						
d on/day med	Sanitation	Bunks	Blankets	Bath Water	Coffee	Cig.	Recreational Supplies
al.* wafer	chemical toilet	No	No	No	No	No	No
al.* wafer	chemical toilet	No	No	No	No	1 pk.	No
al.* biscuit	chemical toilet	No	No	No	No	1 pk.	No
al. cracker . carbo 48 cal.	chemical toilet	No	No	No	No	1 pk. adults	paper and pencils
al. afer, iscuit, cracker, pl.)	chemical toilet	No	No	No	No	1 pk.	No
al. cracker . carbo 14 cal.	chemical toilet	No	No	No	No	1 pk.	No

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Chapter 2 - Experimental Studies V and VI

I. Experimental Study V

Experimental Study V (ES V) was the third two-week confinement study conducted. It was similar to previous studies in that the shelteree group consisted of 30 men, women, and children, aged 7-70, who were confined to 8 sq. ft./person living space, and required to sleep on a concrete floor covered only with 3/16" corrugated fiberboard. No bunks or blankets were provided. No recreational materials other than pencils and children's textbooks were permitted. No washing water was provided, and sanitation facilities consisted of a chemical commode.

ES V differed from previous occupancy tests in several respects. The primary purpose was to evaluate the use of a shelter handbook in a shelter not having a trained shelter manager. Consequently, a shelter manager (SM) was selected but not trained prior to entry. The second purpose of ES V was to obtain a relative preference ranking of the three basic cereal rations: the bulgur wheat wafer, the Nabisco wheat-flour biscuit, and the Nebraska wheat-corn-flour cracker. These rations were randomized on a daily basis, e.g., the biscuit one day, the cracker the next day, the wafer the third day, etc. The daily caloric ration consisted of 600 calories of the basic cereal ration plus 300 calories of the carbohydrate supplement. A third purpose of ES V was to evaluate certain commode chemical tests. Lastly, there was assessment of the effect of stressful shelter confinement on cognitive vigilance, as measured by visual and auditory signal detection tests.

In terms of the experimental conditions involved, the primary conclusions of ES V were: (1) the group completed the study successfully without the aid of a trained shelter manager; (2) of the three survival cereal rations, the Nabisco biscuit was the most preferred, with the bulgur wafer and Nebraska cracker being next and equally preferred; (3) the commode chemical, phenol, proved satisfactory; (4) the eight defections occurring were due to physiological ailments and inability to adjust; (5) cognitive vigilance, in terms of in-shelter visual and auditory signal detection tasks, showed no deterioration during shelter confinement.

II. Experimental Study VI

Experimental Study VI (ES VI), the first of its kind ever conducted in the United States, involved 300 shelterees in a week-end confinement test.

The purposes of ES VI were to evaluate (1) shelter staff management of a 300-person group for a 50-hour confinement period,

(2) optimal size of manageable shelteree units within the total group, (3) in-shelter activity programs, (4) an in-shelter handbook, (5) use of shelterees ranging in age from 3-66 years, (6) Office of Civil Defense supplies for a 300-person shelter, and (7) various ventilation conditions and equipment.

The original mission was to evaluate 300-person shelter management as proposed in current Office of Civil Defense (OCD) training material. However, this mission was changed, at the request of OCD, to include a synthesis and application of the various findings of previous occupancy tests by OCD contractors and regional training centers. Since the possible test designs were multiple, it was decided to concentrate on certain variables for the 50-hour confinement period and to exclude others for investigation in future tests.

The 11-man management staff is outlined in Figure 1. Two additional staff members served as in-shelter observers. The six shelteree sections, A through F, were composed of 25, 25, 50, 50, 75, and 75 members, respectively, in an effort to evaluate optimal section size. The shelter management staff/shelteree ratio was approximately 1:27.

The 300-person shelter group consisted of men, women, and children. Seventy-five per cent of the group was composed of family units. A comparison of the ES VI group with the 1960 U. S. Census is given in Table 2.

The total group of 300 persons included the shelter management staff, two physicians and two nurses, seven Civil Defense Research (CDR) observers, five OCD observers, one observer from the U. S. Army Military Police School at Ft. Gordon, Georgia, and three engineers from the General American Transportation Corporation, MRD Division, Niles, Illinois. The OCD observers represented the Washington office and the three training centers located at Battle Creek, Brooklyn, and Alameda.

The recruited shelterees submitted a medical history statement for evaluation prior to selection for the study. No physical examination

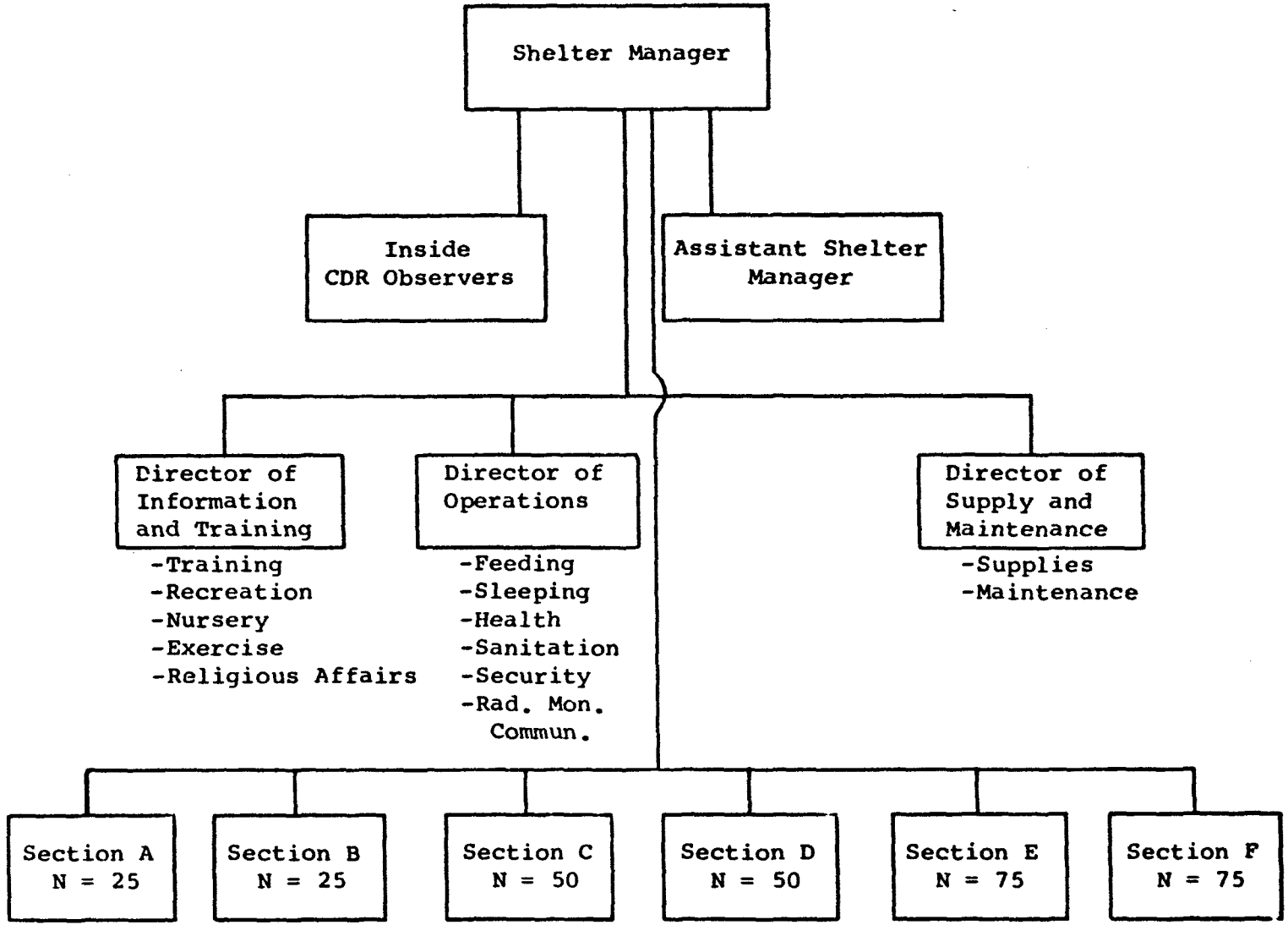

Figure 1. Shelter staff organization (ES VI).

Table 2

Shelteree Characteristics
(ES VI)

	U. S. Census (1960)	ES VI (1964)
Number of Shelterees		300
Age Range		3-66 years
Median Age	29.5 years	17 years (mean age 23)
Median Education	10.6 years	12.8 years
Sex	Male 49%, Female 51%	Male 50.7%, Female 49.3% (152 males, 148 females)
Race	White 88.6%, Non-White 11.4%	White 88.7%, Non-White 11.3% (266 whites, 34 non-whites)

was given, although shelterees were questioned on the day of entry with regard to any infectious or other illness.

The shelter selected for ES VI was one marked and stocked in accordance with procedures established by the National Shelter Program; it had a protection factor of over 100. The shelter was located on the University of Georgia campus, in the basement of the Georgia Center for Continuing Education.

The shelter configuration is shown in Figure 2. The dotted line delineates the actual shelter area which consisted of two rooms. The larger room contained approximately 2,500 sq. ft. of space; the smaller, about 500 sq. ft. of space. One of the 50-person sections occupied the smaller room. Also the central toilet area was divided into separate facilities for men and women. Temporary wall construction, behind which were observation areas, is noted at points A through G. The five camera ports are designated by triangles and Roman numerals. Observer ports, denoted by squares and Arabic numerals, were similarly located. The main observation room, position 1, contained various recording equipment.

The General American Transportation Corporation, MRD Division, coordinated the testing of certain ventilation conditions in this study.

Since ES VI was composed of shelterees in the age range of 3-66 years, and since these volunteers were not given thorough pre-shelter physical examinations, it was judged medically infeasible to introduce heat stress as an experimental variable. Ventilation, therefore, was kept optimal.

In-shelter program variables investigated consisted of central vs. sectional control of training lectures, supply distribution, exercise and recreational activities, and religious services. It was not the purpose of ES VI to evaluate content of the training lectures, but rather the scheduling of such within the overall shelter activity program.

Two sleeping arrangements were evaluated. On the first night the shelterees were segregated sexually into two groups: men and boys, women and girls. On the second night, however, sections remained intact, with family groups sleeping in the middle of the section, single males on one side and single females on the other.

An experimental handbook was written specifically for ES VI, to be used by the shelter management staff during the study. The handbook was designed to enable a minimally trained staff to organize and operate a 300-man shelter for a week-end study. The rationale for the handbook came from experimental findings of past CDR studies, scientific reports of other research organizations, and prepared manuals of the various CD training schools. The handbook contained information

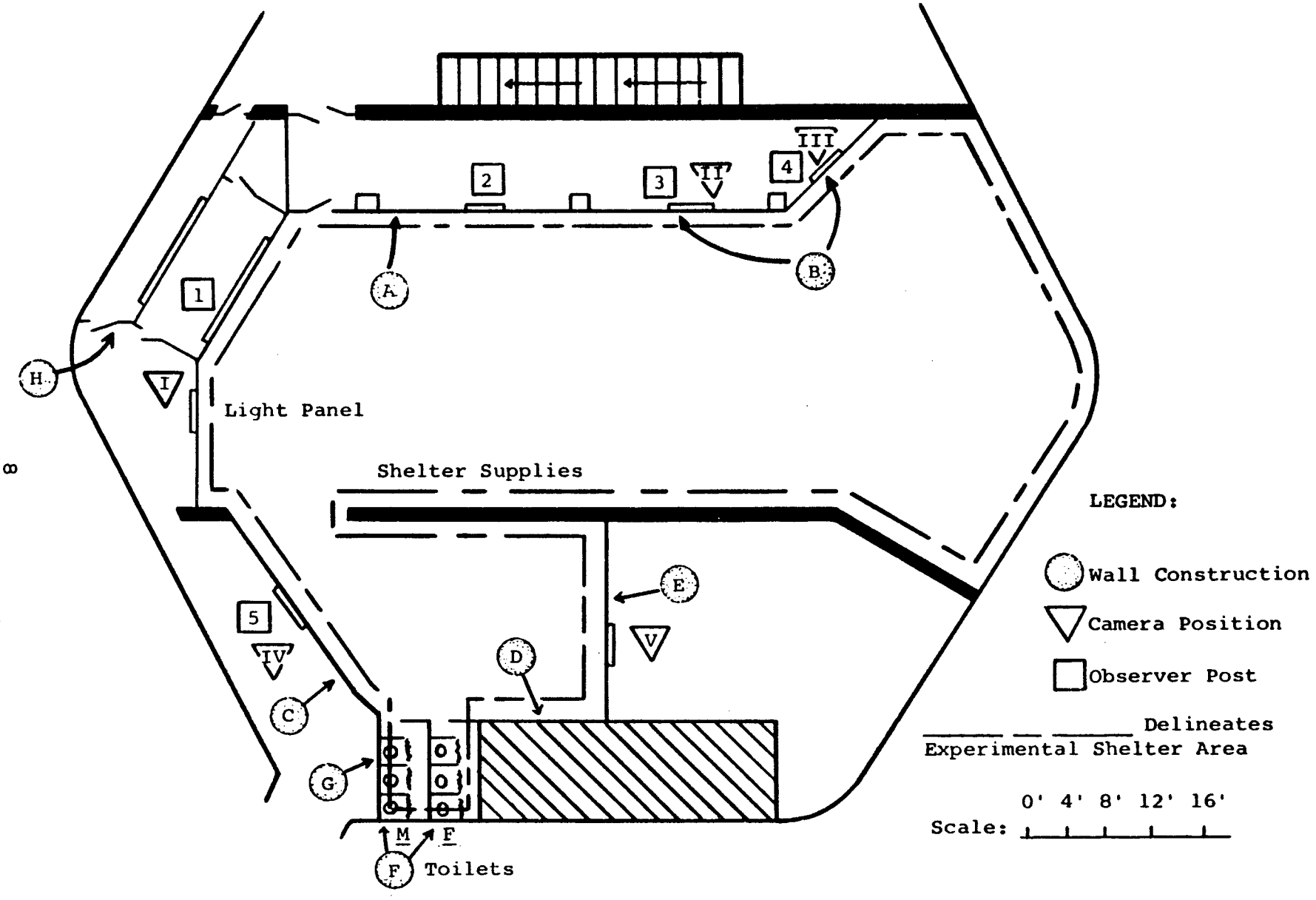

Figure 2. The 300-person shelter (ES VI).

on entry procedures, management and physical facilities, duties of the various staff members, recreational suggestions, training lectures, and a shelter activity schedule.

Fundamental conclusions are presented here:

A. Shelter Staff Organization

1. The pre-selected 11-man shelter staff appeared adequate for management of the 300-person group.

2. There is a need for further delineation of the functions of the shelter staff, especially during initial phases of shelter confinement.

3. Communication among staff members needs improvement.

B. Section Size

A 25-30 person section is manageable without further division.

C. In-Shelter Program

1. Shelteree Reactions

a. Major shelteree discomforts were concerned with sleeping conditions, the chemical commode, and lack of bathing facilities.

b. Primary medical complaints were headaches and nausea.

c. Ten sq. ft. of space/person, including storage, appeared adequate for the 300-person group. However, further attention is needed in space utilization and allocation.

2. Shelteree Activities

   a. Sleeping within sections was preferred over a division based exclusively on shelter-wide sexual segregation. (Families composed 75 per cent of this shelter population.)

   b. Food distribution four times/day and water distribution six times/day proved to be sound procedures.

   c. More consideration within the activity program should be given to the needs of younger children.

   d. The nursery plan proved valuable, but needs further testing.

   e. Sanitation rules need more specification and observance requires greater emphasis.

3. Training Program

   The section lecture was preferred over the centralized lecture.

D. Shelter Handbook

A shelter handbook proved to be helpful in shelter management. Present test results have indicated necessary revisions.

E. Use of Young Children as Shelterees

1. Nausea appeared most prevalent among children who did not eat the crackers.

2. Young children must be supervised in the use of toilet facilities.

F. OCD Supplies

1. The fiberboard commodes proved inadequate when the interior plastic lining ruptured.

2. To insure conservation of toilet tissue and hand cleaner, strict control is necessary.

3. The most frequently consumed medical kit items were aspirin and phenobarbital.

4. Lack of janitorial supplies contributed significantly to the sanitation problem.

A synthesis of the findings of all six occupancy tests conducted to date, as well as implications for the National Shelter Program, will be found in the main body of this report.

Chapter 3 - Forecast

I. Introduction

The occupancy studies conducted to date at the University of Georgia have indicated the adequacy of presently stocked OCD supplies for the maintenance of a good physiological state in healthy men, women, and children. It has also been found that no deleterious psychological or social effects occur from two-week periods of group confinement under austere conditions.

By the spring of 1963, it was apparent to the University of Georgia researchers that certain aspects of occupancy research had emerged as pivotal points for future research. These aspects were at that time presented to the Office of Civil Defense as follows: (1) the development of an in-shelter activity program that would (a) help occupants to adjust rapidly to shelter life, and (b) prepare them for immediate adjustment to the post-attack world upon emergence; (2) the development of an abbreviated yet realistic shelter manager training course to be implemented on a nationwide basis in event of a sudden nuclear emergency; (3) the development of an in-shelter handbook for use by groups without a trained shelter manager; (4) continual assessment of changes in the OCD stocking policy. It was further recommended that these four areas be evaluated experimentally.

A. In-Shelter Program

The need for a good in-shelter program is obvious. However, there can be various emphases placed on the orientation of such a program. The University of Georgia researchers believe that training involving shelter adjustment can be effected within a few days; the program should then be oriented toward adjustment to the post-attack world. This training involves both the empirical knowledge of physical adjustment (decontamination techniques, sources of stored food supplies, etc.) and also psychological preparation (strengthening of morale and motivation), so that upon emergence the civilian population will "turn to" and exert maximal effort toward national stabilization.

B. Shelter Manager Training

The historical record of the United States indicates a reluctance in preparing for war. The public attitude toward Civil Defense seems to indicate a slowness in implementing a civilian training program. There is a possibility, therefore, that this nation will suddenly encounter a nuclear emergency without sufficient civilian preparation for fallout shelter living. Consequently, and to be more realistic, it would appear advisable to have ready a practical short course, crash program type of shelter manager training, amenable to instant nationwide implementation. This program

might conceivably be reduced to a one-day indoctrination in the essentials of survival.

C. Shelter Handbook

The severest assumption, of course, is that the civilian population will be totally unprepared and suddenly thrust into the community fallout shelter situation. This possibility should be realistically met. A solution would be a handbook to be placed in all fallout shelters as part of standard stocking procedures. The handbook would be constructed in such a way that it could be implemented by a naive shelter leader with average intelligence. Followed faithfully, the content of the manual would insure in-shelter training and adjustment, as well as adequate planning for post-shelter emergence.

II. Proposed Research

A. A Basic Premise

The basic orientation of the research effort at the University of Georgia is to prepare for the ultimate and most realistic nuclear emergency situation, described above as one in which the civilian population will enter community fallout shelters without the benefit of a trained shelter manager. A shelter handbook appears to be a solution to this emergency. However, the content of such a manual should be experimentally validated, utilizing large groups confined under minimal survival conditions, and, if possible, in actual community fallout shelters.

Concurrently with the derivation of the shelter handbook, experimental studies should be conducted on in-shelter training programs and post-attack preparation. Evaluation of OCD shelter provisions would parallel these investigations. Even though research would be centered on the situation in which there would be no trained shelter manager, development of shelter manager staff training should not be neglected. As long as nuclear war can be delayed, the interim time should be utilized to its fullest extent. Therefore, occupancy tests should also evaluate the effectiveness of shelter manager training, and the development of a maximally effective training program in minimal time.

B. Research Proposal - 1965

In the opinion of the University of Georgia researchers, the preparation of a shelter handbook for an untrained 1,000-person shelter group could be accomplished in three years. For 1965, two occupancy tests are proposed. The first would be a one-week test (one day pre-shelter processing, five days shelter occupancy, one day post-shelter processing) involving 300 men, women, and children,

aged 7-70 years. Use of shelterees below the age of 7 years will be contingent on medical advice. All test volunteers will be medically screened as in previous long-term occupancy tests. Shelter Organization variables to be studied will be the staff/shelteree ratio, size of sections within the total group, command structure, and leadership. A shelter handbook will also be tested. Shelter Activity variables will include training lectures, sleeping arrangements, supply distribution, and exercise and recreational activities. Shelter Environmental variables will include space, temperature and humidity, water and food rations, sanitation, and standard stocked OCD equipment and supplies. Subjective and objective measures of experimental conditions will be obtained. A film report will also be made.

The second occupancy test, a week-end study, will also be a 300-person study, the primary purpose of which will be to test the use of the shelter handbook without a trained shelter staff. The filmed research documentary will be produced by the Georgia Center for Continuing Education. The half-hour, black-white sound film will portray the human experience, research findings, and implications of the two occupancy tests.