TM(L)-2938/001/00

TECHNICAL MEMORANDUM

(TM Series)

This document was produced by SDC in performance of contract OCD-PS-65-71
Work Unit Number 2611C EOC Operations Study

Final Report On

Emergency Operations Simulation Research

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10 May 1966

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ABSTRACT

This document contains the findings, conclusions, and recommendations resulting from the study of emergency operations under contract OCD-PS-65-71. Also described are the methods and techniques applied to each task.

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ACKNOWLEDGMENT

The authors wish to acknowledge the valuable contributions that several persons, in addition to the research staff, have made toward this project effort. Of particular assistance were James W. Kerr and George C. Van den Berghe of the OCD Support Systems Research Division, and A. R. Durand of the Dikewood Corporation. Within SDC, the laboratory engineering and technical support provided by Vince Galati and members of his staff is gratefully appreciated. Finally, the invaluable assistance and interest provided by John W. Davis, Executive Director of the Los Angeles County and Cities Disaster and Civil Defense Commission, in obtaining local City Managers and their staffs as participants for the laboratory sessions was of particular significance and is gratefully acknowledged.

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CHAPTER 1

BACKGROUND AND INTRODUCTION

In May 1965, the System Development Corporation (SDC) was awarded a contract (OCD-PS-65-71) by the Office of Civil Defense to investigate the operational system requirements for Emergency Operating Centers by providing a simulation research facility and by performing relevant research studies. This volume of the final contractual report and three others, TM(L)-2938/000/00, TM(L)-2938/002/00, and TM(L)-2938/003/00, document and summarize the results of this applied research effort.

The specific work statements described in Contract OCD-PS-65-71 called for:

1. The establishment of the research facility, including the operations room of an Emergency Operating Center (EOC) and the supporting simulation and observation areas.

2. The development of a simulation research model of a prototypical urban area including an organizational and operational plan, a supporting resource data base, and a disaster effects compendium for the model.

3. The conduct of experimental studies utilizing operations simulation methods. This task involved the observation and analysis of selected operational functions within the EOC; studies to be conducted under varying attack conditions and at different time increments.

4. The investigation of various types of input, display and simulation equipments, including their uses within an Emergency Operating Center.

5. The investigation of the potential application of electronic data processing within Emergency Operating Centers.

6. The evaluation of simulation as a research tool in the design, development, evaluation and improvement of the EOC program. This involved relating the use of model simulation to the use of replication simulation in a non-laboratory environment for research purposes.

An additional task added to the contract in February 1966 was as follows:

7. The examination of fire data collected during the civil disturbances in South Los Angeles in August 1965. Emphasis in this examination was on fire spread behavior and fire service performance

and on determining whether these conditions were in any way analogous to those caused by fallout.

Three Quarterly Status Reports and seven monthly progress reports have been published and submitted describing the activities undertaken on each of these tasks. The final report consists of three basic volumes and a summary volume. This second volume presents the results of the research that was primarily laboratory oriented. In it, a chapter is devoted to each of the following subjects:

Chapter 2: A discussion of operations simulation and its role as an applied research tool.

Chapter 3: The establishment of the research facility and model environment.

Chapter 4: Emergency action decision experiments.

Chapter 5: The study of various display and special simulation equipments.

Appendices of the volume present environmental non-specific data and experimental materials developed or utilized during the contract.

Although operations simulation was the principal research tool for the experimentation being conducted in the SDC Emergency Operations Research Center, several of the project tasks were necessarily investigated by analytical techniques. These tasks were the investigation of data processing for local civil defense, and the examination of the Watts Riot fire data. Because of their independent nature, their non-experimental orientation, and their specific application by OCD, they are documented separately as volumes three and four of the final report. A short description of each of these particular task reports and the summary report follows:

Volume one, TM(L)-2938/000/00, Summary Report on Emergency Operations Research, summarizes each of the other three volumes, including their major conclusions and recommendations.

Volume three, TM(L)-2938/002/00, Data Processing for Local Civil Defense: An Investigation of the Potentials, is a guide that describes the potential applications of electronic data processing in civil defense operations as well as the factors that should be considered prior to acquiring EDP equipment. This volume is presented in the programmed instruction format. It guides the non-computer oriented civil defense professional through the basic steps he should consider when determining whether electronic data processing is practical for his operation. Discussed are the system considerations required to determine the time period(s) during which electronic data-processing equipment should be used. Described are potential applications of computer equipment during the

defined periods of emergency, pre-emergency and recovery. In addition, system considerations of the hardware components of a model computer information system are presented, and the factors that determine the capability of an organization to operate a computer-based data-processing system are identified and discussed. Finally, suggestions are given to indicate the course of action to be followed for further studies toward integrating data-processing equipment into local government civil defense operations.

The fourth volume of this report, TM(L)-2938/003/00, Data from the Watts Riot: Results of a Preliminary Analysis and Evaluation, documents the investigation of fire data obtained from the U. S. Department of Agriculture, Forest Service in Riverside, California, pertaining to the August 1965 civil disturbance in the South Los Angeles area. This report discusses the examination of the data from the standpoint of fire spread characteristics, command/control implications, and fire service operations.

CHAPTER 2

OPERATIONS SIMULATION IN APPLIED RESEARCH

GENERAL

The operations simulation technique was employed in the experimental studies described later in this volume. This chapter discusses operations simulation, contrasting its use for research and training purposes, and brings out the principal advantages of employing this technique for applied research. Operations simulation recreates the essential components of a system, either real or conceptual, in a field or laboratory environment, for study, training or investigative purposes. Simulation may be used both for training and research; however, the simulation models used vary for each purpose.

RESEARCH AND TRAINING SIMULATION: CONTRASTS

Emergency operations training often leaves no alternative except to employ simulation to create the essential stress-and-effects environments required to train a system to maintain an acceptable level of capability and proficiency. This is particularly true when a system is not in use operationally on a day-to-day basis and can not be exercised in a live mode because of costs or other factors, as is the case with emergency operations. When simulation is used for system training, the system being trained must be in existence and well-defined. The training is best conducted by utilizing the environment within which the system is expected to operate. Usually, the closer the simulated environment reflects the real environment, the greater the transfer of learning that occurs from the training session to actual operations. Within limits, as much of the system as possible should participate in any simulation exercise, leaving only external interfacing organizational entities to be simulated.

In the Emergency Operations Research, simulation is used as a research tool to determine operational system requirements and specifications, to evaluate design configurations, and to test reliability. When simulation is used in research, the objectives, the degree of environmental control, and the size of the organizational area being focused upon are quite different than when system training is the goal. For example, when research rather than training is the objective, the transfer of participant learning in a simulation could be detrimental since the concepts, procedures, or configuration being used may not have been proven operationally sound. Also, in a research experiment, familiarity with the field environment must be constant among the participants to assure that differences in performance are attributable to the experimental variable.

When performing research experiments, it is preferable to create a controlled operational atmosphere so that a less biased evaluation of the concept, procedures,

or configuration can be obtained. All participants have their individual operational habits and biases; however, removing them from their normal environment tends to reduce the effect of these factors on their performance. Thus, when attempting to conduct controlled research experiments, an experimental laboratory offers certain advantages over the field location. In this laboratory, the researcher is on his home ground and has special materials, equipment, and support personnel readily available to assist in the conduct of the experiment and in the collection of data. Experiments can be rerun in the laboratory with the guarantee that any changes made in the environment were planned rather than accidental. Also, in the laboratory the researcher can control the number and type of visitors who are present during the experiment, thus preventing a research effort from becoming solely a demonstration for observers.

A major distinction between simulation for training and simulation for research is the extent of the environment that must be simulated. Figure 1 illustrates a simulation model designed for the training of a hypothetical local EOC. In this model, all intra-EOC functional areas would be exercised, and decision-makers as well as plotters would participate. Simulation is limited to those activities and agencies external to the EOC. This model would allow the complete internal EOC system to be exercised. Thus, interaction between functions could be stressed, simulated problems could be input and processed as they would be during real emergency operations, and the participants could gain a better understanding of overall emergency operations and thus become more proficient in their individual tasks. None of these distinct training features, however, are the primary goal of a research experiment.

Figure 2 shows a simplified version of the simulation model used for the research study of executive level information requirements performed under this contract. The two figures differ only in the amount of the environment that is simulated. If the model illustrated in Figure 1 were used for research purposes, it would be impossible to accurately determine what factors affected the quality of decisions made at the executive level. Once inputs are made into the total operational system depicted in Figure 1, the researcher loses control of that information. However, when the model shown in Figure 2 is used, the researcher has complete control of all information reaching the decision-making staff. Therefore, he can subsequently analyze the decisions made in light of the information he knows was available to the decision-maker at a particular time during the experiment.

From the research standpoint, the ability to isolate the particular component under study is of vital importance. Accomplishing this, however, poses a very critical problem to the researcher. He must insure that the quality and the quantity of data provided to the decision group in Figure 2 are similar to that which would be provided in the total system process depicted in Figure 1.

The above contrasts between simulation for training and simulation for research have illustrated the following factors:

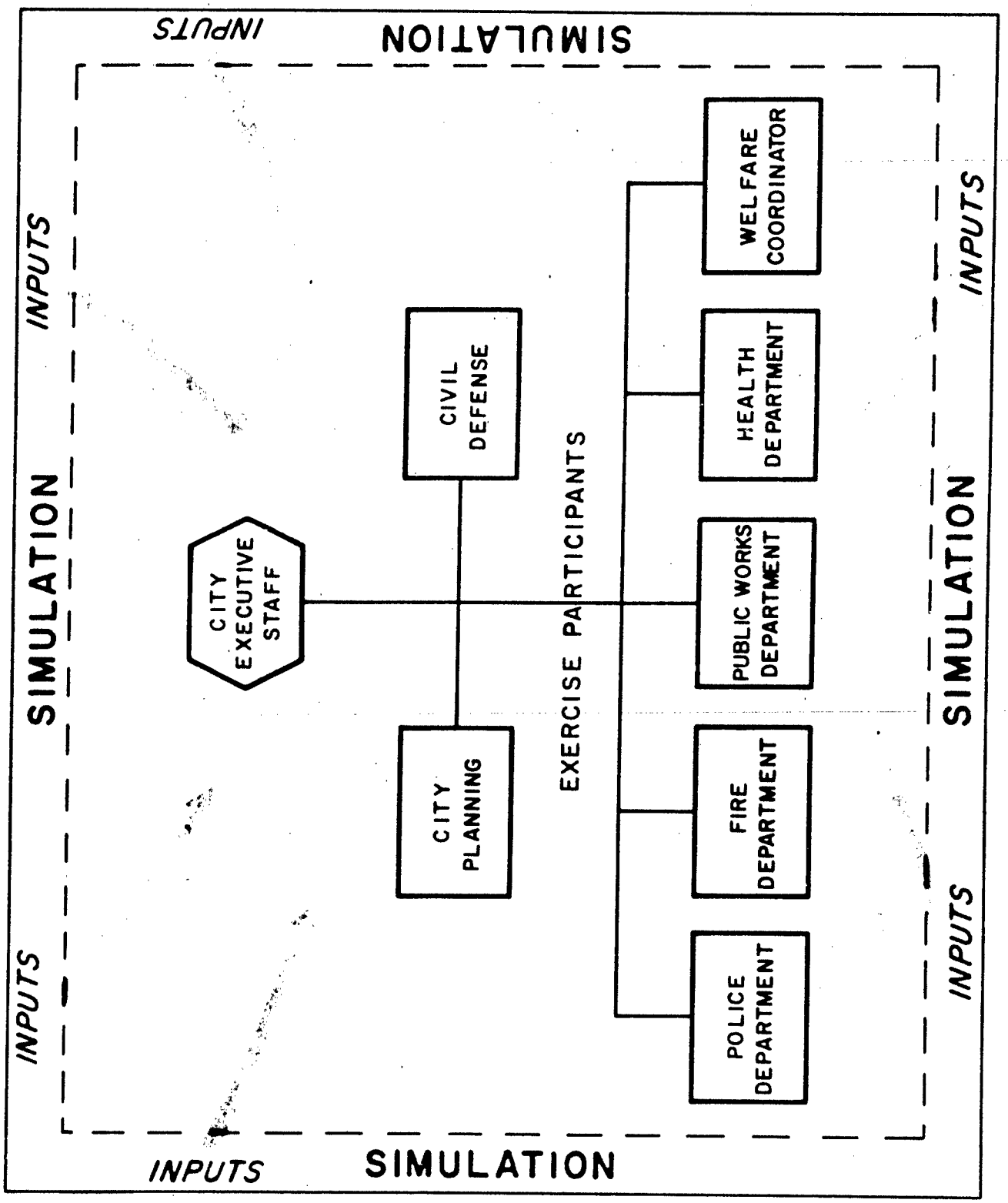


Figure 1. Simulation Model For Training

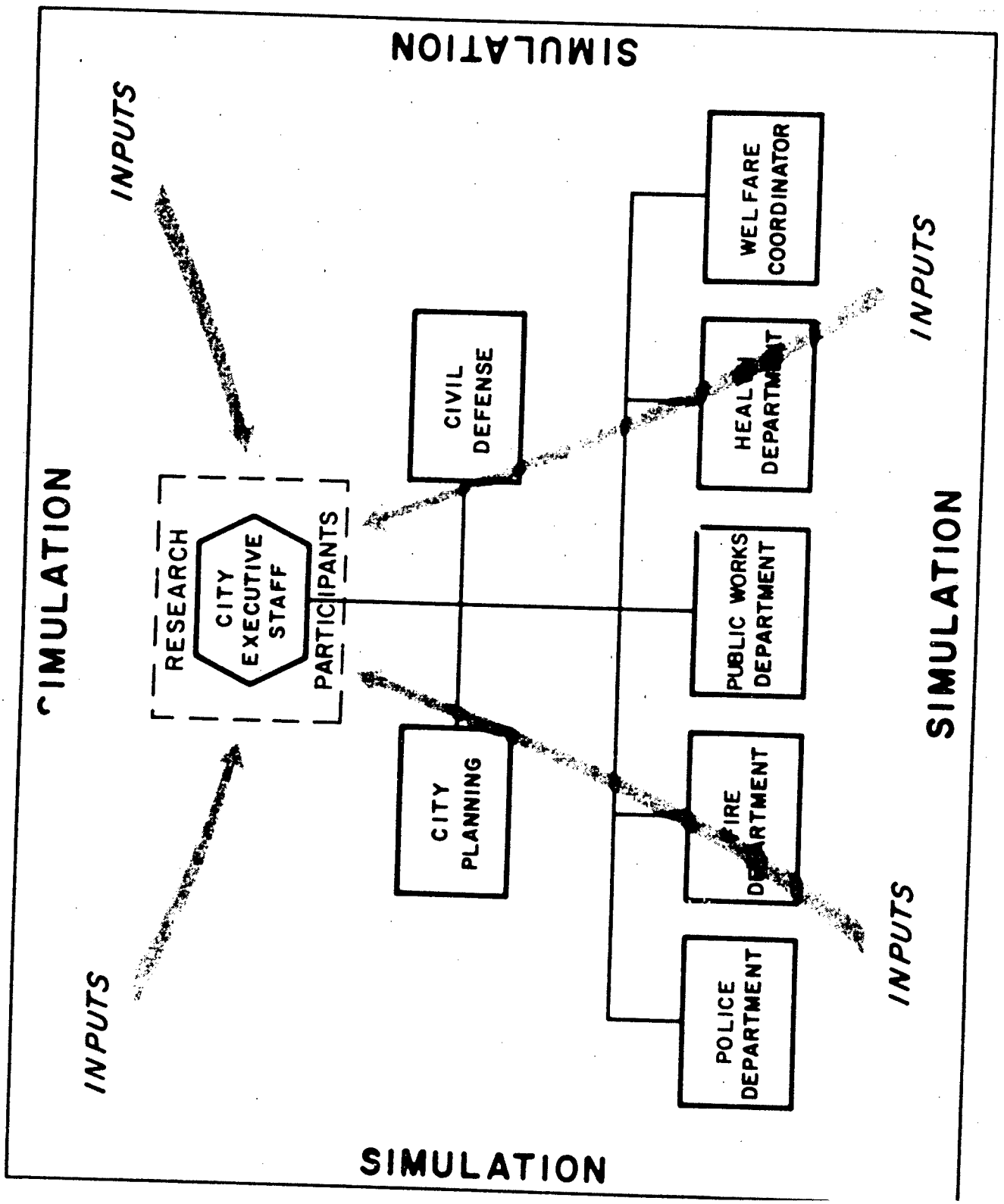


Figure . Simulation Model For Research

1. Simulation designed for training applications does not in itself fulfill research requirements.

2. A field environment, though preferable for training, has definite disadvantages for research.

3. Experimental control is more easily obtained in a laboratory than at a field location.

ADVANTAGES OF SIMULATION FOR USE IN OCD EMERGENCY OPERATIONS RESEARCH

Using simulation as a vehicle for research has several advantages compared with obtaining results from an analytical process. Primarily these are: results obtained analytically are often not credible until they have been tested in the context of an applicable environment. Results obtained from research conducted under a controlled, simulated emergency environment are more readily acceptable by operations personnel and have a greater probability of being operationally sound. Research conducted in this manner can substantially reduce the length of time separating the formulation of research findings and their implementation as operational improvements.

The use of operations simulation as a research tool allows certain operational questions to be answered that would be unanswerable if any other research method were used. No other technique allows the collection of quantifiable operational data under a controlled level of stress. The number of times certain events occurred, and the time delays and movement patterns of personnel are examples of data that can be collected accurately only during emergency operations or properly conducted simulated emergency operations. Simulation also provides the only adequate method of checking out new operational concepts and procedures prior to their field implementation.

In summary, it should be established that there are fundamental distinctions between simulations conducted for training and those conducted for an applied research program, like the Emergency Operations Simulation Research Project, that is interested in the creation and design of future systems. Operations simulation is a technique that can be applied in each case, but the specific applications and purposes will be different.

Following are some distinct advantages of using operations simulation as a research technique:

1. Quantitative measurements of system operations are often more easily taken on a system simulated than on the system in actual operation.

2. In simulation there exists the ability to compress or expand real time.

3. A more precise control of the variables is afforded in a simulation experiment, thus permitting more accurate analysis of results.

4. In simulation the ability to replicate experiments under different conditions is always an asset.

5. Laboratory simulation offers the capability to study systems that have complex operations and interactions and that are not normally available or accessible for observation.

6. The control of events during a simulation can be absolutely adhered to. An identical sequence of events can be prepared and run for each change of the variables that are under investigation. Also, changes within the model may be easily introduced to study effect upon responses.

7. Simulation offers the ability to experiment, test, and evaluate new systems or proposed changes to existing systems in advance of having to make firm commitments about the development, production and implementation of these systems.

CHAPTER 3

ESTABLISHMENT OF THE EXPERIMENTAL ENVIRONMENT

LABORATORY PREPARATION

This chapter briefly describes the laboratory environment, the SDC Emergency Operations Research Center, wherein the project experiments utilizing operations simulation took place. The purpose of describing the laboratory—specifically its configuration and special purpose equipments—is to adequately acquaint the reader with the physical setting and tools of the experimental environment.

The configuration of the laboratory is depicted in Figure 3. The overall laboratory dimensions are 74 x 26 ft., comprising a total of 1,924 sq. ft. The following facilities were constructed within this space:

Three display rooms at 150 sq. ft. each	= 450 sq. ft.
Simulation area	= 208 sq. ft.
Observation area	= 152 sq. ft.
	810 sq. ft.

The configuration of the facility, including wall fabrication and equipment installation, but excluding displays, required approximately 1.5 man-weeks of effort. The preparation of wall displays was accomplished by staff personnel.

As shown in the figure, for each of the experimental areas there is a corresponding simulation area. Three simulator positions and seven telephones were assigned to each of these areas. A common Emergency Broadcast Position was established for use by all three experimental areas. The equipments designed for the Emergency Broadcast System (EBS) area are described in more detail in a later section of this chapter.

Three telephones were located in each of the three experimental areas. The participants were provided with a telephone directory which gave them the numbers for each department within their organization. It also provided instructions on how to make telephone calls to other than departmental organizations.

LABORATORY EQUIPMENT

Equipments found in a simulation laboratory are usually placed there to support the requirements that have been levied by a particular research project. In addition, special equipment is often required for the actual conduct of the

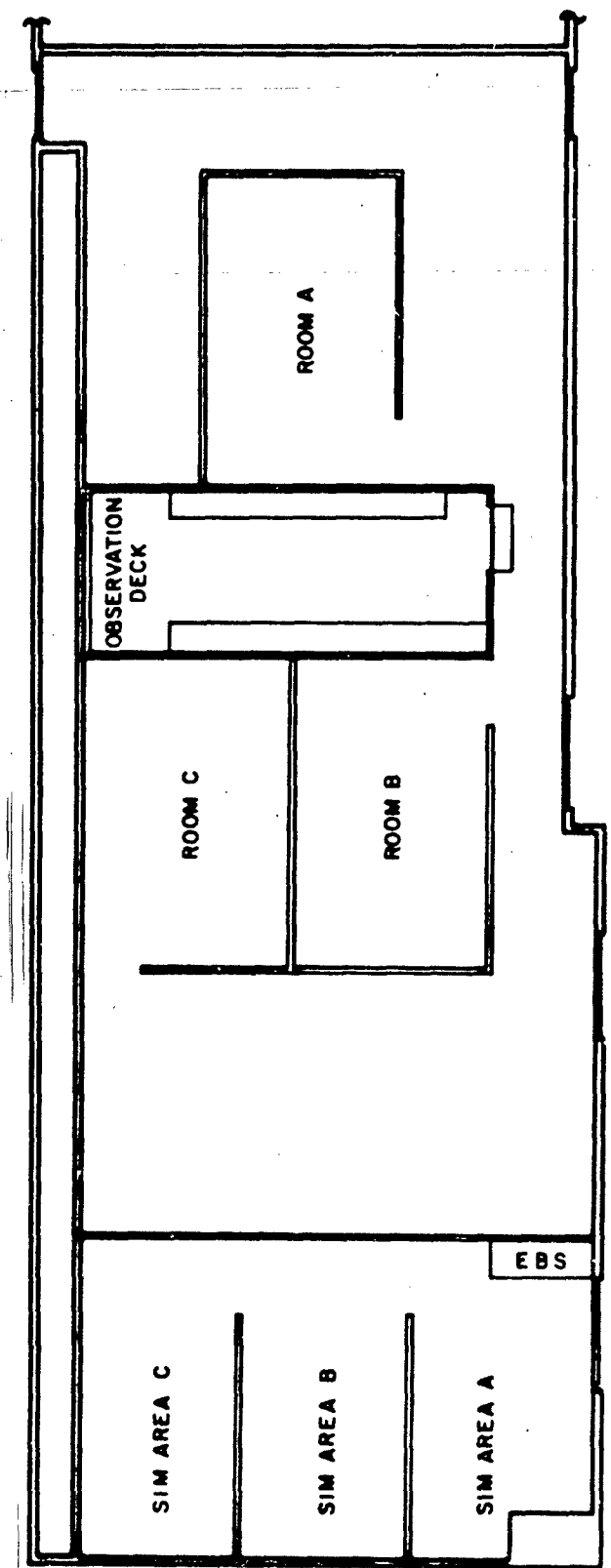


Figure .. Laboratory Configuration

experiment or study; more equipment is usually needed for the collection of data while the experimental or testing process is taking place; and still other pieces of equipment may be used to produce special effects or to increase the realism of the laboratory environment. Later, during the analysis phase of the laboratory work, equipment to assist in the reduction of the data may be necessary. Each piece of laboratory equipment falls into one or more descriptive categories, depending upon its use during a given experiment. The three descriptive categories are: (1) operations equipment—equipment available in the real environment, which must be supplied in the simulated environment so that operations can take place "normally"; (2) simulation equipment—equipment used only as an aid to the simulation staff; and, (3) data-collection equipment.

The laboratory dial telephone system is an example of operations equipment. The telephone forms an integral part of most emergency operations. Therefore, this communications medium should be available to the participants who are asked to perform emergency operations in a laboratory environment. Therein, the researcher tries to make this equipment system perform as many functions as possible. For example, to accommodate three simultaneous but independently operating experiments such as were conducted in this project, the laboratory telephone system has to be divided into three systems, with each system having equal capability and reliability. As explained later in this chapter, slight modifications allow for this system to be used for data-collection as well as for operations.

The simulated local EBS station used in the SDC laboratory is another example of operations equipment having a dual purpose. A direct line to the EBS station was simulated by an EBS telephone in each of the experimental areas. A special number was given to each group, allowing them to dial directly to the EBS station. The components of the simulated EBS capability are shown in Figure 4. Recorders A and B were able to record announcements originating from any of the three experimental areas. Two recorders were adequate to allow each city staff access to the system without waiting. Recorder C contained a tape of pre-recorded local, state, and national announcements.

When a call was received from a city staff member over the EBS telephone (D), it was recorded on either recorder A or B, the beginning tape footage being noted by the simulator. When the announcement was completed, the simulator would rewind the tape to the beginning of the announcement. He then set the switching box (E) so that recorder C would not be heard in that room, and the message could be played back to the staff originating the announcement. The other two staffs continued to hear the material on recorder C. All information was heard over a speaker (F) placed in each experimental area. The simulator could also monitor, through a pair of earphones (G), the EBS information being received by the three groups.

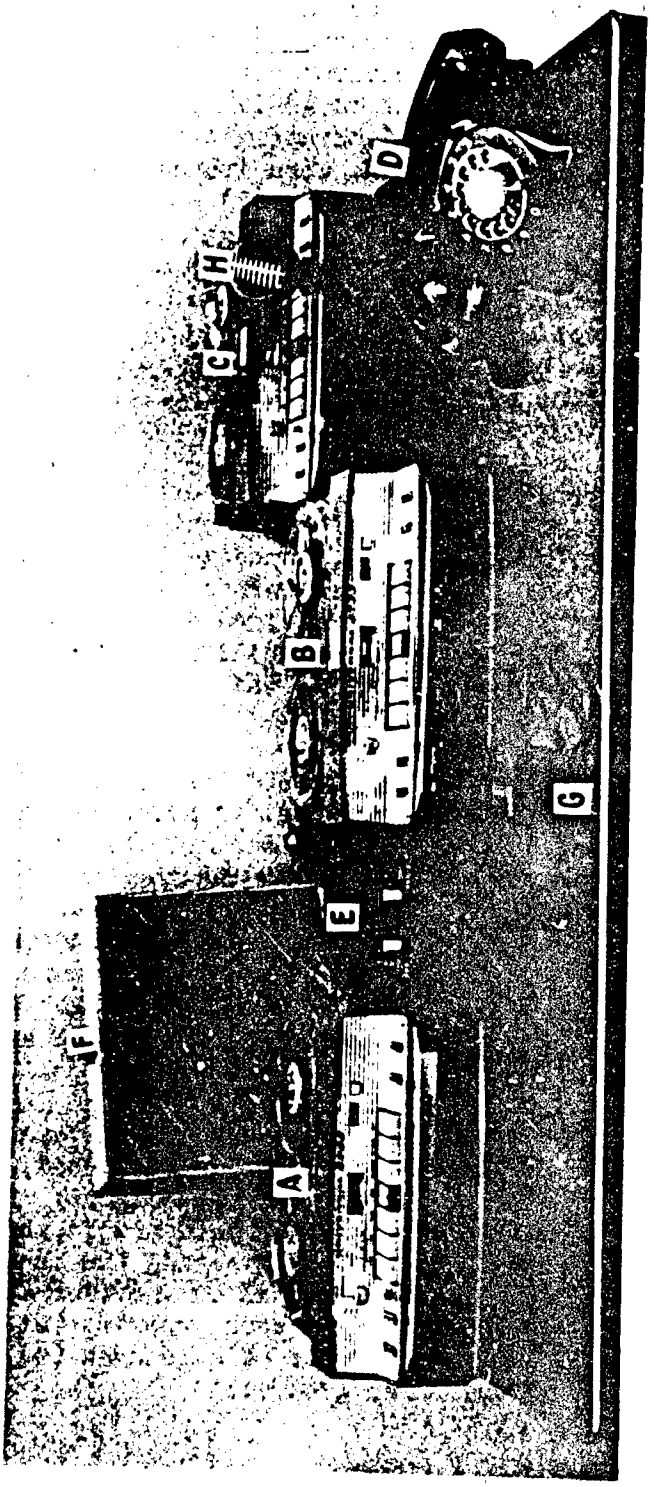


Figure 4. Equipment for Simulating EBS

A microphone (H) was available to enable the use of the EBS system by department heads. When a simulator, playing the role of a department head, was given the proper authentication code by a city staff member, he could make an announcement on behalf of the city manager. This message was also recorded and replayed to only that staff authorizing the announcement in the manner described above.

The simulation equipment provided a realistic replication of a local EBS capability, while, at the same time, allowing for the recording of all EBS announcements for later analysis.

The collection of data for analysis purposes is an important aspect of any experimental research project. The use of operations simulation in the laboratory experiments necessitated the development of special devices and techniques to assist in the accurate, timely collection of data in a dynamic environment. The research conducted under this contract involved groups of executive level decision-makers, who used the telephone as one means of acquiring information upon which to base their decisions. A dial telephone system, internal to the laboratory, was used to provide communications between the decision-makers and the simulators. The simulators, representing the complete external environment, input problem situations and information and responded realistically to the inquiries and directives of the participating staff. A recording of the complete telephone conversations as well as the time that each took place, was essential in the subsequent analysis of the information received and responded to by the decision-makers.

To accomplish this important data-collection task, each telephone line available to the decision-makers was connected with a tape recorder. The recorders were electrically actuated, and operated only when a particular line was activated. A master recorder containing a time tape (10-second hacks) automatically added the correct experiment time at the end of each conversation. This allowed the research staff to recreate and analyze the information exchanged between the decision-maker and simulator without the aid of off-line timing equipment.

This special recording and monitoring equipment substantially lessened the number of notes that had to be taken by the simulators and the observers to recreate the decision process for a subsequent analysis. It also greatly reduced the reliance upon subjective data-collection techniques. Since all conversations and actions taken were permanently recorded, several experiments were conducted over a period of time before the analysis was begun, without fear of losing information important to the analysis.

THE MODEL ENVIRONMENT

A necessary prerequisite to the performance of experimental evaluations or comparative analyses using operations simulation in a laboratory is a consideration of the test vehicle. Regarding laboratory operations simulation, the test vehicle is the environment within which the experimental variables are studied.

For the purposes of this Emergency Operations investigation, the embedding environment was designed in the form of a prototypical urban area. There are three principal reasons why a model rather than a real environment was selected for this study. They are:

1. Controlled Environmental Knowledge.

In comparative analyses, an important variable is the extent of knowledge that participants have of the embedding environment. Even slight differences in their knowledge of the geographical area in which they are solving problems can have an unmeasurable effect upon the final results. The use of an original model environment ensures that each participant begins with equal background information. Therefore, any differences in performance are not the result of differences in degrees of environmental familiarity.

Thus, by having a model environment, the amount of knowledge each group or individual had about the embedding environment could be controlled. Further, it was necessary to establish a model environment that approximated the particular urban area size that, it was felt, should be the concern of the study. The urban area size selected was a central city of approximately 100,000 people.

2. A More General Application of Results.

Research results obtained from an exhaustive examination of the operational problems associated with a real environment are often considered appropriate only for modifying the operational plan used in the environment under study and therefore cannot be imposed with universal success upon others.

Consequently, in order to maximize the application of the results of this research, an artificial but prototypical urban area environment was selected. It is felt that by using an objective model, the results of the research can be universally applied to cities having the same general characteristics. This approach has also provided results that can be applied to the development of other, broadly based systems.

3. Easily Modifiable.

The envisioned research program, using the method of operations simulation experimentation, included an investigation of a wide range of operational functions and activities under varying disaster conditions and different time periods. To use real and different environments would require considerable effort to be expanded in the collection of environmental data and in the design of approximate disaster effects prior to each run. The consideration of a wide range of organizational structures would also be more difficult if a real environment were used. For these reasons, the development of a prototypical model, modularly constructed for ease in modification, offered definite advantages over the use of a system and environment already in existence.

The vision of a prototypical model is, of course, highly abstract. Naturally, cities vary in age, configuration and function, as well as topography. However, in order to provide a practical model for this particular study, the criteria had to be necessarily narrowed, or abstracted. The consensus was to provide first a working model of a city that would combine the essential cultural, topographical, and demographic features of actual cities; then develop an appropriate resource base.

SELECTION OF THE MODEL

At the outset, it appeared that the basis for a model city should be derived from a composite of several cities, and that these cities should be selected from the most populated sector of the country—the area extending from Chicago to New York and from Boston to Washington, D. C. However, it was decided that this sample would be too large for the expeditious handling of the compositing phase of the model city development. The megalopolis from Boston to Washington, D. C. was, therefore, chosen as the geographic area from which a sample of six cities would be selected. The population of the Model City was to be between 75,000 and 100,000 persons and was to be located in an urbanized area of approximately 200,000 persons.

A scrutiny of the 1960 Census of Population, Bureau of the Census, yielded 19 cities that fell within the above urbanized area and central city population limits.

A selection of six of these cities provided the working sample from which a matrix of features was determined. These six cities were: Atlantic City, New Jersey; Binghamton, New York; Lancaster, Pennsylvania; Lowell, Massachusetts; New Britain, Connecticut; and Stamford, Connecticut. The cities were selected using the following criteria: 1) containing an urbanized area apart from the large urban agglomerations, such as New York, Boston, Pittsburgh, Philadelphia, Washington, D. C.; and 2) being representative of coastal cities, resort cities, inland cities, manufacturing cities, and cities with an agricultural hinterland.

A matrix was constructed to organize certain of the physical and cultural features of the selected cities. This matrix provided summary data for use in the compilation of the maps of the Model City and its resource base.

United States Geological Survey quadrangle sheets (1:24,000) for the six cities were studied to determine the general configuration of the model. The physical and cultural features were derived from the quadrangle sheets and recorded on the matrix. An abstract of the matrix provided the detailed number of features that were used as the basis for the Model City.

Subsequent to the development of the matrix, personnel with extensive urban-planning and cartographic experience began the drafting and compilation of the map base.

The initial effort was directed toward establishing land-use patterns. The percentage of city land use, by category, was established as follows:

City Land-Use By Category

Residential	30%
Industrial	10%
Commercial	7%
Road and Highway	20%
Other Public & Semi-Public	15%
Total Developed Land	82%
Vacant Land	18%

After a general land-use pattern had been established, the population characteristics of the city were considered. Statistical data from the U.S. Census Bureau relative to the population distribution were obtained and studied. The different geographical size of the sample cities, together with the statistical data available on population distribution and concentration, and the land-use by category data, all contributed to the outlining of the urban area limits for the model.

A map of the completed Model City is presented in Figure 5. A few general characteristics of this model are contained in the following description, which is primarily designed to familiarize the reader with the general features.

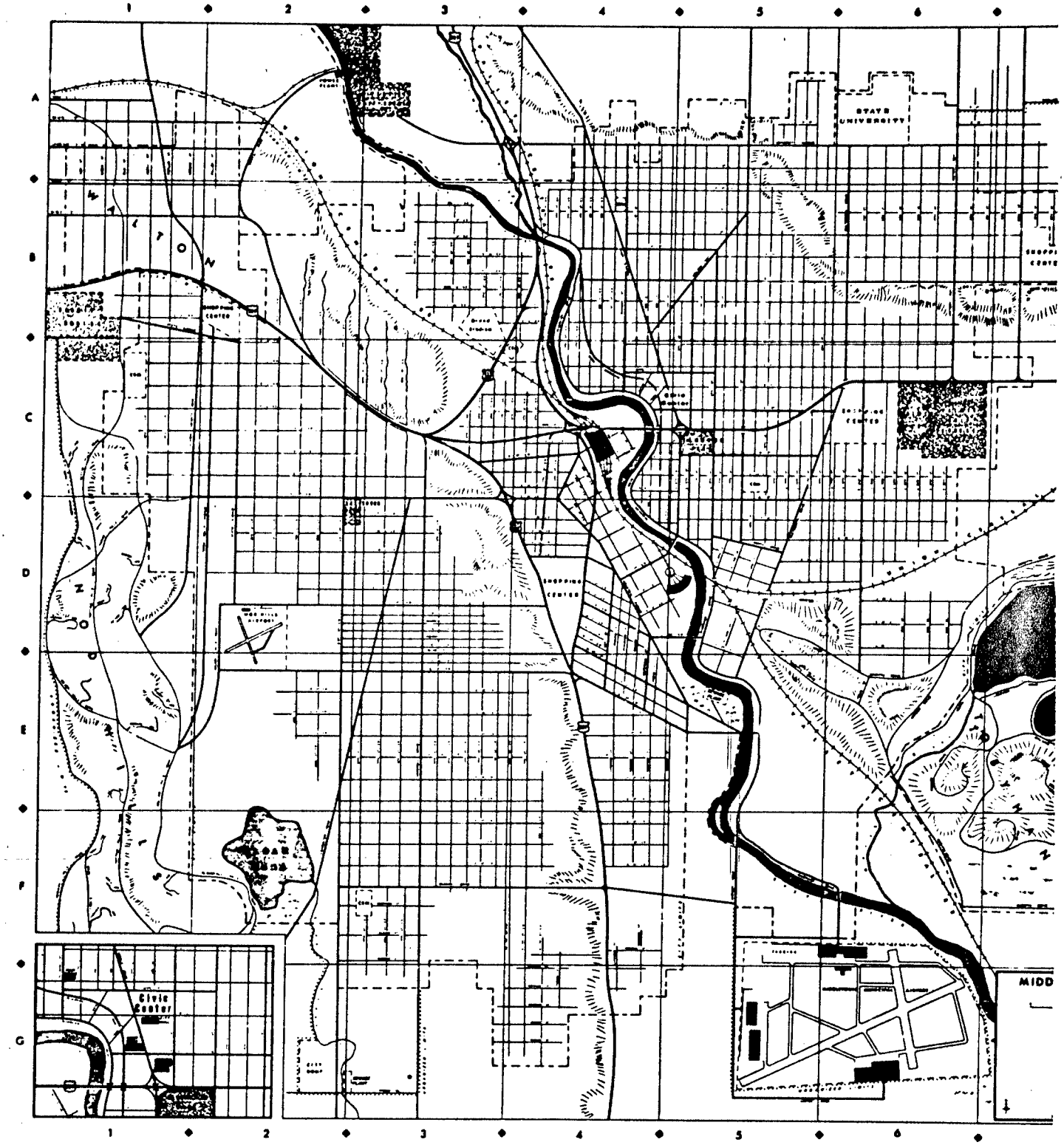


Figure 5. Map of Model City

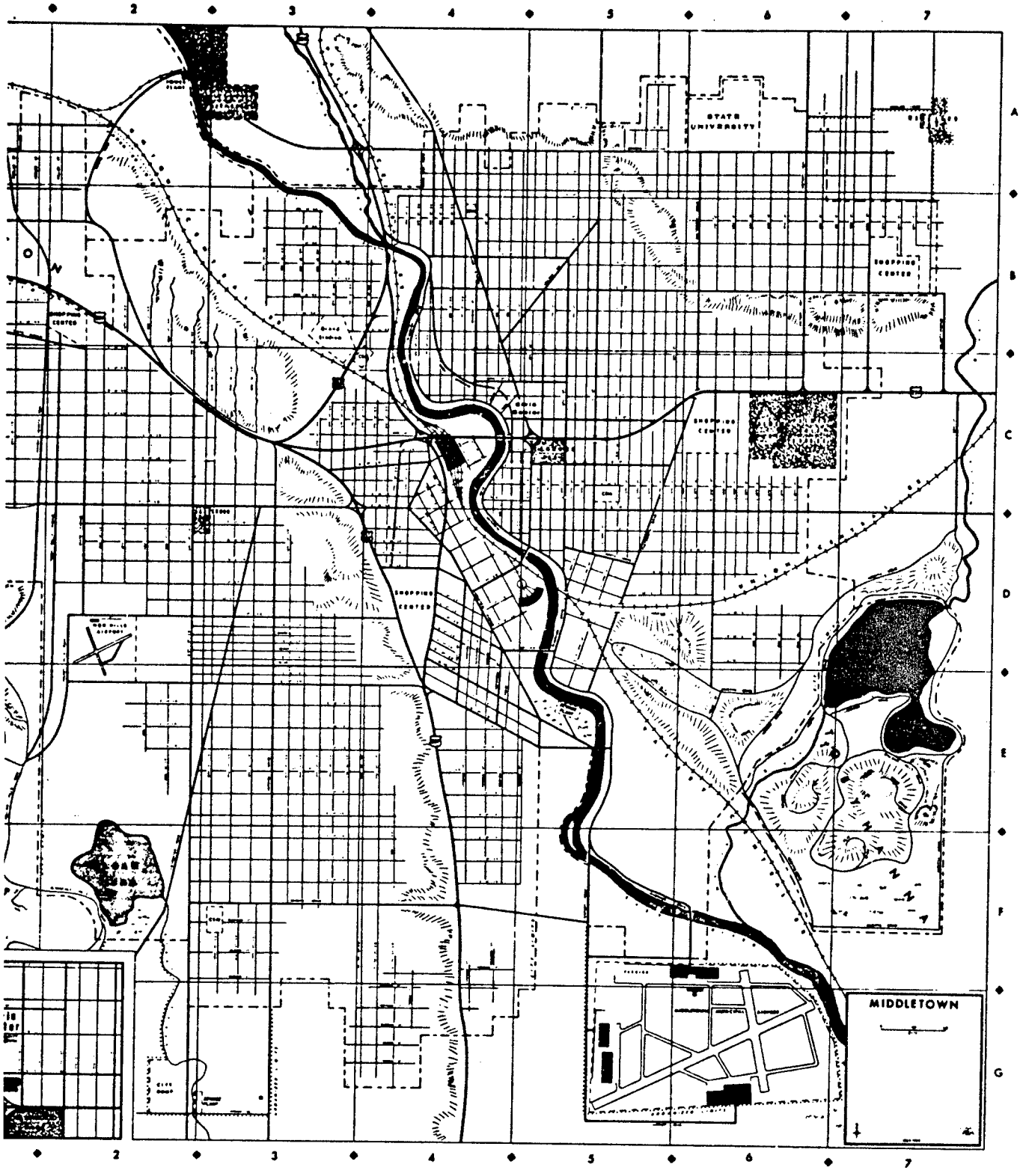


Figure 5. Map of Model City

B

MODEL CITY CONFIGURATION

Model City boundaries were designed to include a built-up or urbanized area approximately 100,000 persons. The Model City is located in a river valley posed of flat and low rolling hill areas. The next largest city is 60 miles the southeast, with 500,000 population in its urbanized area. A major city national and international importance is 200 miles distant; it has an urbanized a of 3,000,000 population. The map in Figure 6 depicts the surrounding area.

"Downtown" Area - The central business district and manufacturing zone are ated at the major bends in the river. This area was the early nucleus of city and plays an important role in its present economic life. It is an a of congested traffic, small block pattern, non-standard street pattern, relatively old buildings. Urban renewal has not been attempted, but ividual buildings have been modernized. A civic center and park complete downtown area.

acent to the Downtown Area - Low-priced housing and warehouses intermingle und the downtown area to form an area in transition. A new shopping cent:r been built southwest of the manufacturing zone, providing a buffer zone ween the transition and the middle-priced housing districts located farther t. A stadium has been placed to the northwest of the downtown area for the e purpose, and also so that it is located on a major traffic artery. A new ustrial park for small manufacturing and research facilities is partially upied. It is located southeast of the downtown area.

ly Developed Residential Areas - The major housing area is interspersed with mercial and public facilities, such as the state university, golf courses, ports, shopping centers, cemeteries, sewage plants, parks, and shopping ips along major and secondary streets. High-priced residential areas are ated three to four miles from the center of the city.

eet Pattern - The downtown area has an uneven, non-standard street pattern corresponding to the major part of the city. Beyond the downtown area, it omes a regular north-south, east-west block pattern interrupted occasionally h diagonal or curved streets and highways. Several subareas have non-con- ming street patterns. One of these is a hilly region where the streets respond generally to the topographic contours; the second is an incorporated a of 3,000 population, where a deliberate attempt was made to design streets o a curving, non-regular pattern; and the third is an incorporated area of 00 population, having its own north-south, east-west street pattern. In se three areas the streets are named; in the rest of the urbanized area, the eets follow a common letter/number indexing scheme.

n the map compilations that were developed, desk-top street maps were created the use of the participant and simulation staffs. Projection vellums were o made in order to provide 6' x 6' maps for use on vertical displays.

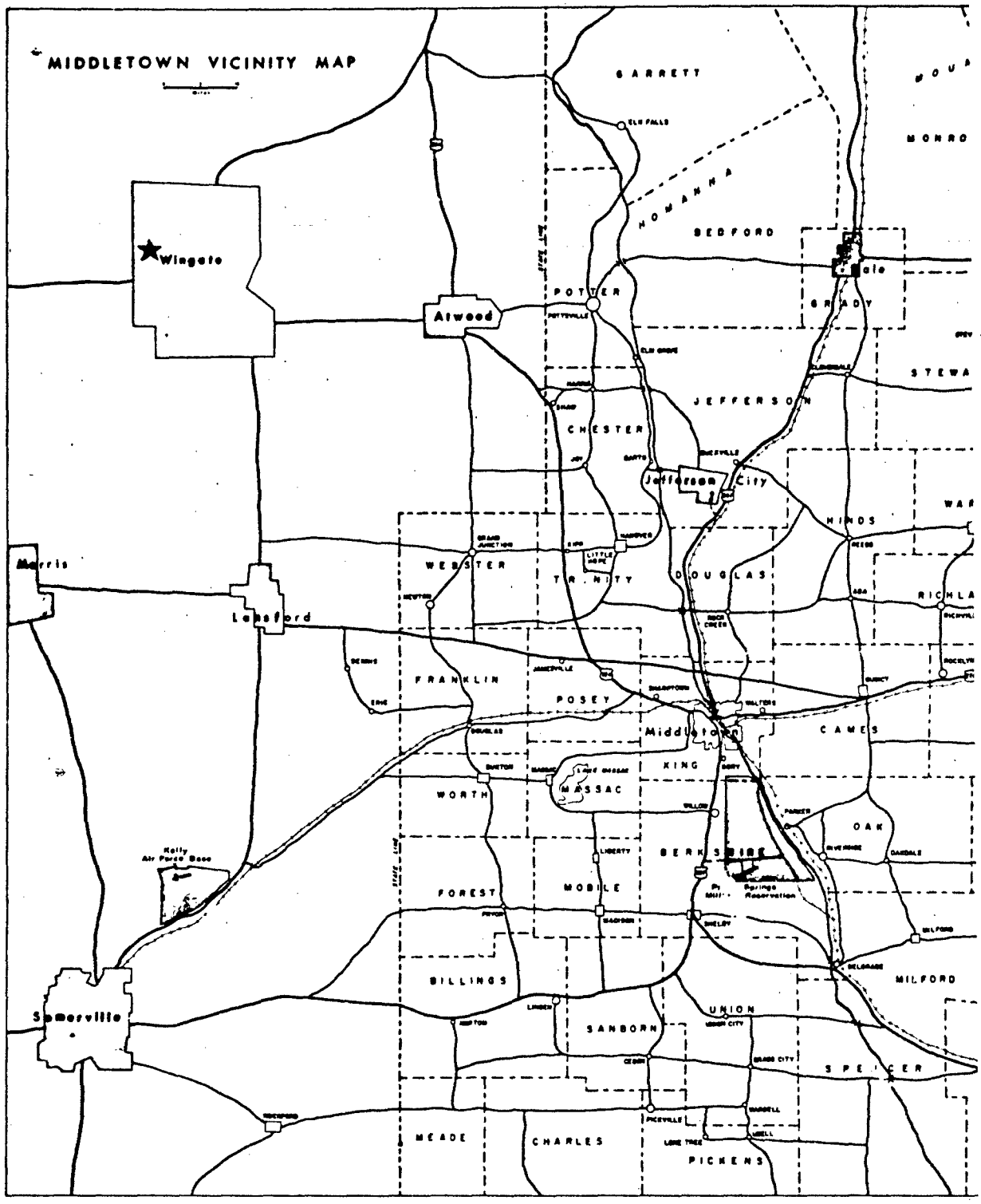
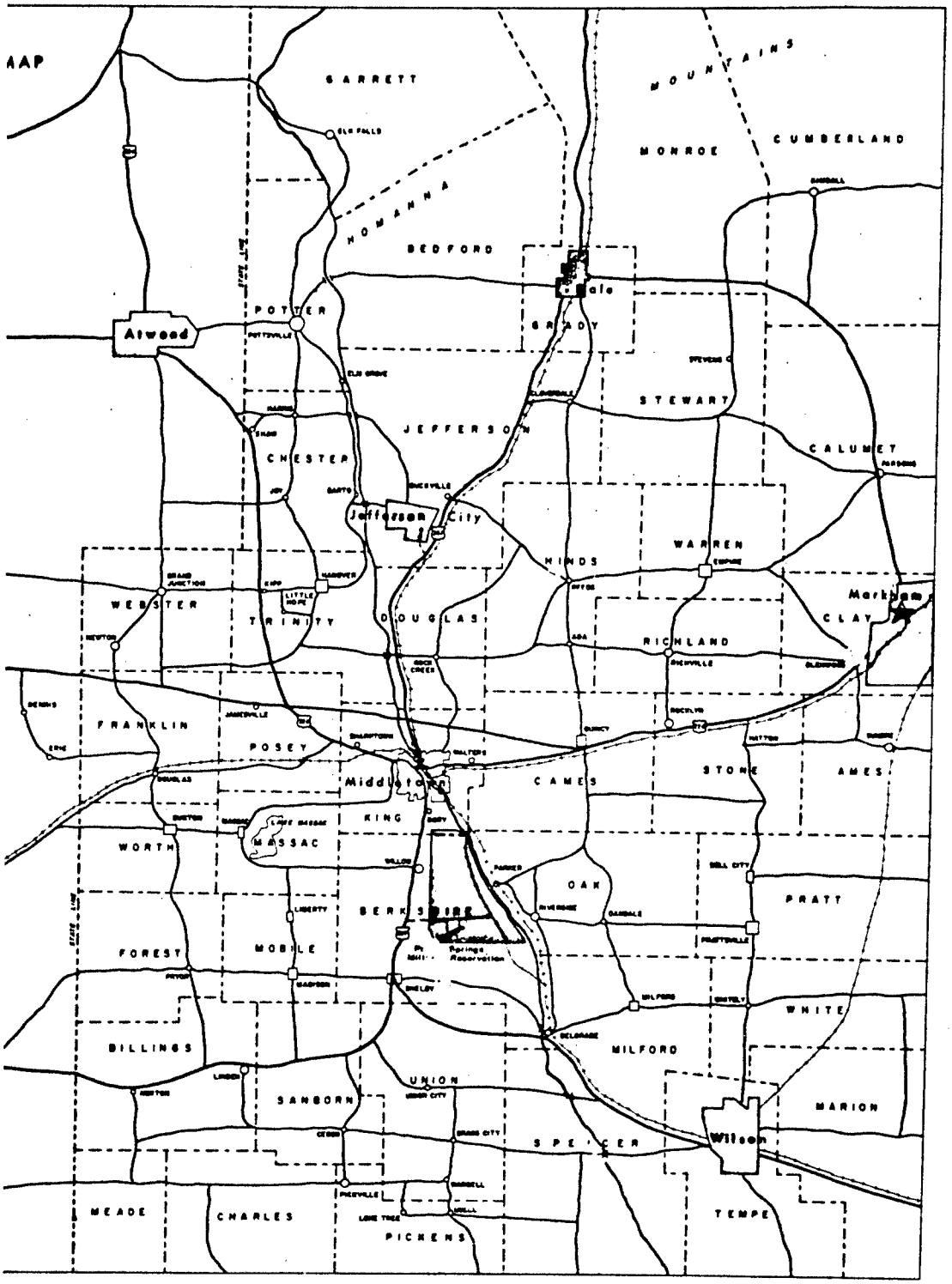


Figure 6. Map of Model Area



6. Map of Model Area

B

The definition of census tract data was accomplished after the land-use categorization had been determined. Eighteen census tracts were formed to provide an average of approximately 6,000 persons per tract. This figure varied depending upon terrain, land-use and cultural factors; however, no tract was less than 4,000 persons.

For purposes of experimental design, overlays were also developed depicting siren locations and maximum (idealized) radii coverages. This overlay superimposed on the map assisted in the determination of the number of persons who would normally hear the sirens (both day and night charts were so developed).

By means of a fairly detailed process, it was possible to provide still another overlay indicating the various shelter locations and the approximate geographical area they would serve based on street patterns and other geographic features. With the combination of the census tract data, siren coverages, and shelter service areas, it was possible to predict with a fair degree of accuracy the number of people in an area who would hear the siren; and from that number and their location to the shelter, it was also possible to determine the approximate number who would seek community shelter as well as the general routes and length of time it would take them to arrive. In addition, by specifying the type of structure and entrance configurations, an estimate of shelter-fill rates and predictions of the number of people that would be unable to get into these shelters could be provided. All of these data were used in the performance of the information requirements experiments. Because all of these data-collection tasks were divided into separate efforts, alterations can easily be made to meet specific future experimental needs.

CITY ORGANIZATION

Like the design of the Model City, its organizational structure was developed to meet experimental design requirements and to be easily modified. The city manager form of government was selected for the Model City because the role of the city manager is well defined with respect to his duties and responsibilities. The title "Mayor" in no way defines the level of responsibility, nor the types of decisions confronting him in a given city. To satisfy the objectives of the research effort, the person who actually managed and was responsible for the emergency operations of the city, was required to participate in the experiment. For this reason, the city manager form of government was selected for the Model City.

Five operating departments, a civil defense staff and a city planning staff, completed the city's organizational framework (see Fig. 7). Each staff and department was assigned specific areas of responsibility for operations during an emergency period; each operated from a separate, fallout-protected facility. The purpose of this decentralized plan for emergency operations was twofold. First, it allowed for the isolation of the executive decision-making staff.

FOR EMERGENCY OPERATIONS

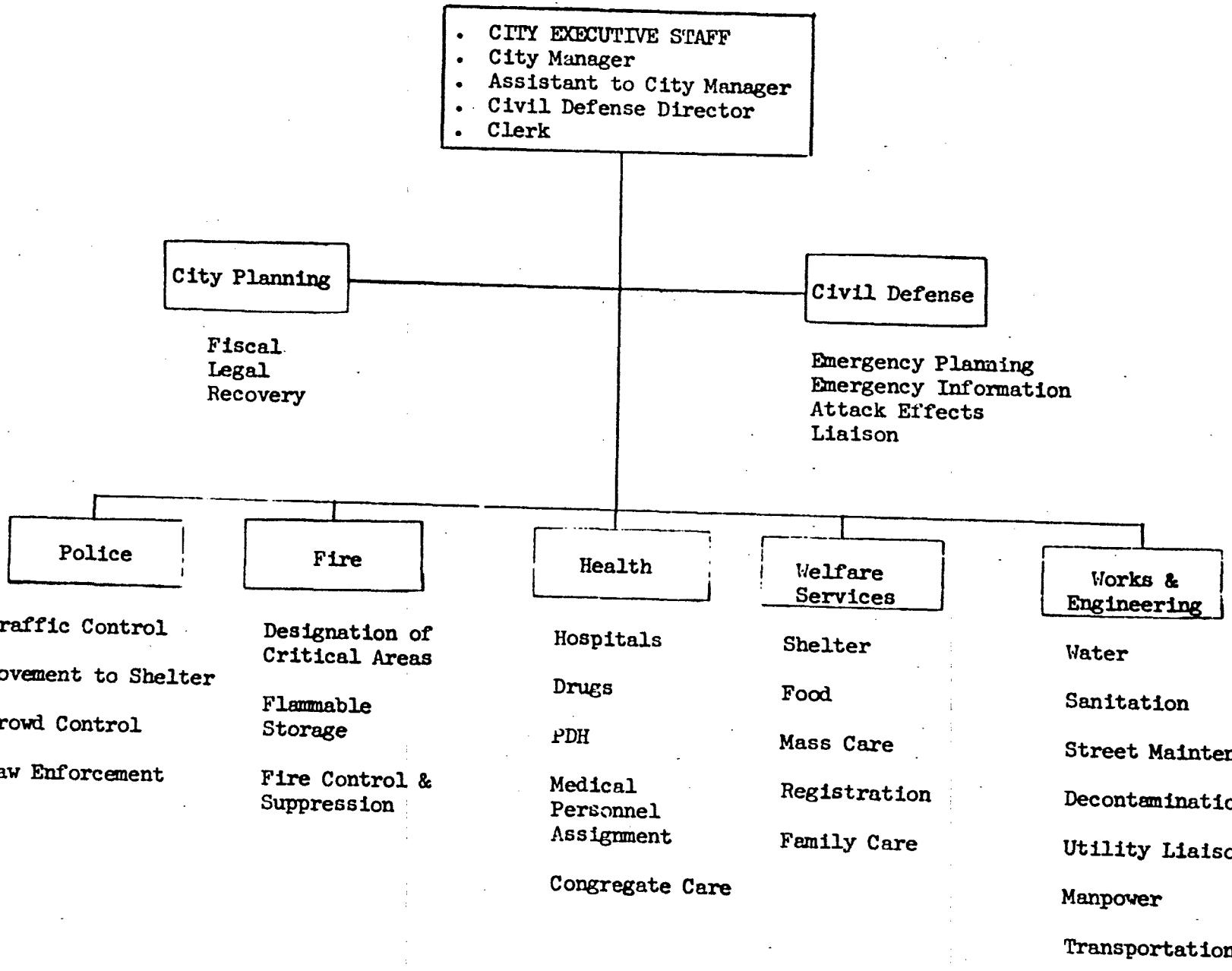


Figure 7.

Their isolation was essential to the fulfillment of the research objectives and also simplified the data-collection and simulation tasks. Second, the decentralized plan provided an opportunity to collect observations, opinions, and some empirical data concerning the practicability of the concept of conducting decentralized emergency operations. Hopefully, this concept can be more thoroughly evaluated as a part of future efforts.

The city organization, being divided into functional modules, offers considerable flexibility. If future research requirements demand additional line operating departments, they may be added without altering the basic reporting relationships. Departments may be combined, management levels added, or staff responsibilities modified without substantially changing the overall organization.

Recommendation

The prototypical urban area model developed for this research has demonstrated its ability to be of value for further and more expanded use in subsequent research studies. Specific development of resources for the model should be accomplished only on an as-required basis. This allows for a more natural and considered evolvement and offers some economy in that effort is not expended on the development of resources until they are needed in the research program.

CHAPTER 4

EMERGENCY ACTION DECISION EXPERIMENTS: PROCESS AND RESULTS

INTRODUCTION

The first application of operations simulation to civil defense problems took place in the SDC laboratory in early 1965, under subcontract with Stanford Research Institute (SRI). Most observers and participants in this initial effort felt that there was great potential in using such simulation as a technique to study Emergency Operations in depth. This conviction resulted in the present contract, OCD-PS-65-71, Emergency Operations Simulation Research.

Two experiments were performed during the present contract: the first involved warning-and-movement-to-shelter, the second focused on an in-shelter period, with each represented by one hour of real-time simulation. The purposes of these experiments were: (1) to establish the information requirements for the City Executive Staff during emergency operations, (2) to establish a display set to provide this required information, and (3) to provide a laboratory facility readied for both future experimentation and as an operational test-bed for equipment proposed for use in emergency operations.

The background decisions that led to the formulation of the above objectives of this research program involved considerable time and effort. The delimiting steps, in chronological order, were:

- The determination of the system level to study
- The selection of independent variables
- The relation of simulation to the system level being studied
- The choice of attack environment
- The choice of city environment
- The selection of experimental design

This chapter discusses these problems, describes how decisions were reached in order to undertake experimental procedures, and afterward elaborates on the details of the information experiments, followed by a presentation of their results.

SYSTEM LEVEL TO STUDY

In general, it is desirable to make as little change in city organization as possible between normal and emergency operations. It does not seem reasonable to add the burden of changes in procedure or organization to city officials who are already faced with difficult problems requiring critical decisions. With this criterion in mind, a skeleton organization chart of a typical city government is presented in Figure 8. It is intended only as an example of the various levels of government, and as an illustration of the interactions of information exchange that occur in emergencies.

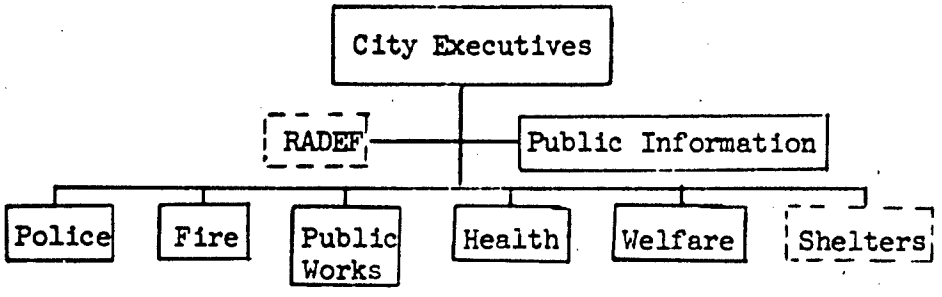


Figure 8. Skeleton organization chart for emergency actions. The two functions enclosed in dashed boxes involve those specifically related to a nuclear emergency, which cannot comfortably be located within a normal, on-going city organization.

Given an emergency actions organization chart such as this, the next question that logically arises is: what portion of it should one study? Implicit here, of course, is the recognition that the first experimental effort cannot safely study too large a portion of this system without running the considerable risk of obscuring important relationships with the multitude of interactions that are bound to occur. Conversely, the effort must cover enough ground to provide practical and meaningful results. Establishing this compromise is not an easy or obvious task.

After much deliberation, it was decided to study the City Executive level of Figure 8. It is at this level of city government that policy governing emergency action is set, or modified. It is to this level that the most important problems, or those too serious or complex to be undertaken within individual departments, come for a final decision. It is at this level where the authority and responsibility rest for interaction with lateral and higher headquarters. Finally, experience in system analyses indicates that overall system performance is often directly relatable to performance at the highest decision levels. Good top-level performance usually indicates good performance throughout the system, but good performance at the middle-management level does not necessarily mean that there is good overall performance.

In order to make accurate and timely decisions,* the City Executive Staff requires information. This information must be tailored to their specific needs in terms of level of appropriate detail, format, timing and clear, definite interpretability. The bulk of such information originates at the operating departments within the city, with the needs of the Executives levying the requirements on the departments to furnish such information. This reporting chain can be directly related to the success of the system. Unless the nature of this reporting chain interaction between Executive and line department is explicitly recognized and provided for, substantially inferior system performance will result. The best way of providing Executive information is by incorporating the reports into the job description of each department, thereby making its collection and transmission upward a matter of standardized routine. If such procedures are not followed, the Executives must use special requests for information, with attendant problems of having disrupted and disorderly collection procedures, greater interference with other departmental tasks, and a negative feeling of executive interference within the departments.

SELECTION OF VARIABLES

There are two major classes of information that apply to the Executive Staff: static and dynamic. Static information is represented by such factors as the amount of knowledge and training that the Executives bring to the problems as well as the style and technique they use in making decisions. It has been argued that there is a possible trade-off between training and the use of procedure guides, or checklists. If true, much less training can accomplish the same degree of efficiency when procedure guides are available. It was strongly desired that actual City Executives serve as participants in these experiments. Since it was realized how busy and relatively unavailable such people would be, procedure guides were designed and used to reduce their training time. Using available time for data-collection purposes, rather than for orientation and training, produced the greatest cost-efficiency rates. Incorporating procedure guides into this experiment also had the strong appeal of producing a potentially useful product in addition to the gain in knowledge—namely, a set of procedure guides that could be used in other civil defense applications.

Dynamic information requirements are the traditional concern of system designers. They are frequently represented by the trichotomy: "What has happened; what is needed; what is available?" The most straightforward way of investigating this information aspect is via display experimentation, wherein the format, timing and quantity of information presented to the participants can be carefully controlled. Thus, the two variables, procedure guides and displays, were chosen to represent the static and dynamic characteristics of information, respectively.

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* See Detailed Results section of this chapter for a discussion regarding the evaluation of decisions.

SIMULATION PROCEDURES

After selecting the level of system study and the variables, the critical problem of controlling the simulation followed. If entire city staffs were brought into the laboratory, how could decisions reached by the Executives be separated from suggestions initiated by their department chiefs? How could such a large group of participants be trained, particularly in light of the relatively short time their schedules allowed for these experiments? These and similar questions compelled a decision to operate these first experiments in a "decentralized" mode, where the Executive Staff would be physically separated from the city departments, thereby allowing the substitution of trained SDC simulators as department chiefs. Both control and training efficiency were served by this decision.

The city organization and functional responsibilities of each department are presented in Chapter 3. In essence, each department operated from its normal place of business, but from a protected facility. Thus, problems coming up to the Executives from the departments could be preprogrammed, and the Executive decisions could be isolated and studied without departmental influence.

The City Executive Staff was located in a protected office in the City Hall, and consisted of the City Manager, Assistant to the City Manager, Civil Defense Director, and a display clerk from the SDC staff who did not participate in the decision-making. No attempt was made to structure the decision styles of the teams, nor to influence their methods of load balancing. They could communicate with the "outside" world by telephone, message form, or one-way via the simulated Emergency Broadcasting System (EBS) (for a detailed description of the EBS, see Chapter 3).

THE ATTACK ENVIRONMENT

The simulated weapons effects generated for these experiments can be classified as light blast damage, medium fallout. An air burst was programmed to cause fire and blast damage to about one-fifth of the city, and the cumulative radiation level from a ground burst averaged about 1400 r, 24 hours after the arrival of the initial fallout. All results and interpretations of the present pair of experiments must be considered in the context of this specific weapons environment.

The choice of this particular damage effects model was based primarily upon the need to maintain an environment that was not hopeless. The problems presented to the City Executives had to have apparent solutions, or no information-decision relationships could be uncovered. Thus, a centered, large-effect weapon would defeat the purposes of this research by reducing the alternatives available to the decision makers to trivia. Rather than get enmeshed in the argument of the likelihood of severity of attack, it was decided to side-step this issue by pointing out that regardless of the strategy or severity of the

attack, certain cities would undoubtedly encounter an environment similar to the one described above. Thus, the results of these experiments should be directly applicable to them.

THE MODEL CITY

A significant effort during this contract period went into the design and implementation of a model city. The rationale for the use of a prototypical city environment was principally one of experimental control and economy. Providing each participating team with its home environment would be prohibitively expensive and would cause serious simulation difficulties. Choosing a neutral, existing city would cause problems resulting from the different degrees of knowledge of that city held by the participants. This difference in static information would then result in biased results. The one obvious way of holding this amount of pre-knowledge constant was to use a model city, with each participant then obviously starting with no pre-information whatsoever.* Details of the formulation and construction of the model city, and its resources, are presented in Chapter 3.

The Model City, called "Middletown," was formulated to be 100,000 population in size, with Northeastern characteristics. This particular size was chosen because it provided urban problems, but with a manageable Emergency Staff size, which could be readily accommodated within the SDC laboratory. Its Northeastern characteristics were chosen as representing the greatest portion of people within the United States. A map of Middletown is depicted in Figure 6.

A hypothetical area map, showing the state and region in which Middletown was located, was also developed (see Figure 7). The Model City was purposely located near a state border, so that future cross-jurisdictional problems could be studied.

EXPERIMENTAL DESIGN

The principal concern of the experimental method is to control all conditions that could influence the results, except for the conditions (independent variables) under study. The closer this standard of control is approached, the greater the confidence the researcher will have that any changes that are observed are actually the result of the conditions under study. Experimental

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* It is interesting to note that using a model rather than a real city has an additional advantage: the City Officials were much more willing to accept procedures that differed from their own methods. In the past, SDC researchers have encountered resistance when using actual city environments, and then applying different procedures to that city government operation—difficulties arising from the "But we don't do it that way at all" reaction.

design is directed toward obtaining this control, and at the same time getting as much information from the data collected as possible.

For greatest efficiency, it was decided to let each team be its own control. This technique requires the rotation of each team through each condition, a procedure which further requires that there be as many teams available as there are conditions under study—or multiples thereof.

Sequential testing, which occurs when using teams-as-own-control, has the associated problems of learning and stimulus (input) memory. Both of these factors work toward improving the performance as the testing continues, and must be explicitly controlled, or they will seriously contaminate the results. To this end, a latin square design was employed, which counterbalanced the order of presentation (learning) with the display variable, and thereby controlled practice. Input memory was controlled by designing three separate but equivalent situations, the rotation of attack effects around the city, and the duplication of the run 1 input messages in run 3.

Finally, the teams were briefed, practiced and run simultaneously as further methods of control, thereby preventing possible advantages that might have occurred to later teams from better briefing presentations or simulator response as a function of practice. The experimental design is presented in Figure 9.

	EXPERIMENT I				EXPERIMENT II		
	order				order		
	1	2	3		1	2	3
city A	ND	Em	Ex	city D	ND	Ex	Em
city B	Em	Ex	ND	city E	Em	ND	Ex
city C	Ex	ND	Em	city F	Ex	Em	ND
	iv	v	vi				

where: ND = No preplanned displays
Em = Emergency Action displays
Ex = Exception displays

where: small roman numerals show the number of procedure guides available during the first Experiment.

and: order of presentation and input stimulus situation are confounded.

Figure 9. The experimental design.

This latin square scheme was chosen primarily because it provided control. Although this design allows an independent assessment of the performance of the teams, no effort has been made to undertake such an analysis. Interest is focused rather on the performance under the various display conditions, using teams as replications of this test. Similarly, an assessment is possible for the effects of practice, and for comparisons of the equivalence of the three input conditions, but again it must be pointed out that the major concern in these experiments was to isolate the effectiveness of the display systems. To keep displays foremost in mind, these secondary analyses have been relegated to the end of the Detailed Results section of this chapter.

The background information having been presented, the details of the experiments will now be examined. First, the displays and the procedure guides used in the experiment will be described in detail.

THE DISPLAYS

As previously indicated, the most straightforward way of investigating what information is required for City Executive decision-making is via display experimentation. To this end, the two experiments were conducted: the first with a movement-to-shelter time orientation, the second during the in-shelter period. These different time periods were purposely chosen to test the display principles through various types of emergencies and classes of problems, since efficiency requires that displays must serve more than a single emergency time period. The alternative to this criterion of efficiency—special displays for each time period—leads to an unmanageably large number of displays, and associated problems of storage, training, shifts in reporting methods, etc.

Even within this constraint of efficiency, there are a very large number of possible display systems that could be tested. Those used in the experiments were chosen as typical examples of display classes, rather than as individual displays, with each class based upon rather different general principles of content and level of detail. Three such display classes were used:

1) Emergency Actions displays (Room A)

2) Exception displays (Room B)

3) No pre-planned displays available (Room C)

The arrangement of the three rooms for simultaneous running is shown in plan view in Figure 10. Each had two telephones for outside communication, plus another special telephone connected to the EBS station as well as maps of the city, and the region (see Figures 5 and 6).

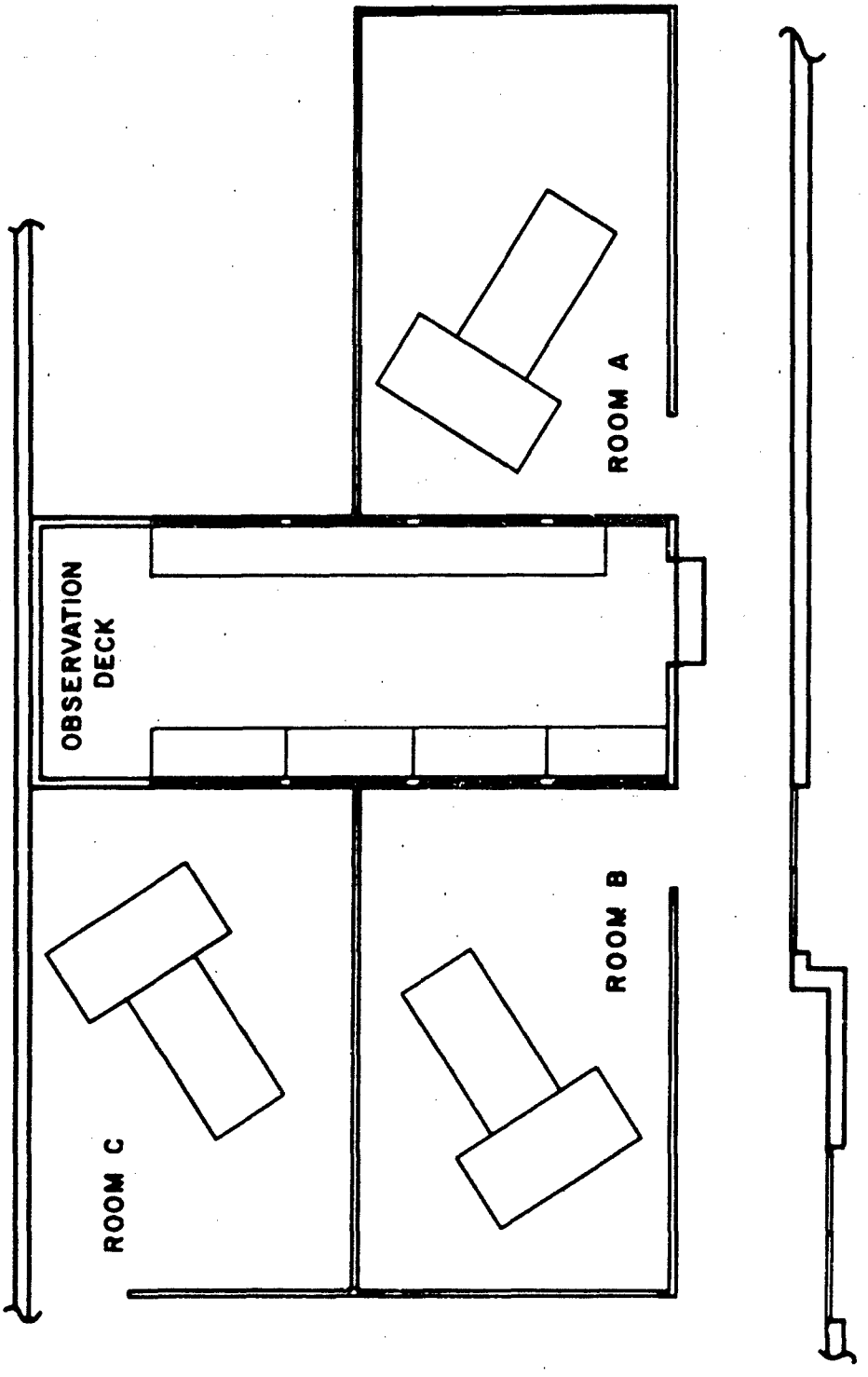

Figure 10. Room Arrangement Plan View

The Emergency Action displays were based on the principle of informing top management of all problems confronting the departments, and the actions being taken to handle these problems. This class of display is usually thought of first in system design because the information is readily available. Indeed, this display set is comparable to that being proposed for use in communities presently building Emergency Operating Centers.* A plan view of this display room is presented in Figure 11.

The principal display in the Emergency Actions room was the Emergency Log (Figure 12), with the geographic location of each emergency keyed to the detailed city map. The same emergency number was transcribed from this display onto a magnetic marker, which was then positioned to show the location of the emergency in the city. Shelter Status information was presented via the Shelter Status Board (Figure 13).

The exception display principle is designed to utilize the "management by exception" idea, which is based upon informing top management only of deviations from a planned standard. Deviations can be either better than or worse than planned, each of which has obvious implications for decision-making. Such displays are directed toward unburdening top management by deleting burdensome detail and data regarding situations under control from their attention. A plan view of the exception display room is shown in Figure 14.

Four specific displays were designed for the exception principle. The most important of these is the Major Problem Status board (Figure 15A), to which each line department reported its two most important problems. This information was updated at ten-minute intervals, unless a new major problem was uncovered sooner. A Shelter Status board, designed on exception principles, is shown in Figure 16. As can be seen, shelters filling according to plan would not be presented on this display—only those under—or over-filling were reported.

The Departmental Efficiency board (Figure 15B) was designed to inform the Executives when a department was getting behind. This type of information is extremely hard to uncover, even when the people involved are under observation, and it was felt that improved system performance could accrue from this display. The information was derived from the communications chief of each department, who was charged with the responsibility of sampling two messages every ten minutes, and computing the time delay between receipt and departmental action. The average time delay of these two messages was forwarded to the display clerk. Finally, a combination of access and supply status information was incorporated on a single display, detailed in Figure 15C. As indicated, the exception standard for supplies was arbitrarily chosen at two days, and access was recorded only for those transportation features that were blocked.

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* Draft Federal Civil Defense Guide, Part E, Chapter 2.

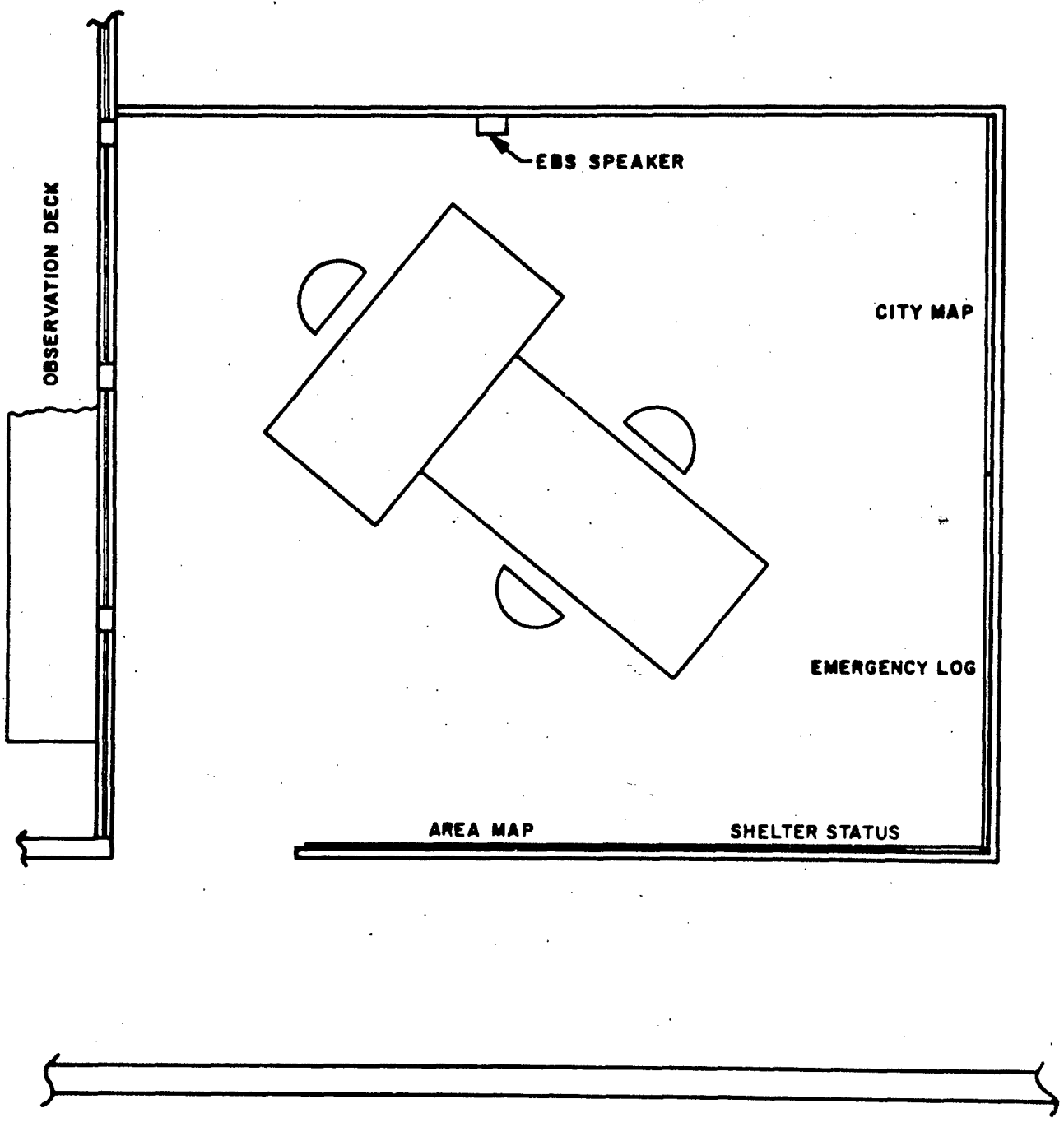
ROOM A
EBS SPEAKER
OBSERVATION DECK
CITY MAP
EMERGENCY LOG
AREA MAP
SHELTER STATUS

Figure 11.

EMERGENCY LOG						
EMER NO.	LOCATION	RPT. TIME	DESCRIPTION	NO. OF PEOPLE	CRIT TIME	ACTION TAKEN/TIME

Figure 12.

SHELTER COMPLEX STATUS							
COMPLEX	COMM	MAX.CAP	NO.IN	EN ROUTE	SPACE AVAILABLE	TIME	COMMENTS

Figure 13.

ROOM B

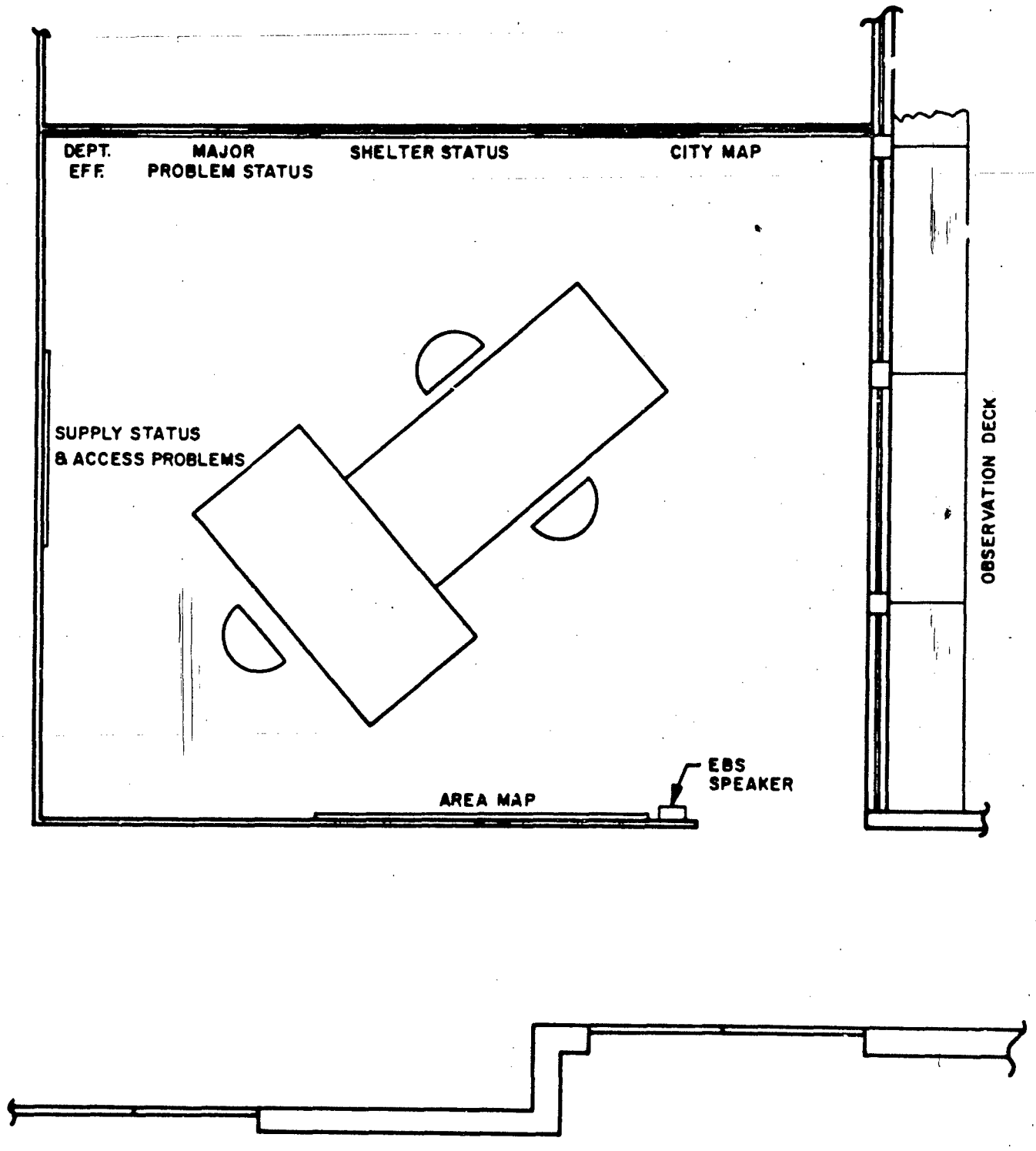

Figure 14.

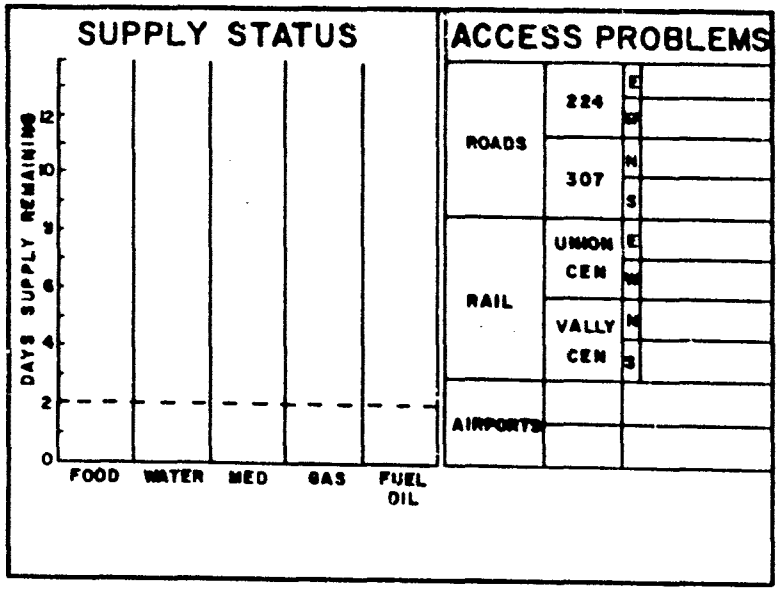

Figure 15C.

MAJOR PROBLEM STATUS

DEPT	PRIOR	TIME	DESCRIPTION	REQUIREMENTS
POLICE				
FIRE				
HEALTH				
WEL.				
PW & E				

Figure 15.

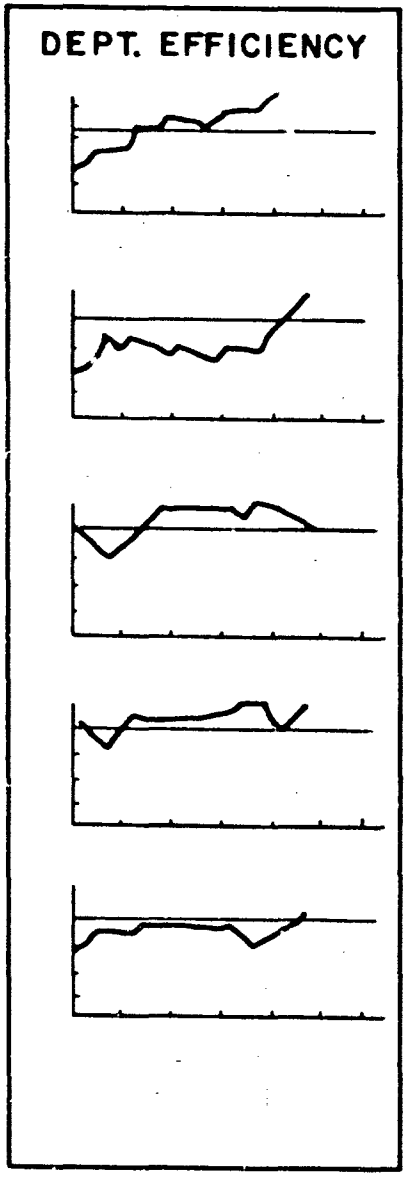

Figure 15B.

SHELTER COMPLEX STATUS

OVERCROWDING

SHELTER COMPLEX	GRID	TIME DAY/ HOUR	PEOPLE IN EXCESS OF			COMMENTS
			SPACE	FOOD	WATER	

AVAILABLE

SHELTER COMPLEX	GRID	TIME DAY/ HOUR	SURPLUS OF			COMMENTS
			SPACE	FOOD	WATER	

Figure 16. Shelter Complex Status Board - Room B

The third display room, involving no pre-planned display, was included as an experimental control to provide a base-line standard. Its plan view layout is shown in Figure 17. Inclusion of a base-line standard is necessary to prevent an uninterpretable result from occurring from these tests: if the other two display rooms show no difference in performance, then without a standard it would be impossible to tell if they performed equally bad, or equally good. A lined chalk board was provided in this room, without labels, so that any information requested by the Executive Staff could be recorded by the display clerk, if the team so wished. It was also hoped that after exposure to the other display rooms, the City Executives might give an indication of their display preferences by setting up this chalk board (Figure 18) to correspond to one or another of the prepared displays.

Two important conditions were observed with these display systems: real world operation, and separation of input design from display design. A frequent difficulty with simulation tests of display systems is that certain information is posted on the displays during the tests that can never be obtained in actual operation. Simply being aware of this problem goes a long way toward preventing it; a conscious effort was exercised in these experiments to prevent its occurrence. Another frequent source of display bias occurs when the experimenters design both display and input. It is relatively easy to design displays that respond to input within a test, but another matter to make sure that the displays are general purpose, and not input specific. Again, conscious awareness helps prevent such bias, and a further separation was made in the present experiments by using a sequential approach: the displays were designed before the inputs were invented. By consulting the results section, it can be seen that these biases were indeed overcome—perhaps even better than was hoped.

THE PROCEDURE GUIDES

Six procedure guides, or checklists, were designed for the first experiment. They were:

1) City Policies

2) Personnel Commitment

3) Priorities

4) How to Use Emergency Broadcasting System

5) EBS Content Guide

6) Shelter Problems

ROOM C

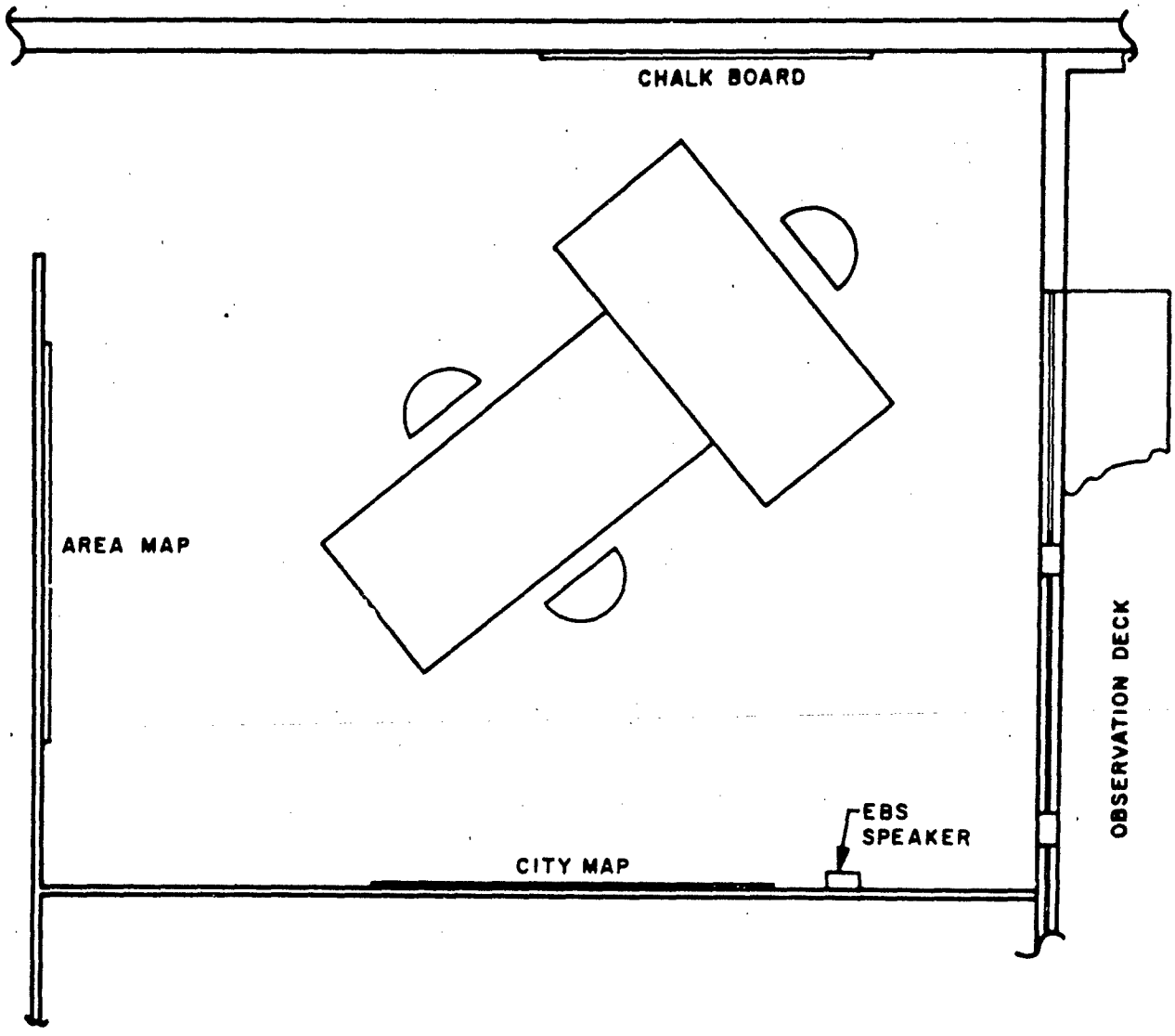

Figure 1.

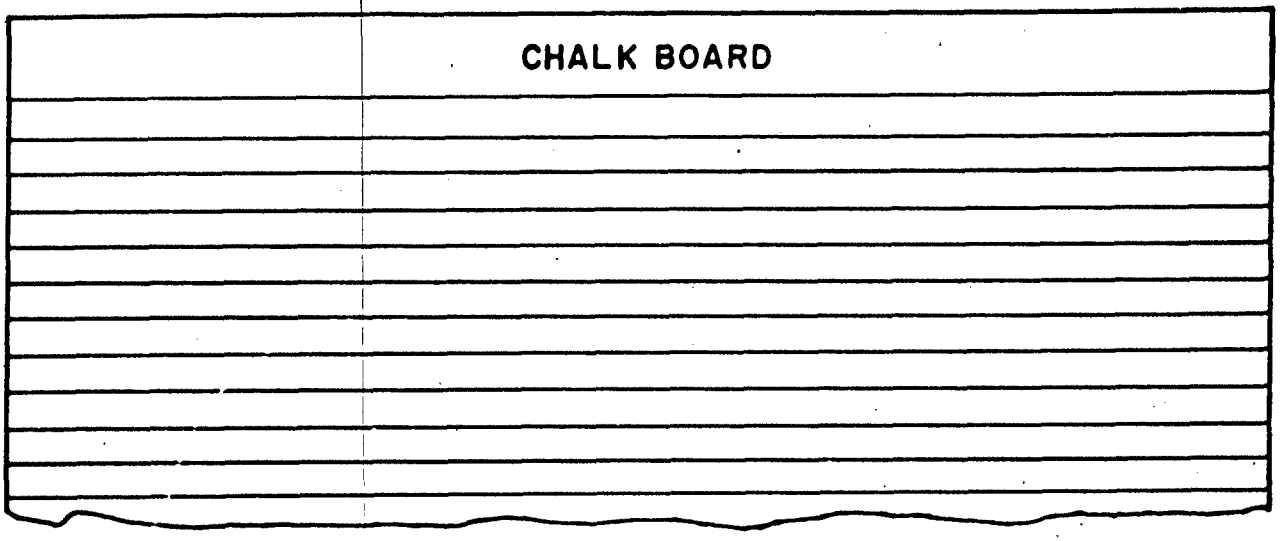

Figure 18. Chalkboard.

The first four of these were available throughout the first experiment; the fifth (EBS Content Guide) was introduced in the second run; and the sixth (Shelter Problems) was available only during the last run. This procedure was necessary because of a suspected residual effect that might occur had a guide been available during an initial experimental run, and then withdrawn. Each guide is presented in Appendix A.

As with display testing under simulated conditions, procedure guides can also easily become biased by being designed to respond to the simulated inputs rather than the real world. Again, simply being aware of this possibility goes a long way toward preventing it.

PROCEDURES

One of the basic assumptions of simulation is that the inputs must be realistic. This is a necessary, but not sufficient condition, because without realistic inputs, all results are immediately questionable. Every effort was made in the present experiments to produce realistic situations, although there is no final authority in such matters. Opinion was solicited from experts, and the

participants were also asked about the realism of the inputs; both groups concurred that these were "typical" problems that could be expected during a nuclear emergency. In the final analysis, it probably falls upon each reader to satisfy himself on this "realism of inputs" issue; they are presented in Appendix B.

Another classic simulation problem results because the attitudes and motives of the participants may differ during simulation from actual conditions. However, simulation vehicles have been tested both in the laboratory and then during actual conditions, and the transfer of results seems to hold quite well. As a rule of thumb, the transfer process from laboratory to operations seems to hold to a general downward displacement of performance, but with relationships maintained (i.e., the general shape of a curve, or relative performance). Thus, simulation results should probably be viewed as upper limits of a range of possible values.

The inputs, designed to be equivalent, were produced in triplicate, so that they could be simultaneously presented to the three rooms. Perhaps the mechanics of the procedure can be best illustrated by diagram. Figure 19 schematically shows how this procedure was implemented. For a discussion of the score ratings, and derived scores, refer to the results section of this chapter.

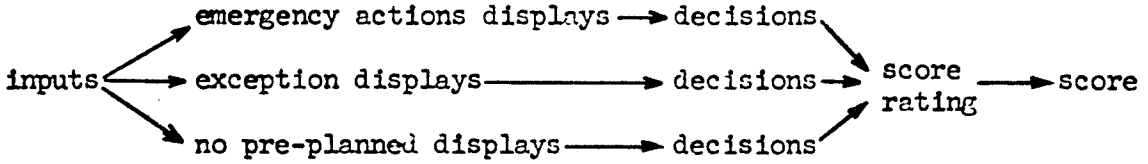

Figure 19. Schematic diagram of the experimental procedures, showing the simultaneous, identical inputs in relation to the major independent variable of display.

The simulators, representing the city department heads, were gathered into a common room containing scripts and displays coded so that they could interpret the "real world" for the Executives. No trickery was involved in these experiments: the simulators always responded to questions to the best of their ability.

The simulation method was changed between the first and second experiment, which may have influenced the results, making the experiments less comparable between themselves (although the researchers do not feel this to be the case). In the first session, each of the display rooms called upon the same simulators: that is, a simulator playing the role of the Chief of Police represented himself as the Chief of Police to all rooms during each run. Since there were only six "active" telephones in the combined display rooms, it was felt that this technique would not result in too many busy signals or confusion on the

part of the simulators beyond that to be expected in an actual emergency environment. This method had the obvious advantage of having the same voice responding as a department head throughout the experiment, but led to difficulties for the simulators in keeping separate the decisions made in the various rooms. When a decision choice was input, some Executives would decide one way, others another—but the simulator was required to remember which room had made which decision, and respond accordingly. This separation led to several errors (note the gaps in the results summary, presented in Appendix C, which resulted from a simulator omitting a telephone input).

For the second experiment, the simulation method was changed to try and lessen the confusion and errors which resulted in the first experiment. In the second experiment, a set of simulators was established for each display room, remaining with the room throughout the three runs. This method overcame the problem of who had made what decision—only one decision had to be remembered—and also allowed a more thorough preparation of the simulation, because each group of simulators could now become specialized for their display room. However, certain apparent penalties accrue from this method. Probably the most serious is the intertwining of simulator ability and display room: if one of the display rooms happened to be blessed with particularly able simulators, their benefit would give better performance to that display system than the others. Another penalty could be a decrease in the realism of the simulation, since different voices now represent themselves as the Chief of Police, from display room to display room.

No data were gathered on which simulation method is superior. The consensus of opinion strongly favored the second method, however, and demonstrably fewer errors and oversights were made using it.

GENERAL RESULTS

General observations will be presented first, so that an overview perspective can be maintained until the end of this section, where specific details are given.

In a sense, the analysis of these experiments presents an unfair picture. Scoring of performance was concentrated on the inputs specifically directed to the City Executives, as it no doubt should be. However, at the same time a large amount of information was presented in the two "active" display rooms about the activities of the various city departments. Unless these departmental activities were related to the specific inputs for the City Executives, any attention paid toward these activities was "penalized" by taking up the Executives' time, but was not reflected in their performance scores. Thus, the scoring methods were weighted heavily in favor of the "no display" room, since no departmental information was presented in that room, thereby allowing the team in this room to concentrate exclusively on the inputs specifically directed for their attention and decisions.

These experiments, like many operational simulations, gave an overall feeling of almost total lack of anticipation on the part of the participants when they started the experiments. Their activities were almost exclusively devoted to waiting to be informed of a crisis, and then taking action, rather than the much more appealing performance of inferring that some difficulty is going to occur from some of the clues that were available, and taking action before a crisis had actually developed. Anticipation performance usually pays large dividends in that small commitments of resources can often prevent or alleviate problems that might otherwise grow to serious proportions.

It is unfortunate that the results derived from these experiments do not reflect the definitely noticeable trend toward anticipatory activity as the participants gained experience from session to session. This shortcoming probably reflects negatively on the sensitivity of the scoring measures used. Similarly, it is unfortunate that most training programs do not measure this increasing awareness of anticipation, since a strong case can be made that this result is one of the greatest benefits of training, particularly in decision-making contexts.

Many of the shortcomings evident in the following experiment results could readily be overcome by training. However, it should also be remembered that in the event of an emergency within the near future, the level of training of these participants would be quite typical. Indeed, these participants were selected as among the best City Executives in the local area, and it is unlikely that their performance would be matched by an "average" team. General results were as follows:

- Telephone procedures were almost unbelievably poor. Frequently, neither the person talking nor the topic of conversation was identified. Frequent misunderstandings occurred from shifts of topics within a conversation, without accurate identification of the topic.

- "Echoing" in conversations materially reduced the speed of telephone conversations. An example might be: the first speaker said: "There's a fire at Fifth and Main," with the second saying, "A fire?" The first, "Yes, a fire." The second, "at Fifth and Main?" The first, "Yes, a fire at Fifth and Main."

- There was a general tendency to commit not nearly enough resources to handle specific problems. Examples include sending one doctor to examine 100 victims, one patrol car to control a riot of 2,000 people, etc.

- Greater importance by far is attached to telephone inputs than written messages, and much greater speed of response occurs from telephone requests than written requests. In no case was a telephone input ignored, while an average of more than 20 percent of the written messages were not responded to. It must be emphasized that this observation is independent of message content.

- Less credence was placed on display information than on other forms of communication. Many instances occurred in which displayed information was immediately and directly available, but telephone inquiries were still made.

- Regardless of the display configuration, the Executive Staffs all showed remarkable ability to identify and concentrate on problems of major importance, while postponing attention on the more routine problems.

In addition to these general observations, two conclusions of major importance quickly became apparent:

- Radiation information was frequently ignored, thereby subjecting personnel to dangerous doses on seemingly trivial missions. This occurred in spite of frequent questioning by the simulators who had to execute the orders from the Executives.

Radiation played only a small part in the first experiment, as the experiment was terminated almost immediately after the first fallout indications. This result, therefore, applies entirely to the second experiment. Only four specific requests for radiation information were made, covering a time span of nine hours (three teams operating simultaneously for three runs). In addition, 19 instances were identified where the Executives derived radiation information from their displays, and made allowances for this danger. However, this total of 23 times in which attention was paid to radiation contrasts very poorly with the 72 events that were directly indicated in the runs to require such consideration, and with many additional opportunities from such decisions as evacuating people, or setting up welfare stations. There were many indications that the phenomenon of radiation was poorly understood by the Executives. For instance, one suggested that evacuees be covered with tarps to "keep the radiation off them" and another ordered police personnel into intense radiation areas to post "no smoking" signs. The other major conclusion was:

- Public information announcements on EBS were poor in quality, and often badly timed.

Slightly more than two EBS announcements per hour occurred, as an average. However, many of these were the result of requests for a public announcement by the department heads, and were usually of an urgent nature (e.g., indication of poisoning in the water supply—tell people to boil any unstored water for a half-hour before drinking), yet there was an average 25-minute delay. It was also obvious that the City Executives gave much greater interpretive abilities to the listening audience than is probably true. (Advertising agencies are reported to work on the theory that the average listener has a 12-year old mentality.)

Tabulation of the results quickly showed that too few decisions occurred that could be directly traced to the procedure guides to give any sort of quantitative information. This difficulty can be partially attributed to the design methods (of reducing bias: see p. 41), and partially to lack of foresight. In any event, it does not seem legitimate to present data on so few cases.

DETAILED RESULTS*

Whenever measures that involve people are collected, a certain amount of fluctuation will be observed in the data: people vary both between each other and even with themselves when measured at different times. This variation complicates analysis, since any differences that are observed could come either from this sampling fluctuation, or from real differences between experimental conditions. It is customary to set a quantitative decision point, prior to collecting data, about how large a difference must be found before it is considered as coming from the experimental conditions. The choice of such a confidence level for these experiments has been set at 40 percent.**

This confidence level is considerably higher than the traditional 5 percent point usually used. The rationale for 40 percent is to prevent a finding of "no difference," even at the risk of declaring that a true difference exists between display systems, when in fact no difference is really there. In this research, it does not seem to be a serious decision error to suggest that one of three similar-cost systems is better if it really isn't, because one of them (or a comparable model) will be used in any event. The truly serious error, which this strategy is designed to minimize, is stating that there is no difference (the display systems are equal), when in fact one is better than the others. Even small performance advantages could mean the difference between life and death to many citizens.

Quantifying the decisions that came out of these experiments was complicated by the fact that no scoring model existed. That is, there is no objective method available that indicates whether a certain decision course is the right one, while another is wrong. For example, one decision input had the State Adjutant General request the mobilization of Middletown's national guard unit, to serve elsewhere. Several of the department heads, and many of the police and firemen of Middletown were members of the National Guard, and would therefore be lost for emergency duties if this request was honored. What decision would you make as City Manager? What is the objective "right" decision? Obviously, the "correctness" of decision on issues such as this is a matter of judgment.

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* An example of a detailed tabulation is presented in Appendix C. All of the analyses and tabulations have not been included in the appendix because of space problems. However, raw data and analyses are available for inspection.

** The choice of a 40 percent confidence criterion was presented to the Project Monitor in a briefing in April, 1965.

Another dimension needed to establish a composite performance measure involves the importance of the decisions. Some of the problems were much more critical than others, and better decisions on these problems is more important than superior decision performance on the more routine decisions. Both input aspects—importance and decision quality—were quantified by use of a 7-point rating scales, with low numbers indicating poorer decisions or less important problems. Five SDC "experts" rated each dimension independently, with the final result being an average of these ratings (shown as "importance" and "rating" columns in Appendix C). There was excellent agreement in these judgments, so it was felt that there was no requirement to perform a correlation on the judges: only 3 cases out of 198 had judged separation of as much as 2 points. Zero values on the ratings were reserved exclusively for problems that were completely ignored by the City Executives. See Appendix D for judgment criteria.

Note (Appendix C) that there was a large difference in rating for problem importance between the first experiment and the second. The judges indicated that the second experiment's inputs were nearly 50 percent more important than those of the first (an average of 49 as compared to 73 for each run: or a single problem comparison averaging 3.5 for the first, 4.6 for the second experiment). In terms of the 7-point scale, the average problem difficulty for the first experiment is one-half point less than medium difficulty, (4 on the rating scale) while the second experiment averaged 4.6, or nearly a point higher than medium difficulty.

Overall decision quality was the most important measure of performance for the experiments. Summed through order of presentation and teams, so that the major variable of display sets can be clearly seen, the results were:

	Exp. I	Exp. II
Emergency Action	38.5 percent	44.4 percent
Exception	45.1	47.3
No displays	45.0	45.8
Mean	42.9	45.8

The percentages here refer to average decision quality, based on a 4 rating: if the teams had attained average decision performance, they would have received a 50 percent score.*

* An analysis of variance, with 2 and 89 degrees of freedom, with a 40 percent confidence limit, gives an F ratio (estimated) of 1.7. In terms of the derived percentage figures, a difference of 1.6 percent is significant.

These results were surprising from a number of standpoints. First, none of the display conditions proved very beneficial. If the problems were realistic, (and all indications are that this is true), then serious consideration should be given to studying the inputs, and figuring out what display methods would serve these—the exact method that was previously indicated as risking bias (see p. 39). Secondly, these results offer dramatic evidence for the often-heard display dictum that states: either the wrong kind of information, or the wrong level of detail will do more harm than no information at all. The results for the Emergency Action displays were particularly discouraging, because of the strong possibility that this display set will be recommended for use in local EOCs. It also is important to remember the discussion about how the scoring method favored the "no-display" condition, undoubtedly elevating the results from this display room to a considerably higher level than the two other "active" display rooms. An index of this effect can be seen when the number of telephone calls made from the various display rooms is compared. The telephone results were:

	Exp. I	Exp. II
Emer. Actions	25	46
Exception	25	38
No Display	20	32
Mean	23	39

If it is assumed that the number of calls reflect the amount of effort, and the amount of knowledge that "something is going on in the outside world that needs to be followed," these results show lower efficiency from the no-display room. These results again provided a surprise, in that it had been predicted on the part of the experimenters that there would be many more telephone calls from the no-display room than from the other two, as this was about the only way the participants in that room had of acquiring information.

Considering overall performance and telephone calls together provides some insight about a problem unique to room A, the Emergency Actions display room. Several of the teams, in both experiments, spent some of their time and some of their telephone calls informing various city departments of events displayed on the Emergency Log. In terms of the scoring methods used, such activity probably lowered the scores obtained in the Emergency Actions room, since this time could have been better spent on the problems specifically directed to the City Executives for their decisions. Several times when this activity occurred, the researchers felt that the briefing and training was deficient, and that the participants did not understand that the information posted on the Emergency Log was coming from the departments involved. When

this was checked, either by the simulator on the telephone, or in the debriefing sessions following each run, the response was that the executives were aware of this, but were "just checking." Of course, there may be a moral here also—that information should not be presented that can induce a waste of time by "just checking."

Another measure of performance is latency—the delay between the receipt of a decision request and the response to it. This metric was complicated by a difficulty previously alluded to, that an average of more than 2 written messages were completely ignored per run (out of 11), while no telephone requests were so treated. It was also apparent that written messages were often set aside for periods of time, while telephone calls were nearly always attended to at once (the exceptions occurred only when telephone calls competed with each other). Thus, it is apparent that two quite different populations of responses have occurred, and that these are better served if treated separately. First, consider telephone latencies:

	Exp. I	Exp. II
Emergency Actions	3.0 min.	2.6 min.
Exception	2.1	2.3
No Display	3.9	3.6
Mean	3.0	2.8

In a sense, these results look inconsistent, in that the response was slightly faster in the second experiment, in which the problems were rated as being much more difficult. This trend is generally true throughout the results, and would seem to indicate either that the three teams of the second experiment were better performers than those in the first, or that the change in simulation procedure allowed better performance in the second experiment. No objective method of separating these effects is possible, but the consensus opinion of those involved with this research is that the teams were quite similar.

For written message latency, the results were:

	Exp. I	Exp. II
Emergency Actions	12.3 min.	10.1 min.
Exception	11.7	9.5
No Display	18.0	16.8
Mean	14.0	12.1

These measures are based only upon those written messages that were responded to, excluding those that were ignored. A median was computed for all written messages, which takes these omissions into account; this computation raised the latency about 2 minutes.

The absolute numbers for these latencies should be treated as general indications only, for many of the measures had to be estimated. A timing tape, which was used to record times after telephone calls were completed, did not function consistently. However, it is felt that great credence can be placed on the extremely large difference between written and telephone latencies, and that this result can have significant use in future EOC design. For example, it would appear to be important to control incoming telephone calls with great care, since even important written messages will probably get secondary attention if they are in competition, even with routine telephone messages. Similarly, advantage can be taken of this tendency by using verbal rather than written communication for important problems.

To this point, the results have been presented for all decisions within the runs. It seemed likely that more sensitive comparisons would be evidenced if the results for the more important problems were extracted for separate inspection. Thus, those problems rated as the critical ones by the judges were isolated from the more routine issues: six from each run. It should be remembered, however, that there were large rating differences between the first and second experiments, with the latter much higher in importance.

For decision quality on these important problems, the results were:

	Exp. I	Exp. II
Emergency Actions	38.2 percent	47.8 percent
Exception	50.0	51.2
No Display	54.0	47.6
Mean	47.4	48.9

As can be seen, a slight improvement in performance has occurred by removing the routine problems from consideration. Indeed, it would be fair to say that the performance has improved to an average level. Again, it must be remembered that the results for the "no-display" room are inflated by the scoring method.

These percentages do not reflect the remarkable ability that all teams showed in establishing which were the important and which were the routine problems. Many times the participants said: "this is top priority," and "this is our most important problem," which statements were <u>invariably</u> true, but did not

occur with enough frequency or consistency to use as a measure. Similarly, their voice tones became more urgent—but how does one count these for inclusion in an analysis? Finally, a crude index was formulated: the number of words and its necessary correlate, the amount of time spent on the various problems. The results were quite clear-cut:

	Exp. I	Exp. II
Important problems	240 words	300 words
Unimportant problems	60	75

Rather than actually counting words, the lines of text in the telephone transcripts were counted (a small sample indicated that 15 words per line was a representative average). This accounts for the "rounded off" appearance of these figures, and the fact that each is a multiple of 15.

Separating the important from the unimportant problems did not change the telephone latency at all, apparently indicating that the Executives were responding as fast to verbal requests as they could, and that they gave greater importance to telephone calls. However, there was a change in written message latency, as follows (important problems only):

	Exp. I	Exp. II
Emergency Actions	6.3 min.	6.9 min.
Exception	5.5	5.4
No Display	11.7	10.1
Mean	7.8	7.2

Thus, considerably faster attention was paid an important written input than an unimportant one, but once again it should be noted that even unimportant telephone calls received faster attention than important written messages. As explained before, these numbers had to be estimated in many cases, so the absolute number is not very reliable: only the trend should be considered.

OTHER VARIABLES

In addition to results specifically directed toward the display question, a few comments should be made on the other variables. A rather surprising result occurred in terms of practice, or improved performance as the sessions went on (e.g., see Appendix C). There was a decided improvement between

the first and second sessions, as might be expected, but then instead of continued improvement from the second to the third runs, somewhat poorer performance occurred. One could easily make the platitudinous "explanation" of fatigue, but this hardly seemed likely from the bright-eyed appearance and lively conversations shown by the participants after completing the experiment.

A somewhat complex explanation seems appropriate: a strong residual effect was apparent throughout the runs of each experiment. That is, in spite of cautions to the contrary, the participants would carry over from one session to the next anticipation of problems. The most obvious case of this occurred with the activation of the National Guard problem, which happened to occur in the first run of the first experiment. The City Managers in the second and third sessions (which did not have a National Guard activation problem) would immediately get on the telephone and request the Governor's office to let the City retain its National Guard force. Naturally, this type of activity takes time and attention, and would build up through each run—probably to the point where their performance scores would suffer.

Several interesting comments were obtained from the participants. In general, they did not like operating with a decentralized organization, and complained about it often. Such strong opinions were expressed as: "This experience has convinced me that we'll never organize this way." They all also became acutely conscious of how important communications are, simply by the frustrating experience of not being able to get through to their department heads as swiftly or as often as they wanted. They also complained about lack of feedback, and the lack of facilities (other than paper and pencil) for recording their decisions so that follow-up information could be displayed. This seems to be an excellent suggestion, and will be followed up in the next section:

RECOMMENDATIONS

- Experimental simulation is a definitive method for studying information requirements at the executive level of local government. Studies should be continued at this level on other information dimensions, and should be initiated at the staff and line department levels.

- Similar experimental simulation studies could profitably be undertaken for national, regional and state levels of government, preferably in the near future so that obtained results which indicate reporting needs from local government can be implemented without upsetting the local system.

- Information dimensions of the executive level of local government that deserve priority study by experimental simulation are:

  a. Tempering decisions in terms of radiation and other hazards.

  b. Improving the quality and timing of emergency broadcast information.

c. Improving the match of resource allocation to emergency need.

d. Establishing the desirability of colocation of executive Staff and Department heads.

- The displays proposed in the Draft Federal Civil Defense Guide, Part E, Chapter 2, (essentially the Emergency Actions Display set of the present experiment) should not be used for local government city executives, and should be further investigated for applicability for staff and line department use within the EOC.

- Verbal communications should be provided the executive staff. However, incoming calls should be controlled to prevent unimportant verbal messages from preventing consideration of important written communications.

- Participants in experimental simulations should continue to be professional employees, rather than relying on role-playing by participants who are not actively engaged in government.

- The procedure guides developed for these experiments should be field tested for application to local government needs.

- The exception display set, incorporating the improvements presented, should be used for future executive level studies. Specific improvements to be incorporated into the exception display set are as follows:

  a. City Map and Major Problem Board. Should be physically closer together, with the problems keyed geographically to the Map with magnetic symbols, as in the Emergency Actions room. In addition, the capability of showing large areas as well as specific points should be provided so that such information as radiation contours and fire fronts can be geographically referenced.

  b. Major Problem Board. Space should be provided for the City Executives to post their own information. Column(s) should be added where an alerting indication can be posted that shows "follow-up" or "report back" categories.

  c. Major Problem Board. There should be a space separating the various departments, in addition to the colored line already provided.

  d. Shelter Status Board. Even though designed on exception principles, there is still too much detail for Executives. The major categories of "shelters reporting troubles" and "shelters available" probably represents a better level of detail.

e. Departmental Efficiency Board. This information was apparently never used. Therefore, in order to preserve display space, this concept should be abandoned.

f. Access Board. Quite useful, but should probably be located on the other side of the City Map from Major Problem Board. Magnetic markers showing the geographic location of access problems should also be included.

g. Supply Status Board. Well received and useful. Even the arbitrarily chosen standard of 2-days-supply-remaining was well liked. This board should be expanded to include "equipment and personnel" status as well, for this information was frequently requested.

Probably the most beneficial result of these experiments is that they have provided the vehicle for readiness. The city environment, disaster problems, and a comparison display set are now accomplished facts-in-being, ready for additional research or for use as test-bed facilities to test the merits of proposed EOC equipment or procedures, without either the time delays or expenses of having to go over this particular ground again.

CHAPTER 5

DATA DISPLAY INVESTIGATION

This chapter briefly describes the results to date of an investigation into methods of displaying the information required for executive staff decision-making. The objective of this study was to consider the alternative methods of displaying information, with particular emphasis on techniques of merging essential data elements into a common display. The amount of effort applied to this task was limited due to modifications in the basic contract late in its active period.

Information display requirements are best determined after careful consideration has been given to the amount and type of information that is required by the user of the display in performing his function. This necessary first step establishes display content. A subsequent step is to examine, and modify if required, the techniques available to present this information to the user. Factors to be considered are:

1. Frequency of use
2. Viewing distance
3. Light requirements
4. Number of people requiring the same information
5. Quantity of data to be displayed at one time
6. Cost of the display method

In developing the display system, the requirements of the user should be the primary criteria against which the contents as well as the techniques are judged and selected. Such factors as cost, space and time available may of necessity influence the final selection; however, what is being compromised should be known and given careful consideration.

Research into the information requirements of decision-makers (see Chapter 4) has indicated that the quality of the decisions made at the executive level decrease when a quantity of detailed information concerning lower echelon operations was presented to them. These results have implications for the amount and type of data that are required to be displayed at the executive decision-making level.

Display of summary data and the display of information only when it indicates an unacceptable deviation from a plan (exception display) appears to be the direction in which the design of displays for executive level EOC decision makers should proceed. In view of these findings, an attempt has been made in a separate investigation, described below, to reduce the number of fixed surfaces required in an EOC, and combine essential data onto a common display.

Work thus far has focused upon the combining of summary data and exception displays for an "on demand" manual category selection presentation through the use of a rear screen projection system. Figure 20 presents a photograph of the display surfaces presently in use in the SDC Emergency Operations Research Center. The center display is being rear projected. This technique allows for the reduction of the total number of display surfaces required for decision-making in an EOC. The rear projection technique provides several features useful in an EOC, and in addition solves some of the problems encountered when front posted vertical displays are used. Rear projected transparencies can be updated while on the projector, thus the display surface is always in full view of the operational personnel. Two transparencies can be made containing a particular display format. While one is being projected, the other can be at one of the functional areas; for example, at the RADEF area, where an analyst is preparing the most recent information for its next presentation. Erasable colored felt-tip markers are commercially available that will allow for multi-colored presentations of various data elements, thus increasing the flexibility of this display system. Transparencies can be easily and economically produced at about $.24 each on any 3M Brand or Thermo-Fax Infrared copy machine.

Enlarged sections of a city map can be made into transparencies and projected for easier and more detailed viewing by an entire staff. In addition, colored overlays can be prepared showing a major emergency, hazards, available resources, and alternative solutions on one display surface without the clutter of extraneous data. An example of this type of display is represented in Figure 21. When the emergency has been handled, the transparency can be cleaned with a damp cloth for reuse. Bulletins also can be written on acetate, in color if desired, and projected for staff attention.

The equipment required for this display technique is also useful for presenting information at briefings, lectures, and training sessions during non-emergency times. The projector used during this investigation was a commercially available 1000-watt transpaque projector.

As work progresses on the Information Requirements project, further display implications may also be noted. The formats and presentation techniques thought to be useful will be incorporated in future experimental runs to test their applicability under simulated operational conditions. A continuing effort will be made in this area to describe research findings in terms of their impact on display content and configuration.

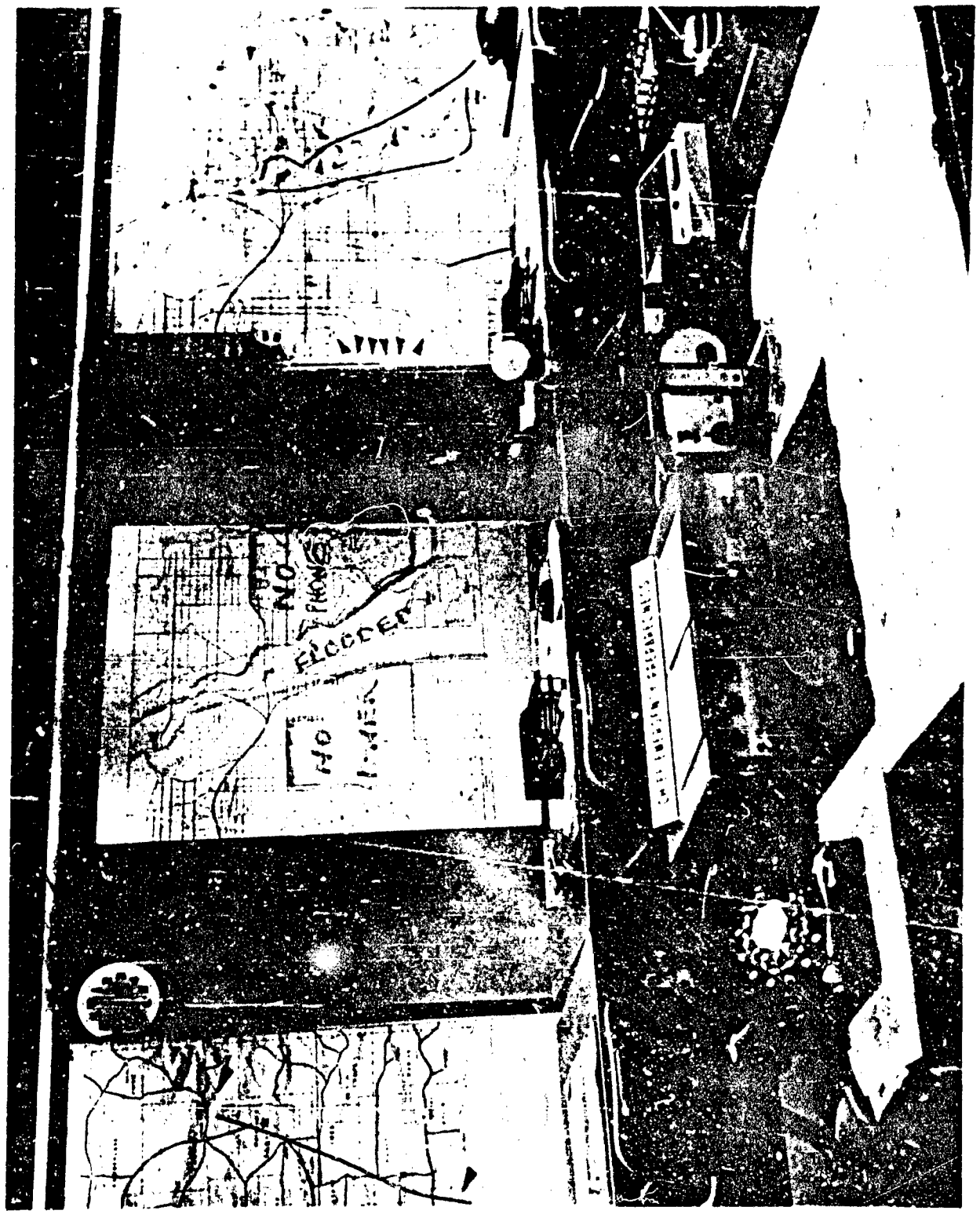

Figure 20. Rear Projected Display

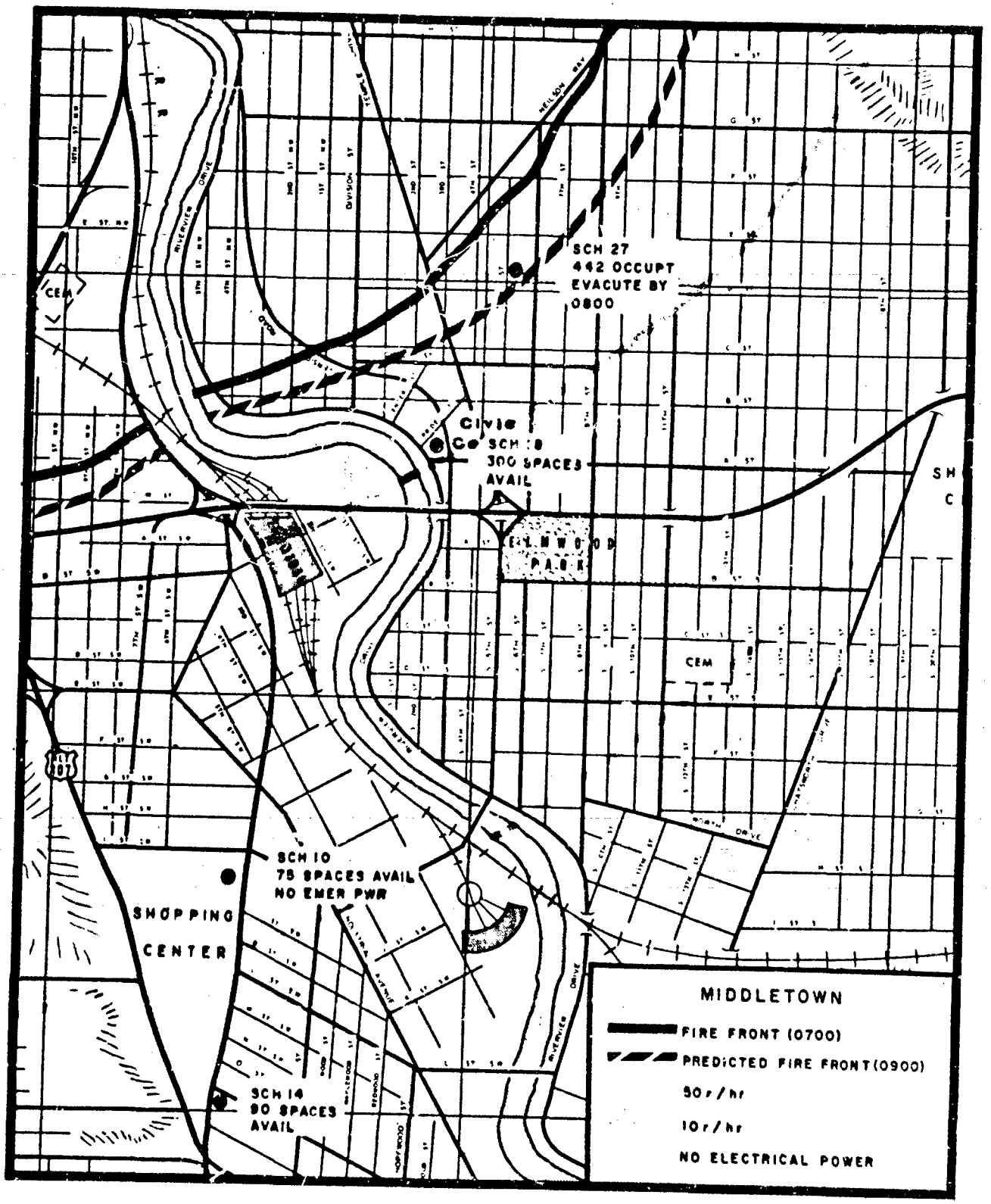

Figure 21. Major Emergency Display

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APPENDIX A: PROCEDURE GUIDES

This appendix presents the contents of the six checklists available to the City Executives as aids for decision-making.

CITY POLICIES

General

1. The city manager must declare a state of emergency before emergency actions can be initiated.

2. Only the city manager (or his duly authorized representative) may communicate with official agencies outside city government.

Commandeering

1. Only the city manager can grant permission to commandeer.

2. After permission is obtained, police officials must be notified so that the action is not mistaken as looting.

3. The legal office must be informed of amount, so that repayment records can be kept.

Emergency Broadcasting System

1. Only the city manager has authority to use EBS.

2. Only the city manager shall know the authenticating code.

Hazardous Assignments

1. Volunteers should be used, if possible.

2. Do not use special skills as volunteers for unskilled missions.

3. Do not assign people to areas with more than 50 r's radiation.

4. Do not assign people to missions if they have accumulated 50 r or more.

Interdepartmental Assistance

1. Each city department shall give all possible assistance to other departments when requested.

2. The department that first handles a problem shall maintain responsibility for the problem when other departments furnish assistance.

CITY POLICIES (Cont'd)

Lives versus Property

1. No property value shall be considered comparable to a human life.

2. Private property may be used or destroyed only with permission of the city manager.

3. The legal office shall be notified of such actions, so that repayment records can be kept.

Mutual Aid

1. Mutual aid agreements may be set aside by the city manager if, in his judgment, such requests would jeopardize the city.

Shelters

1. First come, first served.

2. Maximum occupancy shall be based upon floor space, not food or water supplies.

3. Shelter managers shall not expose themselves to hazards, nor volunteer for missions outside shelter.

Supplies

1. All critical supplies shall be figured for the city's needs for 1 day. Special considerations, such as curtailed or augmented use shall be taken into account in computing 1 day's supply.

2. At earliest possible time, all city departments shall report their supplies status to the city manager's office.

3. All critical supplies shall be declared frozen, to be released only upon permission of city manager.

PERSONNEL COMMITMENT

Hazards

1. How much radiation will men face?

2. How much radiation have they accumulated already?

3. Do they face any other hazards, such as Fire? Gas? Looters? Riots? Citizens trying to protect private property?

4. Have men volunteered for this duty?

5. Do volunteers know fully the hazards they will face?

Access

1. Can crews get to the emergency?

2. Can the necessary equipment get to the emergency?

3. Can crews without equipment do any good?

4. Can crews get there and return safely?

5. Can they get there in time?

6. Are crews already equipped, or do they have to get special equipment?

7. Have you given them the best route?

8. How costly would a delay be? For future commitments? For number of lives saved? Amount of property saved?

Skills

1. Are special skills needed for this emergency?

2. If so, are these special skills available?

3. If available, will they volunteer?

4. Is this emergency important enough to risk such special skills? Should they be held in reserve for a larger emergency possible in future?

PRIORITIES

1. Is this my most important problem?

2. Will this continue to be my most important problem for some time?

3. Do I have enough men and equipment available to meet this problem?

   a. To solve it?

   b. To stabilize it?

   c. To decrease it in intensity?

4. What effect would a delay in assignment have on this problem?

   a. Will it continue to grow? Perhaps it is beyond solution, and resources might be better used on other problems.

   b. Will it remain about the same size? If so, is there another problem which might grow larger than this problem if left unattended?

   c. Will it decrease? If so, commitment locks promising.

HOW TO USE EMERGENCY BROADCAST SYSTEM

1. Dial radio station WEBS, telephone no. 15.

   a. If busy, dial alternate extension 16.

   b. If both extensions are busy, wait a moment and try again.

2. Identify yourself to engineer, using authenticating code word "ALERT."

3. Tell engineer how many times announcement is to be repeated.

4. Engineer will give you a 5-second countdown. At end of countdown, the recording equipment will be ready to receive your announcement.

5. Make announcement, with first statement: "This is city manager_____ apeaking." If you authorize anyone else to use EBS, instruct them to identify themselves similarly. You will also have to tell them the authenticating code word.

6. Try and repeat important phrases or concepts of your announcement, preceded by words: "I repeat, . . ."

7. Always finish announcement with statement: "This is city manager_____ returning you to your EBS station."

EBS CONTENT GUIDE

When making an EBS announcement, consider the following things:

CONTENT CONSIDERATIONS: Will this message . . . . . .

1. Worry people, such as homeowners, separated families, sick?
2. Disrupt shelter routine?
3. Give false hopes that might have to be retracted later?
4. Give information of use to the enemy?
5. Require additional announcements later?

EBS announcements may be made for the following uses:

INSTRUCTIONS:

1. Keeping routes clear.
2. Shelter locations of shelters that are undercrowded.
3. Emergency supplies are to be reserved for public use -- do not try and hoard these supplies needed for survival.
4. Warnings on looting, firearms.
5. Obey police, firemen, civil defense officials.

GENERAL INFORMATION FOR CITIZENS:

1. Condition of city, state, nation, neighboring communities.
2. Estimate of how long shelter stay will be.
3. Morale messages, such as "make the best of this trying situation," and "we are gathering family information as rapidly as possible."
4. Radiation picture.

SPECIAL REQUESTS

1. Call for special skills, volunteers.
2. Communicate with units that have lost other modes of communication.
3. Communicate with nearby towns when other modes have been lost.
4. As time allows, using EBS to broadcast the names and shelter locations of families.

SHELTER PROBLEMS

A. Shelters Not Filling:

1. Are sirens working? (FD)
2. Do people believe sirens? (PD)
3. Is EBS working? (WEBS)
4. Do people know shelter locations? (Wel)
5. Are routes to shelters open? (PD)
6. Are shelters close enough to reach? (PD)
7. Are people trying to leave city? (PD)
8. Are people staying in home shelters? (Wel)

SHALL I MAKE A MORE DRAMATIC ANNOUNCEMENT ON EBS?

B. Some Shelters Overcrowded, Others Undercrowded:

1. Are all shelter locations being announced? (Wel)
2. Do police know all shelter locations? (Wel)
3. Do police know which shelters have space? (Wel)

SHALL I MAKE AN EBS ANNOUNCEMENT GIVING LOCATION OF AVAILABLE SHELTERS? OVERCROWDED SHELTERS? BOTH?

C. Not Enough Official Shelter Spaces:

1. Should mass expedient shelters be constructed?
   a. If yes, is equipment available?
   b. Where is most protected location?
2. Should people be firected to seek home shelter?
3. Is evacuation from the city safe?

SHALL I MAKE AN EBS ANNOUNCEMENT ABOUT THIS DECISION?

D. A Shelter must be evacuated:

1. Is there enough time to consider the following? If not start people walking in the safest direction, then consider:

SHELTER PROBLEMS (Cont'd)

a. How many people involved?
b. Are there enough shelter spaces available? If not, should expedient shelter be constructed? Where? Is equipment available for this job?
c. Are available spaces within walking distance? If not, is transportation available? Enough for everyone? For supplies? For sick and elderly only?
d. What hazards face evacuees? Radiation? Fire?
e. Has the best route been chosen? For speed? Safety?

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APPENDIX B: PROBLEM INPUTS

The problems presented to the City Executives for decisions. To prevent memorization, three sets of problems were designed, one for each run of an experiment. The inputs for both Experiment I and Experiment II are presented in this appendix.

EXPERIMENT 1

MESSAGE 1

RUN 1

TO: City Manager
FROM: C.D. Staff

NUMBER: C-M-1
TIME: 1610

MESSAGE TEXT:

An attack warning message was received at the National Warning System warning point in Police Headquarters at 1600 hours. Attack Warning sirens were activated at that time to sound the take cover signal. Community shelter plans are being placed into effect. Incomplete information indicates that the population is beginning to move into fallout shelters. Many police units are being assigned to positions for aiding the population movement. All five city departments have placed emergency plans into effect. Incoming message traffic is increasing at a rapid rate. The EBS system (WEBS) for Middletown has been implemented, and the station is presently broadcasting pre recorded information.

There have been unconfirmed reports from adjacent areas that NUDETS have occurred, although specific information is not yet available.

RUN 2

SAME AS ABOVE

RUN 3

SAME AS ABOVE

MESSAGE 2

RUN 1

TO: City Manager
FROM: Police

NUMBER: P-V-2
TIME: 1615

MESSAGE TEXT:

This is Chief Anderson. The Service Statistical Corp. just called me about all the city's tax and financial records which they have at their building at 7th and C St. They were converting the records for computer processing, and don't have any secure space to store these records during this emergency. They won't accept responsibility, and suggest that we move the records to the Tobyhanna Mine Depository. It looks like it would take about 4 police cars and 12 to 15 officers about an hour and one-half to do this. I refused because all my men are committed to emergency assignments. I contacted Gorski at PW & E and he flatly refused to send a truck and men, saying that his policy was to have people take shelter, and not jeopardize their lives unless you order it directly. What should we do?

RUN 2

TO: City Manager
FROM: Police

NUMBER: P-V-2
TIME: 1615

MESSAGE TEXT:

This is Chief Anderson. We've just received a request from the Parker Springs Military Commander to provide a police escort through town for a military truck convoy which is heading for Parker Springs from Markham. They told me that these trucks are loaded with munitions and require safe passage. They are now on Hwy. 224 at the eastern edge of town. It looks like it would take about 7 police cars and 14 men to do this, and all of my men have emergency assignments. If we do this escorting, some of our movement to shelter plans will have to be set aside. What should we do?

MESSAGE 2 (Cont'd)

RUN 3

TO: City Manager
FROM: Police

NUMBER: P-V-2
TIME: 1615

MESSAGE TEXT:

This is Chief Anderson. We have just been notified by officials of the Evets Barge Co. that they have 8 barges tied up near S. L Street bridge. These barges are loaded with chlorine, and if they catch on fire or get broken into the river, deadly chlorine gas will be generated. No tugs available. They have requested me to give them men, trucks and escort to get the chlorine out of the city. I have asked Gorski for trucks, but he refuses to expose his men to such a hazard unless you specifically order him to. What should we do?

MESSAGE 3

RUN 1

TO: CD Director
FROM: CD Staff

NUMBER: C-M-3
TIME: 1618

MESSAGE TEXT:

Field units have reported a tremendous flash SE of city at 1615. Exact location unknown. No reports of damage as yet.

We have confirmed a NUDET about 1 mile NE of Lake Massac. Exact size and type unknown at this time.

RUN 2

TO: CD Director
FROM: CD Staff

NUMBER: C-M-3
TIME: 1618

MESSAGE TEXT:

Field units have reported a tremendous flash NW of city at 1615. Exact location unknown. No report of damage as yet.

We have confirmed a NUDET about 1 mile NE of Lake Massac. Exact size and type unknown at this time. Also have confirmed NUDETS just N of Atwood, just N of Dale and at Kelly AFB.

RUN 3

TO: CD Director
FROM: CD Staff

NUMBER: C-M-3
TIME: 1618

MESSAGE TEXT:

Field units have reported a tremendous flash SE of city at 1615. Exact location unknown. No reports of damage as yet.

We have confirmed a NUDET about 1 mile NE Lake Massac. Exact size and type unknown at this time.

MESSAGE 4

RUN 1

TO: City Manager
FROM: CD Staff

NUMBER: C-V-4
TIME: 1621

MESSAGE TEXT:

This is Bill Elder at CD HQTS. We have just received a message from CD that the National Guard is to be activated immediately. We are to make an EBS announcement ordering all reservists to report to the Guard Armory. Chief Anderson was on the phone when we got this message, and he told me that two of his captains and 25 of his men would be affected, and so would myself, Beroni, and many of the firemen. He doesn't want you to make the announcement. State wants confirmation that we received and will comply with this message. What do you want to do?

RUN 2

TO: City Manager
FROM: CD Staff

NUMBER: C-V-4
TIME: 1621

MESSAGE TEXT:

This is Bill Elder at CD Headquarters. We have just received a message from State CD Headquarters that all mobile RACES operators in Middletown are to be sent to Jefferson City. They are to report to Jefferson City EOC at 5th and Main St. Mr. Dolan of welfare was on the phone when we got this message, and said that losing his RACES communications would seriously impair his shelter work, and said he hopes you won't execute this order. State wants confirmation that we received the order and will comply with it. What should we do?

RUN 3

TO: City Manager
FROM: CD Staff

NUMBER: C-V-4
TIME: 1621

MESSAGE TEXT:

This is Bill Elder at CD headquarters. We have just received a message from State CD that Package Disaster Hospital is to be sent to Markham. Dr. Carter was on the phone when we got this message and he told me that he didn't think we should send it because we might need it. State wants confirmation of receipt of this message, and that we will comply. What do you want to do?

MESSAGE 5

RUN 1

TO: CD Director
FROM: CD Staff

NUMBER: C-M-5
TIME: 1624

MESSAGE TEXT:

Request from State CD for present best estimate of condition or status of: longest airport runway, (usable length), telephone trunks with adjacent cities, U.S. Highways within city limits, and rail lines within city limits. Reply TWX ASAP.

RUN 2

TO: CD Director
FROM: CD Staff

NUMBER: C-M-5
TIME: 1624

MESSAGE TEXT:

Request from State CD for present status of: Jet fuel supply of airport, telephone communications with Kelly and Parker Springs military bases, U.S. 307 N and 224 W, and Rail lines N and W. Reply TWX ASAP.

RUN 3

TO: CD Director
FROM: CD Staff

NUMBER: C-M-5
TIME: 1624

MESSAGE TEXT:

Request from State CD for present best estimate of status of heavy equipment, highway to Parker Springs Military Reservation, and 224 E. to Markham, Union Valley RR east, and RACES communication with Jefferson City Health Department.

MESSAGE 6

RUN 1

TO: City Manager
FROM: CD Staff

NUMBER: C-M-6
TIME: 1627

MESSAGE TEXT:

State CD asks confirmation or denial of rumors about thousands of Middletown residents evacuating toward Jefferson City on 307. Jefferson City officials unable to contact you and are alarmed over this situation because of severe shortage of supplies and shelter space. If true, state number, mode of travel and expected arrival time for evacuees at Jefferson City. Suggest use of EBS to recall people to Middletown, if appropriate.

RUN 2

TO: City Manager
FROM: CD Staff

NUMBER: C-M-6
TIME: 1627

MESSAGE TEXT:

State CD asks confirmation of denial of report from State Highway Patrol that thousands of Franklin and Posey County refugees are heading for Middletown. If true, State wants to know if you can shelter and feed these refugees. If you cannot help them, suggest use of EBS to inform them now about status of Middletown shelter and supply problems.

RUN 3

TO: City Manager
FROM: CD Staff

NUMBER: C-M-6
TIME: 1627

MESSAGE TEXT:

State CD has relayed request from AG to confirm or deny rumors that Parker Springs Military base has decided to evacuate civilian employees to Middletown. If true, can you handle them? If not, suggest use of EBS to inform them of lack of facilities in Middletown.

MESSAGE 7

RUN 1

TO: City Manager
FROM: Governor

NUMBER: Governor-V-7
TIME: 1630

MESSAGE TEXT:

Desires your estimate of total population not yet sheltered in Middletown Public Fallout Shelters. Please advise by return TWX as soon as possible. If situation deemed critical please state requests for aid.

RUN 2

TO: City Manager
FROM: Governor

NUMBER: Governor-V-7
TIME: 1630

MESSAGE TEXT:

We need to know how many people in Middletown still have not gone into shelter. The state RADEF group predicts fallout soon on entire western part of state. Please advise by return TWX ASAP. If situation is deemed critical, please state requirement for aid.

RUN 3

TO: City Manager
FROM: Governor

NUMBER: Governor-V-7
TIME: 1630

MESSAGE TEXT:

This is Governor Hooper. We would like to find out how many casualties Middletown has suffered at the present time, and if the hospital and care center facilities you have will be enough to care for your predicted casualties of the next two days.

MESSAGE 8

RUN 1

TO: City Manager
FROM: Health Chief

NUMBER: H-M-8
TIME: 1633

MESSAGE TEXT:

Blood supplies nearly exhausted. Donors urgently needed or many patients will die. Tried to use EBS, but radio station said we need your authorization. Welfare felt that asking donors to go to the hospitals would be contrary to city policy of immediately seeking and staying in shelters, and would also create traffic congestion and possible danger to donors. Please advise your decision as soon as possible.

RUN 2

TO: City Manager
FROM: Health Chief

NUMBER: H-M-8
TIME: 1633

MESSAGE TEXT:

The County Squire Retirement Rest Home is threatened by fire (at Nodding Hills and F St. NW). These patients can't move by themselves. Tried to use EBS to ask for volunteers with station wagons to help, but the radio station said we need your authorization first. Welfare has no vehicles, and all our ambulances are busy. Welfare also said they thought that trying to call for station wagons would endanger the volunteers and cause traffic congestion. What should we do?

RUN 3

TO: City Manager
FROM: Health Chief

NUMBER: H-M-8
TIME: 1633

MESSAGE TEXT:

Plasma supplies running critically low. Blood donors needed or many shock cases will die. Tried to use EBS but the radio station said we need your authorization. Welfare felt that asking donors to go to the hospitals would be contrary to city policy of seeking shelter, and would create traffic congestion and possible danger to donors. Please advise your decision ASAP.

MESSAGE 9

RUN 1

TO: CD Director
FROM: Health

NUMBER: H-M-9
TIME: 1636

MESSAGE TEXT:

CD Disaster Hospital, presently at the auditorium at 146 4th St. S., is loaded and ready to move. Plans call for it being set up at the airport. However, we have heard that there are many fires down there, possibly endangering equipment and personnel. Request you determine whether we should proceed with plan, or whether you want hospital relocated.

RUN 2

TO: City Manager
FROM: Health Chief

NUMBER: H-M-9
TIME: 1636

MESSAGE TEXT:

URGENT
Water supply apparently contaminated, probably by sabotage. There have been about 50 cases of poisoning reported so far. It is imparative that any water collected after 1600 be boiled for 30 minutes before use. Tried to use EBS to warn people, but radio station said we needed your authorization. Please advise ASAP.

RUN 3

TO: CD Director
FROM: Health

NUMBER: H-M-9
TIME: 1636

MESSAGE TEXT:

A Congregate Care Center was set up in Palmer Park and Golf Course. It looks like fire will threaten it soon. About 400 refugees being treated at present time. Should we move it? Where? Please advise ASAP.

MESSAGE 10

RUN 1

TO: City Manager
FROM: Welfare Chief

NUMBER: W-V-10
TIME: 1639

MESSAGE TEXT:

Our best estimate at this time would indicate there are five to ten thousand persons in the South Eastern area in the streets seeking shelter. There are at least 6000 spaces in the downtown shelters but little or no chance of getting transportation to people. Should we direct them to proceed down town or out of town? Units with public address capability in the area have directed people back to their homes but most refuse to go and are demanding directions to safe locations. Frankly I don't know what to do. What would you recommend?

RUN 2

TO: City Manager
FROM: Welfare Chief

NUMBER: W-V-10
TIME: 1639

MESSAGE TEXT:

Our best estimate at this time is that there are 7 to 14 thousand people seeking shelter or trying to leave the NW section of town. There are at least 6000 shelter spaces downtown, but little chance of getting transportation for these people. PA units in the area have directed people to go back to their homes, but the fires have caused most of them to refuse. Shall we direct them down town, or out of town, or where?

MESSAGE 10 (Cont'd)

RUN 3

TO: City Manager
FROM: Welfare

NUMBER: W-V-10
TIME: 1639

MESSAGE TEXT:

About 10,000 people in SE section of town will not go to public shelter or seek shelter in their homes because of fire. There are about 6000 spaces available downtown, but we have no way of transporting these people. Should we direct them to public shelters, or toward some safer part of town? Should we try to evacuate them out of town? Frankly, I don't know what to do. What do you recommend?

MESSAGE 11

RUN 1

TO: City Manager
FROM: Police

NUMBER: P-M-11
TIME: 1642

MESSAGE TEXT:

We are short of vehicles. Gorski unable to help. Best bet would be to commandeer taxis from Central Cab Co. Gordon, the owner, refuese permission. We need written authorization from you. Will you authorize?

RUN 2

TO: City Manager
FROM: Police

NUMBER: P-M-11
TIME: 1642

MESSAGE TEXT:

55 criminally insane inmates, in Riverview Mental Hospital at 108 Nut St. (B3) NW are threatened by fire. We have no vehicles for evacuation. Should we release them, or commandeer Greyhound buses to transport them to county jail?

RUN 3

TO: City Manager
FROM: Police

NUMBER: P-M-11
TIME: 1642

MESSAGE TEXT:

State Corrective Farm, with 700 juvenile incorrigables (located just NW of Upper Toby Lake) is threatened by fire. They're locked in, and unless we do something, will be completely trapped. Should we let them go? Or should we try and transport them to County and City jails (at civic center)?

MESSAGE 12

RUN 1

TO: CD Director
FROM: CD Staff

NUMBER: C-M-12
TIME: 1646

MESSAGE TEXT:

State CD requests an estimate of percent of Middletown population in shelters with PF of over 100, percent in shelters PF over 500, number in home shelters and percent evacuating area.

RUN 2

TO: CD Director
FROM: CD Staff

NUMBER: C-M-12
TIME: 1646

MESSAGE TEXT:

State CD requests an estimate of percent of Middletown population that will not be housed in public fallout shelters, whether you intend to build expedient shelters for them or have them seek individual shelter, and whether food and water supplies are adequate for 10 days.

RUN 3

TO: CD Director
FROM: CD Staff

NUMBER: C-M-12
TIME: 1646

MESSAGE TEXT:

State CD requests an estimate of Middletown population in shelters with PF between 100 and 500, those in shelters with a PF in excess of 500, those in home shelters and those who have evacuated the town.

MESSAGE 13

RUN 1

TO: City Manager
FROM: Col. Ridgeway USAF

NUMBER: USAF-V-13
TIME: 1650

MESSAGE TEXT:

We need city fire assistance desperately. I have asked Chief Beroni for help, but he refused, saying that the fire situation in the city was also desperate. Government warehouses out here are threatened and so is the fuel storage area.

RUN 2

TO: City Manager
FROM: Col. Adams, Parker Springs Base

NUMBER: USA-V-13
TIME: 1650

MESSAGE TEXT:

We need heavy construction equipment here badly, to build emergency shelter for some missile systems and warheads we have here for test. I have asked Mr. Gorski for help, but he refused saying that the City also needed the equipment for civilian protection. We think that protecting these retaliation systems deserves first consideration. If we don't get help, these missiles are going to be worthless.

RUN 3

TO: City Manager
FROM: Jefferson County Commissioner Johnson

NUMBER: Jeff. County V-13
TIME: 1650

MESSAGE TEXT:

State CD has given us the job of constructing a refugee camp, and we have a site about 20 miles south of Jefferson City. Jefferson City has been pretty hard-hit, and can't spare us anything at the present time. We need a motor patrol, 2 cats and 4 dump trucks. Can you help?

MESSAGE 14

RUN 1

TO: City Manager
FROM: Fire Chief

NUMBER: F-V-14
TIME: 1654

MESSAGE TEXT:

Telephone: Beroni to CM

The fire in the fuel storage area at S. 25th and G. St. is completely out of control. The only chance we have of stopping it on the west, is to create a fire break in the Union Central Warehouses at S. 23rd and H. St. We'll have to blow up some of those buildings. Unable to contact any union central officials. All the buildings are securely locked, and we can't find out what's inside. It's either blast here or move even farther back to S. 21st St. We must make a fast decision. Can we blow up the Union Central property?

RUN 2

TO: City Manager
FROM: Fire Chief

NUMBER: F-V-14
TIME: 1654

MESSAGE TEXT:

The fire in the river just north of the Riverside Golf Course is completely out of control. The only chance we have of stopping it before it hits the city docks and downtown area is to break the river channel dike and drain the oil out into the Union RR right-of-way just north of the city line. There are some railroad warehouses here that will be lost, but it's either this or the whole city near the river threatened. The foam pumper that we borrowed from the airport has been unable to put a dent on the fire.

MESSAGE 14 (Cont'd)

RUN 3

TO: City Manager
FROM: Fire Chief

NUMBER: F-V-14
TIME: 1654

MESSAGE TEXT:

The fire on the northeastern slopes of the Tobyhanna Hills along Marietta Drive (D6) is completely out of control, and moving North rapidly. The only chance we have of stopping it is to knock down the buildings on the north side of Marietta. Our EBS tower is threatened if we don't make our stand here, and even then I can't guarantee anything. So you'd better do some contingency planning about what will happen in the event that the tower gets burned down.

MESSAGE 15

RUN 1

TO: City Manager
FROM: Welfare

NUMBER: W-M-15
TIME: 1657

MESSAGE TEXT:

Middletown Central Market warehouse 300 K St. SW is being looted by about 100 people. Some appear to be armed. No police units in the area. Have tried to call Chief Anderson but am unable to get through. Can you coordinate this and get some help for our staff at the warehouse?

RUN 2

TO: City Manager
FROM: Welfare

NUMBER: W-M-15
TIME: 1657

MESSAGE TEXT:

Middletown Central Market warehouse, 300 K St. SW is being looted by about 100 people. Some appear to be armed. No police units in the area. Have tried to call Chief Anderson, but can't get through. Can you coordinate this and get some help for our staff at the warehouse?

RUN 3

TO: City Manager
FROM: Welfare

NUMBER: W-M-15
TIME: 1657

MESSAGE TEXT:

Our field units report looting of the Ames Firearms Co. at Hopewood and Q St. SW. Our staff is helpless to stop it. No police units in area. Have tried to call Chief Anderson but can't get through. Can you coordinate this, as I think it's a serious threat?

MESSAGE 16

RUN 1

TO: City Manager
FROM: Police

NUMBER: P-V-16
TIME: 1700

MESSAGE TEXT:

The telephone company is wildly upset over Beroni's fire break decision -- trying to hold the S. 21st fire at H Street. They have just completed a 5 million dollar underground cable distribution point in this area, and any demolition would disrupt vital communications for cross country telephones. Mr. Donahue, the general manager, has put in a call to the governor about this, and has placed his trucks in the streets to prevent the firemen from getting in. What should we do?

RUN 2

TO: City Manager
FROM: Police Chief

NUMBER: P-V-16
TIME: 1700

MESSAGE TEXT:

Union RR officials are wildly upset over Beroni's decision to flood their property with the oil on the river. They say that this manuever will ruin the right-of-way for several years. Also, who's going to pay the manufacturers for destroying the stuff in the warehouses? They feel that rail transportation is a major contributor to defense, and that this decision of Beroni's will put them out of business for weeks. They have called the Dept. of Commerce about this, and want us to wait until they find out the Federal RR Commission's attitude before we go ahead. What should we do?

MESSAGE 16 (Cont'd)

RUN 3

TO: City Manager
FROM: Police

NUMBER: P-V-16
TIME: 1700

MESSAGE TEXT:

Some of our most prominent citizens who live in the Tobyhanna area are protesting Beroni's decision to raze their homes, and are sniping at the firemen. Beroni told me that unless his men get safe escort, they won't be able to make the fire break, and station WEBS is sure to go off the air. Do you want to find if another station can take over EBS functions? Do you want to make an EBS announcement over WEBS while it's still working to tune in to another station's frequency?

MESSAGE 17

RUN 1

TO: City Manager
FROM: Public Works

NUMBER: E-M-17
TIME: 1703

MESSAGE TEXT:

Please authorize our confiscation of Palmer Equip. Co. cranes and building razing equipment. Urgently needed and only equipment available unless we want to stand for a 3-hour delay. Palmer refuses, stating that equipment is being stored for a government contract.

RUN 2

TO: City Manager
FROM: Welfare

NUMBER: W-M-17
TIME: 1703

MESSAGE TEXT:

We're having trouble with the Carter Defense Plant officials. They have a basement that would be great for shelter spaces -- with a PF of over 500 and space for about 8000 people. It's right where we need it. However, the company won't let people inside their fence, because they have secret equipment there. What should we do?

RUN 3

TO: City Manager
FROM: Fire

NUMBER: F-M-17
TIME: 1703

MESSAGE TEXT:

Please authorize our confiscation of 2 helicopters from the Bolt Helicopter Co. They are ready to go, but Mr. Thomas -- Co. President -- said that they are Army property, and has instructed his industrial guards to resist confiscation. We need them badly for reconnaissance.

MESSAGE 18

RUN 1

TO: CD Director
FROM: CD Staff

NUMBER: C-M-18
TIME: 1705

MESSAGE TEXT:

State CD asked to be advised what the two most urgent problems facing Middletown are at this time, and what specific assistance is needed. Reply NLT 1710.

RUN 2

SAME AS ABOVE

RUN 3

SAME AS ABOVE

EXPERIMENT 2

MESSAGE 1

RUN 1

TO: City Manager
FROM: CD Staff

NUMBER: C-M-1
TIME: 0900

MESSAGE TEXT:

Situation Summary: The 1 MT air burst 7 miles southeast of town has burned out the entire Tobyhanna area up to the Union RR tracks, where a successful fire break was made. The 1 MT ground burst at Lake Massac has produced severe fallout across Middletown. Detailed accumulative and current radiation levels are contained in the attached sheet.

Personnel -- All regular police, fire, public works and ambulance personnel have accumulated 50 to 60 r. About 20 per cent of each service have volunteered for emergency assignments throughout yesterday and last night, and have accumulated 300 - 400r. Most are showing signs of radiation sickness. The departments are using auxiliary and volunteer personnel as much as possible, particularly on lower priority problems.

Utilities -- All utilities lost in SE section of town up to E street south. Water pressure low throughout town, and supplies critically low in isolated spots of NE and SW. Electricity is intermittent or completely out in NE and SW, although the distribution system is all right. Emergency workers are restoring power on a section-by-section basis in these areas. Gas supplies good, and the system is usable throughout the city with the exception of the SE.

Communications -- Local telephone operating with intermittent outages throughout town, with the exception of the burned out area. Long distance to S and SE completely lost. Roundabout routing can reach S and SE, but long delays are to be expected. RACES mobile and portable communications good, both between departments and within and outside city.

Shelters -- Detailed information included on attached sheet. About 15,000 in SW and many hundred in NE in home shelters, rated with a 10 protection factor. All regular shelters completely filled. The Walton area is in the highest fallout area, and people in home shelters are nearing the maximum dose.

Municipal Airport -- All building burned down, but the major runways are usable. Access on both Riverview drive and Airport road impossible from debris. Access only from US 307.

MESSAGE 1 (Cont'd)

RUN 2

TO: City Manager
FROM: CD Staff

NUMBER: C-M-1
TIME: 0900

MESSAGE TEXT:

Situation Summary: The 1 MT air burst 3 miles northwest of town has burned out all of Walton and down to US 224, where a successful fire break was made. The 1 MT ground burst 5 miles east of Madison has produced severe fallout across Middletown. Detailed accumulative and current radiation levels are contained in the attached sheet.

Personnel -- All regular police, fire, public works and ambulance personnel have accumulated 50 to 60r. About 20 per cent of each service have volunteered for emergency assignments throughout yesterday and last night, and have accumulated 300 - 400r. Most are showing signs of radiation sickness. The departments are using auxiliary and volunteer personnel as much as possible, particularly on lower priority problems.

Utilities -- All utilities lost in Walton (north-west) section of town, down to US 224. Water pressure low throughout town, and supplies critically low in isolated spots of NW and SE. Electricity is intermittent or completely out in NW and SE, although the distribution system is all right, and the power plant operating. Emergency workers are restoring power on a section-by-section basis in these areas. Gas supplies good, and the system is usable throughout city, with the exception of the NW.

Communications -- Local telephone operating with intermittent outages throughout Middletown, with the exception of the burned out area. Long distance to S and SE completely lost. RACES mobile and portable communications good, both between departments and within and outside city.

Shelters -- detailed information included on attached sheet. About 15,000 in NE and many hundreds in SE in home shelters, rated with a 10 protection factor. All regular shelters completely filled. The SE area of town is in the highest fallout area, and people in home shelters are nearing maximum dose.

Municipal Airport -- All buildings and runways in good condition. Access available from both US 307 and Airport Road.

RUN 3

SAME AS RUN 1

MESSAGE 2

RUN 1

TO: CD Director NUMBER: C-M-2
FROM: CD Staff TIME: 0905

MESSAGE TEXT:

The following reports have been received from various radiological monitoring stations, which completes the 0900 hourly summary. They are included on the enclosed reporting form, organized to read from top to bottom for each grid column.

RUN 2

TO: CD Director NUMBER: C-M-2
FROM: CD Staff TIME: 0905

MESSAGE TEXT:

The following reports have been received from various radiological monitoring stations, which completes the 0900 hourly summary. They are included on the enclosed reporting form, organized to read from top to bottom for each grid column.

RUN 3

TO: CD Director NUMBER: C-M-2
FROM: CD Staff TIME: 0905

MESSAGE TEXT:

The following reports have been received from various radiological monitoring stations, which completes the 0900 hourly summary. They are included on the enclosed reporting form, organized to read from top to bottom for each grid column.

MESSAGE 3

RUN 1

TO: City Manager
FROM: Police Chief

NUMBER: P-V-3
TIME: 0908

MESSAGE TEXT:

We have stopped a military truck convoy at University Ave. and U.S. 307. They want a police escort through town to the Municipal Airport, so they can rendezvous with some air force cargo planes. The trucks have jet fuel and munitions, so I'm concerned about letting them into town. What should we do?

RUN 2

TO: City Manager
FROM: Fire Chief

NUMBER: F-V-3
TIME: 0908

MESSAGE TEXT:

Shelter complex 15 (Grand Stadium) reports 2 gasoline storage tanks just north of them to be leaking. This is a severe fire threat to the shelter, and should be washed down. However, every one of my men has at least 55r, and SC 15 reports about 20r per hour at this time. Should I call for volunteers in my department to exceed their radiation limit? We estimate that this is about a 2 hour job.

RUN 3

TO: City Manager
FROM: CD Staff

NUMBER: C-V-3
TIME: 0908

MESSAGE TEXT:

Just received a message from the Governor's office. He has activated the National Guard for duty in Markham and other parts of Clay County. The order requests us to make an EBS announcement that all Guard members are to report to the Armory immediately. As you may recall, about 20 per cent of our shelter managers are members, and so is Chief Beroni and 2 police captains, and so am I. The governor's office wants us to notify them as soon as we have complied with the request.

MESSAGE 4

RUN 1

TO: CD Director
FROM: CD Staff

NUMBER: C-M-4
TIME: 0911

MESSAGE TEXT:

State CD headquarters requests present estimate of condition of U.S. Highways within city limits, and between Middletown and Jefferson City, and Middletown and Markham.

RUN 2

TO: CD Director
FROM: CD Staff

NUMBER: C-M-4
TIME: 0911

MESSAGE TEXT:

State CD headquarters present status of rail transportation within city, south to Parker Springs Military Base, and west to Kelly Air Force Base. Reply TWX ASAP.

RUN 3

TO: CD Director
FROM: CD Staff

NUMBER: C-M-4
TIME: 0911

MESSAGE TEXT:

State CD headquarters requests our present best estimate of food, water and fuel supplies for 7 days. Reply by return TWX ASAP.

MESSAGE 5

RUN 1

TO: City Manager
FROM: City Manager Ellis, of Dale

NUMBER: CD Dale-V-5
TIME: 0914

MESSAGE TEXT:

My welfare department has requested to use the DALE EBS station to try and reunite families. I have not been able to get through to the FCC representatives at Markham for a ruling. Do you, or would you allow your EBS station to be used for this purpose? We have no plans for this sort of thing.

RUN 2

TO: City Manager
FROM: City Manager Reed, of Jefferson City

NUMBER: Jeff. City-V-
TIME: 0914

MESSAGE TEXT:

Our EBS station has been off the air for the past 2 hours, and probably won't be working again for the rest of the day. Our people have been listening to your EBS station, and I would appreciate it if you would authorize my use of your station to make announcements from time to time.

RUN 3

TO: City Manager
FROM: Police Chief

NUMBER: P-V-5
TIME: 0914

MESSAGE TEXT:

State police have asked if they could share our dispatching facility. Their transmitter went out about 20 minutes ago, and they think it will be off the air for another 8 to 10 hours. Since they control about 22 vehicles, I estimate that this would lower our efficiency about 25 per cent. However, they've been very helpful always. I said I'd have to check with you before any decision could be reached. What should we do?

MESSAGE 6

RUN 1

TO: City Manager
FROM: CD Staff

NUMBER: C-M-6
TIME: 0917

MESSAGE TEXT:

There are about 15,000 people in home shelters in NE and SW that have accumulated 200r by now. If they do not get better protection in next 2 hours, they will become completely incapacitated.

RUN 2

TO: City Manager
FROM: Police Chief

NUMBER: P-M-6
TIME: 0917

MESSAGE TEXT:

Telephone busy. Received report from State Police that several thousand evacuees are approaching from Rocklyn and Quincy. Can we handle them? What measures should I take?

RUN 3

TO: City Manager
FROM: CD Staff

NUMBER: C-M-6
TIME: 0917

MESSAGE TEXT:

Most home shelterees in the SW section of the city have already or will soon reach dangerous radiation dosage. Could we work out a plan for rotating those people in community shelters with less than 50r going to home shelters, while those in home shelters go to the spaces in community shelters, with a better PF?

MESSAGE 7

RUN 1

TO: City Manager
FROM: Gov. Hooper

NUMBER: Gov-M-7
TIME: 0920

MESSAGE TEXT:

The President has asked that we supply him with an estimate of the casualties within our state. Do your best to estimate the number of Middletown citizens that are dead, injured and sick from radiation. Please reply TWX ASAP.

RUN 2

TO: City Manager
FROM: Gov. Hooper

NUMBER: Gov.-M-7
TIME: 0920

MESSAGE TEXT:

For reconstruction planning, it is necessary to have your estimate of time that citizens can leave shelter. Please reply by TWX as soon as possible.

RUN 3

TO: CD Director
FROM: CD Staff

NUMBER: C-M-7
TIME: 0920

MESSAGE TEXT:

State Health Dept. requests our present best estimate of number of dead and sick in relation to total hospital beds and doctors available. Reply TWX ASAP.

MESSAGE 8

RUN 1

TO: City Manager
FROM: EBS radio engineer Tiffany

NUMBER: Radio station-V-8
TIME: 0923

MESSAGE TEXT:

We have just picked up an unauthorized broadcast near our frequency, which will be heard on transistors. The messages are full of hate and misinformation, and will probably have a strong effect on shelterees. We haven't been able to locate this transmitter yet, and will probably need police help to find it and put a stop to this threat. Meanwhile, how can we inform listeners that our messages are the real thing?

RUN 2

TO: City Manager
FROM: Health Chief

NUMBER: H-V-8
TIME: 0923

MESSAGE TEXT:

Shelter MDs report 40 to 50 cases of what appears to be water poisoning. Each patient has complained of drinking water from the city supply before being strickened. The people should probably be told to drink only stored water, or else boil city water for 30 minutes before drinking. It looks like sabotage rather than an accident.

RUN 3

TO: City Manager
FROM: Welfare Chief

NUMBER: W-V-8
TIME: 0923

MESSAGE TEXT:

Rumors spreading that nerve gas has been dropped from an airplane in NW part of city. About 25 people in SC 10 died suddenly for no apparent reason. The rumors claim that CD personnel have gas masks but won't let regular citizens have them. Some shelters have shut down ventilating systems. This problem could get out of hand quickly. Can you reassure the people on EBS?

MESSAGE 9

RUN 1

TO: City Manager
FROM: Health Chief

NUMBER: H-M-9
TIME: 0926

MESSAGE TEXT:

The Package Disaster Hospital has been set up in a radiation-free area between the municipal airport and Dory. However, it's not being used, because of the outlying location. Jefferson City urgently needs it. Should we send it up there, keep it where it is, or relocate within Middletown at a more central place?

RUN 2

TO: City Manager
FROM: Welfare Chief

NUMBER: W-M-9
TIME: 0926

MESSAGE TEXT:

Shelters 10, 10B and 10C which were evacuated yesterday, because of fire are now available. All supplies were removed, so it is unstocked. These shelters will hold 2,098 people. What bases of use do you recommend?

RUN 3

TO: City Manager
FROM: Welfare Chief

NUMBER: W-M-9
TIME: 0926

MESSAGE TEXT:

Telephone busy. Power off in SC 60 area. Ventilation problems causing illness and some deaths. No emergency power available. Some are leaving shelter against orders, and the rest are becoming unmanageable. Should we evacuate them? No other shelter spaces available.

MESSAGE 10

RUN 1

TO: City Manager
FROM: Police Chief

NUMBER: P-V-10
TIME: 0929

MESSAGE TEXT:

The State Corrective Farm at 22nd and T St. SW reports 300 prisoners must be relocated or released to seek better shelter. They have received more than 200r. State Patrol told me to handle the problem however we wish, and they would back us up. What do you recommend?

RUN 2

TO: City Manager
FROM: Welfare

NUMBER: W-V-10
TIME: 0929

MESSAGE TEXT:

Shelter managers report that teams they have sent out to commandeer food and supplies are being shot by the police. Anderson says that he can't tell who they are, and so much looting is going on that his police can't take the time to check out every case. We always inform him before we go, but it doesn't help. The Shelter managers are unable to get volunteers to go on these missions now. I think we need some kind of identification system. Can you take this up with Chief Anderson?

RUN 3

TO: City Manager
FROM: City Manager Reed of Jefferson City

NUMBER: City-V-10
TIME: 0929

MESSAGE TEXT:

We sent some Welfare people down to your city to pick up the supplies that Mr. Dolar had offered, and they were shot at by your police. 4 were killed. We thought that tying a handkerchief around the upper arms was the correct identification process. What's gone wrong?

MESSAGE 11

RUN 1

TO: City Manager
FROM: Health Chief

NUMBER: H-M-11
TIME: 0932

MESSAGE TEXT:

Could not get through on telephone. Hospitals and shelters report thousands of deaths from injury and radiation. I am unable to cope with this problem by normal methods. Mass burial seems unavoidable. Please advise on your policy for registration of dead, and methods of disposal.

RUN 2

TO: City Manager
FROM: Health Chief

NUMBER: H-M-11
TIME: 0932

MESSAGE TEXT:

The Package Disaster Hospital is loaded and ready to relocate. The Elmwood Park and Nod Hills airport locations (planned locations) are unusable because of high radiation. Please advise where it should be located.

RUN 3

TO: City Manager
FROM: Health Chief

NUMBER: H-M-11
TIME: 0932

MESSAGE TEXT:

The Package Disaster Hospital was set up in a radiation-free area just north of the Power Plant. However, it's not being used, because of the outlying location. Markham urgently needs it. Should we send it over there, keep it where it is and take patients to it, or relocate it somewhere else in the city at a more central location?

MESSAGE 12

RUN 1

TO: CD Director
FROM: CD Staff

NUMBER: C-M-12
TIME: 0936

MESSAGE TEXT:

State CD headquarters sent the following TWX:

> Gov. Hooper has ordered this office to coordinate the redistribution of all vital survival supplies within the state. Please forward to this office ASAP the status of city supplies for a projected 10-day period. List separately those supplies in short supply, and those in excess of requirements. The survival of our state depends upon your prompt cooperation.

RUN 2

TO: CD Director
FROM: CD Staff

NUMBER: C-M-12
TIME: 0936

MESSAGE TEXT:

State CD headquarters requests our estimate of number in community shelters, number in home shelters and number who have evacuated the city. Reply TWX ASAP.

RUN 3

TO: CD Director
FROM: CD Staff

NUMBER: C-M-12
TIME: 0936

MESSAGE TEXT:

Governor's office requests our present best estimate of damage to essential facilities and resources in Middletown, including hospitals, utilities, food and medical supply warehouses. Reply his office TWX ASAP.

MESSAGE 13

RUN 1

TO: CD Manager
FROM: Welfare Chief

NUMBER: W-V-13
TIME: 0940

MESSAGE TEXT:

I have just been talking with Dr. Carter (health chief), and he said that he had just sent you a message about this. All shelters report that the dead are becoming a serious health and morale problem, and that we must provide vehicles and men to remove the bodies, and dispose of them. Gorski doesn't want to commit his men to such a task, but it has to be done. Can you call him up and get him to cooperate?

RUN 2

TO: City Manager
FROM: Health Chief

NUMBER: H-V-13
TIME: 0940

MESSAGE TEXT:

Our hospital facilities are completely overcrowded, and more patients are coming in all the time. We have about 800 terminal radiation cases that are taking up beds and drugs, and drugs are getting critically short. I wondered if we should set up some sort of priority system for hospital beds. Many of the doctors are against this, so I need your backing to put such a system in operation. Can you make an EBS, so these reluctant doctors will believe me?

RUN 3

TO: City Manager
FROM: Police Chief

NUMBER: P-V-13
TIME: 0940

MESSAGE TEXT:

Our transmitter has burned out, and we need to maintain control over our units. Can I use EBS to dispatch police vehicles for the next hour or so? The transmitter should be repaired by then.

MESSAGE 14

RUN 1

TO: City Manager
FROM: CD Staff

NUMBER: C-M-14
TIME: 0944

MESSAGE TEXT:

State CD headquarters has asked if our RACES units can act as relay between Markham and Jefferson City. They can't get through to Jefferson City. Would restrict our use of RACES by 50 per cent. What should I report to them?

RUN 2

TO: City Manager
FROM: Welfare Chief

NUMBER: W-M-14
TIME: 0944

MESSAGE TEXT:

Telephone busy. Shelter managers report that shelterees are insisting on the use of communications for exchange of information about separated families. Several of the shelters (42 and 75) are threatening to shoot the shelter managers unless they comply. They need help soon.

RUN 3

TO: City Manager
FROM: Health Chief

NUMBER: H-V-14
TIME: 0944

MESSAGE TEXT:

Could not get through on telephone. Cur supply of morphine and other pain killers is critically short. We have about 500 doses left. State health has promised a new supply, but won't be able to deliver until tomorrow afternoon. Meanwhile, I think we should establish a priority for drug usage, administering only to potential survivors. Many other doctors disagree with me. What do you think? I will need your backing to establish a priority system.

MESSAGE 15

RUN 1

TO: City Manager
FROM: Welfare Chief

NUMBER: W-V-15
TIME: 0947

MESSAGE TEXT:

Shelters report that false broadcast information is creating panic and control trouble among shelterees. Many want to leave shelters right now. I think we should confiscate their radios, at least until these hate broadcasts are shut off. The shelter managers will need your backing on this. Maybe an announcement on EBS to this effect would help.

RUN 2

TO: City Manager
FROM: Welfare Chief

NUMBER: W-V-15
TIME: 0947

MESSAGE TEXT:

We're having trouble in quite a few shelters about sharing baby food. Some mothers brought a large supply, others no baby food at all. Those without want to buy or beg some from those with extra. Maybe if you would make an EBS announcement about when the shelterees can expect to get out of the shelters that then the mothers with several days supply would share. They won't believe the shelter managers. Can we institute a system for making those with extra baby food share with those without any?

RUN 3

TO: City Manager
FROM: Welfare Chief

NUMBER: W-V-15
TIME: 0947

MESSAGE TEXT:

Some shelters are having a drug problem, because some diabetics did not bring enough insulin with them. Dr. Carter tells me we have plen.,y available, it's just hard to get it transported to the shelters. In the meantime, I think we should ask those diabetics who have an extra supply to share it with those who are short. Perhaps an EBS announcement would help instill the right attitude.

MESSAGE 16

RUN 1

TO: City Manager
FROM: Welfare Chief

NUMBER: W-M-16
TIME: 0950

MESSAGE TEXT:

Telephone busy. Shelters 50F & 50G in SC 50 are flooding from a broken water main. (4th St. SW, near the Public Works Equipment yard). Gorski unable to say when water can be shut off. Must evacuate 273 shelterees within next hour. Have no spaces available for them. What do you recommend?

RUN 2

TO: City Manager
FROM: CD Staff

NUMBER: W-M-16
TIME: 0950

MESSAGE TEXT:

Telephone busy. Shelters 50F & 50G in SC 50 are becoming gas-filled from a broken gas main. (4th St. SW, near the Public Works Equipment yard). Gorski unable to say when gas can be shut off. Must evacuate 273 shelterees within next hour. Have no spaces available for them. What do you recommend?

RUN 3

TO: City Manager
FROM: Police Chief

NUMBER: P-M-16
TIME: 0950

MESSAGE TEXT:

Systematic looting of guns and liquor seems to be taking place. Most of my regulars either have pressing emergency duties or have accumulated high radiation. Can we get outside help or deputize volunteers to stop this threatening situation?

MESSAGE 17

RUN 1

TO: City Manager
FROM: Police Chief

NUMBER: P-M-17
TIME: 0953

MESSAGE TEXT:

Incidence of looting sharply increasing. Officers unable to control by normal methods. Request authorization to shoot looting suspects on sight. Will be unable to control the situation much longer without such action.

RUN 2

TO: City Manager
FROM: Police Chief

NUMBER: P-M-17
TIME: 0953

MESSAGE TEXT:

There is mob rule in SW part of city. A large gang (about 150) have set up a road block on S. Q St., exacting tolls and raping women. They are well armed. We will probably have to undertake a pitched battle to break this up. Do we have your authorization to enact riot control methods?

RUN 3

TO: City Manager
FROM: Welfare Chief

NUMBER: W-M-17
TIME: 0953

MESSAGE TEXT:

Shelter 10C must be evacuated because of fire in upper stories of bldg. There isn't enough water pressure to get water up to fire. All shelter spaces are gone, and I don't know what to do with the evacuees. Where should I send them?

MESSAGE 18

RUN 1

TO: City Manager
FROM: Gov. Hooper

NUMBER: C-M-18
TIME: 0955

MESSAGE TEXT:

Washington wants a summary of the situation in the state. Will you please inform me of the two most critical problems facing your city at this time. Reply TWX by 1000.

RUN 2

SAME AS ABOVE

RUN 3

SAME AS ABOVE

(page 116 blank)

APPENDIX C: DETAILED TABULATIONS

These data show the judges' rating of problem importance, decision quality, and resulting weighted results of performance.

10 May 1966

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TM(L)-2938/001/00

Emer. Actions

INPUT	PROBLEM IMPORTANCE	DECISION QUALITY	PRODUCT
City-C			
2	2	3	6
3	3		
4	4	4	16
5	1	3	3
6	4	2	8
7	2	3	6
8	3	3	9
9	3	6	18
10	4	4	16
11	2	4	8
12	1	5	5
13	5	5	25
14	3	6	18
15	3	4	12
16	5	5	25
17	2	4	8
18	2	0	0
Σ	49		183
City-A			
2	2	5	10
3	3		
4	4	5	20
5	1	2	2
6	4	4	16
7	2	6	12
8	3	1	3
9	3	4	12
10	4	3	12
11	2	4	8
12	1	5	5
13	5	5	25
14	3	4	12
15	3	4	12
16	5	3	15
17	2	4	8
18	2	1	2
Σ	49		174

No Display

INPUT	PROBLEM IMPORTANCE	DECISION QUALITY	PRODUCT
City-A			
2	4	4	16
3	3	0	0
4	3	3	9
5	1	4	4
6	4	1	4
7	2	3	6
8	2	3	6
9	4	4	16
10	4	2	8
11	3	0	0
12	1	7	7
13	3	6	18
14	4	2	8
15	3	4	12
16	2		
17	4	0	0
18	2	0	0
Σ	48		114
City-B			
2	4	4	16
3	3	3	9
4	3	4	12
5	1	3	3
6	4	4	16
7	2	3	6
8	2	6	12
9	4	4	16
10	4	3	12
11	3	6	18
12	1	2	2
13	3	2	6
14	4	6	24
15	3	4	12
16	2		
17	4	3	12
18	2	3	6
Σ	48		170

INPUT	PROBLEM IMPORTANCE	DECISION QUALITY	PRODUCT
City-B			
2	5	4	20
3	3	4	12
4	2	4	8
5	1	1	1
6	4	4	16
7	2	7	14
8	3	3	9
9	3	0	0
10	4		
11	3	6	18
12	1	3	3
13	3	2	6
14	5	1	5
15	3	2	6
16	3	4	12
17	2	4	8
18	2	7	14
Σ	49		152 | Σ 449
City-C			
2	5	7	35
3	3	3	9
4	2	3	6
5	1	3	3
6	4	5	20
7	2	5	10
8	3	7	21
9	3	4	12
10	4		
11	3	2	6
12	1	6	6
13	3	4	12
14	5	4	20
15	3	0	0
16	3	4	12
17	2	4	8
18	2	0	0
Σ	49		180 | Σ = 524

	INPUT	PROBLEM IMPORTANCE	DECISION QUALITY	PRODUCT
			City-B	
	2	2	4	8
	3	3		
	4	4	3	12
	5	1	5	5
	6	4	3	12
	7	2	4	8
	8	3	4	12
Except	9	3	0	0
	10	4	3	12
	11	2	4	8
	12	1	2	2
	13	5	4	20
	14	3	6	18
	15	3	4	12
	16	5	4	20
	17	2	4	8
	18	2	6	12
		49		169
				$\Sigma P=526$

INPUT	PROBLEM IMPORTANCE	DECISION QUALITY	PRODUCT
	City-C		
2	4	6	24
3	3	1	3
4	3	2	6
5	1	2	2
6	4	2	8
7	2	5	10
8	2	1	2
9	4	4	16
10	4	4	16
11	3	4	12
12	1	4	4
13	3	5	15
14	4	4	16
15	3	1	3
16	2		
17	4	6	24
18	2	5	10
	48		171
			$\Sigma P=454$

INPUT	PROBLEM IMPORTANCE	DECISION QUALITY	PRODUCT
	City-A		
2	5	3	15
3	3	4	12
4	2	4	8
5	1	2	2
6	4	4	16
7	2	3	6
8	3	4	12
9	3	5	15
10	4		
11	3	3	9
12	1	2	2
13	3	6	18
14	5	6	30
15	3	4	12
16	3	4	12
17	2	7	14
18	2	1	2
	49		185 $\Sigma=525$
			$\Sigma P=517$
			$\Sigma\Sigma=1498$

	INPUT	PROBLEM IMPORTANCE	DECISION QUALITY	PRODUCT
		City-E		
Emer. Actions	3	6	4	24
	4	3	5	15
	5	2	5	10
	6	7	6	42
	7	3	3	9
	8	7	4	28
	9	4	7	28
	10	5	3	15
	11	7	6	42
	12	3	0	0
	13	6	3	18
	14	4	2	8
	15	6	4	24
	16	4	6	24
	17	5	4	20
	18	3	3	9
	Σ	75		316
		ity-D		
No Display	3	6	5	30
	4	3	5	15
	5	2	2	4
	6	7	1	7
	7	3	6	18
	8	7	3	21
	9	4	2	8
	10	5	3	15
	11	7	4	28
	12	3	6	18
	13	6	5	30
	14	4	4	16
	15	6	1	6
	16	4	5	20
	17	5	4	20
	18	3	6	18
	Σ	75		274

	INPUT	PROBLEM IMPORTANCE	DECISION QUALITY	PRODUCT
		City-F		
	3	6	4	24
	4	2	2	4
	5	5	5	25
	6	6	1	6
	7	3	2	6
	8	7	7	49
	9	6	3	18
	10	6	5	30
	11	5	3	15
	12	1	3	3
	13	6	3	18
	14	5	3	15
	15	3	4	12
	16	5	2	10
	17	5	1	5
	18	2	0	0
	Σ	73		240
		City-E		
	3	6	5	30
	4	2	2	4
	5	5	4	20
	6	6	4	24
	7	3	3	9
	8	7	6	42
	9	6	4	24
	10	6	3	18
	11	5	0	0
	12	1	2	2
	13	6	4	24
	14	5	3	15
	15	3	4	12
	16	5	7	35
	17	5	4	20
	18	2	1	2
	Σ	73		281

	INPUT	PROBLEM IMPORTANCE	DECISION QUALITY	PRODUCT
		City-D		
	3	6	3	18
	4	3	4	12
	5	4	7	28
	6	6	2	12
	7	2	4	8
	8	7	2	14
	9	4	5	20
	10	5	5	25
	11	5	5	25
	12	2	2	4
	13	5	2	10
	14	6	4	24
	15	4	0	0
	16	5	4	20
	17	4	5	20
	18	2	2	4
	Σ	70		244=800
		City-F		
	3	6	4	24
	4	3	6	18
	5	4	6	24
	6	6	4	24
	7	2	5	10
	8	7	4	28
	9	4	3	12
	10	5	2	10
	11	5	3	15
	12	2	2	4
	13	5	3	15
	14	6	4	24
	15	4	6	24
	16	5	4	20
	17	4	2	8
	18	2	2	4
	Σ	70		264=819

Except

INPUT	PROBLEM IMPORTANCE	DECISION QUALITY	PRODUCT
	City - F		
3	6	6	36
4	3	5	15
5	2	4	8
6	7	3	21
7	3	4	12
8	7	5	35
9	4	4	16
10	5	3	15
11	7	2	14
12	3	0	0
13	6	1	6
14	4	0	0
15	6	2	12
16	4	3	12
17	5	4	20
18	3	1	3
Σ	75		225
	Σ =815		

INPUT	PROBLEM IMPORTANCE	DECISION QUALITY	PRODUCT
	City-D		
3	6	6	36
4	2	3	6
5	5	4	20
6	6	4	24
7	3	5	15
8	7	3	21
9	6	7	42
10	6	6	36
11	5	5	25
12	1	6	6
13	6	5	30
14	5	6	30
15	3	4	12
16	5	1	5
17	5	4	20
18	2	0	0
Σ	73		338
	Σ =859		

INPUT	PROBLEM IMPORTANCE	DECISION QUALITY	PRODUCT
	City-E		
3	6	4	24
4	3	7	21
5	4	6	24
6	6	3	18
7	2	0	0
8	7	3	21
9	4	3	12
10	5	1	5
11	5	6	30
12	2	1	2
13	5	6	30
14	6	4	24
15	4	7	28
16	5	4	20
17	4	3	12
18	2	2	4
Σ	70		275 =838
	Σ =783		Σ=2457

(page 122 blank)

APPENDIX D: JUDGMENT CRITERIA

Criteria used by judges for rating problem difficulty and decision quality.

The seven-point rating scale used for establishing the importance of problems, in the judgment of five SDC experts, took the following form:

not very important	of medium importance	of critical importance

Each judge independently rated the problems. He was given a set of cards, with one problem on each card, and asked to locate the cards on the scale reproduced above. Thus, the judgments are relative between the various problems (as all were continuously available). Typically in a task of this type, judges will choose examples that they feel "bound" the extremes of the scale, and will then fit the other problems to these standards.

The guidelines for rating problem importance used the philosophy of the greatest good for the greatest number. Thus, the first experiment was most concerned with getting the people to shelter, while the second was keeping them protected from the hazardous fallout environment. Specifically, the guidelines included: the number of people involved in the problem, how important the people were to immediate post recovery, how threatening information might be toward starting panic or causing malcontentment, whether vital supplies or access routes and facilities would be affected, and how much impact information might have on immediate emergency operations.

For decision quality judgments, a similar rating scale as that shown above was used. A zero point was added, and used exclusively for problems which were completely ignored by the City Executives. Another important distinction was the method of comparison: single problems only were considered at one time, but the decisions of the three teams were compared to each other for relative efficacy. After ranking the three decisions, weights were assigned on the seven-point scale to indicate not only that one team's decisions were better, but how much better.

The guidelines for these ratings were essentially those presented in the procedure guides, or checklists, that were available to the participants (presented in Appendix A). These included: were the environmental hazards such as fallout considered? Was there access available? Was the right equipment and personnel available? Were the rules for using EBS followed, both for method and content? Were shelter problems, such as evacuation, undertaken according to the checklist? Were the provisos of the city policies followed? By considering the procedure guides, the reader will be able to determine the scope and detail of the quality of decisions assumptions that formed the basis of these judgments.

Unclassified

Security Classification

DOCUMENT CONTROL DATA - R&D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

ORIGINATING ACTIVITY (Corporate author)

System Development Corporation
Santa Monica, California

2a. REPORT SECURITY CLASSIFICATION

Unclassified

2b. GROUP

REPORT TITLE

Final Report On Emergency Operations Simulation Research

DESCRIPTIVE NOTES (Type of report and inclusive dates)

AUTHOR(S) (Last name, first name, initial)

Dusack, B. L., Flint, R., Gibbons, R. D., Haney, T. P., Swavely, D. C.

REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
10 May 1966	130	

CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
ork Unit Number 2611C EOC Operations PROJECT NO. Study.	TM(L)-2938/001/00
	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)

AVAILABILITY/LIMITATION NOTICES

Distribution of this document is unlimited

SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY

ABSTRACT

This document contains the findings, conclusions, and recommendations resulting from the study of emergency operations under contract OCD-PS-65-71. Also described are the methods and techniques applied to each task.

D FORM 1 JAN 64 1473

Unclassified

Security Classification

KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Civil Defense						
Emergency Operations Simulation						
Simulation Model						
Model City						
Shelter Complex						

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