

NBS-GCR-77-94

**Smoke as a Determinant of
Human Behavior in Fire
Situations (Project People)**

June 30, 1977

Prepared for
**U.S. Department of Commerce
National Bureau of Standards
Washington, D.C. 20234**

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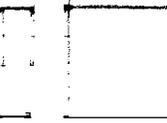
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College Park, MD 20742

NBS Grant No. 4-9027

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SMOKE AS A DETERMINANT OF HUMAN BEHAVIOR IN FIRE SITUATIONS
(PROJECT PEOPLE)

By

Dr. John L. Bryan
Principal Investigator

Prepared under support from The Center for Fire Research,
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Fire Protection Curriculum
College of Engineering
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College Park, Maryland

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PREFACE

This study involved the interview of participants in fire situations at the scene of the fire by fire department personnel. Thus, the study was directly and intimately involved with local jurisdiction fire departments for the collection of the study data. In addition, the members of the project fire service advisory committee were of great value and assistance in the development of the questionnaires, and in the identification of relationships for the analysis of the study data. This study would not have been possible without the sincere, dedicated, and valuable assistance of the following members of the Fire Service Advisory Committee:

James M. Jones, Lieutenant, City of Annapolis, Maryland Fire Department

Bruce W. Hisley, Division Chief, and Frank Homberg, Jr., Captain, Fire Prevention, Anne Arundel County, Maryland Fire Department.

Frank Little, Battalion Chief and Lyman H. Howe, Lieutenant, Investigation, Baltimore City, Maryland Fire Department

Stephen R. Kearney, Captain, Fire Prevention, Baltimore County Fire Department

William P. Wheeler, Sergeant, College Park Volunteer Fire Department

Charles P. Dismuke, Chief Fire Marshal, and James A. Milke, Fire Protection Engineer, Fairfax County Fire Department

Richard W. Shaw, Captain, Deputy Fire Administrator, and Martin J. Lepore, Sergeant, Howard County Fire Department

Walter A. Wise, Captain and Earle B. Poole, Lieutenant, Fire Prevention, Montgomery County Fire and Rescue Service

David T. Endicott, Education Specialist, Prince William County, Fire Department

The coding of the interview data and the development of the programs for the computer tabulation and analysis of the study data was accomplished by students in the Fire Protection Curriculum of the College of Engineering at the University of Maryland. This essential and critical phase of the project was capably completed by the following individuals: Thomas V. Rodante, Harold D. Hicks, Jr., William P. Wheeler, James A. Milke, Jamie E. Weaver, and David J. Icove.

The preparation of the numerous progress reports on this study and the final report of the study was accomplished in an effective, efficient and capable manner by Mrs. Eloise McBrier and Mrs. Cindy Silberman.

The complete responsibility for any errors or omissions in the conduct of this study and the final study report is accepted by the principal investigator. This statement of recognition and appreciation to both organizations and individuals is not intended to imply any sharing of this responsibility.

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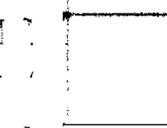
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I. INTRODUCTION

The understanding, observation and study of the behavior of individuals relative to their overt reactions in fire situations has been of concern to individual researchers, and society for many years. The principal investigator conducted his original investigation in this area, following an occurrence of extreme nonadaptive behavior in a fire incident at a church sponsored oyster roast in 1956 (3). The investigation by Wood (14), in 1972, provided the conceptual and operational model for the design and development of this study.

The initial interest in this study was developed through conversations with personnel at the Center for Fire Research, at the National Bureau of Standards, principally Mr. Irwin Benjamin, and Mr. Daniel Gross. A supporting financial grant was processed by The Fire Research Center, National Bureau of Standards, effective September 1, 1974 for a two year study. To enable the participation of the study personnel in the Second Joint Panel Meeting on Fire Safety and Research of the United States and Japan Cooperative Program on Natural Resources, this grant was extended until December 15, 1976. Following this extension, the grant was extended again until June 30, 1977 to enable a more complete analysis of the extensive study data collected.

The Center for Fire Research project monitors on the study have consisted of Mr. Harold Nelson, Mr. Jeffrey Shribe, Dr. Gilda Haber, and most recently Dr. Bernard Levin. The study was designed to provide for the interviewing of the selected participants in the fire incidents at the scene of the incident by fire department personnel. The following research objectives were established and utilized in the formulation of the study design.

A. Study Objectives.

The research objectives for the study were determined to involve the achievement of the following detailed examinations of the interaction of the following various study variables:

1. A verification of the information and data collected by Wood (14) in England relative to the movement of personnel through smoke in the evacuation of a building.
2. A determination of the relationships of the demographic variables of the occupants of the buildings involved in the fire incidents.
3. An examination of the various physical environmental features of the building affecting the evacuation behavior of the occupants including, the arrangement of lighting, the awareness of exit and egress routes, and the observation of exit signs.
4. The reported effectiveness of the evacuation signal, and a determination of the means of alerting the occupants utilized in the fire incidents.
5. The reported visual and olfactory indications of the fire incident relative to the generation, diffusion, velocity and color of the smoke involved in the fire incident, and the influence of the smoke on the determination of the evacuation behavior by the participants.

Wood (14), in his study completed in 1972, utilized data collected from approximately 1,000 fire incidents involving over 2,000 persons in England. Wood's study indicated the behavioral reactions of most occupants involved the following actions: Evacuation of themselves or others; An attempt to control or fight the fire; and procedures designed to warn or alert others as to the occurrence of the fire incident. The verification of Wood's study was one of the essential research objectives for this study. The analysis and detailed study of the critical results from both studies are presented in Section VII of this report.

The variables of the socioeconomic indicators of the participants were determined in an attempt to relate the behavior of the participants to the data developed by O'Neill. (11) The variables of the participants occupation, sex, age, and national origin, were all examined. The information developed by the Underwriters' Laboratories, (12) concerning the obscuration of exit signs by smoke, and the recollection of the signs by Bryan (3), was examined relative to these participants. Unfortunately only a very few of the buildings were equipped with exit signs, due to the predominate number of residential buildings of the single family type. The data relative to the 47 occupancies provided with exit signs, which is approximately 14 per cent of the incident population, is presented in Table XX, in Section III of this report.

The determination of the egress and the evacuation routes by the participants of a building due to the introduction of natural light was established by Cannon, (4). However, the greater awareness of egress routes and exit signs by older, female subjects was also referenced by Cannon. (4) Both of these findings were examined in this study relative to the

evacuation behavior.

Brave, (1) previously established the most effective color for the visual recognition of exit signs to be a yellow-orange color, when viewed by subjects through smoke tinted and obscured filters. Thus, the color of the exit signs was examined in the study, as reported by the participants in the fire incident buildings. The information previously developed relative to the effectiveness of a verbal evacuation signal with a public address system, rather than audible alarm devices was examined.

The examination of the influence of the smoke, as visually and olfactorily perceived by the participants of the fire incident building, and the influence of the awareness of the physical presence of the smoke on the determination and selection of egress routes by the participants, was the primary objective of this study. Thus, the variables of the fire incident as a threat seemed to indicate the variables of smoke production, involving the amount, color, and the velocity of smoke movement might become behavioral determinants of the individual's behavioral processes of recognition, validation, and the confirmation as established by Withey (13) in the nature or severity of the fire incident situation. This study therefore, examined the influence of the odor or visual sighting of smoke on the awareness of the fire incident and the structuring of the behavior relative to the fire incident. Data was collected on the movement of the participants into and through the smoke, the distances moved, the participants who had to turn back and the reported reasons for turning back, relative to smoke or heat. Wood, (14) previously examined the movement of individuals into smoke in the escape routes and his results were compared with the results of this study in Section VII of this report.

The principle focus of this study was thus concerned with the influence of smoke on the awareness of the individual as to the occurrence of the fire incident, and the selection of and initiation of the evacuation behavior.

B. Limitations of the Study:

1. The study was limited to the geographical area composed of the metropolitan complex surrounding Washington, D.C. and Baltimore, Maryland.
2. The participants of the fire incidents were interviewed in varying time intervals following the fire incident dependent upon the type of fire department personnel conducting the interviews, and the jurisdiction involved in the fire incident.
3. The fire incidents selected for inclusion in the study had to initially be reported to the fire department, and secondly to be occupied at the time of occurrence of the incident.
4. The incidents selected by the participating jurisdictions occurred between January 15, 1975 and April 30, 1976.
5. The interviews were conducted by fire department personnel with varying interview experience in the study, in the various jurisdictions.
6. The local jurisdictions participated in the study for varying periods of time, with the final incident collection period from January to April, 1976 involving only eight of the original jurisdictions.
7. The fire incidents were selected for inclusion in the study by various criteria in the various jurisdictions involved in the study, relative to the availability of interviewing personnel, the time of the incident, and the occupancy involved in the

fire incident.

8. Detailed in depth interviews were not conducted of the participants in the fire incidents, and no interviews were conducted of personnel involved in the fire incident who were physically injured, or emotionally upset.

There are many problems associated with the conduct of a study of this type relative to the complete involvement of the participants in the fire incident in the study situation. It was decided to utilize fire department personnel in the interviewing situation, due to the official involvement of these personnel in the fire suppression and investigation of the fire origin activities. Also as Wood (14) indicated, the personnel in many of the fire incidents tend to disperse to various locations and, the attainment of interviews after approximately twenty-four hours following the fire incident becomes most difficult as follows:¹

Time factors. In practice I arrived at the scene of the fire from a few hours after the fire up to 5 days after. Both periods were disadvantageous. Arriving soon after the fire in no obvious official capacity caused difficulties with police, firemen and participants. Longer periods of time involved difficulties in tracing participants, and lapses in recall.

The fire department personnel at the fire scene in an official capacity have access throughout the fire scene, and in addition to interviewing participants, were utilized in the study to provide essential and critical information relative to the physical environment of the fire incident building. The study involved the utilization of a structured interview questionnaire form, so the identical data and information was attempted

¹Peter G. Wood, The Behavior of People in Fires. Borehamwood: British Joint Fire Research Organization, Fire Research Note 953, November, 1972, p. 23.

to be obtained from the participants in the fire incidents, regardless of the jurisdiction involved in the fire incident and the interviewing of the participants. The collection of the study information, obviously was limited to the fire incidents perceived by the participants to be of a serious enough nature to call the fire department, thus the incipient small fire extinguished by an occupant was excluded from this study.

II. STUDY PROCEDURE

The concept of utilizing both social scientists and fire department personnel in a concentrated and coordinated approach to the problem of assessing the behavior of individuals in fire incidents was initially developed by Wood. (14) This concept of a coordinated approach to the problem was also adopted with this study. However, in addition, the fire department personnel were involved from the inception of the study with the application of their empirical knowledge and experience in the development of the questionnaire utilized to guide the conduct of the interviews with the occupants of the fire incident buildings. Wood provided some interesting and valuable insights relative to the development of the questionnaire and the formulation of specific items in the questionnaire, from his previous study experience in Great Britain.

This study was designed to be implemented following the general study procedure utilized by Wood, (14) with the interviewing of the participants to be conducted by fire department personnel at the fire scene. The personnel involved in the conduct of the study adopted the title of "Project People" for this research study, since the primary objective of this study involved the determination and analysis of the actions of individuals in a building at the time a fire incident occurred at the building.

A telephone inquiry was conducted of the chief executive officers of the fire departments in the metropolitan Washington, D.C. and Baltimore,

Maryland area in September, 1974 seeking their participation in the study. The response of all the officers was affirmative, and a fire service advisory committee for the study was formulated with representatives from all of the participating fire departments, at the initial meeting on October 15, 1974.

A. The Fire Service Advisory Committee

Eleven jurisdictions participated in the study for the entire project period, however, two jurisdictions only participated in the development of the interview questionnaires, and once the data collection phase of the study was initiated in January, 1975 these two jurisdictions withdrew from the study. However, the Prince William County Fire Department and the College Park Volunteer Fire Department entered the study at the beginning of the data collection phase so the balance of eleven jurisdictions in the study as initially represented on the fire service advisory committee was maintained.

The eleven jurisdictions participating in the interviewing of the individuals at the scene of fire incidents, with the exception of the two jurisdictions mentioned previously were also involved in the development and design of the interview questionnaires. Thus, the majority of the personnel involved in the collection of the data had also been involved in the preparation of the questionnaire form.

The eleven participating jurisdictions with the number of fire incidents and the number of participants is presented in Table I of this report. Although eleven jurisdictions are shown in Table I, one jurisdiction

TABLE I
 JURISDICTION DISTRIBUTION OF STUDY POPULATION

Jurisdiction	Participants	Per Cent	Incidents	Per Cent
Alexandria	15	2.6	6	1.8
Annapolis	40	6.8	20	6.0
Anne Arundel County	51	8.7	31	9.3
Arlington County	17	2.9	11	3.3
Baltimore City	99	17.0	91	27.2
Baltimore County	46	7.9	24	7.2
College Park	35	6.0	10	3.0
Fairfax County	54	9.2	23	6.9
Howard County	109	18.7	69	20.6
Montgomery County	32	5.5	10	3.0
Prince William County	86	14.7	40	11.9
N = 11	584	100.0	335	100.0

provided no additional interview data after the initial reporting period from January 15 to June 30, 1975, and three jurisdictions provided no additional data following the completion of the second reporting period from July 1, 1975 to December 31, 1975. Thus, the final reporting period from January 1, 1976 to April 30, 1976 only involved the participation of seven of the initial eleven jurisdictions. Thus, it would appear the problem of interviewing participants at the fire scene was exceedingly difficult for some departments, and adequately accomplished by other departments.

The participating jurisdictions designated various fire department personnel to participate on the fire service advisory committee on the study project. This committee meet consistently once a month to review problems which may have developed relative to the interpretation or coding of the responses from the questionnaires. These monthly review sessions were of significant value for the study particularly in relation to the need for agreement on the interpretation of similar response situations. The fire service advisory committee was of significant assistance in the identification of the potential critical relationships between variables, with the identification of areas for further analysis and study.

The personnel assigned to the collection and supervision of the interview data varied from jurisdiction to jurisdiction. However, in most areas, the personnel most familiar and experienced with the study project, the members of the fire service advisory committee supervised the completion of the questionnaires, and were also personally involved in the interviewing process. It should be realized, the interview personnel were all provided

with an instruction period relative to the utilization of both of the questionnaire instruments. In addition, all of the fire department personnel were experienced in duties that involved investigation or interview procedures with the public in their official duties.

The membership of the fire service advisory committee, upon the completion of the study project involved the following individuals:

James M. Jones, Lieutenant, City of Annapolis, Maryland Fire Department; Bruce W. Hisley, Division Chief, Fire Prevention, and Frank J. Homberg, Jr., Captain, Fire Prevention, Anne Arundel County, Maryland Fire Department; Frank Little, Battalion Chief, Investigation, Lyman H. Howe, Lieutenant, Baltimore City Fire Department; Stephen R. Kearney, Captain, Fire Prevention, Baltimore County, Maryland Fire Department; William P. Wheeler, Sergeant, College Park, Maryland Volunteer Fire Department; Charles P. Dismuke, Chief, and James P. Milke, Fire Protection Engineer, Fairfax County, Virginia, Fire Department; Richard W. Shaw, Captain, Deputy Fire Administrator, and Martin J. LePore, Sergeant, Howard County, Maryland Fire Department; Walter A. Wise, Captain, Fire Prevention, and Earle B. Poole, Lieutenant, Fire Prevention, Montgomery County, Maryland Fire and Rescue Service; and David T. Endicott, Education Specialist, Prince William County, Virginia Fire Department.

B. The Interview Questionnaires.

The questionnaires for this study were developed by the study personnel in cooperation with the fire service advisory committee, during October and November, 1974. The fire service advisory committee after reviewing the questionnaire utilized in Wood's Study (14), decided the questionnaire should be limited to two pages for each fire incident. One

page, entitled Part I was used to obtain essential resource information concerned with the building, and the observations of the fire department personnel upon their arrival and during their operational activities at the fire scene. The second page of the questionnaire, Part II was concerned with the participants, and was utilized for the interviews as a structured guide to the questions to be asked of each participant by the fire department personnel. Part I of the questionnaire was completed by the fire department personnel obtaining the data, from personal observations at the fire scene, interviews with fire department personnel on the scene, or the fire department records.

Part II of the questionnaire was completed by the fire department official at the fire scene, with the recording of the verbal responses of the individual participants interviewed at the fire scene. The questionnaires were assembled with three Part II questionnaires attached to each Part I questionnaire. However, the largest number of persons interviewed for a single fire incident consisted of nine persons, and obviously at least one person was interviewed for each fire incident.

Both of the questionnaire sheets were designed for the collection of information at the scene of the fire incident, and to facilitate the assimilation of information from persons at the fire scene. The Part I questionnaire form was entitled "The Building and the Fire", and contained fourteen enumerated items on the form, although a total of 34 information items were required for these 14 enumerated items. The Part I form is presented on page 14, as Figure I of this report. The identification of the interviewer was found to be most useful when a question arose during the coding process relative to the

BEHAVIOR OF PEOPLE IN FIRES

Part I. The Building and The Fire Jurisdiction _____

Incident Identification _____

Address _____ Date of Fire _____

Time of Alarm _____

Weather: Temperature _____ Windy _____ Humid _____ Rain _____ Snow _____ Fair _____

1. Area or Room of Fire Origin _____ Floor _____

2. Rooms or area involved at time of Fire Dept. arrival _____

3. Extent of visible smoke spread in bldg. at time of Fire Dept. arrival: Room or area of origin _____ Floor of origin _____ Other floors _____ Total # of floors _____

4. Number of stories in bldg. _____ Occupancy _____

5. Number of known alarms in previous year _____

6. Type of manual fire alarm: Bell _____ Horn _____ P.A. _____ Other _____ None _____

Connected to Fire Dept. Y _____ N _____

7. Type of required fire fighting equipment: Extinguishers _____ Standpipe hose _____

Evidence or observation of use by occupants? _____

8. Type of automatic detectors provided: Heat _____ Smoke _____ Both _____ None _____

Evidence or reports of operation? _____

9. Number of automatic sprinklers which operated? _____ None provided _____

10. Color of exit signs in bldg. _____ None provided _____

11. How many people in bldg. when fire was discovered? _____ How many left before Fire Dept. arrival? _____ After Fire Dept. arrival? _____ How many did not leave at anytime? _____ How many were rescued? _____

12. Behavior of occupants observed by Fire Dept. _____

13. Observed obstructions to egress from bldg. _____

14. Observations-remarks by interviewer _____

Interviewer _____ Date _____

interpretation of a response, since the coder could then contact the interviewer and clarify the response. Thus, the validity of the conversion of the responses on the questionnaire forms to the coding sheets was believed to be maintained.

To achieve a high level of validity and reliability in the coding process, the Part I and Part II forms were completed by the interviewer at the scene and then mailed to the University for the coding, key punching, and the computer tabulation. Students in the Fire Protection Engineering program at the University of Maryland were utilized in the coding of the questionnaire forms, and the computer processing and tabulation of the questionnaire data.

Figure 2 illustrates the Part 2 questionnaire concerned with the person and the fire. Thus, for every fire incident included in this study a Part I questionnaire was completed, and at least one Part II questionnaire would also be completed. However, additional persons were often interviewed, and this practice was encouraged to interview as many participants as practical for each fire incident. The largest number of persons contacted in a single fire incident consisted of nine persons interviewed in an apartment house fire incident. Thus, for the total reporting period of this study as previously indicated, the study data consisted of 335 fire incidents and 584 participants.

The Part 2 questionnaire as illustrated in Figure 2 on page 16, was designed to be followed by the interviewer in his discussion with the participant. However, some of the items on the questionnaire were extended, and additional information was often found on the back of the form, especially the information under item 7 - "What did you do when you realized there was a fire?" The answers sometimes exceeded the space for the three responses listed, and the interviewer would place the additional

FIGURE II
Part II. The Person and The Fire

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- Occupation _____ Incident Identification _____
- National Origin _____ Sex _____ Age _____ Language Problem _____
1. Your presence in bldg.? Live _____ Work _____ Visit _____ Time _____
 2. You are familiar with how many ways out of the bldg.? _____
 3. Did you believe the building to be safe? Y _____ N _____ Why? _____
 4. How did you first become aware there was a fire? _____
 5. Who was with you in the bldg. when you first became aware of the fire? _____

 6. Where were you when you realized there was a fire? _____
How close were you to the fire? _____
 7. What did you do when you realized there was a fire? 1. _____
2. _____ 3. _____
 8. Did you voluntarily leave the bldg. - area during the fire? Y _____ N _____ When? _____
How? Stairway _____ Elevator _____ Balcony _____ Escape _____ Window _____ Door _____
Other _____ Was this your usual way? Y _____ N _____
Did you leave by: Own efforts Y _____ N _____ Assisted By others _____ By Fire Dept. _____
 9. How far did you travel in leaving? feet. Estimated time? _____
 10. Why did you not leave the bldg. - area? _____
 11. Was there any visible smoke? Y _____ N _____ Any odor? Y _____ N _____ Did you try to
move through the smoke? Y _____ N _____ How far did you try to move? feet. How
far could you see at the time? feet. Smoke become thicker? Y _____ N _____
Did you have to turn back? Y _____ N _____ Due to: Smoke _____ Heat _____ How far could
you see when you turned back? _____ feet.
 12. Did you return into the bldg. during the fire? Y _____ N _____ Why? _____
 13. Did you notice lighted exit signs? Y _____ N _____ Color of signs? _____
 14. Did you hear the fire alarm or detectors operate? Y _____ N _____ When? _____
 15. Previous training on actions to take in a fire: Number of times taken? _____
Type? _____ Given by? _____ Last course? _____
 16. Number of times involved in fire before? _____ Last previous occurrence? _____
 17. Any obstructions to egress from bldg.? _____
 18. Any aids to egress from bldg.? _____
 19. Remarks: _____

responses on the back of the sheet. The last item relative to remarks also resulted in the interviewer being able to provide additional information on the back of the questionnaire form.

The completed Part I and Part II questionnaires were mailed to the University of Maryland, usually within 24 hours of the interview. The questionnaires were recorded when received by date, the reporting jurisdiction, the type of occupancy and the number of Part II questionnaires received for each fire incident. The coding of all the questionnaire responses were accomplished by student analysts, with a coding manual developed to insure uniform coding between analysts. The coded questionnaire data was then entered into the computer tabulation program for the project. Printouts were obtained in chronological order for each jurisdiction, and these printouts were reviewed at the monthly meetings of the fire service advisory committee for coding or key punching errors, before the initiation of the analysis of the data.

C. The Data Analysis Program

David J. Icove, formerly a student in the Fire Protection Engineering program at the University of Maryland, and presently a graduate student at the University of Tennessee developed the computer programs for the analysis of the questionnaire data. Harold D. Hicks, James A. Milke, William P. Wheeler, and Jamie E. Weaver were also involved with the coding of the data, and the implementation of the data analysis with the developed computer programs.

The data coding, processing, and analysis of the fire incidents was performed on the University of Maryland's UNIVAC 1108 computer system. Four major computer programs were utilized to provide the complete software

support for this study. The statistical computations and comparisons were performed using the Statistical Package for the Social Science, (S.P.S.S.) version 6.02, (10). The SPSS package was interfaced to the questionnaire data file using subprograms written in Fortran IV. The following design objectives for the data analysis were considered in the design of the data analysis programs:

1. The horizontal transfer of the data analysis programs to participating researchers.
2. Standardized methods of statistical analysis in the social sciences were utilized.
3. The development of new analytical techniques for illustrating and describing sequential behavior.

The questionnaire data were stored as a sequential data file, and in addition to the coded data included the narrative data relative to the remarks of the interviewer, from the Part I questionnaire, with the information given by the participant which was not readily codeable, but was pertinent to the incident.

Four computer programs provided the statistical and utility routines required for project people. These computer printouts were distributed at the monthly meetings of the project advisory committee, for evaluation of the reliability and the validity of the processed data. The computer program descriptions and listings are provided for documentation and as an aid to future verification studies:

1. Subprogram INSUM - This program prints an incident summary, from the questionnaire data base. Numbered consecutively and sorted by jurisdiction, the printout clearly lists the encoded and narrative information. The fire incident data appears first

from Part I of the questionnaire, followed by the participant interview data from Part II, with the interview data for each participant in the incident listed sequentially.

2. Subprogram ONE - By separating the fire incidents from the accumulated data file, the Part I data can be analyzed. A Fortran IV program places the fire incident data in a temporary sequential file where it was read by a SPSS program. This file was maintained in a three card format representing each fire incident.
3. Subprogram TWO - A Fortran IV program temporarily stores the Part II questionnaire data on a sequential file to be analyzed by a SPSS program. Again a three card file format was utilized for the storage of the participant interview data.
4. Subprogram ONETWO - This Fortran IV program interfaces the fire incident data from Part I of the questionnaire with the participant interview data from Part II of the questionnaire. The resulting sequential data file then consists of a 6 card format with 3 cards of Part I data and 3 cards of Part II data. A SPSS program reads this sequential file and compares the data elements of Part I with Part II.

The subprograms ONE, TWO and ONETWO produced the statistical analyses which were essential to the comparative understanding of the questionnaire data. Frequency distributions of each variable were essential to the comparative understanding of the questionnaire data. Frequency distributions of each variable were performed and outputted in tabular form, for examination and study. The comparison of pairs of

variables was developed using the cross tabulation features of the SPSS program. The data presented in Sections IV - VI in this report were derived from these cross tabulations.

III. THE FIRE INCIDENT POPULATION

The incident population for this study consisted of a total of 335 fire incidents which occurred between January 15, 1975 and April 30, 1976. During these fire incidents a total of 584 participants in the fire incident were interviewed. The characteristics of this participant population will be examined and analyzed in Section IV of this report. The data for the incident population was primarily concerned with the characteristics of the fire incident building. However, the characteristics of fire development, including the smoke production within the building, and the observations of the fire department personnel upon their arrival and during the fire incident were also collected from the Part I questionnaire form which was previously shown as Figure I of this report.

A. The Fire Incidents .

The various aspects of the incident population will now be examined to establish the critical and essential variables of this population to indicate the parameters of the population of the various buildings, relative to the types of fire incidents involved in this study. It should be remembered, the fire incident had to be reported to the fire department to become eligible for inclusion in the study. Thus, the minor, incipient, and the successfully extinguished fire without fire department notification, as studied in the national household fire survey, (9) and the survey by Crossman, Zachary, and Pigman, (6) were not included in this study.

1. The Jurisdiction Distribution of Fire Incidents.

The jurisdictional distribution of the 335 fire incidents were presented in Table I, in Section II of this report, and it should be noted the smallest number of 6 incidents were from Alexandria, Virginia and the largest number of 91 were obtained from the City of Baltimore, Maryland.

2. The Incident Distribution by Months.

The distribution of the fire incidents by the month of the occurrence of the fire incident are presented in Table II. It should be remembered due to the time interval of the study from January 15, 1975 until April 30, 1976, the frequency for the months of January, February, March and April would be expected to be higher than the other months of the study. This expectation is of course obvious by the inspection of Table II. The examination of the distribution of the fire incidents by the months provides an approximation of the weather conditions to be expected due to the seasonal variations. However, data was collected on the Questionnaire form I, relative to the approximate temperature and the general weather conditions at the time of the fire incident.

3. The Incident Distribution Related to Temperature and Weather.

The initial data was collected by the fire department investigator at the time of the fire incident relative to the approximate temperature, and the weather conditions to provide a frame of reference for the possible dependent effects of weather and temperature that might be effective in inhibiting the evacuation of the building. Thus, the information was collected relative to the approximate temperature and the weather conditions relative to precipitation, wind or fair conditions. The temperature and weather

TABLE II
DISTRIBUTION OF FIRE INCIDENTS
MONTH OF YEAR

Month	Incidents	Per Cent		
January	43	12.8		
February	42	12.5		
March	43	12.8		
April	46	13.7		
May	28	8.4		
June	18	5.4		
July	22	6.6		
August	16	4.8		
September	27	8.1		
October	19	5.7		
November	6	1.8		
December	25	7.5		
N = 12	335	100.0		
Incidents	M = 27.9	SE _M = 3.72	SD = 12.88	SE _{SD} = 2.64

information for the fire incidents is presented in Table III. It should be noted, that almost one half, approximately 47.8 per cent of the fire incidents included in the study occurred during fair weather. However, it should be recognized there may have been a bias on the part of the fire department personnel to collect interviews at the fire incidents which occurred in the fair weather.

From the examination of Table III, it is apparent the distribution of the fire incidents by temperature would not be considered to be a normal distribution. It should be noted that the mean temperature at the time of the fire incident was approximately 53 degrees F. There has been some evidence in previous studies of human behavior in fire incidents that precipitation or extremely cold weather may create a reluctance by some of the occupants to evacuate the building during a fire incident. Bryan (3), reported the attitude present in some of the participants of the Arundel Park fire which resulted in a reluctance to evacuate as the response to the initial visual stimulus of small flames and smoke, due to the inclement cold rain outside the structure.

4. The Time of Occurrence of The Fire Incidents.

The time of the occurrence of the fire incidents included in this study are presented in Table IV. Upon examination of the data in Table IV it appears the fire incidents included in the study were rather evenly distributed throughout the twenty-four hour period of the day. The distribution of the incidents for the various hours indicated a range from a low of six incidents between 6 and 7 a.m., and a high of twenty-four incidents between noon and 1 p.m. The distribution of the incidents for the study was skewed toward

TABLE III
 DISTRIBUTION OF FIRE INCIDENTS
 BY TEMPERATURE AND WEATHER

Approx. Temp. °F	Incidents	Per Cent	Weather	Incidents	Per Cent
0 - 10	20	6.0	Fair	160	47.8
10 - 20	3	.9	Snow	14	4.2
20 - 30	14	4.2	Rain	48	14.3
30 - 40	60	17.9	Humid	60	17.9
40 - 50	62	18.5	Windy	44	13.1
50 - 60	31	9.3	Not Reported	9	2.7
60 - 70	49	14.6			
70 - 80	61	18.2			
80 - 90	24	7.2			
90 - 100	11	3.3			
N = 10	335	100.0	N = 6	335	100.0
Incidents	M = 33.5 SE _M = 7.15	SD = 22.62 SE _{SD} = 5.08	M = 55.83 SE _M = 22.38	SD = 54.80 SE _{SD} = 15.89	
Temperature	M = 52.95 SE _M = 6.97	SD = 121.62 SE _{SD} = 4.96			

TABLE IV
 DISTRIBUTION OF FIRE INCIDENTS
 TIME OF OCCURRENCE

Hour	Incidents	Per Cent	
0 - 1	17	5.0	
1 - 2	9	2.7	
2 - 3	10	3.0	
3 - 4	12	3.5	
4 - 5	9	2.7	
5 - 6	8	2.4	
6 - 7	6	1.8	
7 - 8	12	3.5	
8 - 9	9	2.7	
9 - 10	14	4.2	
10 - 11	20	6.0	
11 - 12	16	4.8	
12 - 1	24	7.2	
1 - 2	16	4.8	
2 - 3	16	4.8	
3 - 4	18	5.4	
4 - 5	22	6.6	
5 - 6	17	5.0	
6 - 7	14	4.2	
7 - 8	15	4.5	
8 - 9	19	5.7	
9 - 10	13	3.9	
10 - 11	12	3.5	
11 - 12	7	2.1	
N = 24	335	100.0	
M = 13.96	SD = 4.78	SE _M = .976	SE _{SD} = .60

the awake hours for the occupants, as defined for this study the awake hours were considered to be from 7 a.m. until 10 p.m., and, the sleeping hours from 10 p.m. to 7 a.m. Thus, examination of Table IV indicates that 90 fire incidents occurred during the sleeping hours defined in this study as between 10 p.m. and 7 a.m., and this sleeping time fire incident sample comprised approximately 26.86 per cent of the total fire incident population.

B. The Fire and Smoke Characteristics of the Incidents.

The type of fire incident relative to the amount of flame and smoke production is an essential aspect of the perception of the fire incident as a threat to the occupants of the building. Thus, the fire department official reported on the following critical features, relative to the flame and smoke production observed by the fire department: The area of fire origin; the floor level of fire origin; and, the area of fire and smoke involvement at time of the fire department arrival.

1. The Area of Fire Origin.

The area of fire origin was determined by the fire department investigator at the scene of the incident, and it should be noted the area of origin in the study relative to the residential occupancies differs from the occupancy areas reported in the National Household Fire Survey reported by the National Fire Prevention and Control Association. (9) The household survey indicated 65 percent of the fires involved kitchens. However, as indicated in Table V of this study, the kitchen was the second most common area of fire origin with 63 fire incidents for 18.8

per cent of the incident population. It should be noted from Table V, that over half of the fire incidents, approximately 54.6 per cent were initiated in residential occupied areas, consisting of the sleeping area, living room, and the kitchen. It should be noted, as indicated later in Table X the most prevalent occupancy in the incident population was the single family dwelling, which tended to bias the fire incident population. This bias was introduced due to the study parameter which required the building to be occupied at the time of the fire incident, for inclusion in the study.

However, it should be recognized the difference in these areas of origin results are to be expected, when it is realized the national household fire survey, interviewed the residents of households and were thus, obtaining the large population of non fire department reported incidents which were excluded from this study. The National Household Fire Survey indicated approximately 10 per cent of the residence related fires in the study were incidents reported to the fire department. This proportion of 10 per cent substantially agrees with the data reported by Crossman, Zachary, and Pigman (6) which indicated the fire department was notified of approximately 11 per cent of the residential fire incidents in Berkeley, California. Thus, it would appear the primary difference in the area of origin in this study and the National Household Fire Survey (9) involved a reflection of the difference in the type and the perceived severity of the fire incidents in the two populations. The National Household Fire Survey consisted primarily of fire incidents which were of such limited severity, they were extinguished by the occupant and the fire department was not notified. Thus, these fire incidents were not perceived to be threatening to the participants involved in the fire incident.

TABLE V
AREA OF FIRE ORIGIN

Area	Incidents	Per Cent
Bedroom	79	23.6
Kitchen	63	18.8
Living Room	41	12.2
Storage Room	30	9.0
Multiple Use	12	3.6
Laundry Room	12	3.6
Lavatory	8	2.4
Furnace Room	8	2.4
Hallway	6	1.8
Closet	5	1.5
Rubbish Area	4	1.2
Vehicle Area	4	1.2
Machinery Room	4	1.2
Office	3	0.8
Ceiling - Floor	3	0.8
Showroom	2	0.6
Switchgear Area	2	0.6
Crawl Space	2	0.6
Ceiling - Roof	2	0.6
Stairway	1	0.3
Lobby	1	0.3
Dining Room	1	0.3
Printing Area	1	0.3
Electrical Equipment	1	0.3
Manufacturing Area	1	0.3
Elevators	1	0.3
Chimney	1	0.3
Other	22	6.6
Not Reported & Unclassified	15	4.5
<hr/>		
N = 29	335	100.0
<hr/>		
M = 11.55	SE _M = 3.54	SD = 19.08
		SE = 2.51
<hr/>		

It should be remembered as stated in Section I of this report, in the Limitations of The Study, the fire incident had to be reported to the fire department to have any possibility of selection for inclusion in the fire incident population, since the data investigation and interviews were conducted by fire department personnel. It should also be remembered from these same limitations a fire incident was not included in the study population unless the building was occupied at the time of the fire incident. The reporting of the fire incident to the fire department was the initial action necessary for the selection of a particular fire incident for inclusion in the study. Thus, if the fire incident was extinguished by the occupants, and not reported to the fire department the incident was by definition excluded from the study population.

2. The Floor Level of The Area of Fire Origin.

The floor level of the area of fire origin as presented in Table VI, was primarily determined by the types of occupancies and buildings included in the fire incident population which essentially consisted of residential occupancies, and primarily single family dwelling. The first floor was the floor of fire origin in 151 of the fire incidents, consisting of approximately 45 per cent of the incident population. When the fire incidents on the second floor, and in the basement are also included, 89 per cent of the fire incident population is represented. It should be noted from Table VI, the floors on which a fire incident originated above the fifth floor, were the sixth, eighth, twelfth, and nineteenth floors. It should be noted, the height of the buildings included in the fire incident population

TABLE VI
FLOOR LEVEL OF FIRE ORIGIN

Floor Area	Incidents	Per Cent	
Basement	53	15.8	
1	151	45.1	
2	94	28.1	
3	18	5.4	
4	4	1.2	
5	1	0.3	
6	2	0.5	
8	1	0.3	
12	1	0.3	
19	1	0.3	
Attic	1	0.3	
Patio	1	0.3	
Not Reported	7	2.1	
N = 13	335	100.0	
M = 25.76	SE _M = 12.95	SD = 46.74	SE = 9.19

varied from one to thirty stories, with eleven buildings that could be classified as high rise buildings, since these buildings exceeded seven stories in height. The most prevalent height of the 335 buildings involved in the fire incident population, consisted of two story buildings, which was approximately 44.8 per cent of the buildings involved with fire incidents in this study.

Upon review of Table V, relative to the area of fire origin, and Table VI, concerned with the floor level of fire origin, it would appear the majority of the fire incidents involved the residential occupancies, in the living areas of the buildings, from the basement through the second floor.

3. The Area of Fire and Smoke Involvement at Time of Fire Department Arrival.

In an attempt to obtain an indication of the severity of the fire incident for the participants, and a measure of the perceived severity of the fire incident, the data was obtained from the officer in charge of the first arriving fire department unit, as to the extent of the area of flame and smoke involvement in the building. It should be remembered, the fire incidents had to be interpreted by at least one of the participants as a threatening incident to provide the motivation for the action of calling the fire department.

It should be noted the severity of the fire incidents included in this study population varied from the incidents which self extinguished prior to the fire department arrival, to a dwelling fire incident which involved eight fatalities. Relative to the extent of human behavior activities,

the fire incidents varied from a single person leaving a one story dwelling, to a fire incident in a seven story apartment building involving the evacuation of approximately 200 occupants, with one fatality and several serious injuries.

Table VII, presents the area of the building observed to be involved in fire at the time of the fire department arrival on the scene. It is obvious of course, that Table VII should be relatively similar to Table V previously presented, concerned with the area of fire origin. The essential difference in the area of fire origin data and the area of fire involvement data would appear to be in the increase of the involvement of the multiple use areas from 12 for the area of origin population to 56 for the area of fire involvement population. This increase in fire involvement for multiple use areas may indicate in some of the fire incidents the propagation of the fire from the specific area of origin to adjoining areas. When the increase in the not reported and unclassified categories in Table VII is considered, the percentage of the fire incidents involved in the not reported, the multiple use area, the bedroom, living room, and the kitchen at the time of arrival of the fire department consists of 66.7 per cent of the fire incident population. While in Table V, relative to the area of fire origin the percentage of the fire incident population in the identical categories involved 62.7 per cent of the fire incident population.

Table VIII, presents the data observed by the officer in charge of the first arriving fire department unit, relative to the visible observed smoke spread within the fire incident building at the time of arrival. It is readily apparent the most prevalent situation, involving 41.5 per cent of the fire incidents, was to observe smoke spread throughout the floor

TABLE VII
 AREA INVOLVED AT THE FIRE DEPARTMENT ARRIVAL

Area	Incidents	Per Cent	
Bedroom	56	16.7	
Kitchen	43	12.8	
Living Room	27	8.1	
Supply Storage Area	25	7.5	
Multiple Use	55	16.3	
Laundry Room	9	2.7	
Hallway	6	1.8	
Lavatory	5	1.5	
Vehicle Area	6	1.8	
Heating Equipment Area	5	1.5	
Machinery Area	3	0.9	
Ceiling - Roof	3	0.9	
Wall	3	0.9	
Stairway	2	0.6	
Showroom	2	0.6	
Office	2	0.6	
Closet	2	0.6	
Rubbish Area	2	0.6	
Switch Gear Area	2	0.6	
Crawl Space	2	0.6	
Ceiling - Floor	2	0.6	
Lobby	1	0.3	
Printing Area	1	0.3	
Manufacturing Area	1	0.3	
Elevator	1	0.3	
Duct	1	0.3	
Chimney	1	0.3	
Other	24	7.2	
Not Reported & Unclassified	43	12.8	
N = 29	335	100.0	
M = 11.55	SE _M = 3.17	SD = 17.10	SE _D = 2.25

of fire origin. It should be noted, smoke spread occurred beyond the room or area of origin in 252 of the incidents which is approximately 75.2 per cent of the fire incident population. If we reduce the population in this analysis by the not reported incidents, we find the fire produced smoke on the floor of origin and other floors in 79 per cent of the fire incidents. Thus, it is apparent the propagation of smoke was extensive in the majority of the fire incidents included in this study.

The data presented in Table IX, indicates the total observed visible smoke spread, as reported by the officer in charge of the first arriving fire department unit at the scene of the fire incident. As would be expected from the previous discussion on Table VIII, the prevalent smoke spread apparently involved a single floor in 138 of the fire incidents which is approximately 41.2 per cent of the fire incident population. This figure is in approximate agreement with the 139 incidents reported to be observed with smoke spread on the floor of fire origin as presented in Table VIII. When the visible smoke spread involving one, two and three floors is considered, the majority of the fire incidents are included for a total of 277 fire incidents or approximately 79.7 per cent of the total fire incident population. It should be noted, the range of the observed visible smoke spread from the fire incident as observed by the fire department officer upon his arrival varied from a single floor to the maximum of seven floors. In addition, 120 of the fire incidents, consisting of approximately 41.8 per cent of the fire incident population, involved visible smoke spread of two or more floors.

C. The Characteristics of The Buildings in The Fire Incident Population.

There would appear to be certain inherent characteristics of the buildings involved in the fire incidents, which might have an influence on

TABLE VIII
 VISIBLE SMOKE SPREAD AT FIRE DEPARTMENT ARRIVAL

Area	Incidents	Per Cent	
None	19	5.7	
Room - Area of Origin	47	14.0	
Floor of Origin	139	41.5	
Other Floors	113	33.7	
Not Reported	17	5.1	
N = 5	335	100.0	
M = 67	SE _M = 24.96	SD = 55.91	SE _{SD} = 17.72

TABLE IX
 TOTAL NUMBER OF FLOORS OF SMOKE AT FIRE DEPARTMENT ARRIVAL

Number of Floors	Incidents	Per Cent	
1	138	41.2	
2	92	27.5	
3	37	11.0	
4	7	2.1	
5	2	0.6	
6	1	0.3	
7	1	0.3	
Not Reported	57	17.0	
N = 8	335	100.0	
M = 41.87	SE _M = 17.99	SE = 50.92	SE _{SD} = 12.77

the physical environment and thus predetermine certain behavioral responses. The occupancy of the building determines the function or purpose of the structure, which usually determines the characteristics of the population which occupies the building. Cannon, (4) found the openings on the ground floor which provided natural light to the interior of department stores served to identify the exit locations for many patrons. Similarly, Cannon (4) found the presentation of a visual and verbal message prior to the showing of the feature film, in a motion picture theatre, resulted in the increased recognition of the exit sign as evaluated by the recall of the color of the sign, for the female, adult population.

The characteristics of the buildings in this study have been examined in relation to the occupancy of the building; the number of stories in the building; and the number of fire alarms reported to the fire department during the year prior to the reported fire incident.

1. The Occupancies Within The Fire Incident Population.

The occupancies of the buildings in which the fire incidents occurred in this study are presented in Table X. It is apparent the single family dwelling was the predominant occupancy involved in the study with a total of 199 of the fire incidents, or approximately 59.4 per cent of the total fire incident population. It should be noted, when all of the residential occupancies consisting of both the residential dwellings and the apartments are considered, 84.5 per cent of the fire incidents in the study occurred in these occupancies.

The prevalence of the residential occupancy in the fire incident population appears to be a reflection of the occupancy population for the jurisdictions participating in the study as previously presented in

TABLE X
OCCUPANCY OF BUILDINGS

Occupancy	Incidents	Per Cent	
Dwelling (1 Family)	199	59.4	
Apartments (< 20 Units)	62	18.5	
Dwelling (2 Family)	14	4.2	
Apartments (> 20 Units)	8	2.4	
Restaurant	7	2.0	
Motel and Hotel	5	1.5	
School	5	1.5	
College Dormitory	3	0.9	
Office	3	0.9	
Hospital	2	0.6	
Club	2	0.6	
Fraternity - Sorority	2	0.6	
Food Store	2	0.6	
Clothing Store	2	0.6	
Other	17	5.1	
Not Reported	2	0.6	
N = 16	335	100.0	
M = 20.94	SE _M = 12.44	SD = 49.75	SE _{SD} = 8.83

Table I. Also, it should be remembered this study was limited to the consideration of fire incidents in which the occupants were in the structure when the fire incident occurred. Upon examination, it also becomes apparent the residential occupancies are often occupied for a longer period of time, throughout the twenty-four hour day than many of the other occupancies. Some of the occupancies included in the study were obviously included due to the location of the participating jurisdictions. The college dormitory and the sorority or fraternity house occupancies reflect the unique occupancy characteristics of one jurisdiction which included a large university with a 9,000 resident student population.

Some of the interesting occupancies which involved a single fire incident and were therefore placed under the "other" classification involved a mobile home, a houseboat, a fire station, a delicatessen, a service station, a dry cleaning plant, a paint manufacturer, a photographic laboratory, and an aeronautical instrument manufacturer.

It should be remembered, the selection of the fire incidents for the study population was apparently influenced by the primary and essential duties of the fire department personnel involved in the data collection procedures. The fire department personnel involved in this study may be classified relative to their basic functional positions within the various fire department organizations as follows: Fire prevention bureau personnel primarily a fire prevention inspector or fire education specialist were involved in the data collection. Fire company personnel, often the officer in charge of the initial responding company, with the

rank of Sergeant, Lieutenant, or Captain, although one jurisdiction utilized the responsible Battalion Chief. One jurisdiction with arson investigators, utilized the services of these highly trained and very specialized personnel for the collection of the study data.

The fire incident population relative to the occupancies involved in the buildings appeared to be a rather accurate reflection of the fire incidents which possess the necessary component of human occupancy within the structure when the fire incident occurred. It should be remembered the fire incident fatalities and injuries in the United States primarily involve fires in residential occupancies including dwellings and apartments.

2. The Height of The Buildings in The Fire Incident Population.

The height of a building is usually a function of the location of the building and the occupancy of the building. Upon consideration of the occupancies in the fire incident population it is expected the most prevalent height, for the fire incident building would be two stories as indicated in Table XI. It should also be noted that 89.9 per cent of the buildings in the fire incident population for this study were under four stories in height. The maximum height for any building included in the fire incident population was obtained with a thirty story apartment building. Generally any building with a height exceeding 7 stories is considered to be a "high rise building." Thus, Table XI, indicates the fire incident population only included 11 fire incidents in buildings exceeding 7 stories in height, which is approximately 3.2 per cent of the fire incident population.

It should be noted, there were a total of 16 buildings with a height above 4 stories included in the fire incident population. The restricted heights of the buildings involved in the fire incident population of this study would appear to be a result of the predominate types of building

TABLE XI
TOTAL NUMBER OF FLOORS IN BUILDINGS

Floors	Incidents	Per Cent	
1	63	18.8	
2	150	44.8	
3	88	26.2	
4	14	4.2	
5	1	0.3	
6	3	0.9	
7	1	0.3	
8	3	0.9	
9	2	0.6	
10	1	0.3	
11	1	0.3	
12	1	0.3	
17	1	0.3	
24	1	0.3	
30	1	0.3	
Not Reported	4	1.2	
N = 16	335	100.0	
M = 2.60	SE _M = .089	SD = 1.61	SE _{SD} = .063

construction for the residential occupancies in the suburban areas. These buildings primarily consist of one and two story dwellings, and the garden type of apartments. The garden type of apartment construction consists of three and four story buildings, which is usually the maximum height permitted without the installation of elevators.

3. The Number of Known Fire Alarms in The Building During The Previous Year.

This item relative to the number of known previous alarms in the building was an attempt to determine if prior conditioning due to numerous fire alarms or the absence of fire alarms might predetermine the response actions of the participants. However, the concept of known alarms was defined to include only the number of fire alarms as obtained from the fire department records, and thus did not include the sounding of the interior evacuation alarm without the notification of the fire department. It was reported by the fire department personnel in some of the participating jurisdictions, that activation of the evacuation fire alarms in apartment buildings is often a relatively frequent occurrence. Thus, the occupants of the building will not evacuate at the time of a fire incident until required to do so by the fire department personnel.

The frequency data relative to the number of known previous fire alarms for the 46 fire incidents in which this information was reported is presented in Table XII. It is important to remember that data was not presented for the occupancies with no known previous alarms, which constituted a total of 289 buildings, while the fire incidents which occurred in buildings with known previous fire alarms consisted of only 13.7 per cent of the fire incident population for this study.

TABLE XII
 NUMBER OF KNOWN ALARMS IN
 PREVIOUS YEAR IN BUILDING

Number of Alarms	Buildings	Per Cent	
1	18	39.2	
2	7	15.2	
3	5	10.9	
4	7	15.2	
5	1	2.2	
6	2	4.3	
7	1	2.2	
10	2	4.3	
16	1	2.2	
20	2	4.3	
N = 10	46	100.0	
M = 3.81	SE _M = 1.27	SD = 8.60	SE _{SD} = 0.90

Considering the 46 fire incidents in buildings with previous known fire alarms, 37 fire incidents or approximately 80.3 per cent of the 46 fire incidents occurred in buildings with a total of four or less fire alarms during the previous year. Eighteen of the buildings had a single fire alarm during the previous year, and two buildings, both college dormitories had 20 fire alarms during the previous year.

D. The Fire Protection Equipment of The Buildings.

The fire protection equipment provided in the buildings involved in the fire incidents for this study were investigated and noted by the fire department personnel at the scene. It was hypothesized the amount and type of fire protection equipment, might affect the occupant's formation of the concept of the building as being safe or unsafe. Data was collected on the type of manual fire alarm alerting devices utilized; the provision of fire extinguishers; the provision of standpipe hose; the buildings in which the fire protection equipment was utilized by the occupants; the type of automatic detectors provided in the buildings; the occupancies provided with automatic fire detectors; the operation of the automatic fire detectors; the occupancies equipped with automatic sprinkler systems; the sprinkler systems which operated, and the determination of the occupancies in the fire incident population provided with exit signs relative to the color of the exit signs.

1. The Type of Manual Fire Alarm Alerting Device and The Connection of The Alarm System to The Fire Department.

Manual fire alarm systems were provided in 60 of the buildings involved in fire incidents, or approximately 17.9 per cent of the 335

buildings involved in the fire incident population. The information relative to the manual fire alarm systems and the connection of these systems to the Fire Department is presented in Table XIII. It should be noted, only three of the fire alarm systems, all in public or industrial occupancies were connected to the fire department.

2. The Occupancies Provided With Fire Extinguishers.

A total of 112 buildings were equipped with fire extinguishers, which is approximately 33.4 per cent of the fire incident population. A total of twenty-seven different occupancies were involved in the 112 buildings with fire extinguishers, and this data is provided in Table XIV. It should be noted that most of the public occupancy buildings in the fire incident population were provided with fire extinguishers. This response was expected since most of these buildings are required by local ordinance or state law to provide this type of fire protection equipment. The occupancy with the greatest number of buildings with fire extinguishers, appears to be the apartment buildings with less than 20 units within the building. While the occupancy with the next greatest number of buildings was the single family dwelling, with 26 dwellings being provided with fire extinguishers. It is significant to compare this Table XIV relative to fire extinguishers, with Table XVIII, concerned with the installation and operation of automatic fire detectors, the single family dwelling was the occupancy with the greatest number of fire incidents in which an automatic fire detector operated.

Relative to the number of buildings in the various occupancy classifications provided with fire extinguishers as presented in Table XIV, it is significant to note that most of the occupancies utilized by the public have all the buildings provided with fire extinguishers. However, fire extinguishers are a type of manual fire fighting equipment, and this equipment requires activation and operation by the occupants of the structure. Thus, the

TABLE XIII
 TYPE OF MANUAL FIRE ALARM
 AND OCCUPANCIES CONNECTED TO FIRE DEPARTMENT

Type of Alarm	Buildings	Per Cent	Connected Occupancy	Bldgs.	Per Cent
Bell	54	90.0	Hotel	1	33.3
Other	4	6.6	Clothing Store	1	33.3
Public Address	2	3.3	Paint Manufact.	1	33.3
N = 3	60	100.0		3	100.0
M = 20	SE _M = 17.03	SD = 29.46	SE _{SD} = 12.09		

TABLE XIV
OCCUPANCIES PROVIDED WITH EXTINGUISHERS

Occupancy	Buildings	Per Cent		
Apartments (< 20 Units)	37	33.0		
Dwelling (Single Family)	26	23.1		
Apartments (> 20 Units)	7	6.3		
Restaurant	6	5.4		
School	4	3.6		
College Dormitory	3	2.7		
Hotel and Motel	3	2.7		
Manufacturing	3	2.7		
Store	3	2.7		
Hospital	2	1.8		
Fraternity - Sorority	2	1.8		
Office	2	1.8		
Other	14	12.5		
N = 13	112	100.0		
M = 8.62	SE _M = 3.02	SD = 10.90	SE _{SD} = 2.14	

data on the fire fighting behavior of the participants should also be examined in Section V of this report.

3. The Occupancies Provided with Standpipe Hose.

Table XV presents the data on the number of occupancies which included buildings provided with the standpipe and hose equipment as a manual fire protection system for the building. It should be noted, the inclusion of the three single family dwellings was questioned at the time of the data submittal for the study, and these dwellings were equipped with a connected 1 inch rubber hose system with a nozzle, permanently installed in the dwelling, designed and intended for the fire fighting use of the occupants. A total of 21 buildings were provided with a standpipe hose system, which is approximately 6.3 per cent of the fire incident population for this study.

4. The Occupancies in Which Fire Fighting Equipment Was Used by Occupants.

Table XIV indicated there were 112 buildings provided with fire extinguishers and Table XV indicated a total of 21 buildings were provided with standpipe hose systems. Thus, a considerable segment of the buildings in the fire incident population were provided with standard fire protection equipment requiring action by the participants to utilize the equipment. It is apparent the fire fighting behavior of the occupants of these buildings involves variables beyond the provision of the fire fighting equipment. These human behavior variables would involve the age, sex, previous training, and previous fire experience of the participants.

TABLE XV
OCCUPANCIES PROVIDED WITH STANDPIPE HOSE

Occupancies	Buildings	Per Cent	
Apartment (> 20 Units)	5	23.8	
Dwelling (1 Family)	3	14.3	
Hospital	2	9.5	
Motel	2	9.5	
College Dormitory	2	9.5	
Office	2	9.5	
City Club	1	4.8	
College Building	1	4.8	
Apartment (< 20 Units)	1	4.8	
Clothing Store	1	4.8	
Paint Manufacturing	1	4.8	
N = 11	21	100.0	
M = 1.91	SE _M = 0.37	SD = 1.22	SE _{SD} = 0.26

The fire fighting behavior of the participants in these fire incidents were analyzed and is presented in Section V of this report. A total of 64 fire incidents were involved in which the occupants engaged in the fire fighting behavior and the occupancies involved in these incidents are presented in Table XVI.

5. The Types of Fire Detectors, The Occupancies Provided With Detectors, and The Operation of The Detectors.

Table XVII presents the information on the three types of automatic fire detectors provided in 21 buildings of the fire incident population. The most prevalent type of automatic fire detector was the smoke detector, which was located in twelve buildings. Heat detectors were provided in five buildings, and as indicated in Table XVII, combination heat and smoke detectors were located in four buildings. It is apparent that both stand-pipe hose systems and detectors were not extensively utilized in the fire incident population, since only 6.3 per cent of the total fire incident population with 335 buildings were provided with this fire protection equipment.

The number of buildings for the various occupancies in the fire incident population provided with automatic fire detectors and the occupancies in which the detectors operated in the fire incident are presented in Table XVIII. It should be noted of the twenty-one buildings with automatic fire detectors in the buildings, fourteen of these buildings had detectors which operated in a fire incident. The most prevalent occupancies with the building equipped with a fire detector was the single family dwelling, and the apartments with less than 20 units as indicated in Table XVIII. However, it should be noted, of the two hospitals included in the fire incident population, both of the hospitals were provided with automatic fire detectors, while

TABLE XVI

OCCUPANCIES IN WHICH FIRE FIGHTING
EQUIPMENT WAS UTILIZED BY OCCUPANTS

Occupancy	Incidents	Per Cent
Dwelling (1 Family)	23	35.9
Apartment (< 20 Units)	18	28.1
Restaurant	3	4.8
Apartment (> 20 Units)	3	4.8
Manufacturing	2	4.8
Hotel and Motel	2	3.2
School	3	3.2
Billard Center	1	1.5
City Club	1	1.5
Hospital	1	1.5
Dwelling (2 Family)	1	1.5
College Dormitory	1	1.5
Service Station	1	1.5
Office	1	1.5
Photographic Laboratory	1	1.5
Other	2	3.2
N = 16	64	100.0
M = 4.00	SE _M = 1.64	SD = 6.55
		SE _{SD} = 1.16

TABLE XVII
TYPE OF AUTOMATIC DETECTORS
IN BUILDINGS

Detector	Buildings	Per Cent	
Smoke	12	57.1	
Heat	5	23.8	
Heat and Smoke	4	19.1	
N = 3	21	100.0	
M = 7.0	SE _M = 2.52	SD = 4.36	SE _{SD} = 1.79

TABLE XVIII
DETECTORS IN BUILDINGS AND OPERATION

Occupancy	Building	Per Cent	Operated	Per Cent
Dwelling (1 Family)	9	42.8	4	28.7
Apartments (20 Units)	4	19.0	3	21.6
Hospital	2	9.4	1	7.1
School	1	4.8	1	7.1
Dwelling (2 Family)	1	4.8	1	7.1
Hotel	1	4.8	1	7.1
Mobile Home	1	4.8	1	7.1
Office	1	4.8	1	7.1
Paint Manufacturing	1	4.8	1	7.1
N = 9	21	100.0	14	
M = 2.33 SD = 1.13	SE _M = 0.90 SE _{SD} = 0.27	M = 1.55 SD = 2.69	SE _M = 0.38 SE _{SD} = 2.69	

only one of the five schools included in the fire incident population was provided with automatic fire detectors. The operation of the automatic fire detectors in the four single family dwellings in the fire incident population involved fire incidents as reported by the occupants and the fire department personnel to include situations in which the lives of the occupants were believed to have been saved by the operation of the detectors.

6. The Occupancies in Which Automatic Sprinklers Were Provided and Operated.

As would be expected with a fire incident population consisting of fires primarily in residential occupancies, there were very few buildings in the study provided with automatic sprinkler systems. Table XIX presents the seven occupancies, consisting of five apartment buildings, and two industrial occupancies for a total of seven buildings which were provided with automatic sprinkler systems. It should be noted, none of the five apartment buildings, were provided with complete automatic sprinkler systems throughout the building. These apartment buildings were provided with partial automatic sprinkler systems, primarily in the public areas, and the occupant storage areas. However, both of the industrial occupancies consisting of the paint manufacturing plant and the photographic laboratory were completely equipped with an automatic sprinkler system.

7. The Occupancies Provided With Exit Signs.

Table XX presents the data and information on the buildings classified by their occupancy, relative to the provision of exit signs in the buildings. It can be noted of course, that all of the school buildings, the clothing

TABLE XIX
 OCCUPANCIES IN WHICH
 AUTOMATIC SPRINKLERS OPERATED

Occupancy	Incident	Per Cent	
Apartment (< 20 Units)	4	57.1	
Apartment (> 20 Units)	1	14.3	
Paint Manufacturing	1	14.3	
Photographic Laboratory	1	14.3	
N = 4	7	100.0	
M = 1.75	$SE_M = 0.75$	$SD = 1.50$	$SE_{SD} = 0.53$

TABLE XX
EXIT SIGNS BY OCCUPANCY

Occupancy	Buildings With Signs	Per Cent	Occupancy Population	Per Cent
Apartments (> 20 Units)	8	17.0	8	100
Apartments (< 20 Units)	5	10.6	62	8.1
Restaurants	5	10.6	7	71.4
School	5	10.6	5	100.0
College Dormitory	3	6.4	3	100.0
Office	3	6.4	3	100.0
Fraternity - Sorority	2	4.3	2	100.0
Clothing Store	2	4.3	2	100.0
Other	14	29.8	243	5.8
N = 9	47	100.0	335	
M = 5.22	SE _M = 1.27		M = 20.94	SE _M = 12.44
SD = 3.80	SE _D = 0.90		SD = 49.75	SE _{SD} = 8.83

stores, the office buildings, the college dormitories, and both of the fraternity sorority houses were provided with exit signs. It would appear the provision of exit signs in the various buildings, is a similar situation to the provision of the fire extinguishers, being primarily concentrated in the occupancies relative to the degree of public access to the building. It should be noted that 47 buildings out of the total fire incident population of 335 buildings were provided with exit signs for approximately 14 per cent of the fire incident building population.

IV. THE PARTICIPANT POPULATION

The participant population of the study consisted of a total of 584 persons, who were in the buildings involved in the fire incidents. In a few cases, the participants were outside of the building when they became aware of the fire incident. However, these persons were included in the study if they entered the building, immediately upon becoming aware of the fire incident. The primary data related to the participants was collected from part II of the questionnaire, as previously illustrated in Figure 2 of this report on page 16. The characteristics and behavioral dynamics of the participant population were obtained from the observations of the fire department interviewer at the time of the interview at the fire scene and the responses of the participant.

A. Demographic Characteristics of the Participant Population.

The distribution of the participant population relative to their geographical distribution from the various jurisdictions involved in the study was previously presented in Table I on page 10. The range of participants varied from a high of 109 participants from Howard County, Maryland to the low of 15 individuals from the City of Alexandria, Virginia. As previously discussed, the interviewing of participants varied with the availability and duty assignments of the fire department personnel. The greatest number of persons from a single fire incident consisted of nine persons interviewed at an apartment house fire incident. Obviously, the least number of participants interviewed at a single fire incident consisted of a single individual.

1. The Jurisdictional Distribution of the Participant Population.

It should be remembered the participants were not equally distributed throughout the jurisdictions due to differences in the selection of fire incidents, and the availability of personnel to interview the participants at the fire scene. The Howard County, Maryland, Fire Department interviewed the greatest number of participants, while the City of Alexandria, Virginia provided the smallest number of participant interviews. It should be remembered from Table I the jurisdiction with the greatest number of fire incidents did not have the greatest number of participants in the study population. A compilation of the distribution of participants related to each fire incident in the various jurisdictions is provided in Table XXI.

2. The Occupational Distribution of the Participant Population.

The occupations of the members of the participant population are presented in Table XXII. It is a reflection of the sexual distribution of the population presented in Table XXIV, and the selection of fire incidents involving principally residential occupancies as previously presented in Table X, which resulted in the predominate occupation for 18 per cent of the participant population being housewife. The variety of the occupations for the participants is presented in Table XXII, and it would appear the occupation of student might have been biased by the principal occupancy in one jurisdiction being a large university.

TABLE XXI
 JURISDICTIONAL DISTRIBUTION OF PARTICIPANT POPULATION
 RELATED TO FIRE INCIDENTS

Jurisdiction	Participants	Incidents	Mean Number of Participants-Incident
Alexandria	15	6	2.50
Annapolis	40	20	2.00
Anne Arundel County	51	31	1.65
Arlington County	17	11	1.56
Baltimore City	99	91	1.09
Baltimore County	46	24	1.92
College Park	35	10	3.50
Fairfax County	54	23	2.35
Howard County	109	69	1.58
Montgomery County	32	10	3.20
Prince William County	86	40	2.15
N = 11	584	335	11
Range =	15-109	6-91	1.09-3.50
M=52.6 SD=31.6 M=30.4 SD=26.9 M=1.74 SD=0.72			
SE _M =1.31 SE _{SD} =0.93 SE _M =1.47 SE _{SD} =1.04 SE _M =0.22 SE _{SD} =0.71			
Per Cent of Participant Population = 100.0			

TABLE XXII
 OCCUPATIONAL DISTRIBUTION OF PARTICIPANT POPULATION

Occupation	Participants	Per Cent
Housewife	104	23.4
Student	66	14.8
Manager	18	4.1
Retired	15	3.4
Teacher	14	3.2
Secretary	13	2.9
Nurse	8	1.8
Office Clerk	8	1.8
Sales Person	7	1.6
Custodian	7	1.6
Social Worker	7	1.6
Supervisor	7	1.6
Assembly Men	7	1.6
Technician	7	1.6
Military	7	1.6
Counselor	6	1.4
Driver	6	1.4
Waiter	6	1.4
Government Worker	6	1.4
Receptionist	5	1.1
Domestic	5	1.1
Check Out Clerk	5	1.1
Construction	5	1.1
Resident Manager	4	0.9
Mechanic	4	0.9
Printer	4	0.9
Cook	4	0.9
Other	88	19.8
N = 28	443	100.0

Per Cent of Participant Population = 75.9

3. The National Origin of the Participant Population.

The national origin of the participants was obtained from observation and the participant's response to the questionnaire as verbally related to the interviewer. As would be expected, the majority of the participants were from North America and the United States as indicated in the distribution presented in Table XXIII on page 64 of this report. It should be noted there were a total of 552 participants in this distribution or approximately 94.5 per cent of the total participant population of 584 persons. It should be observed only 20 participants were from outside of North America, consisting of approximately 3.7 per cent of this population presented in Table XXIII.

4. The Sexual Distribution of the Participant Population.

During the interview, the fire department personnel classified the sexual type of the participant. The sexual distribution for 582 of the participants is presented in Table XXIV. Given the predominant residential type of occupancy involved in the study, the sexual distribution for the participant population is obviously skewed. There were 56 more female participants than male participants for a female population of 319 or approximately 54.8 per cent of the participant population. It should be noted the sexual identification of two participants in the study was not determined.

5. The Age Distribution of the Participant Population.

The age distribution of the participant population was determined from the analysis of the data collected by the interviewers. The fire department personnel utilized both verbal responses of the participants,

TABLE XXIII
 NATIONAL ORIGIN OF PARTICIPANT POPULATION

Nationality	Participants	Per Cent
North American	242	43.8
United States		
(White)	210	38.0
(Black)	78	14.1
(Oriental)	2	0.4
France	3	0.5
Great Britain	3	0.5
Israel	3	0.5
Cuba	2	0.4
Germany	2	0.4
Virgin Islands	1	0.2
South America	1	0.2
Guatemala	1	0.2
Palestine	1	0.2
Italy	1	0.2
Japan	1	0.2
Greece	1	0.2
N = 16	552	100.0
Range = 1 - 242	Per Cent of Participant Population = 94.5	

TABLE XXIV
SEXUAL DISTRIBUTION OF PARTICIPANT POPULATION

Sex	Number	Per Cent
Female	319	54.8
Male	263	45.2
N = 2	582	100.0
Per Cent of Participant Population = 99.6		

and their personal observations. The range of reported ages varied from a low of 6 years to a high of 90 years for the 534 participants included in the age distribution population. The data on the age distribution of the participants is presented in Table XXV. It should be noted the mean age of the participant population as presented in Table XXV was 34.5 years of age, with a standard deviation for this distribution of 5.88. Thus, the mean and the standard deviation were computed for the age distribution utilizing the following formulae from Garrett's Text:² For the computation of the Mean: $M = \frac{Efx}{N}$. The Standard Deviation was also computed with a formula taken from Garrett's test for utilization with original raw scores:³ $SD = \sqrt{\frac{NEX^2 - (EX)^2}{N}}$

The Standard Error of the Mean was computed for the mean, again by the utilization of a formula from Garrett's text:⁴ $SE_M = \frac{SD}{\sqrt{N}}$

The Standard Error of the Standard Deviation for the age distribution was also computed utilizing the following formula from Garrett's text:⁵ $SE_{SD} = \frac{.71 SD}{\sqrt{N}}$ These formulas were also used for the identical components of the statistical computations in the tables presented in sections III, IV, V, VI and VII of this report.

²Henry E. Garrett, Statistics in Psychology and Education, New York: Longmans, Green & Co., 4th edition, 1953, p. 29.

³Ibid. p. 55

⁴Ibid. p. 182.

⁵Ibid. p. 195.

TABLE XXV
DISTRIBUTION OF AGE OF PARTICIPANT POPULATION

Age	Participants	Per Cent	
6-10	14	2.6	
11-15	19	3.6	
16-20	54	10.2	
21-25	83	15.5	
26-30	92	17.2	
31-35	58	10.8	
36-40	48	8.9	
41-45	41	7.8	
46-50	36	6.8	
51-55	36	6.8	
56-60	15	2.8	
61-65	14	2.6	
66-70	12	2.2	
71-75	4	0.7	
76-80	5	0.9	
81-85	2	0.4	
86-90	1	0.2	
N = 17	534	100.0	
M = 34.5	SE _M = 0.25	SD = 5.88	SE _{SD} = 0.18
Range = 6 - 90			
Per Cent of Participant Population = 91.4			

B. The Fire Incident Building Populations.

The fire department official at the scene of the fire incident collected information relative to the total population of persons in the fire incident building at the time of the fire incident, and some basic information related to the behavior of the total building population. This information is presented to provide an understanding of some of the essential characteristics of the building populations exposed to the fire incidents in this study. It should be remembered the participant population of this study was selected from the fire incident building population by the interviewer.

1. Building Population at the Time of the Fire Incident.

The population of the fire incident building at the time of the incident is presented in Table XXVI. The most frequent population apparently consisted of 2 persons in a total of 59 fire incidents for 18 per cent of the fire incidents in this distribution. The fire incident building population distribution consisted of a total of 327 fire incidents or approximately 97.6 per cent of the total fire incident population of 335 incidents. The range of populations in the fire incident buildings varied from the obvious minimum of 1 person in the residential occupancies to the high of 3,000 persons in a high school occupancy. The mean population for buildings in the 327 fire incidents was computed at 35.05 persons per fire incident building. While the standard deviation of this distribution was computed at 5.92. The total population exposed in the 327 fire incidents consisting of 11,462 persons is an indication of the total

TABLE XXVI
POPULATION IN BUILDINGS WHEN FIRE DISCOVERED

Number of Persons	Per Cent Population	Incidents	Per Cent
1	0.4	44	13.4
2	1.0	59	18.0
3	1.3	48	14.7
4	1.1	32	9.8
5	1.3	29	8.8
6	0.9	18	5.5
7	0.5	8	2.4
8	0.6	9	2.7
9	0.1	2	0.6
10	0.8	9	2.7
11 - 20	2.7	23	7.0
21 - 30	3.8	16	4.9
31 - 40	3.4	11	3.4
41 - 50	1.6	4	1.1
60	0.5	1	0.3
70	0.6	1	0.3
75	0.6	1	0.3
100	0.9	1	0.3
150	5.2	4	1.1
200	3.5	2	0.6
300	5.2	2	0.6
330	2.9	1	0.3
500	4.4	1	0.3
700	6.1	1	0.3
880	7.8	1	0.3
1900	16.6	1	0.3
3000	26.2	1	0.3
11,462	100.0	327	100.0
M = 35.05	SE _M = 0.33	SD = 5.92	SE _{SD} = 0.23
Range = 1 - 3000	1 - 59 Per Cent of Incident Population = 97.6		

life risk exposure of this study.

2. Evacuation Population Who Left Before Fire Department Arrival.

Information was collected relative to the number of persons from the total fire incident building population who had evacuated the building, before the arrival of the fire department. It was originally assumed the evacuation of the building prior to the confirmation of the severity of the fire occurrence by the arrival of the fire department, would provide an indication of the interpretation of the perceived severity of the threat of the fire occurrence to the building population. The distribution of the number of persons who evacuated the building prior to the arrival of the fire department is presented in Table XXVII. It should be noted in approximately 20 per cent of the 264 fire incidents on which this data was collected, 2 persons evacuated the building. The range of persons involved in the evacuation behavior prior to the fire department arrival varied from a single person in 40 fire incidents to 877 persons in a single fire incident.

The information presented in Table XXVII indicates a total population of 3900 persons evacuated from the 264 fire incident buildings prior to the arrival of the fire department. This distribution when computed for a mean figure, resulted in 14.7 persons in each of the 264 evacuations as reported by the fire department official. It should be realized there were an additional 71 fire incident buildings involved in the fire incident population on which this data was not obtained during the study. The distribution of the 3900 persons who evacuated the 264 buildings should be compared with the data from Table XXVI, relative to the total

TABLE XXVII

PEOPLE IN BUILDING EVACUATED BEFORE FIRE DEPARTMENT ARRIVAL

Number of Persons	Per Cent Population	Incidents	Per Cent
1	1.0	40	15.2
2	2.8	55	20.8
3	3.0	39	14.8
4	2.8	28	10.6
5	2.3	18	6.9
6	2.0	13	5.0
7	1.1	6	2.3
8	1.6	8	3.0
9	0.7	3	1.1
10	2.1	8	3.0
11-20	5.3	13	5.0
21-30	12.6	18	6.9
31-40	4.5	5	1.9
41-50	2.6	2	0.7
69	1.8	1	0.4
80	2.1	1	0.4
100	2.6	1	0.4
150	3.8	1	0.4
189	4.8	1	0.4
300	7.7	1	0.4
400	10.3	1	0.4
877	22.5	1	0.4
N = 3900	100	264	100
M = 14.7	SE _M = 0.24	SD = 3.84	SE _{SD} = 0.17
Range 1 - 877	1 - 55 Per Cent of Incident Population = 78.8		

population in the fire incident buildings at the time of the fire incident.

3. Evacuation Population Who Left After Fire Department Arrival.

Table XXVIII, presents the data on the total population consisting of 1226 persons who were reported to have not left the building until after the arrival of the fire department. In many of these 76 fire incidents the personnel were ordered from the building by the fire department personnel. It should be noted that fire incidents did occur and were included in the study for both evacuation before fire department arrival, Table XXVII and evacuation after fire department arrival, Table XXVIII, since there were cases with portions of the building evacuating at different times. In addition there were incidents where portions of a building did not evacuate at all, with the personnel remaining in the building.

Related to the evacuation of personnel after the arrival of the fire department it should be noted of the 76 fire incidents included in this population, a single person was involved in the evacuation after fire department arrival for approximately 34 per cent of this distribution. The range of personnel involved in the evacuations varied from 1 to 600 persons. The mean figure computed from the reported population of 1,225 persons and 76 fire incidents consists of 16.1 persons evacuating after the arrival of the fire department, which compares to the mean figure of 14.7 persons evacuating before the arrival of the fire department, for a difference in means of these two populations of 1.4.

This difference between the two means was compared using a Critical Ratio procedure from Garrett,⁶ and was found to have a critical ratio of

⁶Garrett, Op Cit., p. 213-215.

TABLE XXVIII
 PEOPLE IN BUILDING LEFT AFTER
 FIRE DEPARTMENT ARRIVAL

Number of Persons	Per Cent Population	Incidents	Per Cent
1	2.1	26	34.2
2	3.1	19	25.0
3	1.0	4	5.4
4	1.3	4	5.4
5	2.8	7	9.2
6	1.0	2	2.6
7	0.6	1	1.3
10	0.8	1	1.3
12	1.0	1	1.3
13	1.1	1	1.3
15	2.4	2	2.6
20	1.6	1	1.3
30	2.4	1	1.3
45	3.7	1	1.3
50	4.2	1	1.3
70	5.7	1	1.3
100	16.3	2	2.6
600	48.9	1	1.3
<hr/>			
N = 1226	100.0	76	100.0
<hr/>			
M = 16.1	SE _M = 0.46	SD = 4.01	SE _{SD} = 0.32
<hr/>			
Range = 1 - 600	1 - 26	Per Cent of Incident Population = 22.7	
<hr/>			

2.69, which is significant, being above the 1 per cent level of confidence.

4. Building Population Who Did Not Leave During The Fire Incident.

The information collected by the fire department personnel, relative to the persons in the fire incident building, who did not leave during the fire incident is presented in Table XXIX. This population consisted of a total of 2,169 persons in 83 fire incidents. The range of populations that did not evacuate the building varied from a single person in 25 incidents to 700 persons in a single incident. It must be emphasized the populations presented in Tables XXVII through XXIX, are estimates of the personnel engaged in these types of behavior provided by the fire department officials at the scene of the fire incident. In Section V of this report we will be examining the data for the participant population, the persons actually interviewed, as to their evacuation or nonevacuation behavior. The reasons for the lack of an evacuation as verbally elicited from the participant population are presented in Table XLVIII A on page 164 of this report.

It should be noted that a mean of 26.13 persons was computed from the nonevacuation population of 2,169 for 83 fire incidents. This mean figure of 26.13 persons remaining in the building for 83 fire incidents should be compared with the mean of 14.7 persons who evacuated before the arrival of the fire department, and the mean of 16.1 persons who evacuated after the arrival of the fire department.

5. Building Population Rescued from The Fire Incident Building.

Table XXX, presents the data concerning 125 persons in 27 fire incidents who were rescued from the fire incident building. The range of these rescue

TABLE XXIX
PEOPLE IN BUILDING WHO DID NOT LEAVE

Number of Persons	Per Cent Population	Incidents	Per Cent
1	1.1	25	30.2
2	1.1	12	14.4
3	1.4	10	12.1
4	1.1	6	7.2
5	2.3	10	12.1
6	0.6	2	2.4
8	0.7	2	2.4
10	0.5	1	1.2
11	0.5	1	1.2
12	0.6	1	1.2
15	0.7	1	1.2
16	0.7	1	1.2
20	0.9	1	1.2
25	1.1	1	1.2
28	1.3	1	1.2
30	1.4	1	1.2
100	4.7	1	1.2
116	5.3	1	1.2
150	13.8	2	2.4
275	12.7	1	1.2
330	15.2	1	1.2
700	32.3	1	1.2
<hr/>			
N = 2169	100.0	83	100.0
<hr/>			
M = 26.13	SE _M = 0.56	SD = 5.12	SE _{SD} = 0.39
<hr/>			
Range = 1 - 700	1 - 25	Per Cent of Incident Population = 24.8	
<hr/>			

TABLE XXX
PEOPLE IN BUILDING RESCUED

Number of Persons	Per Cent Population	Incidents	Per Cent
1	10.4	13	48.2
2	8.0	5	18.5
3	4.8	2	7.4
4	6.4	2	7.4
5	4.0	1	3.7
8	6.4	1	3.7
10	8.0	1	3.7
15	12.0	1	3.7
50	40.0	1	3.7
N = 125	100.0	27	100.0
M = 4.62	SE _M = 0.41	SD = 2.15	SE _{SD} = 0.29
Range = 1 - 50	1 - 13	Per Cent of Incident Population = 8.06	

populations varied from a single person in 13 fire incidents to 50 persons in a single incident.

These 125 persons were approximately 1.1 percent of the 11,462 persons in the 335 fire incident buildings at the time of the fire incident as previously presented in Table XXVI. It should be noted that 39 participants or 6.7 per cent of the participant population were rescued from a fire incident building. Twenty-nine of these participants were rescued by the fire department, and ten were rescued by others. It should be recognized, that a high percentage of the individuals in the building population who were rescued required medical treatment and hospitalization following the fire incident, and were thus excluded from the participant population of this study.

C. Behavioral Frames of Reference of The Participant Population.

The participant population, consisting of the 584 persons interviewed at the fire scene, were questioned relative to their familiarity with the building, the extent of time they had been in the building, and their belief in the fire safety of the building. In addition, since Brown (2) indicated physical proximity was one of the critical factors relative to the individual's determination of a behavior mode of response, the participant's distance from the fire was determined. It was also considered to be important to determine the means by which the individual became aware of the fire incident. The persons who were alone at the time of the fire incident or the sociological and cultural roles of the other persons with the participant. Some of the most critical information developed in this section concerned the means by which the participant became aware of the occurrence of the fire

incident. The means of awareness tended to vary depending on the physical location of the individual to the fire incident, their being alone or with others, and in some cases the nature of the fire incident:

1. Participants Presence in The Building.

The determination of the participants functional purpose in the building at the time of the fire incident, was determined from the verbal responses of the participants. The classification categories were pre-established to consist of working, living, and visiting for the responses of the participants. It was assumed, the information relative to the purpose of the participant in the building, and the time the individual had been in the building would provide an indication of the familiarity of the individual with the building and the physical arrangement and environment of the means of egress for the building. Table XXXI presents the information for the 578 participants, relative to this item. The predominate number of participants, consisting of 469 persons or approximately 81 per cent of this population indicated their functional purpose in the building was due to the building consisting of their residence.

2. Time of Participant Population in The Building.

The time of the participants in the building, was directly related to their function in the building, as determined by the Live, Work and Visit Categories utilized in the questionnaire, and presented in Table XXXI. The time of the participants in the building varied from a person visiting in the building of 1 hour, to a participant who had resided in the fire incident building for a period of 45 years. Table XXXII, presents the data

TABLE XXXI
PRESENCE IN BUILDING OF PARTICIPANT POPULATION

Presence	Number of Participants	Per Cent
Live	469	81.1
Work	76	13.1
Visit	33	5.8
N = 3	578	100.0
Range = 33 - 469	Per Cent of Participant Population = 98.9	

TABLE XXXII
PARTICIPANT POPULATION BY TIME IN BUILDING

Hours	Persons	Per Cent	Months	Persons	Per Cent	Years	Persons	Per Cent
1	2	0.7	1	3	1.1	1	28	10.1
2	1	0.4	2	4	1.4	1.2	1	0.4
4	1	0.4	3	8	2.9	1.25	2	0.7
5	1	0.4	4	4	1.4	1.50	5	1.8
6	2	0.7	5	5	1.8	1.9	1	0.4
7	1	0.4	6	14	5.1	2	30	10.8
9	1	0.4	7	3	1.1	2.2	2	0.7
12	1	0.4	8	5	1.8	2.5	1	0.4
16	1	0.4	9	6	2.2	3	31	11.2
24	1	0.4				4	6	2.2
48	1	0.4				5	19	6.9
56	2	0.7				6	14	5.1
						7	6	2.2
						8	11	3.9
						8.5	1	0.4
						9	5	1.8
						10	6	2.2
						11	1	0.4
						12	9	3.3
						13	2	0.7
						14	5	1.8
						15	8	2.9
						17	2	0.7
						18	2	0.7
						20	2	0.7
						21	2	0.7
						22	2	0.7
						23	2	0.7
						28	1	0.4
						30	1	0.4
						45	1	0.4
N = 15		5.7	52		18.8	209		76.5
Total N = 276		Per Cent of Participant Population = 47.3						
Range = 1 hour to 45 years								

relative to the time of the participant population in the building, for a total of 276 of the participants or approximately 47.3 per cent of the total participant population. The time of the participants in the fire incident building is presented in the time intervals of hours, months, and years, to provide a logical sequence of the time of the participants in the building.

3. Belief of Participants in The Safety of The Building.

The belief of the participants, relative to the safety of the building was verbally elicited in direct response to the inquiry of the fire department official at the scene. Table XXXIII presents the responses of the participant population relative to their belief in the safety of the building. It should be noted, that 89 persons, or approximately 15.2 per cent of the total participant population believed the building was unsafe. It should be remembered, however, that all the participants were being interviewed, after the occurrence of a fire incident in the building.

Relative to the 89 members of the participant population who considered the building to be unsafe, the reasons given in response to the question of why they considered the building to be unsafe are presented in Table XXXIIIA. The reasons were classified as to the principle areas of concern for the participants, relative to the content of the statements. It should be noted the various features of the means of egress were of concern to 22 of the participants, construction features were the second most frequently mentioned items by 17 of the participants, and fire hazards were of concern to 15 of the participants. Thus 54 participants or approximately 61 per cent of the participants who believed the building to be unsafe were concerned with

TABLE XXXIII
PARTICIPANT POPULATION DISTRIBUTION
RELATIVE TO BELIEF IN THE SAFETY OF THE BUILDING

Safety Belief	Number of Participants	Per Cent
Safe	465	83.9
Unsafe	89	16.1
N = 2	554	100.0
Range = 89 - 465	Per Cent of Participant Population = 94.8	

TABLE XXXIIIA
 DISTRIBUTION OF CONCERNS FOR BELIEF IN
 BUILDING BEING UNSAFE BY THE PARTICIPANT POPULATION

Concerns	Participants	Per Cent
Means of Egress	22	24.7
Construction	17	19.1
Fire Hazards	15	16.9
Fire Protection - Extinguishers	9	10.1
Materials - Storage	7	7.9
Electrical	6	6.7
Maintenance	6	6.7
Miscellaneous	4	4.5
Not Reported	3	3.4
N = 9	89	100.0
Range = 3 - 22		PerCent of Participant Population = 15.2

means of egress, construction features and the fire hazards in the buildings. The reasons listed under the classification of miscellaneous, were primarily concerned with the general problem of the unpredictable nature of a fire occurrence. Two of the four comments under miscellaneous indicated a fire could occur in any residence.

4. Participant Population Awareness of The Fire.

The stimulus which first indicated to the participant the occurrence of the fire incident is recorded in Table XXXIV. It should be noted there were thirteen varied stimuli which tended to alert the participants as to the fire incident. The most prevalent means of awareness of the fire incident, was the odor of the smoke produced by the fire incident. However, it should be noted the second most frequent means of awareness was the act of being notified by other participants of the fire incident. However, when this item of notification by others is combined with the fourth most frequent stimulus of being notified by a family member, the procedure of being notified by another person becomes the most prevalent means of becoming aware of the fire incident for 224 members of the participant population which was approximately 39 per cent of this population. It should be noted under the third most frequent stimulus of noise, that 42 individuals were alerted by the noise of fire alarm signals or bells within the building, and the noise of other occupants moving in hallways or stairways was also mentioned frequently.

Relative to Table XXXIV, it appears, the alerting action of other individuals upon the discovery of a fire incident may be a very important mechanism. The physical variables related to the occurrence of a fire incident consisting of the odor of the smoke, the sight of the smoke or the flame, and the sensing of the heat, accounted for the initial awareness

TABLE XXXIV
 DISTRIBUTION OF THE MEANS OF AWARENESS OF
 THE FIRE INCIDENT FOR THE PARTICIPANT POPULATION

Means of Awareness	Participants	Per Cent
Smelled Smoke	148	26.0
Notified by Others	121	21.3
Noise	106	18.6
Notified by Family	76	13.4
Saw Smoke	52	9.1
Saw Fire	46	8.1
Explosion	6	1.1
Felt Heat	4	0.7
Saw-Heard Fire Department	4	0.7
Electricity Went Off	4	0.7
Pet	2	0.3
N = 11	569	100.0
Range = 2 - 148	Per Cent of Participant Population = 97.4	

of the fire incident for approximately 250 participants, consisting of 44 per cent of the population represented in Table XXXIV.

The means of awareness by the participants for the fire incident was compared for the participants relative to their sexual identification. Thus, Table XXXIVA presents the means of awareness for both the male and female members of the participant population. It should be noted of the 569 members of the participant population involved in the means of awareness for the fire incident analysis, 262 were men and 307 were women, for a total of approximately 97.4 per cent of the participant population. The similarity in the means of awareness are evident for both the male and female members of the population. The three most frequent means of awareness for the men were notification by others, noise, and the odor of smoke, while the three most frequent means of awareness for the female members of the population were the odor of smoke, the notification by others, and the notification by a family member.

The differences in the percentage of the male and female populations for the various means of awareness were examined in Table XXXIVB, in an attempt to determine if any of these differences were statistically significant. As shown in Table XXXIVB, it is apparent that 22.5 per cent of the males as contrasted to 15.4 per cent of the females were alerted to the fire incident by noise. However, this difference was statistically significant above the five per cent level of confidence. In a similar manner, the fact that 12.2 per cent of the men were alerted by the sight of smoke as opposed to 6.5 per cent of the females, was also statistically significant above the five per cent level of

TABLE XXXIVA
SEXUAL DISTRIBUTION OF PARTICIPANT POPULATION
RELATIVE TO THE AWARENESS OF FIRE

Means of Awareness	Men	Per Cent	Women	Per Cent	Total	Per Cent	
Others Notified	59	22.5	62	20.2	121	21.3	
Family Member Notified	28	10.7	48	15.6	76	13.4	
Smelled Smoke	58	22.1	90	29.3	148	26.0	
Saw Smoke	32	12.2	20	6.5	52	9.1	
Saw Fire	22	8.4	24	7.8	46	8.1	
Felt Heat	1	0.4	3	1.0	4	0.7	
Noise	59	22.5	47	15.4	106	18.6	
Explosion	2	0.8	4	1.3	6	1.1	
Saw or Heard Fire Apparatus	0	0	4	1.3	4	0.7	
Awakened by Pet	0	0	2	0.6	2	0.3	
Electricity Off	1	0.4	3	1.0	4	0.7	
N = 11	262	100.0	307	100.0	569	100.0	
Range = 0 - 59	2 - 90	Per Cent of Participants = 97.4					

TABLE XXXIVB
SIGNIFICANCE OF SEXUAL DIFFERENCES ON AWARENESS
OF FIRE FOR PARTICIPANT POPULATION

Means of Awareness	Men Per Cent	Women Per Cent	$P_1 - P_2$	$SE_{P_1 - P_2}$	C.R.
Smelled Smoke	22.1	29.3	7.2	3.71	1.94
Others Notified	22.5	20.2	2.3	3.45	0.66
Noise	22.5	15.4	7.1	3.29	<u>2.16*</u>
Family Notified	10.7	15.6	4.9	2.88	1.70
Saw Smoke	12.2	6.5	5.7	2.43	<u>2.34*</u>
Saw Fire	8.4	7.8	0.6	2.29	0.26
Explosion	0.8	1.3	0.5	0.89	0.56
Felt Heat	0.4	1.0	0.6	0.71	0.85
Saw-Heard Apparatus	0	1.3	1.3	0.70	1.85
Electricity Off	0.4	1.0	0.6	0.71	0.85
Pet	0	0.6	0.6	0.48	1.25
N = 11	262	307			

* Critical Ratios significant at or above the 5 per cent level of confidence.

confidence. The Standard Error of the differences in the percentages

was computed using the following formula:⁷ $SE_{P_1-P_2} = \sqrt{PQ \left[\frac{1}{N_1} + \frac{1}{N_2} \right]}$

as developed in Garrett's text. The formula for the Critical Ratio

was obtained from the same text in the following formula:⁸

$$CR = \frac{(P_1 - P_2) - 0}{SE_{P_1 - P_2}} \quad \text{The Significance of the Critical Ratio was}$$

then determined from the Tables of t, for the reliability of Statistics.⁹

Relative to the sexual differences on the awareness of the fire it is interesting to note the women had a higher percentage of their population than the males becoming aware of the fire incident by the stimulus of, "smelled smoke", "family notified", an "explosion", "felt heat", "saw-heard apparatus", "the loss of electricity", and "by a pet". While the male population had a higher percentage of awareness from the stimulus of, "others notified", "noise", "saw smoke", and "saw fire". It is readily apparent the location of the participant, the distance of the participant from the fire, and the presence of other persons with the participant could influence their means of awareness of the fire incident. It would appear the means of awareness directly related to the changes in the physical environment due to the fire incident, including the seeing of smoke or fire, and the experiencing of heat generally involved a close proximity to the fire incident. The significance of the distance of the participant from the fire, and the means of awareness is examined in Table XXXVIID on page 101.

⁷Garrett, Op. Cit. p. 237.

⁸Ibid.

⁹Ibid. p. 427.

5. Persons With Participant at Time of Fire Incident.

The information relative to the persons with the participant at the time of the fire incident are presented in Table XXXV. It will be noted the majority of the participants, were with other persons at the time of the fire incident. The indication from many of the participants, consisting of 54 per cent of the population as being with family members is a reflection of the residential occupancies. It should be remembered residences were the predominate occupancy of the buildings included in the fire incident population, as previously presented in Table X on page 39. Thus, it is apparent, there might be a difference in the frame of reference of the alone participant, alerted to the fire incident by an odor of smoke, and a participant with other persons who could assist in the confirmation and definition of the situation. Latane and Darley (8) found in their study with college students, the presence of other persons, with as few as two persons, created a difference in the action of reporting in an ambiguous smoke stimulus situation. It would appear the inhibition of the reporting action with other individuals, may be a result of the attempts, in some cases to structure, define, and relate the ambiguous smoke stimulus to an appropriate situational response.

6. Location of Participants When They Became Aware of The Fire.

It seems reasonable to assume, the closer an individual is to the location of the fire incident, the more threatening the fire may be to the individual, and thus affecting the response to the fire incident. Brown, (2) recognized the need for the study of the location of the individual

TABLE XXXV
 PERSONS WITH PARTICIPANT AT TIME OF FIRE

Persons	Participants	Per Cent
Family	313	54.7
No one	101	17.6
Co - Workers	52	9.1
Occupants	36	6.3
Friend	28	4.9
Roommate	22	3.8
Various Persons	16	2.8
Repairman	2	0.4
Fireman	1	0.2
Pet	1	0.2
N = 10	572	100.0
Range = 1 - 313	Per Cent of Participant Population = 97.9	

relative to the perception and interpretation of the threat.

The individual's location in the building when the fire occurred was obtained for a total of 508 of the participants or approximately 86 per cent of the total participant population. Table XXXVI presents the locations of the participants at the time of the occurrence of the fire incident. It should be noted, the majority of the participants were in the bedroom at the time of the fire incident, with the living room and the kitchen being the second and third most frequent locations. Thus, the basic inhabited areas of most single family residences, the bedroom, the living room, and the kitchen accounted for the location of approximately 68 per cent of this population. The predominance of the bedroom, living room, and kitchen areas would appear to have been determined by the predominance of the residential occupancies in the fire incident population as previously presented in Table X, and the time of the fire incident as previously presented in Table IV, on page 26. From Table XXXVI it should be noted that 14 participants were outside of the building when they became aware of the fire incident. Thus in conformance with the operational definition relative to the selection of participants for this study, these individuals had to subsequently enter the building, usually to assist in the notification or evacuation of the participants.

7. Distance of The Participants from The Fire.

Table XXXVII contains the responses of 542 participants, or 92.8 per cent of the total participant population relative to the individual participant's distance from the location of the fire incident. The fire

TABLE XXXVI

LOCATION OF PARTICIPANT POPULATION WHEN AWARE OF FIRE

Area	Participants	Per Cent
Bedroom	201	39.6
Living Room	99	19.5
Kitchen	49	9.6
Hallway	26	5.2
Dining Area	16	3.1
Office	14	2.8
Outside	14	2.8
Lavatory	13	2.6
Stairway	14	2.8
Lobby, Entranceway	9	1.8
Crawl Space, Substructure	9	1.8
Class or Meeting Room	6	1.2
Laboratory	6	1.2
Multiple Use Area	6	1.2
Laundry Room	5	0.9
Garage, Carport	5	0.9
Means of Egress	3	0.6
Sales Area	3	0.6
Printing, Photo Room	2	0.4
Elevator	2	0.4
Library	1	0.2
Assembly Area	1	0.2
Process Area	1	0.2
Storage Area	1	0.2
Machinery Room	1	0.2
Boiler Room	1	0.2
N = 26	508	100.0
Range = 1 - 201	Per Cent of Participant Population = 86.9	

TABLE XXXVII

DISTANCE OF PARTICIPANTS FROM THE FIRE

Feet	Participants	Per Cent
.5	1	0.2
1	3	0.6
1	30	5.5
2	27	5.0
3	19	3.5
4	2	0.4
5	29	5.2
6	9	1.7
7	3	0.6
8	7	1.3
9	1	0.2
10	94	17.3
11	1	0.2
12	15	2.7
15	49	9.0
18	1	0.2
20	66	12.2
24	1	0.2
25	31	5.7
30	55	10.1
33	1	0.2
35	8	1.5
36	1	0.2
40	9	1.7
45	4	0.7
48	2	0.4
50	28	5.2
60	8	1.5
65	1	0.2
70	2	0.4
75	3	0.6
80	1	0.2
90	1	0.2
100	14	2.6
120	1	0.2
150	5	0.9
160	1	0.2
200	4	0.7
400	1	0.2
999	1	0.2
1050	1	0.2
1500	1	0.2
N = 42	542	100.0
M = 12.9	SE _M = 0.88	SD = 20.4
		SE _{SD} = 0.62

department official converted the responses of the participants to distance as measured in feet by the physical inspection and observation of the premises, when the individuals responded with a spatial location within the building.

Upon examination of Table XXXVII, it immediately becomes apparent the majority of the participants in this population were rather close to the fire incident when they became aware of the incident, usually within the room or area of origin, or immediately adjacent to the area of origin. It should be noted the mean distance for the 542 participants from the fire incident consisted of 12.9 feet, with a standard deviation of 20.4 feet. Thus, 38.5 per cent of the study population were within 10 feet of the fire incident, and approximately 66 per cent of the participant population were within 20 feet of the fire incident, in most cases within the same living or residential unit. Thus, it would appear from the indicated responses, these 542 participants were primarily very intimately involved with the initiation, or initial discovery of the fire incident. It also seems appropriate to conclude the majority of the participants were usually within the fire incident occupancy consisting of a dwelling or apartment unit. It should be noted that only 29 participants were farther than 100 feet from the location of the fire incident, and the 14 participants indicated in Table XXXVI as being outside of the building are probably included in these 29 participants.

Withey, (13) has indicated the perception of the timing of the imminence of the threat is a critical factor in the individual's response selection of a behavioral reaction to the perceived threat. Thus, the location and proximity of the participant to the fire incident appears

to be an important determining variable.

The distance from the fire for the participant population as presented in Table XXXVII, was classified into categories to facilitate the analysis. Table XXXVIIA presents the distances from the fire for the 542 members of the participant population, with the distances classified into six categories: 10 feet and less, 11 to 20 feet, 21 to 30 feet, 31 to 50 feet, 51 to 100 feet, and above 100 feet. It should be remembered that 66 per cent of this population consisting of 358 participants were within 20 feet of the fire, when they became aware of the incident. Thus, it would be reasonable to assume these participants were all within the residential occupancy, or primary occupational unit of fire origin.

The classification of the 542 members of the participant population relative to the six categories of distance are presented in Table XXXVIIB as compared to the means of awareness of the fire incident as previously presented in Table XXXIV on page 85. It is of interest to note that individuals alerted by the physical stimuli of the fire incident were generally distributed closer to the fire incident than were the participants alerted by other individuals, or the noise from other persons or alarm devices. It appears obvious for an individual to feel the heat from a fire incident, the individual must be in close proximity to the flame shield. Thus, the four participants who became aware of the fire incident due to the heat were all within 10 feet of the fire. The percentages of the participants with their distances from the fire incident were calculated for the means of awareness classification consisting of the other notified, family member notified, and the noise. These were then compared with the percentages of participants and their distance from the fire for the classifications of the odor of smoke, saw the smoke, saw the flames and felt the

TABLE XXXVIIA
 DISTANCE FROM FIRE
 OF THE PARTICIPANT POPULATION

Distance - Feet	Frequency	Per Cent
0 - 10	225	41.5
11 - 20	133	24.5
21 - 30	86	15.9
31 - 50	53	9.8
51 - 100	25	4.6
100 >	20	3.7
N = 6	542	100.0
Range = .5 - 1500 20 - 225 Per Cent of Participants = 92.8		

TABLE XXXVIIIB
 DISTANCE FROM FIRE RELATED TO AWARENESS OF FIRE

Feet	0-10	11-20	21-30	31-50	51-100	100+	Unreported	Total	Per Cent
Others Notified	38	28	23	13	8	9	2	121	21.3
Family Members	23	26	14	4	2	2	5	76	13.4
Smelled Smoke	64	30	21	20	3	3	7	148	26.0
Saw Smoke	25	13	5	3	3		3	52	9.1
Saw Fire	36	3	5	2				46	8.1
Felt Heat	4							4	0.7
Noise	26	29	15	11	9	6	10	106	18.6
Explosion	3	2	1					6	1.1
Saw/Heard F.D.	2	1	1					4	0.7
Awakened by Pet	1		1					2	0.3
Electricity Off	3	1						4	0.7
N = 11	225	133	86	53	25	20	542	569	100.0
Per Cent	41.5	24.5	15.9	9.8	4.6	3.7	100.0		

heat. The results of this analysis are presented in Table XXXVIIC on page 100.

The significance of the distance of the participant from the fire as being under or over 20 feet is presented in Table XXXVIID. This significance of the differences in the percentages of the two populations was obtained from the formulas in Garrett for the standard error of the differences in the percentages and the Critical Ratio as previously presented.¹⁰ The differences in the percentage of the participants relative to the means of awareness of other persons notifying them, and the seeing of the fire were both significant above the 1 per cent level of confidence. The means of awareness classification of noise had a significant difference between the two populations at the 5 per cent level of confidence.

D. Previous Training and Fire Experience Variables of The Participants.

It was assumed, the participants who had received training concerned with evacuation, alerting, or fire fighting procedures might behave with responses different from individuals without such training. Thus, information was collected for the type of previous training received by the participants, the agency or organization which provided the training, the number of times the training had been received, and the date of the last training course received by the participant. In a similar manner it was assumed that previous experience in a fire incident, should have provided the participant with a learning situation in the fire environment. Thus, these individuals should behave with a different selection of response actions than participants without the presumed advantage of previous fire experience. The frequency of any previous experiences in fire incidents were determined, and the date of the individual's most recent fire experience for the participant

¹⁰Garrett, Op. Cit., P. 236-237.

TABLE XXXVIIC

ANALYSIS OF THE DISTANCE FROM THE FIRE OF THE
PARTICIPANT RELATIVE TO THE AWARENESS OF THE FIRE

Awareness	Feet 0-20	Per Cent	Feet 21-100>	Per Cent	Total	Per Cent
Smelled Smoke	94	26.3	47	25.6	141	26.0
Others Notified	66	18.4	53	28.8	119	22.0
Noise	55	15.4	41	22.3	96	17.8
Family Notified	49	13.7	22	12.0	71	13.1
Saw Smoke	38	10.6	11	6.0	49	9.0
Saw Fire	39	10.9	7	3.8	46	8.5
Explosion	5	1.4	1	0.5	6	1.1
Felt Heat	4	1.1	0	0	4	0.7
Saw-Heard Apparatus	3	0.8	1	0.5	4	0.7
Electricity Off	4	1.1	0	0	4	0.7
Pet	1	0.3	1	0.5	2	0.4
N = 11	358	100.0	184	100.0	542	100.0
Range = 1 - 94			0 - 53		2 - 141	

TABLE XXXVIID
SIGNIFICANCE OF THE DISTANCE UNDER AND
OVER 20 FEET FROM THE FIRE OF THE PARTICIPANTS
RELATIVE TO AWARENESS OF THE FIRE

Awareness	Feet 0-20 Per Cent	Feet 21-100> Per Cent	P_1-P_2	$SE_{P_1-P_2}$	CR
Smelled Smoke	26.3	25.6	0.7	3.93	0.18
Others Notified	18.4	28.8	10.4	3.70	<u>2.81**</u>
Noise	15.4	22.3	6.9	3.42	<u>2.01*</u>
Family Notified	13.7	12.0	1.7	3.02	0.56
Saw Smoke	10.6	6.0	4.6	2.56	1.79
Saw Fire	10.9	3.8	7.1	2.49	<u>2.85**</u>
Explosion	1.4	0.5	0.9	0.93	0.96
Felt Heat	1.1	0	1.1	0.74	1.49
Saw-Heard Apparatus	0.8	0.5	0.3	0.74	0.40
Electricity Off	1.1	0	1.1	0.74	1.49
Pet	0.3	0.5	0.2	0.56	0.36
N = 11	358	184			

* Critical Ratio significant at or above the 5 per cent level of confidence.

**Critical Ratio significant at or above the 1 per cent level of confidence.

population, were determined.

1. Type of Previous Training of Participant Population.

A total of 199 members of the participant population indicated they had received training prior to the occurrence of the fire incident. Table XXXVIII presents the types of training received by these participants, and the most frequent type of training consisted of fire drill procedures, with fire safety, and fire prevention seminar being the second and third most popular types of training received by participants. The remaining types of training received by the participants involved; occupational safety, fire extinguisher training, health safety and civil defense classes. It should be noted the 199 persons who had received previous training consisted of approximately 34 per cent of the total participant population.

2. Agency Providing Training.

Approximately 34 per cent of the total participant population, consisting of 199 participants indicated they had received their training from a total of 11 agencies, as indicated in Table XXXIX. It is apparent most of the training was received from the individual's employer, an educational institution or the military. In the context of this study the military could also be considered to be an employer type of training situation. Thus, when the agency classifications of employer, military, and government are combined a total of 88 participants or approximately 44 per cent of the population received training from an employer situation. Additionally, when the agencies of teacher, college, and high school are combined, 60 participants or approximately 30 per cent of the population

TABLE XXXVIII
 TYPE OF PREVIOUS TRAINING
 OF THE PARTICIPANT POPULATION

Training	Frequency	Per Cent
Fire Drill - Evacuation	71	35.7
Fire Safety	45	22.6
Fire Prevention Class	40	20.1
Occupational - Safety	20	10.1
Fire Extinguisher Class	9	4.5
School	6	3.0
Health - Safety	6	2.5
Civil Defense	3	1.5
N = 8	199	100.0
Range = 3 - 71	Per Cent of Participant Population = 34.1	

TABLE XXXIX
 AGENCIES PROVIDING TRAINING
 OF THE PARTICIPANT POPULATION

Agencies	Frequencies	Per Cent
Employer	45	22.6
High School	41	20.6
Fire Department	36	18.1
Military	32	16.1
College	11	5.5
Government	11	5.5
Television Media	6	3.0
Scouts	5	2.6
Red Cross	3	1.5
Teacher	8	4.0
Police	1	0.5
N = 11	199	100.0

Range = 1 - 45 Per Cent of Participant Population = 34.1

received their training in educational institutions. It should be noted that 3 per cent of the population received their training from the television media and approximately 18 per cent from a fire department. The distribution of the agencies providing training was elicited from the participants.

3. Frequency of Training of Participants.

Data was collected on the frequency of the training for 140 of the members of the total participant population, and this information is presented in Table XL. The greatest number of participants had received training once, with 55 participants consisting of 39 per cent of this population. An additional 23 participants, or 16 per cent of the population had received training twice, with 55 per cent of the population receiving training one or two times. The greatest number of training sessions attended consisted of 99 for an individual with the occupancy classification of forest warden, who was also a volunteer fire department member.

4. The Date of The Last Training Course for Participants.

The date of the last training course attended, prior to the occurrence of the fire incident was obtained. It is essential to remember the data for this study was limited to fire incidents which occurred from January 15, 1975 until April 30, 1976. Table XLI presents the last date of training for the 169 members of the participant population who provided this information. It is interesting to note that approximate 64 per cent of this population received their training in the five years from 1971 to 1975, and the oldest reported training date was 1930 approximately 45

TABLE XL
THE FREQUENCY OF TRAINING OF THE PARTICIPANT POPULATION

Frequency of Training	Participants	Per Cent
1	55	30.4
2	23	16.5
3	9	6.5
4	6	4.3
5	3	2.1
6	4	2.9
7	3	2.1
8	2	1.4
9	1	0.7
10	8	5.7
12	8	5.7
13	1	0.7
15	2	1.4
16	1	0.7
20	7	5.0
23	1	0.7
30	1	0.7
36	1	0.7
50	2	1.4
60	1	0.7
99	1	0.7
N = 21	140	100.0
Range = 1 - 99	Per Cent of Participant Population = 24.0	

TABLE XLI

DATE OF THE LAST TRAINING COURSE FOR PARTICIPANT POPULATION

Year	Participants	Per Cent
1976	4	2.4
1975	45	26.3
1974	28	16.7
1973	13	7.8
1972	11	6.5
1971	10	5.9
1970	9	5.3
1969	6	3.5
1968	6	3.5
1967	2	1.2
1966	3	1.8
1965	4	2.4
1964	4	2.4
1963	3	1.8
1962	2	1.2
1961	1	0.6
1960	2	1.2
1958	1	0.6
1956	1	0.6
1955	2	1.2
1950	1	0.6
1946	3	1.8
1945	5	2.9
1944	2	1.2
1930	1	0.6
N = 25	169	100.0
Range = 1 - 47	Per Cent of Participant Population = 28.9	

years prior to the fire incident included in this study.

5. The Previous Fire Experience of The Participant Population.

Table XLII presents the previous fire experience of 165 members of the participant population which is approximately 28 per cent of the total participant population, or one out of four participants, who had previously experienced a fire incident situation. It is apparent from an examination of Table XLII, that most of the previous fire experience consisted of a single occurrence, since 89 persons or approximately 54 per cent of this population had experienced a single previous fire incident. However, an additional 13 persons provided a total of 62 per cent of the fire experience population for one and two fire incidents. It is of interest to note that a total of 7 participants had experience in 10 or more fire incidents, with this experience being obtained in the military, or an occupational area such as police or security guards, or as volunteer fire department members.

6. The Date of The Last Previous Fire Experience.

Table XLIII presents the reported data on the 165 participants which is approximately 28 per cent of the total participant population relative to the last date of their previous fire incident. It should be noted that approximately 70 per cent of the previous fire experience was obtained in the five years from 1971 to 1975. Referring to Table XLI, concerning the date of the last training, it will be remembered that approximately 64 per cent of the previous training population received their training in the five years from 1971 to 1975. Another interesting

TABLE XLII
PREVIOUS FIRE EXPERIENCE OF THE PARTICIPANT POPULATION

Frequency	Participants	Per Cent
1	89	53.9
2	13	7.9
3	4	2.4
4	3	1.9
6	2	1.2
8	1	0.6
10-15	1	0.6
16-20	2	1.2
51-100	1	0.6
101-150	2	1.2
151-200	1	0.6
Not Reported	46	27.9
N = 12	165	100.0
Range = 1 - 89 Per Cent of Participant Population = 28.2		

TABLE XLIII
 DATE OF LAST PREVIOUS FIRE EXPERIENCE
 * OF PARTICIPANT POPULATION

Year	Participants	Per Cent
1976	1	0.6
1975	32	19.4
1974	25	15.2
1973	40	24.2
1972	10	6.1
1971	6	3.7
1970	6	3.7
1969	4	2.4
1968	2	1.2
1967	5	3.0
1966	4	2.4
1965	6	3.7
1964	1	0.6
1963	1	0.6
1961	3	1.8
1960	2	1.2
1959	1	0.6
1958	1	0.6
1957	1	0.6
1955	3	1.8
1954	1	0.6
1951	1	0.6
1949	1	0.6
1948	1	0.6
1940	1	0.6
1939	1	0.6
1935	2	1.2
1933	2	1.2
1930	1	0.6
N = 29	165	100.0

Range = 1 - 47

Per Cent of Participant Population = 28.2

coincidence is the 165 and 169 total population figures for the segments of the participant population providing the last date of the previous fire experience, and the last date of the previous training.

It would thus appear for the participant population involved with previous training and previous fire experience, the majority of the training and the fire experience was obtained within the five years prior to the fire incident included in the study. However, there is also the possibility that retention of the factors relative to the dates of the previous fire incidents, and the previous training may be affected by decay, and these apparent phenomenon may be the result of recall decay phenomenon.

V. THE ACTIONS OF THE PARTICIPANT POPULATION

The documentation of the actions of the participants relative to their response to the perception and recognition of the occurrence of the fire incident was one of the objectives of this study. The fire department official at the fire scene attempted to obtain the first three actions of the participants in their sequential order of enactment. When more than three actions were indicated, the additional actions were listed on the reverse side of the questionnaire form, previously illustrated as Figure II on page 16 of this report.

The greatest number of sequential actions that were documented by an interviewer in this study involved a total of seven actions, involving two reentries into the building. This extended sequence of actions involved the evacuation of other family members and fire fighting.

A. The Distribution of the First Actions of the Participant Population.

The first, second and third actions of the participants were elicited in response to the question, "What did you do when you realized there was a fire?"

Table XLIV presents the first actions of the participant population with the data being presented as elicited from 580 participants which was approximately 99.3 per cent of the total participant population of 584 persons. These initial actions of the participants are presented as the action classifications with only the actions utilized by 1 or 2 persons being grouped in the "other" category. A total of 25 action

classifications have thus been identified and utilized in Table XLIV.

From an examination of Table XLIV, it is apparent the most frequently initiated first action consisted of the notification of other individuals. These first action reports confirm the data previously presented in Table XXXIV, which indicated a total of 197 participants had become aware of the fire incident after being notified by other persons, including members of their own family. Thus, 34.7 per cent of the participant awareness population of 569 persons became aware of the fire incident after being notified of the fire incident by other individuals. It should be recognized the first action as well as the means of awareness of the fire incident, were probably to some extent influenced by the distance of the participants from the fire incident. It should be remembered as previously indicated in Table XXXVIIB, approximately 66 per cent of the participant population were within 20 feet of the fire incident when they became aware of the fire incident.

Upon examination the first actions indicated in Table XLIV would seem to indicate most of the participants generally were engaged in actions that would be considered to be communicative to other individuals, family members, and official assistance agencies such as the fire department. These communicative action responses would be considered to be alerting or alarm activities relative to the fire incident. It is also apparent many of the first actions could be characterized as being related to the containment of the fire incident, with actions to control, limit or extinguish the fire incident. However, some of the first actions of the participants could be characterized as involving evacuation, or actions concerned with leaving the fire area or the fire incident building,

TABLE XLIV
DISTRIBUTION OF THE FIRST ACTIONS OF THE PARTICIPANT POPULATION

Action	Participants	Per Cent
Notified Others	87	15.0
Searched for Fire	59	10.1
Called Fire Department	52	9.0
Got Dressed	47	8.1
Left Building	44	7.6
Got Family	44	7.6
Fought Fire	27	4.6
Got Extinguisher	27	4.6
Left Area	25	4.3
Woke Up	18	3.1
Nothing	16	2.7
Had Others Call F.D.	13	2.2
Got Personal Property	12	2.1
Went to Fire Area	12	2.1
Removed Fuel	10	1.7
Enter Building	9	1.6
Tried to Exit	9	1.6
Went to Fire Alarm	9	1.6
Telephoned Other Relative	7	1.2
Tried to Extinguish	7	1.2
Closed Door to Fire Area	6	1.0
Pulled Fire Alarm	5	0.9
Turned Off Appliances	5	0.9
Checked on Pets	5	0.9
Other	25	4.3
N = 25	580	100.0
Range = 5 - 87		Per Cent of Participant Population = 99.3

including attempts to evacuate. The remaining first actions could be characterized as activities related to a personal concern. These actions would include the obtaining of personal property, the checking on pets, and the action of getting dressed. Thus, the first actions could be characterized as involving communicative, containment, evacuation, and personal concerns behavior modes.

1. Sexual Distribution of The First Actions of The Participant Population.

The analysis of the differences in the first actions of the participant population relative to the male and female members of the population are presented in Table XLIVA. It should be noted the total identified male members of the participant population were 262 and the total number of female members were 318 for a total of 580 participants considered as to their first actions in Table XLIVA.

Relative to the possible identified cultural-sexual role differences in the behavioral actions as indicated in the reported first actions, it may be important that of the six most frequent first actions, the notifications of others appears to have little sexual differentiation. However, 14.9 per cent of the males searched for the fire as a first response as contrasted with only 6.3 per cent of the females. Conversely, the first actions of, "calling the fire department", "leaving the building", "getting dressed", and "got family", appeared to be predominately first actions for the female population as opposed to the male population.

The statistical significance of the differences in the percentages of the male and the female populations relative to their first actions

TABLE XLIVA

SEXUAL DISTRIBUTION OF THE PARTICIPANT POPULATION RELATED TO FIRST ACTION

Action	Male	Per Cent	Female	Per Cent	Total	Per Cent
Notified Others	43	16.3	44	13.8	87	15.0
Searched for Fire	39	14.9	20	6.3	59	10.1
Called Fire Department	16	6.1	36	11.4	52	9.0
Got Dressed	15	5.8	32	10.1	47	8.1
Left Building	11	4.2	33	10.4	44	7.6
Got Family	9	3.4	35	11.0	44	7.6
Fought Fire	15	5.8	12	3.8	27	4.6
Got Extinguishers	18	6.9	9	2.8	27	4.6
Left Area	12	4.6	13	4.1	25	4.3
Woke Up	10	3.8	8	2.5	18	3.1
Nothing	7	2.7	9	2.8	16	2.7
Had Others Call F.D.	9	3.4	4	1.3	13	2.2
Got Personal Property	4	1.5	8	2.5	12	2.1
Went to Fire Area	5	1.9	7	2.2	12	2.1
Removed Fuel	3	1.1	7	2.2	10	1.7
Enter Building	6	2.3	3	0.9	9	1.6
Tried to Exit	4	1.5	5	1.6	9	1.6
Went to Fire Alarm	3	1.1	6	1.9	9	1.6
Telephoned Others- Relatives	2	0.8	5	1.6	7	1.2
Tried to Extinguish	5	1.9	2	0.6	7	1.2
Closed Door to Fire Area	2	0.8	4	1.3	6	1.0
Pulled Fire Alarm	3	1.1	2	0.6	5	0.9
Turned Off Appliances	2	0.8	3	0.9	5	0.9
Check on Pets	2	0.8	3	0.9	5	0.9
Other	17	6.5	8	2.5	25	4.3
N = 25	262	100.0	318	100.0	580	100
Range = 2-43	2 - 44		5 - 87			
Per Cent of Participant Population = 44.8	54.5		99.3			

were determined and computed. The statistical procedures utilized for the comparison of the percentages of the various subpopulations of the participant population are identical to the procedures identified on page 89 of this report. The computation of the difference in the percentage for the subpopulations, the computation of the standard error of the difference in the percentages, and the computation of a critical ratio. The significance of the critical ratio was determined with the t test for the level of confidence from Garrett's text.¹¹

The significance of the differences in the first actions of the male and female members of the participant population are presented in Table XLIVB. The difference in the 14.9 per cent of the male population that, "searched for the fire" as contrasted with 6.3 per cent of the female population was significant above the 1 per cent level of confidence. The other significant differences in the first actions in which the males dominated was the action of, "obtaining an extinguisher," in which 6.9 per cent of the male population acted, as contrasted with 4.1 per cent of the female population, and this difference was significant at the 5 per cent level of confidence.

It should also be noted the prevalence for the female population as first actions to, "leave the building," and to, "obtain other family members." These first actions involved 10.4 and 11 per cent of the female members as contrasted to 4.2 and 3.4 per cent of the males. All of these differences in the actions of the men and women were statistically significant at the 1 per cent level of confidence. In addition, as presented in Table XLIVB,

¹¹Garrett, Op. Cit. p. 427.

TABLE XLIVB
SIGNIFICANCE OF SEXUAL DIFFERENCES ON FIRST ACTION OF
PARTICIPANT POPULATION

First Action	Male Per Cent	Female Per Cent	$P_1 - P_2$	$SE_{P_1 - P_2}$	CR
Notified Others	16.3	13.8	2.5	2.98	0.83
Searched for Fire	14.9	6.3	8.6	2.51	<u>3.43**</u>
Called Fire Dept.	6.1	11.4	5.3	2.41	<u>2.19*</u>
Got Dressed	5.8	10.1	4.3	2.30	1.87
Left Building	4.2	10.4	6.2	2.22	<u>2.79**</u>
Got Family	3.4	11.0	7.6	2.22	<u>3.42**</u>
Fought Fire	5.8	3.8	2.0	1.77	1.13
Got Extinguishers	6.9	2.8	4.1	1.77	<u>2.31*</u>
Left Area	4.6	4.1	0.5	1.70	0.29
Woke Up	3.8	2.5	1.3	1.45	0.90
Nothing	2.7	2.8	0.1	1.38	0.72
Had Others Call F.D.	3.4	1.3	2.1	1.23	1.71
Got Personal Property	1.5	2.5	1.0	1.17	0.85
Went to Fire Area	1.9	2.2	0.3	1.20	0.25
Removed Fuel	1.1	2.2	1.1	1.08	1.02
Enter Building	2.3	0.9	1.4	1.02	1.37
Tried to Exit	1.5	1.6	0.1	1.05	0.09
Went to Fire Alarm	1.1	1.9	0.8	1.02	0.78
Telephoned Others - Relatives	0.8	1.6	0.8	0.91	0.87
Tried to Extinguish	1.9	0.6	1.3	0.91	1.43
Closed Door to Fire Area	0.8	1.3	0.5	0.87	0.57
Pulled Fire Alarm	1.1	0.6	0.5	0.75	0.66
Turned Off Appliances	0.8	0.9	0.1	0.79	0.12
Check on Pets	0.8	0.9	0.1	0.79	0.12
Other	6.5	2.5	4.0	1.70	<u>2.35*</u>
N = 25	262	318			

* Critical ratios significant at or above the 5 per cent level of confidence.

** Critical ratios significant at or above the 1 per cent level of confidence.

the difference in the actions of the male and female populations was indicated by 11.4 per cent of the women, "calling the fire department," as a first action as opposed to 6.1 per cent of the men. This difference in the first action of, "calling the fire department," was statistically significant at the 5 per cent level of confidence. Thus, the prevalence of the women in their first actions was to, "call the fire department," "leave the building," and, "obtain other family members," while the prevalence of the men was to, "search for the fire," and to, "obtain extinguishers." These prevalences were all significant differences relative to the first actions of the participant population at or above the 5 per cent level of confidence.

2. The Influence of Previous Training on The First Actions of the Participant Population.

The participant population contained 140 members of the population who had previously received fire related training, prior to the fire incident which initiated their inclusion in the participant population of this study. It was desired to examine the participant population relative to their first actions, to determine if there were any significant differences in the first action responses of the 140 individuals who had received training to the 440 individuals who had not received any training. The number of times training had been received, and the type of training received by the members of the participant population have been previously presented in Section IV of this report in Tables XXXVIII and XL on pages 103 and 106.

The distribution of the first actions of the participant population as divided into the two subpopulations relative to previous training are presented in Table XLIVC. The 140 members of the participant population who had received training consisted of approximately 24 per cent of the total participant population. While the 440 individuals without training consisted of approximately 75.3 per cent of the total participant population.

Table XLIVD presents the statistical analysis of the differences in the percentage of participants in the training and nontrained subpopulations relative to the first actions. The first actions of the nontrained population consisting of, "obtained other family members," and "went to the fire area," were both statistically significant at the 5 per cent level of confidence. The greater number of trained participants, "obtaining an extinguisher," with the difference of 4.3 per cent between the subpopulations was also significant at the 5 per cent level of confidence. It should be apparent there are not as many significant differences in the first actions between the trained and nontrained subpopulations, as occurred between the male and female populations. In addition, the differences between the trained and nontrained populations were not as significant statistically as the differences between the male and female subpopulations. Remember, Table XLIVD indicated none of the differences relative to the training of the participants were significant at the 1 per cent level of confidence. The first four most prevalent actions of the trained participants were to "notify others," "search for the fire," "get an extinguisher," and to, "call the fire department." However, the four most prevalent actions of the nontrained participants also involved as the first action the, "notification of others," "the calling

TABLE XLIVC

DISTRIBUTION OF FIRST ACTIONS OF PARTICIPANT POPULATION WITH
AND WITHOUT PREVIOUS TRAINING

Second Actions	Previous Training		No Previous Training		Total	Per Cent
	Participants	Per Cent	Participants	Per Cent		
Notified Others	25	17.9	12	14.1	87	15.0
Searched for Fire	20	14.3	39	8.9	59	10.1
Called Fire Department	9	6.4	43	9.8	52	9.0
Got Dressed	7	5.0	40	9.2	47	8.1
Left Building	7	5.0	37	8.4	44	7.6
Got Family	4	2.9	40	9.2	44	7.6
Fought Fire	7	5.0	20	4.5	27	4.6
Got Extinguisher	11	7.9	16	3.6	27	4.6
Left Area	7	5.0	18	4.1	25	4.3
Woke Up	6	4.3	12	2.7	18	3.1
Nothing	4	2.9	12	2.7	16	2.7
Had Others Call F.D.	4	2.9	9	2.0	13	2.2
Got Personal Property	3	2.1	9	2.0	12	2.1
Went to Fire Area	0	0	12	2.7	12	2.1
Removed Fuel	3	2.1	7	1.6	10	1.7
Enter Building	1	0.7	8	1.8	9	1.6
Tried to Exit	2	1.4	7	1.6	9	1.6
Went to Fire Alarm	2	1.4	7	1.6	9	1.6
Telephoned Others - Relatives	2	1.4	5	1.1	7	1.2
Tried to Extinguish	1	0.7	6	1.4	7	1.2
Closed Door to Fire Area	1	0.7	5	1.1	6	1.0
Pulled Fire Alarm	2	1.4	3	0.7	5	0.9
Turned Off Appliances	1	0.7	4	0.9	5	0.9
Check on Pets	0	0	5	1.1	5	0.9
Other	11	7.9	14	3.2	25	4.3
N = 25	140	100.0	440	100.0	580	100.0
Range = 0-25	3-43					
Per Cent of Participant Population =	24.0		75.3		99.3	

TABLE XLIV D

SIGNIFICANCE OF THE DIFFERENCE IN FIRST ACTIONS OF PARTICIPANT POPULATION
WITH AND WITHOUT PREVIOUS TRAINING

Actions	Previous Training	No Previous Training	$P_1 - P_2$	$SE_{p_1 - p_2}$	CR
	Per Cent	Per Cent			
Notified Others	17.9	14.1	3.8	3.46	1.10
Searched for Fire	14.3	8.9	5.4	2.93	1.84
Called Fire Department	6.4	9.8	3.4	2.77	1.23
Got Dressed	5.0	9.2	4.2	2.66	1.58
Left Building	5.0	8.4	3.4	2.57	1.32
Got Family	2.9	9.2	6.3	2.58	<u>2.44*</u>
Fought Fire	5.0	4.5	0.5	2.03	0.25
Got Extinguisher	7.9	3.6	4.3	2.03	<u>2.12*</u>
Left Area	5.0	4.1	0.9	1.97	0.46
Woke Up	4.3	2.7	1.6	1.68	0.95
Nothing	2.9	2.7	0.2	1.57	0.13
Had Others Call F.D.	2.9	2.0	0.9	1.42	0.63
Got Personal Property	2.1	2.0	0.1	1.36	0.07
Went to Fire Area	0	2.7	2.7	1.36	<u>1.99*</u>
Removed Fuel	2.1	1.6	0.5	1.25	0.40
Enter Building	0.7	1.8	1.1	1.18	0.93
Tried to Exit	1.4	1.6	0.2	1.22	0.16
Went to Fire Alarm	1.4	1.6	0.2	1.22	0.16
Telephoned Others - Relatives	1.4	1.1	0.3	1.06	0.28
Tried to Extinguish	0.7	1.4	0.7	1.06	0.66
Closed Door to Fire Area	0.7	1.1	0.4	0.96	0.42
Pulled Fire Alarm	1.4	0.7	0.7	0.92	0.76
Turned Off Appliances	0.7	0.9	0.2	0.92	0.22
Check on Pets	0	1.1	1.1	0.86	1.28
Other	7.9	3.2	4.7	1.97	<u>2.38*</u>
N = 25	140	440			

*Critical ratios significant at or above the 5 per cent level of confidence

the fire department,"with the actions of, "getting dressed," and, "getting other family members."

3. The Effect of Previous Fire Experience on The First Actions of the Participant Population.

It would appear the individuals in the participant population who had previously been involved in a fire incident might have their first action modified by the learning effect of the experience obtained in the previous fire incident. Thus, an analysis was conducted comparing the first actions of the 165 members of the participant population who had previous fire experience with the 415 individuals without previous fire experience. It should be remembered the distribution of the frequency of the previous fire experience, and the date of the last fire experience for the participant population was previously presented in Tables XLII and XLIII, on pages 109 and 110.

Table XLIVE presents the distribution of the first actions of the subpopulations with and without fire experience. It is apparent the most prevalent first four first actions of the subpopulation with previous fire experience were, "the notification of other persons," "the searching for the fire," "getting dressed," and, "the calling of the fire department." While the most prevalent first four actions of the no fire experience subpopulation consisted of, "the notification of other person," "the searching for the fire," "the calling of the fire department," and, "the leaving of the building."

Table XLIVF presents the statistical analysis of the subpopulations

TABLE XLIVE

DISTRIBUTION OF FIRST ACTIONS OF PARTICIPANT POPULATION WITH AND
WITHOUT PREVIOUS FIRE EXPERIENCE

Second Actions	Previous Fire Experience		No Previous Fire Experience		Total	Per Cent
	Participants	Per Cent	Participants	Per Cent		
Notified Others	24	14.6	63	15.3	87	15.0
Searched for Fire	20	12.2	39	9.5	59	10.1
Called Fire Department	16	9.8	36	8.7	52	9.0
Got Dressed	19	11.6	28	6.7	47	8.1
Left Building	9	5.5	35	8.4	44	7.6
Got Family	10	6.1	34	8.2	44	7.6
Fought Fire	5	3.0	22	5.3	27	4.6
Got Extinguisher	7	4.2	20	4.8	27	4.6
Left Area	5	3.0	20	4.8	25	4.3
Woke Up	7	4.2	11	2.6	18	3.1
Nothing	7	4.2	9	2.2	16	2.7
Had Others Call F.D.	2	1.2	11	2.6	13	2.2
Got Personal Property	2	1.2	10	2.4	12	2.1
Went to Fire Area	6	3.6	6	1.4	12	2.1
Removed Fuel	2	1.2	8	1.9	10	1.7
Enter Building	1	0.6	8	1.9	9	1.6
Tried to Exit	2	1.2	7	1.7	9	1.6
Went to Fire Alarm	2	1.2	7	1.7	9	1.6
Telephone Others - Relatives	1	0.6	6	1.4	7	1.2
Tried to Extinguish	2	1.2	5	1.2	7	1.2
Closed Door to Fire Area	1	0.6	5	1.2	6	1.0
Pulled Fire Alarm	2	1.2	3	0.7	5	0.9
Turned Off Appliances	1	0.6	4	1.0	5	0.9
Check on Pets	1	0.6	4	1.0	5	0.9
Other	11	6.6	14	3.4	25	4.3
N = 25	165	100.0	415	100.0	580	100.0
Range = 1 - 24			3-63		5-87	
Per Cent of Participant Population = 28.3			71.1		99.3	

TABLE XLIVF

SIGNIFICANCE OF THE DIFFERENCE IN FIRST ACTIONS OF PARTICIPANT POPULATION
WITH AND WITHOUT PREVIOUS FIRE EXPERIENCE

Actions	No		P ₁ -P ₂	SE _{P₁-P₂}	CR
	Fire Experience Per Cent	Fire Experience Per Cent			
Notified Others	14.6	15.3	0.7	3.30	0.21
Searched for Fire	12.2	9.5	2.7	2.80	0.96
Called Fire Department	9.8	8.7	1.1	2.64	0.42
Got Dressed	11.6	6.7	4.9	2.52	1.94
Left Building	5.5	8.4	2.9	2.44	1.18
Got Family	6.1	8.2	2.1	2.44	0.86
Fought Fire	3.0	5.3	2.3	1.93	1.19
Got Extinguisher	4.2	4.8	0.6	1.93	0.31
Left Area	3.0	4.8	1.8	1.87	0.96
Woke Up	4.2	2.6	1.6	1.60	1.00
Nothing	4.2	2.2	2.0	1.52	1.32
Had Others Call F.D.	1.2	2.6	1.4	1.35	1.04
Got Personal Property	1.2	2.4	1.2	1.32	0.91
Went to Fire Area	3.6	1.4	2.2	1.29	1.71
Removed Fuel	1.2	1.9	0.7	1.19	0.59
Enter Building	0.6	1.9	1.3	1.12	1.16
Tried to Exit	1.2	1.7	0.5	1.16	0.43
Went to Fire Alarm	1.2	1.7	0.5	1.16	0.43
Telephoned Others - Relatives	0.6	1.4	0.8	1.00	0.80
Tried to Extinguish	1.2	1.2	0	0	0
Closed Door to Fire Area	0.6	1.2	0.6	0.92	0.65
Pulled Fire Alarm	1.2	0.7	0.5	0.82	0.61
Turned off Appliances	0.6	1.0	0.4	0.87	0.46
Check on Pets	0.6	1.0	0.4	0.87	0.46
Other	6.6	3.4	3.2	1.87	1.71
N = 25	165	415			

of the participant population consisting of the members with previous fire experience and the members without previous fire experience. Upon examination of this table it is apparent that none of the differences in the percentage of participants engaging in the first actions from these two subpopulations were statistically significant at or above the 5 per cent level of confidence. The examination of these differences in the percentages between these two subpopulations indicate the differences ranged from none to 4.9 per cent on the first action of getting dressed, and this difference was as previously indicated not significant at or above the 5 per cent level of confidence.

Thus, it has been statistically determined the participants who had previous fire experience did not react significantly different relative to their first action responses, than the members of the participant population who did not have previous fire experience.

4. The Relationship of The Belief in The Safety of The Building to The Participant's First Action.

The participant population was dichotomized relative to their indicated belief in the safety of the building in which the fire incident occurred. It should be remembered from Table XXXIII in Section IV, that 89 participants, or approximately 15.2 per cent of the total participant population, believed the building was unsafe, and 465 of the participants, or 79.7 per cent of the total participant population believed the building was safe.

Table XLIVG presents the distribution of the first actions of the participant subpopulation relative to the member's elicited belief in

TABLE XLIVG

DISTRIBUTION OF BELIEF IN SAFETY OF BUILDING AND FIRST ACTION
OF PARTICIPANT POPULATION

Action	Belief Safe	Per Cent	Belief Unsafe	Per Cent	Total	Per Cent
Notified Others	67	14.4	14	15.7	81	14.6
Searched for Fire	52	11.2	5	5.7	57	10.3
Called Fire Department	47	10.1	6	6.7	53	9.6
Got Dressed	31	6.7	8	9.0	39	7.0
Left Building	34	7.3	10	11.2	44	7.9
Got Family	36	7.7	8	9.0	44	7.9
Fought Fire	22	4.7	4	4.5	26	4.7
Got Extinguisher	22	4.7	5	5.7	27	4.9
Left Area	21	4.5	5	5.7	26	4.7
Woke Up	12	2.6	5	5.7	17	3.1
Nothing	5	1.1	2	2.2	7	1.3
Had Others Call F.D.	11	2.4	1	1.1	12	2.2
Got Personal Property	8	1.7	2	2.2	10	1.8
Went to Fire Area	12	2.6	0	0	12	2.2
Removed Fuel	9	1.9	1	1.1	10	1.8
Enter Building	7	1.5	2	2.2	9	1.6
Tried to Exit	6	1.3	4	4.5	10	1.8
Went to Fire Alarm	13	2.8	1	1.1	14	2.5
Telephoned Others - Relatives	6	1.3	0	0	6	1.1
Tried to Extinguish	7	1.5	0	0	7	1.3
Closed Door to Fire Area	4	0.9	1	1.1	5	0.9
Pulled Fire Alarm	5	1.1	0	0	5	0.9
Turned Off Appliances	4	0.9	1	1.1	5	0.9
Check on Pets	2	0.4	1	1.1	3	0.5
Other	22	4.7	3	3.4	25	4.5
N = 25	465	100.0	89	100.0	554	100.0
Range = 2-67			0-14			
Per Cent of Participant Population = 79.7				15.2		94.9

the safety of the building. Table XLIVH presents the computation of the statistical significance of the differences in the percentage of the subpopulations participating in the various first action behavioral responses. Examination of Table XLIVH indicates the most frequent four responses for the participants who believed the building to be safe were as follows: "The notification of others," "searching for the fire," "the calling of the fire department, and, "the obtaining of other family members." While the most frequent four first actions of the participants who believed the building to be unsafe were, "the notification of others," "the leaving of the building," "getting dressed," and, "Obtaining other family members."

The differences between the subpopulations of participants relative to their belief in the safety of the building ranged from a difference of 0.2 to 5.5 per cent. There was only one difference that was statistically significant at or above the 5 per cent level of confidence, and this was the difference of 3.2 per cent in the first action of, "trying to exit from the building."

5. The Relationship of The Distance From The Fire to The First Action of The Participant Population.

It was assumed the physical distance of the participant from the actual source of the flame, heat, and smoke might effect the selection of their first action. Table XLIVI presents the distribution of the participant population with their first actions, and the distance from the fire stratified into six classifications ranging from 0 to 10 feet, to over 100 feet. Information was obtained on the distance from the fire for 542 participants, or approximately 92.8 per cent of the

TABLE XLIVH

SIGNIFICANCE OF DIFFERENCES IN FIRST ACTION BY BELIEF IN SAFETY
OF BUILDING BY PARTICIPANT POPULATION

Action	Belief		$P_1 - P_2$	$SE_{P_1 - P_2}$	CR
	Belief Safe Per Cent	Unsafe Per Cent			
Notified Others	14.4	15.7	1.3	4.02	0.32
Searched for Fire	11.2	5.7	5.5	3.47	1.58
Called Fire Department	10.1	6.7	3.4	3.38	1.01
Got Dressed	6.7	9.0	2.3	2.93	0.78
Left Building	7.3	11.2	3.9	3.08	1.27
Got Family	7.7	9.0	1.3	3.08	0.42
Fought Fire	4.7	4.5	0.2	2.41	0.08
Got Extinguisher	4.7	5.7	1.0	2.40	0.40
Left Area	4.5	5.7	1.2	2.41	0.49
Woke Up	2.6	5.7	3.1	1.98	1.57
Nothing	1.1	2.2	1.1	1.29	0.85
Had Others Call F.D.	2.4	1.1	1.3	1.67	0.77
Got Personal Property	1.7	2.2	0.5	1.51	0.33
Went to Fire Area	2.6	0	2.6	1.67	1.56
Removed Fuel	1.9	1.1	0.8	1.51	0.52
Enter Building	1.5	2.2	0.7	1.43	0.48
Tried to Exit	1.3	4.5	3.2	1.52	<u>2.10*</u>
Went to Fire Alarm	2.8	1.1	1.7	1.78	0.95
Telephoned Others - Relatives	1.3	0	1.3	1.19	1.09
Tried to Extinguish	1.5	0	1.5	1.67	0.89
Closed Door to Fire Area	0.9	1.1	0.2	1.08	0.18
Pulled Fire Alarm	1.1	0	1.1	1.08	1.02
Turned Off Appliances	0.9	1.1	0.2	1.08	0.18
Check on Pets	0.4	1.1	0.7	0.80	0.87
Other	4.7	3.4	1.3	2.36	0.55
N = 25	465	89			

*Critical ratio significant at or above 5 per cent level of confidence.

TABLE XLIVI

DISTANCE FROM THE FIRE RELATIVE TO THE FIRST ACTION OF THE PARTICIPANT
POPULATION

First Action	Distance From Fire (Feet)						Not Reported	Total	Per Cent
	0-10	11-20	21-30	31-50	51-100	100>			
Notified Others	39	21	11	7	3	3	5	87	15.0
Searched for Fire	24	8	10	8	2	6	1	59	10.1
Called Fire Department	24	16	5	4	1	2	0	52	9.0
Got Dressed	8	18	5	5	6	1	4	47	8.1
Left Building	16	9	10	1	3	2	3	44	7.6
Got Family	16	8	7	6	1	2	4	44	7.6
Fought Fire	11	7	7	1	1	0	0	27	4.6
Got Extinguisher	10	7	4	3	1	1	1	27	4.6
Left Area	14	3	1	6	0	1	0	25	4.3
Woke Up	5	4	5	0	1	1	2	18	3.1
Nothing	2	0	4	2	0	0	8	16	2.7
Had Others Call F.D.	6	3	2	1	1	0	0	13	2.2
Got Personal Property	4	0	3	1	1	0	3	12	2.1
Went to Fire Area	2	4	2	3	0	0	1	12	2.1
Removed Fuel	7	2	1	0	0	0	0	10	1.7
Enter Building	4	1	1	0	0	1	2	9	1.6
Tried to Exit	6	2	0	0	0	0	1	9	1.6
Went to Fire Alarm	1	4	3	0	0	0	1	9	1.6
Telephoned Others - Relatives	2	3	1	1	0	0	0	7	1.2
Tried to Extinguish	4	2	0	0	0	0	1	7	1.2
Closed Door to Fire Area	4	1	0	0	1	0	0	6	1.0
Pulled Fire Alarm	2	1	0	1	1	0	0	5	0.9
Turned Off Appliances	2	2	1	0	0	0	0	5	0.9
Check on Pets	3	1	1	0	0	0	0	5	0.9
Other	9	6	2	3	3	1	1	25	4.3
N = 25	225	133	86	53	25	20	38	580	100.0
Per Cent	41.5	24.5	15.9	9.8	4.6	3.7	0	542	100.0

total participant population at the time they became aware of the fire incident. It appears that 225 individuals were within 10 feet of the fire, and a total of 358 participants consisting of approximately 61 per cent of the total participant population were within 20 feet of the fire. Apparently, these 358 participants may be considered to have been within the habited residential unit or the occupancy area of fire origin, due to their proximity to the fire.

Table XLIVJ presents the 542 participants relative to their first actions, dichotomized into two subpopulations established on their being within 20 feet of the fire, or their being farther than 20 feet from the fire. It is obvious some apparent differences in the selection of the first action may occur when one is farther than 20 feet from the location of the fire. The four most popular first actions of the subpopulation located within 20 feet of the fire were as follows: "The notification of others," "calling the fire department," "searching for the fire," and the act of "getting dressed." The four most popular first actions of the participant subpopulation located farther than 20 feet from the fire were as follows: "Searched for the fire", "notified others", "got dressed", and both "left the building" and "got family". The subpopulation located farther than 20 feet from the fire consisted of 184 participants, which was approximately 31.5 per cent of the total participant population.

Table XLIVK presents the computation of the statistical significance of the differences in the two subpopulations relative to the percentage of the populations engaging in the various first action responses relative to the location of the participants within or farther than 20 feet from the fire. An examination of this table indicates that only

TABLE XLIVJ

DISTRIBUTION OF THE DISTANCE WITHIN AND OVER 20 FEET FROM THE FIRE OF
THE PARTICIPANT POPULATION RELATIVE TO THE FIRST ACTION

Actions	Distance from Fire (Feet)				Total	Per Cent
	0-20	Per Cent	21-100	> Per Cent		
Notified Others	60	16.8	22	12.0	82	15.1
Searched for Fire	32	8.9	26	14.1	58	10.7
Called Fire Department	40	11.3	12	6.5	52	9.6
Got Dressed	26	7.3	17	9.2	43	7.9
Left Building	25	7.0	16	8.8	41	7.6
Got Family	24	6.7	16	8.8	40	7.4
Fought Fire	18	5.0	9	4.9	27	5.0
Got Extinguisher	17	4.7	9	4.9	26	4.8
Left Area	17	4.7	8	4.3	25	4.6
Woke Up	9	2.5	7	3.8	16	3.0
Nothing	2	0.6	6	3.3	8	1.5
Had Others Call F.D.	9	2.5	4	2.2	13	2.4
Got Personal Property	4	1.1	5	2.7	9	1.7
Went to Fire Area	6	1.7	5	2.7	11	2.0
Removed Fuel	9	2.5	1	0.5	10	1.8
Enter Building	5	1.4	2	1.1	7	1.3
Tried to Exit	8	2.2	0	0	8	1.5
Went to Fire Alarm	5	1.4	3	1.6	8	1.5
Telephoned Others - Relatives	5	1.4	2	1.1	7	1.3
Tried to Extinguish	6	1.7	0	0	6	1.1
Closed Door to Fire Area	5	1.4	1	0.5	6	1.1
Pulled Fire Alarm	3	0.8	2	1.1	5	0.9
Turned Off Appliances	4	1.1	1	0.5	5	0.9
Check on Pets	4	1.1	1	0.5	5	0.9
Other	15	4.2	9	4.9	24	4.4
N = 25	358	100.0	184	100.0	542	100.0
Range = 3-60			0-26		5-82	
Per Cent of Participant Population =	61.3		31.5		92.8	

TABLE XLIVK

SIGNIFICANCE OF THE DISTANCE WITHIN AND OVER 20 FEET FROM THE FIRE OF
THE PARTICIPANT POPULATION RELATIVE TO THE FIRST ACTIONS

Actions	Distance From Fire (Feet)			SE _{P₁-P₂}	CR
	0-20 Per Cent	21-100	>Per Cent P ₁ -P ₂		
Notified Others	16.8	12.0	4.8	3.21	1.50
Searched for Fire	8.9	14.1	5.2	2.76	1.88
Called Fire Department	11.3	6.5	4.8	2.65	1.81
Got Dressed	7.3	9.2	1.9	2.41	0.78
Left Building	7.0	8.8	1.8	2.37	0.75
Got Family	6.7	8.8	2.1	2.34	0.89
Fought Fire	5.0	4.9	0.1	1.94	0.05
Got Extinguisher	4.7	4.9	0.2	1.91	0.10
Left Area	4.7	4.3	0.4	1.87	0.21
Woke Up	2.5	3.8	1.3	1.50	0.86
Nothing	0.6	3.3	2.7	1.09	<u>2.48*</u>
Had Others Call F.D.	2.5	2.2	0.3	1.37	0.22
Got Personal Property	1.1	2.7	1.6	1.12	1.43
Went to Fire Area	1.7	2.7	1.0	1.25	0.80
Removed Fuel	2.5	0.5	2.0	1.19	1.68
Enter Building	1.4	1.1	0.3	1.01	0.29
Tried to Exit	2.2	0	2.2	1.09	<u>2.02*</u>
Went to Fire Alarm	1.4	1.6	0.2	1.09	0.18
Telephone Others - Relatives	1.4	1.1	0.3	1.01	0.30
Tried to Extinguish	1.7	0	1.7	0.93	1.82
Closed Door to Fire Area	1.4	0.5	0.9	0.93	0.96
Pulled Fire Alarm	0.8	1.1	0.3	0.84	0.35
Turned Off Appliances	1.1	0.5	0.6	0.84	0.71
Check on Pets	1.1	0.5	0.6	0.84	0.71
Other	4.2	4.9	0.7	1.83	0.38
N = 25	358	184			

*Critical ratio significant at or above the 5 per cent level of confidence.

two of the differences were significant above the 5 per cent level of confidence. The difference between the 3.3 per cent of the population farther than 20 feet from the fire, and the 0.6 per cent of the population within 20 feet of the fire which as their first action "did nothing" was a significant difference. It would appear reasonable that a greater percentage of the population located farther from the fire would take no initial action, while members of the population located within 20 feet of the fire would be more motivated to select a dynamic first action response. Conversely, the other difference that was statistically significant involved the 2.2 per cent of the population within 20 feet of the fire who attempted, "to exit," as their first action, while none of the population farther than 20 feet from the fire apparently tried to exit as their first action. The range of the differences in terms of the percentages of these two distance subpopulations related to their first actions varied from 0.1 per cent to 5.2 per cent. The .1 per cent difference between the populations occurred on the first action of "fighting the fire", and the 5.2 per cent difference occurred on the first action of "searching for the fire".

6. The Relationship of The Occurrence of Previous Alarms in The Building and The First Actions of the Participant Population.

The survey conducted by the fire department officer at the fire scene concerned with the fire incident building, obtained information on the number of known alarms in the building for the previous year. It was assumed the participants of the fire incident buildings with previous alarms might react differently from the participants of fire incident buildings without previous alarms relative to their first actions.

Table XLIVL presents the distribution of the first actions of participants in buildings with known previous alarms and the distribution of the first actions of the participants in buildings without known previous alarms. The subpopulation from buildings with known alarms for the preceding year was rather limited totaling 101 participants, which was 17.3 per cent of the total participant population. Also, it is apparent that one third of the previous alarm subpopulation had a previous alarm experience limited to a single instance.

It should be remembered from Table XII in Section III of this report that 46 fire incidents involved buildings with known fire alarms during the previous year.

Table XLIVM presents the two alarm subpopulations dichotomized with the number of participants, and the percentage of the subpopulation related to their first actions. The no previous alarm subpopulation totaled 479 participants, which was approximately 82 per cent of the total participant population. It should be recognized the most frequently selected first actions are identical for both subpopulations with the action of "notifying others" being first, and the action of "searching for the fire" being second. Considering the third most frequently selected response, the previous alarm subpopulation utilized the action of "leaving the area", while the no alarm subpopulation preferred the "calling of the fire department". The fourth most popular action of "getting dressed" was utilized by both subpopulations, being selected by 7.9 per cent of the previous alarm subpopulation and 8.1 per cent of the no alarm subpopulation. Thus, the previous alarm subpopulation and the no alarm subpopulation tabulations relative to

TABLE XLIVL

NUMBER OF PREVIOUS ALARMS IN THE BUILDING AND THE FIRST ACTION
OF THE PARTICIPANTS

Actions	Number of Previous Alarms											Per	
	0	1	2	3	4	5	6	7	10	16	20	Total	Cent
Notified Others	68	7	2	3	4	0	0	0	0	0	1	19	18.8
Searched for Fire	47	6	2	0	0	0	1	1	1	1	0	12	11.8
Called Fire Department	47	3	1	0	1	0	0	0	0	0	0	5	4.9
Got Dressed	39	4	0	1	2	0	0	0	0	0	1	8	7.9
Left Building	37	0	1	3	3	0	0	0	0	0	0	7	6.9
Got Family	38	4	0	1	0	0	1	0	0	0	0	6	5.9
Fought Fire	26	0	0	0	1	0	0	0	0	0	0	1	1.0
Got Extinguisher	24	1	1	0	1	0	0	0	0	0	0	3	3.0
Left Area	16	3	3	1	1	0	1	0	0	0	0	9	8.9
Woke Up	17	0	1	0	0	0	0	0	0	0	0	1	1.0
Nothing	12	0	0	2	0	0	0	0	2	0	0	4	4.0
Had Others Call F.D.	10	1	0	0	1	1	0	0	0	0	0	3	3.0
Got Personal Property	10	0	0	0	1	0	0	0	0	0	1	2	2.0
Went to Fire Area	11	0	0	0	0	0	1	0	0	0	0	1	1.0
Removed Fuel	9	0	0	0	0	0	0	0	0	0	1	1	1.0
Enter Building	9	0	0	0	0	0	0	0	0	0	0	0	0
Tried to Exit	7	0	1	1	0	0	0	0	0	0	0	2	2.0
Went to Fire Alarm	8	1	0	0	0	0	0	0	0	0	0	1	1.0
Telephoned Others - Relatives	5	0	1	1	0	0	1	0	0	0	0	2	2.0
Tried to Extinguish	5	0	0	0	0	2	0	0	0	0	0	2	2.0
Closed Door to Fire Area	6	0	0	0	0	0	0	0	0	0	0	0	0
Pulled Fire Alarm	3	0	0	0	1	0	0	0	0	1	0	2	2.0
Turned Off Appliances	5	0	0	0	0	0	0	0	0	0	0	0	0
Check on Pets	4	1	0	0	0	0	0	0	0	0	0	1	1.0
Other	16	2	1	1	2	1	1	0	0	0	1	9	8.9
N = 25	479	33	13	16	18	4	6	1	3	2	5	101	
Per Cent =	32.7	12.9	15.8	17.8	4.0	5.9	1.0	3.0	2.0	4.9		100.0	
Range =	0-7	0-3	0-5	0-4	0-2	0-1	0-1	0-2	0-1	0-1			

Per Cent of Participant Population = 17.3

TABLE XLIVM

DISTRIBUTION OF THE FIRST ACTIONS OF THE PARTICIPANT POPULATION
RELATIVE TO THE PREVIOUS ALARMS

Actions	Previous Alarms		No Previous Alarms		Total	Per Total Cent
	Participants	Per Cent	Participants	Per Cent		
Notified Others	19	18.8	68	14.3	87	15.0
Searched for Fire	12	11.8	47	9.8	59	10.1
Called Fire Department	5	4.9	47	9.8	52	9.0
Got Dressed	8	7.9	39	8.1	47	8.1
Left Building	7	6.9	37	7.7	44	7.6
Got Family	6	5.9	38	7.9	44	7.6
Fought Fire	1	1.0	26	5.4	27	4.6
Got Extinguisher	3	3.0	24	5.0	27	4.6
Left Area	9	8.9	16	3.3	25	4.3
Woke Up	1	1.0	17	3.5	18	3.1
Nothing	4	4.0	12	2.5	16	2.7
Had Others Call F.D.	3	3.0	10	2.1	13	2.2
Got Personal Property	2	2.0	10	2.1	12	2.1
Went to Fire Area	1	1.0	11	2.3	12	2.1
Removed Fuel	1	1.0	9	1.9	10	1.7
Enter Building	0	0	9	1.9	9	1.6
Tried to Exit	2	2.0	7	1.5	9	1.6
Went to Fire Alarm	1	1.0	8	1.7	9	1.6
Telephoned Others - Relatives	2	2.0	5	1.0	7	1.2
Tried to Extinguish	2	2.0	5	1.0	7	1.2
Closed Door to Fire Area	0	0	6	1.3	6	1.0
Pulled Fire Alarm	2	2.0	3	0.6	5	0.9
Turned Off Appliances	0	0	5	1.0	5	0.9
Check on Pets	1	1.0	4	0.8	5	0.9
Other	9	8.9	16	3.3	25	4.3
N = 25	101	100.0	479	100.0	580	100.0
Range =	0-19		3-68		5-87	

Per Cent of Participant Population = 17.3

the number of participants, and the percentages of the various subpopulations were compared with their first actions.

Table XLIVN presents the statistical analysis of the differences in the first actions utilized by the subpopulations from fire incident buildings with known alarms during the previous year, and from fire incident buildings without known alarms during the previous year. It should be observed the only difference between the first actions of the subpopulations that was statistically significant occurred between the 8.9 per cent of the participants in buildings with previous alarms and the 3.3 per cent of the participants in buildings without previous alarms on their first action of "leaving the area". This difference of 5.6 per cent was statistically significant above the 5 per cent level of confidence. It should also be observed from examination of Table XLIVN, the classification of the "other" first actions had a significant difference between the two subpopulations, which was significant at the 5 per cent level of confidence.

Thus, the differences in the first actions of the participants when dichotomized relative to the participants being in a building with known alarms during the previous year, or a building without known alarms during the previous year, did not appear generally to create a difference in the selection and utilization of the first actions. However, the first action of "leaving the area", in which more of the participants exposed to previous alarms utilized this first action, was a significant exception.

TABLE XLIVN

SIGNIFICANCE OF THE FIRST ACTIONS OF THE PARTICIPANT POPULATION
RELATIVE TO THE PREVIOUS ALARMS

Actions	Previous Alarms Per Cent	No Previous Alarms Per Cent	P_1-P_2	$SE_{P_1-P_2}$	CR
Notified Others	18.8	14.3	4.5	3.92	1.15
Searched for Fire	11.8	9.9	1.9	3.32	0.57
Called Fire Department	4.9	9.9	5.0	3.13	1.60
Got Dressed	7.9	8.1	0.2	2.99	0.07
Left Building	6.9	7.7	0.8	2.90	0.28
Got Family	5.9	7.9	2.0	2.90	0.69
Fought Fire	1.0	5.4	4.4	2.29	1.92
Got Extinguisher	3.0	5.0	2.0	2.32	0.86
Left Area	8.9	3.3	5.6	2.22	<u>2.52*</u>
Woke Up	1.0	3.5	2.5	1.90	<u>1.32</u>
Nothing	4.0	2.5	1.5	1.81	0.83
Had Others Call F.D.	3.0	2.1	0.9	1.64	0.55
Got Personal Property	2.0	2.1	0.1	1.58	0.06
Went to Fire Area	1.0	2.3	1.3	1.58	0.82
Removed Fuel	1.0	1.9	0.9	1.42	0.63
Enter Building	0	1.9	1.9	1.37	1.39
Tried to Exit	2.0	1.5	0.5	1.37	0.36
Went to Fire Alarm	1.0	1.7	0.7	1.37	0.51
Telephoned Others - Relatives	2.0	1.0	1.0	1.19	0.84
Tried to Extinguish	2.0	1.0	1.0	1.19	0.84
Closed Door to Fire Area	0	1.3	1.3	1.14	1.14
Pulled Fire Alarm	2.0	0.6	1.4	0.98	1.43
Turned Off Appliances	0	1.0	1.0	0.82	1.22
Check on Pets	1.0	0.8	0.2	0.83	0.24
Other	8.9	3.3	5.6	2.22	<u>2.52*</u>
N = 25	101	479			

*Critical ratios significant at or above the 5 per cent level of confidence.

B. The Distribution of The Second Actions of The Participant Population.

The elicited second actions of the participant population are presented in Table XLV with a second action population consisting of 506 individuals which is approximately 86.6 per cent of the total participant population. The most frequently initiated response as a second action involved the "leaving of the building", as reported by 106 of the participants consisting of approximately 20.9 per cent of the population. The next most frequent response as a second action involved the behavioral response of "calling the fire department". This response was selected by 74 persons or approximately 14.5 per cent of the second action population. The third most frequent behavior exhibited as a second action involved the "notification of other persons". It will be remembered from Table LXIV on page 114, the behavioral response for the "notification of others", was also the most frequent response as a first action for the participant population. The fourth most popular response as a second action involved the behavioral action of "obtaining family members". It is obvious from the distribution of the second action responses, that both of the first action responses of "woke up" and "nothing" were not utilized as second actions by the participant population of this study.

1. The Significance of The Differences Between The First and Second Actions of The Participant Population.

The percentages of the participant population relative to their utilization of first and second action responses were compared for their statistical significance. It should be remembered the total first

TABLE XLV

DISTRIBUTION OF THE SECOND ACTIONS OF THE PARTICIPANT POPULATION

Actions	Participants	Per Cent
Notified Others	49	9.6
Searched for Fire	12	2.4
Called Fire Department	74	14.5
Got Dressed	9	1.8
Left Building	106	20.9
Got Family	30	5.9
Fought Fire	29	5.7
Got Extinguisher	27	5.3
Left Area	14	2.8
Woke Up	0	0
Nothing	0	0
Had Others Call F.D.	20	4.0
Got Personal Property	19	3.8
Went to Fire Area	5	1.0
Removed Fuel	5	1.0
Enter Building	4	0.8
Tried to Exit	12	2.4
Went to Fire Alarm	9	1.8
Telephoned Others - Relatives	3	0.6
Tried to Extinguish	9	1.8
Closed Door to Fire Area	1	0.2
Pulled Fire Alarm	3	0.6
Turned Off Appliances	3	0.6
Check on Pets	7	1.4
Other	56	11.1
N = 25	506	100.0
Range = 0-106	Per Cent of Participant Population = 86.6	

action population consisted of 580 participants. The comparison of the first and second action responses of the participant population are presented in Table XLVA. The most popular first action response was the "notification of others", while the most popular second action response was "to leave the building". It should be observed from an examination of Table XLVA, the differences between the participant's first and second actions relative to the responses of, "the notification of others", "the searching for the fire", "the calling of the fire department", "the getting dressed", "the leaving the building", "the waking up", and "nothing" were all statistically significant above the 1 per cent level of confidence. Thus, the indication that 14.5 per cent of the second action subpopulation as opposed to 9.0 per cent of the first action subpopulation "called the fire department", and 20.9 per cent of the second action subpopulation "left the building" as compared to 7.6 per cent of the first action subpopulation were established as statistically significant differences.

In addition, also significant was the difference in which 15 per cent of the first action subpopulation "notified others" while 9.6 per cent of the second action subpopulation utilized this response. It should also be observed that 10.1 per cent of the first action subpopulation as contrasted to 2.4 per cent of the second action subpopulation which, "searched for the fire," was another significant difference. The differences with the first action subpopulation participating more in the actions of "getting dressed", "waking up" and "nothing" were significant and to be expected, when one considers the normal sequences of actions followed by individuals. It would appear by definition of the action, one would not expect to find responses for either the second or third actions under

TABLE XLVA
SIGNIFICANCE OF DIFFERENCES BETWEEN FIRST AND SECOND ACTIONS
OF PARTICIPANT POPULATION

Actions	1st Action Per Cent	2nd Action Per Cent	$P_1 - P_2$	$SE_{P_1 - P_2}$	CR
Notified Others	15.0	9.6	5.4	2.01	<u>2.69**</u>
Searched for Fire	10.1	2.4	7.7	1.50	<u>5.13**</u>
Called Fire Department	9.0	14.5	5.5	1.95	<u>2.82**</u>
Got Dressed	8.1	1.8	6.3	1.35	<u>4.66**</u>
Left Building	7.6	20.9	13.3	2.10	<u>6.33**</u>
Got Family	7.6	5.9	1.7	1.53	1.11
Fought Fire	4.6	5.7	1.1	1.34	0.82
Got Extinguisher	4.6	5.3	0.7	1.31	0.53
Left Area	4.3	2.8	1.5	1.13	1.33
Woke Up	3.1	0	3.1	0.80	<u>3.62**</u>
Nothing	2.7	0	2.7	0.71	<u>3.80**</u>
Had Others Call F.D.	2.2	4.0	1.8	1.03	1.75
Got Personal Property	2.1	3.8	1.7	1.02	1.66
Went to Fire Area	2.1	1.0	1.1	0.76	1.45
Removed Fuel	1.7	1.0	0.6	0.71	0.84
Enter Building	1.6	0.8	0.8	0.66	1.21
Tried to Exit	1.6	2.4	0.8	0.83	0.96
Went to Fire Alarm	1.6	1.8	0.2	0.78	0.26
Telephoned Others - Relatives	1.2	0.6	0.6	0.57	1.05
Tried to Extinguish	1.2	1.8	0.6	0.74	0.81
Closed Door to Fire Area	1.0	0.2	0.8	0.79	1.01
Pulled Fire Alarm	0.9	0.6	0.3	0.53	0.56
Turned Off Appliances	0.9	0.6	0.3	0.53	0.56
Check on Pets	0.9	1.4	0.5	0.63	0.79
Other	4.3	10.9	6.6	1.59	<u>4.15**</u>
N = 25	580	506			

**Critical ratios significant at or above the 1 per cent level of confidence.

the first action classifications of "woke up" or "nothing".

Thus, it is apparent the first actions of the participant population which were statistically more frequently utilized than second action responses were the actions of "notifying others", "searched for the fire", "got dressed", "woke up", and "nothing". However, the second action responses that were statistically more significant and were selected more frequently by the second action population were the actions of "calling the fire department" and "leaving the building".

2. Sexual Distribution of The Second Actions of The Participant Population.

The distribution of the male and female subpopulations related to their second actions is presented in Table XLVB. Relative to these second actions responses, the four most popular second actions of "leaving the building", "calling the fire department", "notifying others", and the "obtaining of other family members" as previously presented in Table XLV, are second actions which are also initiated by more members of the female subpopulation than the male subpopulation. However, the first three most frequently selected second actions were identical for both the male and female subpopulations, and these actions consisting of, "leaving the building", "calling the fire department", and "notifying others". The male subpopulation differed in their selection of the fourth most popular response which consisted of both "fighting the fire" and "obtaining an extinguisher", as opposed to the fourth most frequently selected response for the female subpopulation of "obtaining other family members".

TABLE XLVB

SEXUAL DISTRIBUTION OF PARTICIPANT POPULATION RELATED TO SECOND ACTION

Second Actions	Male	Per Cent	Female	Per Cent	Total	Per Cent
Notified Others	21	9.2	28	10.1	49	9.6
Searched for Fire	5	2.2	7	2.5	12	2.4
Called Fire Department	30	13.2	44	15.9	74	14.5
Got Dressed	3	1.3	6	2.2	9	1.8
Left Building	44	19.2	62	22.4	106	20.9
Got Family	11	4.8	19	6.9	30	5.9
Fought Fire	19	8.3	10	3.5	29	5.7
Got Extinguisher	19	8.3	8	2.9	27	5.3
Left Area	7	3.1	7	2.5	14	2.8
Woke Up	0	0	0	0	0	0
Nothing	0	0	0	0	0	0
Had Others Call F.D.	9	3.9	11	4.0	20	4.0
Got Personal Property	7	3.1	12	4.3	19	3.8
Went to Fire Area	3	1.3	2	0.7	5	1.0
Removed Fuel	5	2.2	0	0	5	1.0
Enter Building	2	0.9	2	0.7	4	0.8
Tried to Exit	6	2.6	6	2.2	12	2.4
Went to Fire Alarm	6	2.6	3	1.1	9	1.8
Telephoned Others - Relatives	1	0.4	2	0.7	3	0.6
Tried to Extinguish	4	1.7	5	1.8	9	1.8
Closed Door to Fire Area	0	0	1	0.4	1	0.2
Pulled Fire Alarm	1	0.4	2	0.7	3	0.6
Turned Off Appliances	0	0	3	1.1	3	0.6
Check on Pets	1	0.4	6	2.2	7	1.4
Other	25	10.9	31	11.2	56	11.1
N = 25	229	100.0	277	100.0	506	100.0
Range =	0-44		0-62		0-106	
Per Cent of Participant Population =		39.2		47.4		86.6

The statistical significance of the differences in the selection of the second action responses by the male and female subpopulations is presented in Table XLVC. Examination of this table indicates the only difference between the men and the women relative to their selection of second actions, that was significant above the 1 per cent level of confidence, was the difference between the 8.9 per cent of the male subpopulation which "obtained an extinguisher," and the 2.9 per cent of the female population.

In addition, two differences which were also selected by a higher percentage of the male subpopulation were significant at the 5 per cent level of confidence. The difference consisting of 8.3 per cent of the male subpopulation which "fought the fire" as opposed to 3.5 per cent of the female subpopulation was one of the differences significant at the 5 per cent level of confidence. The other difference involved 2.2 per cent of the male subpopulation which was involved with the response of "removed fuel" while none of the female members initiated this response as their second action, and this difference was thus also statistically significant.

It should be observed that all of the second actions in which the differences between the male and female members of the participant population were statistically significant, involved fire fighting related actions. The fire fighting behavior of the participant population was examined and statistically compared in detail later in this section in Tables L, LA, LB, and LC, on pages 175 to 180.

TABLE XLVC

SIGNIFICANCE OF SEXUAL DIFFERENCES BETWEEN SECOND ACTIONS OF THE PARTICIPANT POPULATION

Actions	Male Per Cent	Female Per Cent	P ₁ -P ₂	SE _{P₁-P₂}	CR
Notified Others	9.2	10.1	0.9	2.66	0.34
Searched for Fire	2.2	2.5	0.3	1.37	0.22
Called Fire Department	13.2	15.9	2.7	3.18	0.85
Got Dressed	1.3	2.2	0.9	1.19	0.76
Left Building	19.2	22.4	3.2	3.58	0.89
Got Family	4.8	6.9	2.1	2.11	1.00
Fought Fire	8.3	3.5	4.8	2.07	2.34*
Got Extinguisher	8.3	2.9	5.4	2.02	2.67**
Left Area	3.1	2.5	0.6	1.48	0.41
Woke Up	0	0	0	0	0
Nothing	0	0	0	0	0
Had Others Call F.D.	3.9	4.0	0.1	1.75	0.06
Got Personal Property	3.1	4.3	1.2	1.71	0.70
Went to Fire Area	1.3	0.7	0.6	0.89	0.67
Removed Fuel	2.2	0	2.2	0.89	2.47*
Enter Building	0.9	0.7	0.2	0.80	0.25
Tried to Exit	2.6	2.2	0.4	1.37	0.29
Went to Fire Alarm	2.6	1.1	1.5	1.19	1.26
Telephone Others - Relatives	0.4	0.7	0.3	0.69	0.43
Tried to Extinguish	1.7	1.8	0.1	1.19	0.08
Closed Door to Fire Area	0	0.4	0.4	0.40	1.00
Pulled Fire Alarm	0.4	0.7	0.3	0.69	0.43
Turned Off Appliances	0	1.1	1.1	0.69	1.59
Check on Pets	0.4	2.2	1.8	1.05	1.71
Other	10.9	11.2	0.2	2.78	0.07
N = 25	229	277			

**Critical ratio significant at or above the 1 per cent level of confidence.

*Critical ratios significant at or above the 5 per cent level of confidence.

C. The Distribution of The Third Actions of The Participant Population.

The distribution of the third actions of the participant population are presented in Table XLVI. Third actions were engaged in by 365 members of the participant population which consisted of approximately 62.9 per cent of the total participant population. It should be remembered, 580 individuals were involved with first actions, which was approximately 99.3 per cent of the total participant population. Thus, the number of participants had decreased by approximately one third from the first to the third action. The first and second most frequent third actions were identical with the first and second most frequent second actions, with the action of "leaving the building" being the most popular third action, and the "calling of the fire department" the second most popular third action. The third most frequently utilized third action involved the "fighting of the fire", and the fourth most popular action consisted of the "notification of others".

In Table XLVI the actions have been increased to 28 specific actions, with the grouping of the other actions to provide a total of 29 classifications. The actions of "going to the balcony", and "awaiting the fire department arrival" were not mentioned as first actions by members of the participant population. However, these were important responses of the third action population since more than 6 per cent of the population engaged in these actions. Considering the original classification of 25 first action categories, in addition to the previously identified first actions that were not selected for a second action of "woke up" and "nothing", the first and second action of "went to the fire area", was

TABLE XLVI
THIRD ACTION OF THE PARTICIPANT POPULATION

Actions	Participants	Per Cent
Notified Others	21	5.8
Searched for Fire	3	0.8
Called Fire Department	46	12.7
Got Dressed	1	0.3
Left Building	131	35.9
Got Family	5	1.4
Fought Fire	42	11.5
Got Extinguisher	6	1.6
Left Area	4	1.1
Woke Up	0	0
Nothing	0	0
Had Others Call F.D.	15	4.1
Got Personal Property	3	0.8
Went to Fire Area	0	0
Removed Fuel	4	1.1
Enter Building	4	1.1
Tried to Exit	2	0.5
Went to Fire Alarm	4	1.1
Telephoned Others - Relatives	4	1.1
Tried to Extinguish	7	1.9
Closed Door to Fire Area	1	0.3
Pulled Fire Alarm	2	0.5
Turned Off Appliances	1	0.3
Check on Pets	2	0.5
Await F.D. Arrival	13	3.6
Went to Balcony	10	2.7
Removed by F.D.	6	1.6
Open Doors-Windows	4	1.1
Other	24	6.6
<hr/>		
N = 29	365	100.0
<hr/>		
Range =	0-131	
<hr/>		
Per Cent of Participant Population = 62.9		
<hr/>		

TABLE XLVI
THIRD ACTION OF THE PARTICIPANT POPULATION

Actions	Participants	Per Cent
Notified Others	21	5.8
Searched for Fire	3	0.8
Called Fire Department	46	12.7
Got Dressed	1	0.3
Left Building	131	35.9
Got Family	5	1.4
Fought Fire	42	11.5
Got Extinguisher	6	1.6
Left Area	4	1.1
Woke Up	0	0
Nothing	0	0
Had Others Call F.D.	15	4.1
Got Personal Property	3	0.8
Went to Fire Area	0	0
Removed Fuel	4	1.1
Enter Building	4	1.1
Tried to Exit	2	0.5
Went to Fire Alarm	4	1.1
Telephoned Others - Relatives	4	1.1
Tried to Extinguish	7	1.9
Closed Door to Fire Area	1	0.3
Pulled Fire Alarm	2	0.5
Turned Off Appliances	1	0.3
Check on Pets	2	0.5
Await F.D. Arrival	13	3.6
Went to Balcony	10	2.7
Removed by F.D.	6	1.6
Open Doors-Windows	4	1.1
Other	24	6.6
N = 29	365	100.0
Range =	0-131	
Per Cent of Participant Population = 62.9		

not selected by any of the third action participants.

1. Significance of The Differences Between the First and the Third Actions of the Participant Population.

The statistical significance in the differences in the selection of the various actions between the first and third actions of the participant population are presented in Table XLVIA. It should be observed that thirteen of these differences were significant above the 1 per cent level of confidence, and one of the differences was significant above the 5 per cent level of confidence. Of the fourteen differences that were significant, five of the actions were responses that were predominant for the third action population as follows: "leaving the building", "fighting the fire", "awaiting the fire department arrival", "going to the balcony", and "removed by the fire department". These five actions were utilized by 55.3 per cent of the third action population. The extreme difference in the selection of the actions between the two populations, when the third action percentage was greater, involved the action of "leaving the building" for 35.9 per cent of the third action population and 7.6 per cent of the first action population.

The remaining nine significant differences between the first and third actions of the participant population involved actions with a higher percentage of selection as first actions in the following classifications: "notification of others", "searched for fire", "got dressed", "got family", "got an extinguisher", "left the fire area", "woke up", "nothing", and "went to the fire area". It is apparent upon examination of Table XLVIA, the difference in the action of "got an

TABLE XLVIA

SIGNIFICANCE OF DIFFERENCES BETWEEN FIRST AND THIRD ACTION OF PARTICIPANT POPULATION

Actions	1st Action Per Cent	3rd Action Per Cent	P_{1-P_2}	$SE_{P_{1-P_2}}$	CR
Notified Others	15.0	5.8	9.2	2.11	<u>4.36**</u>
Searched for Fire	10.1	0.8	9.3	1.64	<u>5.67**</u>
Called Fire Department	9.0	12.7	3.7	2.02	1.83
Got Dressed	8.1	0.3	7.8	1.46	<u>5.34**</u>
Left Building	7.6	35.9	28.3	2.58	<u>10.97**</u>
Got Family	7.6	1.4	6.2	1.47	<u>4.22**</u>
Fought Fire	4.6	11.5	6.9	1.73	<u>3.99**</u>
Got Extinguisher	4.6	1.6	3.0	1.20	<u>2.50*</u>
Left Area	4.3	1.1	3.2	1.15	<u>2.78**</u>
Woke Up	3.1	0	3.1	0.91	<u>3.41**</u>
Nothing	2.7	0	2.7	0.86	<u>3.14**</u>
Had Others Call F.D.	2.2	4.1	1.9	1.11	1.71
Got Personal Property	2.1	0.8	1.3	0.83	1.57
Went to Fire Area	2.1	0	2.1	0.75	<u>2.80**</u>
Removed Fuel	1.7	1.1	0.6	0.81	0.74
Enter Building	1.6	1.1	0.5	0.78	0.64
Tried to Exit	1.6	0.5	1.1	0.72	1.53
Went to Fire Alarm	1.6	1.1	0.5	0.78	0.64
Telephoned Others - Relatives	1.2	1.1	0.1	0.72	0.14
Tried to Extinguish	1.2	1.9	0.7	0.81	0.86
Closed Door to Fire Area	1.0	0.3	0.7	0.55	1.27
Pulled Fire Alarm	0.9	0.5	0.4	0.55	0.73
Turned Off Appliances	0.9	0.3	0.6	0.55	1.09
Check on Pets	0.9	0.5	0.4	0.55	0.73
Await F.D. Arrival	0	3.6	3.6	0.78	<u>4.62**</u>
Went to Balcony	0.2	2.7	2.5	0.72	<u>3.47**</u>
Removed by F.D.	0	1.6	1.6	0.51	<u>3.14**</u>
Open Doors - Windows	0.2	1.1	0.9	0.47	1.91
Other	3.9	6.6	2.7	1.45	1.86

N = 29

580

365

**Critical ratios significant at or above the 1 per cent level of confidence.

*Critical ratio significant at or above the 5 per cent level of confidence.

extinguisher" between 4.6 per cent of the first action population and 1.6 per cent of the third action population was significant above the 5 per cent level of confidence.

The magnitude of the significant differences between the first and the third actions were varied from a difference of 1.6 for the action of "removed by the fire department", to a difference of 28.3 for the action of, "leaving the building".

2. The Significance of the Differences Between the Third and the Second Actions of the Participant Population.

There were eleven statistically significance differences in the selection of actions between the second and third actions. Seven of these eleven differences were significant above the 1 per cent level of confidence, while the remaining four differences were significant above the 5 per cent level of confidence. The five predominant third actions of "leaving the building", "fighting the fire", "awaiting the arrival of the fire department", "going to the balcony", and "removed by the fire department" had significant differences in their percentage of utilization between the third and second action populations.

The six predominant second action significant differences involved the actions of "notification of other persons", "got dressed", "got family members", "got an extinguisher", "got personal property", and "tried to exit". These six action responses of the second action population accounted for second actions of 28.8 per cent of the participants of that population. It is obvious the first and second predominant actions are identical for both the second and third action populations, consisting

TABLE XLVIB

SIGNIFICANCE OF DIFFERENCES BETWEEN SECOND AND THIRD ACTIONS OF PARTICIPANT POPULATION

Actions	2nd Action Per Cent	3rd Action Per Cent	$P_1 - P_2$	$SE_{P_1 - P_2}$	CR
Notified Others	9.6	5.8	3.8	1.86	<u>2.04*</u>
Searched for Fire	2.4	0.8	1.6	0.89	1.80
Called Fire Department	14.5	12.7	1.8	2.36	0.76
Got Dressed	1.8	0.3	1.5	0.75	<u>2.00*</u>
Left Building	20.9	35.9	15.0	3.05	<u>4.92**</u>
Got Family	5.9	1.4	4.5	1.34	<u>3.36**</u>
Fought Fire	5.7	11.5	5.8	1.87	<u>3.10**</u>
Got Extinguisher	5.3	1.6	3.7	1.29	<u>2.87**</u>
Left Area	2.8	1.1	1.7	0.98	1.73
Woke Up	0	0	0	0	0
Nothing	0	0	0	0	0
Had Others Call F.D.	4.0	4.1	0.1	1.34	0.07
Got Personal Property	3.8	0.8	3.0	1.07	<u>2.80**</u>
Went to Fire Area	1.0	0	1.0	0.53	1.89
Removed Fuel	1.0	1.1	0.1	0.68	0.15
Enter Building	0.8	1.1	0.3	0.65	0.46
Tried to Exit	2.4	0.5	1.9	0.86	<u>2.21*</u>
Went to Fire Alarm	1.8	1.1	0.7	0.83	0.84
Telephoned Others - Relatives	0.6	1.1	0.5	0.61	0.82
Tried to Extinguish	1.8	1.9	0.1	0.91	0.11
Closed Door to Fire Area	0.2	0.3	0.1	0.31	0.32
Pulled Fire Alarm	0.6	0.5	0.1	0.53	0.19
Turned Off Appliances	0.6	0.3	0.3	0.53	0.57
Check on Pets	0.4	0.5	0.1	0.43	0.23
Await F.D. Arrival	1.0	3.6	2.6	0.98	<u>2.65**</u>
Went to Balcony	0.8	2.7	1.9	0.86	<u>2.21*</u>
Removed by F.D.	0	1.6	1.6	0.57	<u>2.80**</u>
Open Doors - Windows	0.4	1.1	0.7	0.57	1.23
Other	8.9	6.6	2.3	1.84	1.25
N = 29	506	365			

*Critical ratios significant at or above the 5 per cent level of confidence.

**Critical ratios significant at or above the 1 per cent level of confidence.

of the actions of, "leaving the building" and "calling the fire department".

3. The Sexual Distribution of the Participant Population Relative to the Third Actions.

As previously indicated in Table XLVI, the most popular response adopted as a third action by the participant population was "leave the building". The response of leaving the building was the most frequently utilized response for both the male and female subpopulations involving 61 males and 70 females for 33.3 per cent of the male population and 38.4 per cent of the female population. However, examination of Table XLVIC with the third actions of the participants analyzed according to the male and female subpopulations indicates a divergence in the two subpopulations with the selection of the second most popular third action response. The second most frequently selected third action for the males consisted of the action of "fighting the fire" for 33 individuals which was approximately 18 per cent of the male subpopulation. However, the second most frequently selected third action for the female population involved the action of "calling the fire department" which involved 25 participants, or approximately 13.7 per cent of the female subpopulation. The third and fourth most selected responses for the female population involved 4.9 per cent of this subpopulation for both actions of "had others call the fire department" and "fighting the fire", while for the male subpopulation the third most frequently selected third action was "calling the fire department" for 11.5 per cent of the male subpopulation, and the most popular fourth action was the "notification of others" for 7.2 per cent of this population.

TABLE XLVIC
SEXUAL DISTRIBUTION OF PARTICIPANT POPULATION RELATED
TO THIRD ACTION

Actions	Male	Per Cent	Female	Per Cent	Total	Per Cent
Notified Others	13	7.2	8	4.5	21	5.8
Searched for Fire	1	0.5	2	1.1	3	0.8
Called Fire Department	21	11.5	25	13.7	46	12.7
Got Dressed	0	0	1	0.5	1	0.3
Left Building	61	33.3	70	38.4	131	35.9
Got Family	3	1.7	2	1.1	5	1.4
Fought Fire	33	18.0	9	4.9	42	11.5
Got Extinguisher	4	2.2	2	1.1	6	1.6
Left Area	1	0.5	3	1.7	4	1.1
Woke Up	0	0	0	0	0	0
Nothing	0	0	0	0	0	0
Had Others Call F.D.	6	3.3	9	4.9	15	4.1
Got Personal Property	1	0.5	2	1.1	3	0.8
Went to Fire Area	0	0	0	0	0	0
Removed Fuel	1	0.5	3	1.7	4	1.1
Enter Building	2	1.1	2	1.1	4	1.1
Tried to Exit	1	0.5	1	0.5	2	0.5
Went to Fire Alarm	1	0.5	3	1.7	4	1.1
Telephoned Others - Relatives	1	0.5	3	1.7	4	1.1
Tried to Extinguish	5	2.8	2	1.1	7	1.9
Closed Door to Fire Area	0	0	1	0.5	1	0.3
Pulled Fire Alarm	1	0.5	1	0.5	2	0.5
Turned Off Appliances	1	0.5	0	0	1	0.3
Check on Pets	1	0.5	1	0.5	2	0.5
Await F.D. Arrival	6	3.3	7	3.8	13	3.6
Went to Balcony	5	2.8	5	2.8	10	2.7
Removed by F.D.	3	1.7	3	1.7	6	1.6
Open Doors - Windows	1	0.5	3	1.7	4	1.1
Other	10	5.6	14	7.7	24	6.6
N = 29	183	100.0	182	100.0	365	100.0
Range =	0-61		0-70		0-131	
Per Cent of Participant Population =		31.3		31.2		62.5

male population was predominate and significantly different from the female population on the second actions of, "fought the fire", "got an extinguisher" and "removed the fuel", all essentially fire control and suppression activities. Relative to the third actions, it should be remembered the male population was predominate and significantly different from the female population relative to the third action of, "fought the fire". It should be remembered relative to the significance of the second and third actions when compared for the male and female subpopulations, all of the significant differences were actions involving fire fighting and suppression activities in which the male population was predominant. Thus, the only significant differences between the male and the female populations in which the female population was predominant were found in the first actions.

Relative to the first action differences in which the female population was predominant, Table XLIVB on page 118 should be reviewed. It is apparent the female population was dominant and significantly different from the male population relative to their first action responses on the actions of, "called the fire department", "left the building", and "obtain family members".

The first, second, and third actions of the participant population are summarized in Table XLVII relative to the selection of these actions by the members of the participant population. The apparent trends relative to the percentage of participants from the first to the third action should be compared. The trend of the decrease in the actions of "notify others", and "got family members", with the increasing

TABLE XLVII

SUMMARY OF THE FIRST, SECOND AND THIRD ACTIONS OF THE PARTICIPANT POPULATION

Actions	1st Action Per Cent	2nd Action Per Cent	3rd Action Per Cent
Notified Others	15.0	9.6	5.8
Searched for Fire	10.1	2.4	0.8
Called Fire Department	9.0	14.6	12.7
Got Dressed	8.1	1.8	0.3
Left Building	7.6	20.9	35.9
Got Family	7.6	5.9	1.4
Fought Fire	4.6	5.7	11.5
Got Extinguisher	4.6	5.3	1.6
Left Area	4.3	2.8	1.1
Woke Up	3.1	0	0
Nothing	2.7	0	0
Had Others Call F.D.	2.2	4.0	4.1
Got Personal Property	2.1	3.8	0.8
Went to Fire Area	2.1	1.0	0
Removed Fuel	1.7	1.0	1.1
Enter Building	1.6	0.8	1.1
Tried to Exit	1.6	2.4	0.5
Went to Fire Alarm	1.6	1.8	1.1
Telephoned Others - Relatives	1.2	0.6	1.1
Tried to Extinguish	1.2	1.8	1.9
Closed Door to Fire Area	1.0	0.2	0.3
Pulled Fire Alarm	0.9	0.6	0.5
Turned Off Appliances	0.9	0.6	0.3
Check on Pets	0.9	1.4	0.5
Await F.D. Arrival	0	1.0	3.6
Went to Balcony	0.2	0.8	2.7
Removed by F.D.	0	0	1.6
Open Doors - Windows	0.2	0.4	1.1
Other	3.9	8.9	6.6
N = 29	100.0	100.0	100.0
Range =	0-87	0-106	0-131
Per Cent of Participant Population	99.3	86.6	62.9

trend in the actions of, "called the fire department", "left the building", and "fought the fire", is readily apparent. The actions with a decreasing trend over the three actions would appear to be the following: "Notified others", "searched for the fire", "got dressed", "got family members", "left the area", "woke up", "nothing", "went to the fire area", "pulled fire alarm", and "turned off appliances".

The actions of the participant population which showed an increasing trend in selection and utilization from the first to the third actions, were the following: "Called fire department", "left the building", "fought the fire", "had others call the fire department", "tried to extinguish", "awaited the fire department arrival", "went to balcony", "removed by fire department", and "opened doors or windows". The actions which varied or remained the same through the first, second, and third actions and thus exhibited no defined increasing or decreasing trends were as follows: "Got an extinguisher", "got personal property", "removed fuel", "entered the building", "tried to exit", "went to the fire alarm", "telephone others - relatives", "closed door to fire area", and the action of "check on pets". Thus, it must be remembered the time sequence of the actions relative to the participants, and the fact the time involved in the conduct of the action responses by the participants was also involved in the development of the fire threat. Thus, in the majority of the fire incidents, it would appear when a participant reached the time sequence of a second or third action, the fire incident was perceived as being of such a threatening nature the participant realized it was time to leave the building or secure assistance from the fire department.

D. Variéd Critical Actions of the Participant Population.

Additional actions contained within the first, second, and third actions of the participant population were examined due to the unique nature of the actions or the assumed impact of these actions on the design of this study. It should be realized all of the actions related to the movement of the participants through smoke, and the effect of smoke on the responses of the participants will be reviewed in section VI of this report. Thus, the actions that were examined and compared in detail in this section of the report consisted of the actions of, "not voluntarily leaving the building", the reentry behavior of members of the participant population, and the relationship of the actions of the participants concerned with fighting the fire and calling the fire department.

The first of these related and critical actions of the participant population that was examined consisted of the determination of the participants that did not voluntarily leave the building, and the elicited reasons for the nonevacuation of the fire incident building.

1. The Distribution of the Participant Population Relative to Voluntarily Leaving the Building or Not Leaving the Building.

A total of 107 of the members of the participant population when they became aware of a fire incident in the building, did not engage in evacuation behavior and voluntarily leave the building. Fire department officials have reported that occupants frequently are reluctant to leave certain occupancies such as restaurants, and especially when the physical stimulus of the fire incidents are not positively threatening of a serious fire occurrence.

Table XLVIII presents the distribution of the participant population relative to their voluntary evacuation of the fire incident building or the nonevacuation of the building relative to the sexual status of the participant. It can be observed that a total of 107 participants did not voluntarily leave the fire incident building, and 49 of these participants were male and 58 were female. In addition, 463 participants were reported as engaging eventually in voluntary evacuation of the building, and data was not obtained on 10 participants concerning their evacuation action. The 49 male participants consisted of 18.7 per cent of the male population in this study, while the 58 females consisted of 18.2 per cent of the female members of the participant population.

The reasons given by the 107 participants who were identified as not voluntarily leaving the building during the fire incident are presented in Table XLVIII A. Upon examination of this table it is apparent the predominant reason given was to engage in a fire fighting type of response action, since this rationale was verbally elicited from 52 participants consisting of 48.7 per cent of the nonevacuation population. It is of particular interest to note that seven of the participants were blocked by smoke, five were blocked by fire, five were overcome by smoke, two needed help and two were afraid of fire spread. Thus, a total of 21 participants, approximately 19.6 per cent of the nonevacuation population were participants, that did not voluntarily leave the building, since the physical environment created by the fire incident prevented their voluntary evacuation of the building.

The sexual distribution of the reasons for not evacuating the building given by the participants are presented in Table XLVIII B. Other than the

TABLE XLVIII
SEXUAL DISTRIBUTION OF THE PARTICIPANT POPULATION
RELATIVE TO THE ACTION OF VOLUNTARILY LEAVING THE BUILDING

Voluntarily Left Building	Male	Per Cent	Female	Per Cent	Total	Per Cent
No	49	18.7	58	18.2	107	18.4
Yes	209	79.8	254	79.9	463	79.9
Not Reported	4	1.5	6	1.9	10	1.7
N = 3	262	100.0	318	100.0	580	100.0
Per Cent of Participant Population = 44.9					54.4	99.3

TABLE XLVIII
 REASONS FOR NOT VOLUNTARILY LEAVING THE BUILDING
 GIVEN BY THE PARTICIPANT POPULATION

Reason	Participants	Per Cent
Fight Fire	52	48.7
Notify Others	7	6.5
Blocked by Smoke	7	6.5
Blocked by Fire	5	4.7
Overcome by Smoke	5	4.7
Search for Fire	3	2.8
Needed Help	2	1.9
Secure Property	2	1.9
Afraid of Fire Spread	2	0.9
No Fire in Area	1	0.9
Help Others	1	0.9
Does Not Know	1	0.9
No Response to F.D.	1	0.9
Home	1	0.9
Return to Area	1	0.9
Not Reported	16	15.0
N = 15	107	100.0
Range = 1 - 52 Per Cent of Participant Population = 15.6		

most frequent action of "fight the fire," the agreement between the male and female subpopulations appeared to be scattered. It is interesting to observe the majority of the participants both blocked by the smoke and overcome by the smoke were males, while the majority of the participants blocked by the fire were females. Also, even though the numbers are small it is interesting to note that only females reported their action of not voluntarily leaving the building was related to needing help, while none of the males indicated this reason, although four males and one female were overcome by smoke. It is possible an apparent unwillingness to recognize the threat of the fire incident by the males or the greater number of males engaging in the fire fighting action resulted in more males being overcome by the smoke. It should be observed that seven of the males engaged in their second most frequent action of "notifying others," while no females indicated this action as a reason for not voluntarily leaving the building.

Table XLVIIIIC presents the significance of the differences in the reasons given by the members of the male and female subpopulations relative to their not voluntarily leaving the building. The only reason which was statistically significant in the difference between the male and the female subpopulations was the difference created by 12.1 per cent of the male population, "notifying others," while none of the female subpopulation gave this reason for their nonevacuation of the building. This difference in the subpopulations for the reason of, "notifying others," was significant above the 5 per cent level of confidence.

TABLE XLVIII B
SEXUAL DISTRIBUTION OF THE REASONS FOR NOT
VOLUNTARILY LEAVING THE BUILDING

Reason	Male	Per Cent	Female	Per Cent	Total	Per Cent
Fight Fire	32	55.3	20	40.8	52	48.7
Notify Others	7	12.1	0	0	7	6.5
Blocked by Smoke	4	6.9	4	6.2	7	6.5
Blocked by Fire	1	1.7	5	8.2	5	4.7
Overcome by Smoke	4	6.9	1	2.0	5	4.7
Search for Fire	1	1.7	2	4.2	3	2.8
Needed Help	0	0	2	4.2	2	1.9
Secure Property	2	3.4	0	0	2	1.9
Afraid of Fire Spread	1	1.7	1	2.0	2	1.9
No Fire in Area	0	0	1	2.0	1	0.9
Help Others	1	1.7	0	0	1	0.9
Does not Know	0	0	1	2.0	1	1.9
No Response to F.D.	0	0	1	2.0	1	0.9
Home	0	0	1	2.0	1	0.9
Return to Area	0	0	1	2.0	1	0.9
Not Reported	35	8.6	11	22.4	16	15.0
N = 16	58	100.0	49	100.0	107	100.0
Range =	0 - 32	0 - 20	Per Cent of Participant Population =			
			15.6			

TABLE XLVIIIIC
SIGNIFICANCE OF THE SEXUAL DIFFERENCES
OF THE REASONS FOR NOT LEAVING THE
BUILDING VOLUNTARILY

Reason	Male Per Cent	Female Per Cent	$P_1 - P_2$	$SE_{P_1 - P_2}$	CR
Fight Fire	55.3	40.8	14.5	9.61	1.51
Notify Others	12.1	0	12.1	4.78	<u>2.53*</u>
Blocked by Smoke	6.9	6.2	0.7	4.78	0.15
Blocked by Fire	1.7	8.2	6.5	4.07	1.60
Overcome by Smoke	6.9	2.0	4.9	4.07	1.20
Search for Fire	1.7	4.2	2.5	3.17	0.79
Needed Help	0	4.2	4.2	2.63	1.60
Secure Property	3.4	0	3.4	2.56	1.33
Afraid of Fire Spread	1.7	2.0	0.3	2.56	0.12
No Fire in Area	0	2.0	2.0	1.82	1.10
Help Others	1.7	0	1.7	1.82	0.93
Does Not Know	0	2.0	2.0	1.82	1.10
No Response to F.D.	0	2.0	2.0	1.82	1.10
Home	0	2.0	2.0	1.82	1.10
Return To Area	0	2.0	2.0	1.82	1.10
Not Reported	8.6	22.4	13.8	6.85	<u>2.01*</u>
N = 16	58	49			

* Critical Ratios significant at or above the 5 per cent level of confidence.

2. The Distribution of The Participant Population Relative to The Reentry Behavior of The Participants.

The reentry behavior for this study was defined as the entering of the fire incident building after voluntarily or nonvoluntarily leaving the building, without permission of the fire department personnel if on the scene, and before the premises were considered suitable and safe for entry to the occupants. A total of 163 participants indicated they had engaged in reentry behavior. It should be recognized that several fire incidents occurred with multiple reentry by a single participant, and the fire incident was also reported with multiple reentries by several participants.

Table XLIX presents the elicited reasons from the participants who indicated they had engaged in the reentry behavior. As previously indicated for the behavior of not voluntarily leaving the building, the most frequently given reason for the reentry of the building was to engage in, "fire fighting" behavior. The second most popular response was to, "get personal property," which was the reason given by 28 of the participants or approximately 17.2 per cent of the reentry population. The third most popular reason given was to, "check on fire," and this reason was given by 18 of the participants or 11 per cent of this population. The individual apparently became concerned upon leaving the building as to the status, and progress of the fire and returned to determine the fire situation. "The notification of others," was the fourth most frequently given response for the reentry behavior. While, the fifth and sixth most popular responses consisted of, "assisting the fire department," and to "retrieve pets." An explanation should be provided for the three responses relative to, "taken to hospital" and the one response, "rescue from balcony." All four of these participants

TABLE XLIX
 DISTRIBUTION OF THE PARTICIPANT POPULATION
 RELATIVE TO REASONS FOR REENTRY OF THE BUILDING

Reasons	Participants	Per Cent
Fight Fire	36	22.2
Obtain Personal Property	28	17.2
Check on Fire	18	11.0
Notify Others	13	8.0
Assist F.D.	12	7.4
Retrieve Pets	12	7.4
Call F.D.	9	5.5
Assist Evacuation	4	2.5
Taken to Hospital	3	1.8
Turn Power Back On	2	1.2
Rescue From Balcony	1	0.6
Help Injured Family Member	1	0.6
Turn Off Gas	1	0.6
Open Windows	1	0.6
Close Door	1	0.6
No Apparent Danger	1	0.6
Entered Non Danger Area	1	0.6
Responsibility	1	0.6
Due to Fire	1	0.6
Told to by Others	1	0.6
Not Reported	16	9.8
N = 21	163	100.0
Range = 1 - 36	Per Cent of Participant Population =	27.9

went from a balcony in an apartment house fire incident, through the fire incident building, and three of the participants were taken to the hospital.

The reentry population was analyzed relative to the distribution of the reasons for the reentry with the sexual distribution of the reentry population. This analysis of the reasons for the reentry behavior dichotomized by the male and female subpopulation is presented in Table XLIXA. The previously discussed rank order of the reasons for reentry of the building is retained in both the male and female subpopulation until the fourth most popular reason. The fourth reason for the male population was, "notify others," and the female population utilized the fourth most popular reason of "retrieve pets" and "call the fire department." The reentry behavior was participated in as a response action during the fire incident by 163 participants which is approximately 27.9 per cent of the total participant population. This percentage is slightly lower than the percentage Bryan (3) found engaged in reentry behavior in a single fire incident involving a public assembly occupancy. In this earlier incident the reentry behavior was predominately a male role phenomenon, since of the 22 persons involved in the behavior all except one were males. However, upon examination of Table XLIXA it is apparent the reentry behavior of the participants was distributed over both sexual subpopulations. The male subpopulation engaging in the reentry responses consisted of approximately 59.9 per cent of the reentry population, with 97 participants or approximately 16.6 per cent of the total participant population.

The statistical significance of the differences in the reasons given for the reentry of the building by the male and female subpopulations were computed and are presented in Table XLIXB. Upon examination of this table it is apparent that none of the reported differences are statistically

TABLE XLIXA

SEXUAL DISTRIBUTION OF THE PARTICIPANT POPULATION
RELATIVE TO REASONS FOR REENTRY OF THE BUILDING

Reason	Male	Per Cent	Female	Per Cent	Total	Per Cent
Fight Fire	24	24.7	12	18.3	36	22.2
Obtain Personal Property	13	13.5	15	22.8	28	17.2
Check on Fire	11	11.4	7	10.6	18	11.0
Notify Others	10	10.4	3	4.5	13	8.0
Assist F.D.	9	9.3	3	4.5	12	7.4
Retrieve Pets	6	6.2	6	9.1	12	7.4
Call F.D.	3	3.1	6	9.1	9	5.5
Assist Evacuation	3	3.1	1	1.5	4	2.5
Taken to Hospital	1	1.0	2	3.0	3	1.8
Turn Power Back On	1	1.0	1	1.5	2	1.2
Rescue From Balcony	1	1.0	0	0	1	0.6
Help Injured Family Member	1	1.0	0	0	1	0.6
Turn Off Gas	1	1.0	0	0	1	0.6
Open Windows	1	1.0	0	0	1	0.6
Close Door	1	1.0	0	0	1	0.6
No Apparent Danger	0	0	1	1.5	1	0.6
Entered Non Danger Area	0	0	1	1.5	1	0.6
Responsibility	1	1.0	0	0	1	0.6
Due to Fire	1	1.0	0	0	1	0.6
Told To By Others	0	0	1	1.5	1	0.6
Not Reported	9	9.2	7	10.6	16	9.8
N = 21	97	100.0	66	100.0	163	100.0
Range = 0 - 24			0 - 15		1 - 36	
Per Cent of Participant Population = 16.6				11.3		27.9

TABLE XLIXB
SIGNIFICANCE OF THE SEXUAL DIFFERENCES OF THE
PARTICIPANT POPULATION RELATIVE TO REASONS FOR
REENTRY OF THE BUILDING

Reason	Male Per Cent	Female Per Cent	P ₁ -P ₂	SE _{P₁-P₂}	CR
Fight Fire	24.8	18.3	6.5	6.57	0.99
Obtain Personal Property	13.5	22.8	9.3	5.98	1.56
Check on Fire	11.4	10.6	0.8	4.97	0.16
Notify Others	10.4	4.5	5.9	4.29	1.38
Assist F.D.	1.3	4.5	4.8	4.14	1.16
Retrieve Pets	6.2	9.1	2.9	4.14	0.70
Call F.D.	3.1	9.1	6.0	3.60	1.66
Assist Evacuation	3.1	1.5	1.6	2.47	0.65
Taken to Hospital	1.0	3.0	1.5	2.10	0.71
Turn Power Back On	1.0	1.5	0.5	1.72	0.29
Rescue From Balcony	1.0	0	1.0	1.22	0.82
Help Injured Family Member	1.0	0	1.0	1.22	0.82
Turn Off Gas	1.0	0	1.0	1.22	0.82
Open Windows	1.0	0	1.0	1.22	0.82
Close Door	1.0	0	1.0	1.22	0.82
No Apparent Danger	0	1.5	1.5	1.22	1.23
Entered Non Danger Area	0	1.5	1.5	1.22	1.23
Responsibility	1.0	0	1.0	1.22	0.82
Due To Fire	1.0	0	1.0	1.22	0.82
Told to by Others	0	1.5	1.5	1.22	1.23
Not Reported	9.2	10.6	1.4	4.70	0.30
N = 21	97	66			

significant. Thus, there are apparently no significant differences in the verbally elicited reasons for the reentry behavior from the male and female subpopulations. Thus, it appears the reasons for reentry into the fire incident building were the same for both the male and female members of the reentry population.

A tabulation was computed relative to the occurrence of the reentry behavior when another family member was present in the fire incident and when another family member was not present. Thus, the reentry behavior occurred with approximately 55.2 per cent of the participants having another family member present during the fire incident. However, the remaining 73 participants reentered the building when another family member was not present during the fire incident. A statistical analysis of this difference from 44.8 per cent of the reentry behavior occurring without a family member present and 55.2 per cent occurring when a family member was present, was not a statistically significant difference at or above the 5 or 1 per cent levels of confidence. It would appear the reentry behavior reported in this study resulted from a variety of motivations and attitudes leading to this type of behavioral response which were directly and indirectly related to the differing physical environments, since the majority of the fire incidents involved residential occupancies consisting of single family residences, and apartment structures.

3. The Distribution of The Participant Population Relative to The Fire Fighting Behavior of The Participants.

As indicated previously in this section, specifically in Tables XLIVB, related to the first actions, Table XLVC, related to second actions, and Table XLVID, concerned with third actions, there were significant statistical differences in the actions related to fire fighting behavior when compared

for the male and female subpopulations. These statistical significant differences occurred in action categories of, "searched for fire," "got extinguisher," "removed the fuel," and "fought the fire." All of these fire fighting related behavioral actions were predominately male actions. The action of, "calling the fire department," was only statistically significant once, but most importantly as a first action, with the female members of the participant population being predominant in utilizing this first action response. It was thus, considered to be useful and possibly of some significance to examine the distribution of the participant population relative to the calling the fire department behavioral mode as contrasted to the behavioral mode of fighting the fire.

Table L, presents the distribution of the participant population actions relative to the behavior mode of fighting the fire, or calling the fire department. It should be understood the first, second, and third actions identified under the classifications of "searched for fire," "got extinguisher," "went to fire area," "removed fuel," "tried to extinguish," and "fought fire," were all considered under the behavioral mode of fire fighting. The first, second, and third action responses identified under the classification in the action analysis in this study of, "called the fire department," "had others call the fire department," "went to fire alarm," and "pulled fire alarm," were all considered under the called the fire department behavioral mode. Relative to Table L, it is apparent the behavioral mode of fighting the fire was predominate as a first action response, while the behavioral mode of calling the fire department predominated relative to the second actions, and the actions were approximately equal as a third action response

TABLE L
 DISTRIBUTION OF PARTICIPANT POPULATION
 ACTIONS RELATIVE TO FIRE FIGHTING AND
 CALLING THE FIRE DEPARTMENT MODES

Actions	1st Action		2nd Action		3rd Action		Total	
	Participant	%	Participant	%	Participant	%	Participant	%
Fought Fire	142	24.5	87	17.2	62	17.0	291	50.2
Call F. D.	79	13.6	106	20.9	67	18.4	252	43.4
N = 2	221	38.1	193	38.1	129	35.4	543	93.6

with 17 per cent of the population fighting the fire, and 18.4 per cent calling the fire department. The fire fighting behavioral mode was utilized in 291 of the action responses of the participants for 50.2 per cent of the responses involved in this analysis. While the called fire department behavioral mode was involved with 252 of the responses for 43.4 per cent of the first, second, or third actions.

Table LA, presents the distribution of the sexual status of the 134 participants who engaged in the 291 action responses consisting of the fire fighting behavioral mode, as previously presented in Table L. It should be recognized these 134 participants only had to participate in one of the six identified action classifications, under the first, second, or third action to be identified as having engaged in fire fighting behavior. The fire fighting behavior was thus, primarily a predominant male activity with 84 males engaging in this behavior, which was approximately 62.7 per cent of the fire fighting population and 14.4 per cent of the total participant population. However, 50 females also engaged in this fire fighting behavioral activity mode, and these women were approximately 37.3 per cent of the fire fighting population and 8.5 per cent of the total participant population.

Table LA also presents the distribution of the 134 members of the fire fighting population relative to their ages. It is interesting, that fire fighting behavior was initiated by participants as young as 7 years of age and as old as 80. It should also be noted that 73.8 per cent of the individuals engaged in the fire fighting actions were between the ages of 18 and 47 years of age. Thus, as might be expected, the fire fighting type of activity in general seemed to be an adult type of response activity.

TABLE LA
 FIRE FIGHTING BEHAVIOR
 OF THE PARTICIPANT POPULATION

<u>Sex</u>	Participants	Per cent
Male	84	62.7
Female	50	37.3
Total	134	100.0
<u>Age</u>		
7 - 17	8	5.9
18 - 27	31	23.1
28 - 37	41	30.6
38 - 47	27	20.1
48 - 57	16	11.9
58 - 67	2	1.5
68 - 80	3	2.2
Unknown	<u>6</u>	<u>4.7</u>
Total	134	100.0
Per Cent of Participant Population = 22.9		

The sexual distribution of the participants relative to the action classifications constituting the fire fighting behavior mode and the called the fire department behavior mode are presented in Table LB. In the action classifications for the fire fighting behavior mode, the males were in the majority for every classification except for the actions of, "removed fuel," and "went to fire area," with the majority by the females being by a single participants in both cases. Relative to the classifications in the called the fire department behavior mode, the female participants were in the majority in two actions and they equalled the males in the two action classifications of, "had others call the fire department," and "pulled the fire alarm."

The statistical significance of the differences between the male and female subpopulations relative to their utilization of the action classifications under the behavior modes of fighting the fire and called the fire department were computed and presented in Table LC. The statistically significant differences were all found with the fire fighting behavior mode. The action classification of, "got extinguisher" with 15.6 per cent of the participants being male and 9.6 per cent of the female population, was a difference significant above the 5 per cent level of confidence. The 25.6 per cent of the male population which utilized the action classification of, "fought fire," as opposed to 9.7 per cent of the female population, was a difference that was statistically significant above the 1 per cent level of confidence. Also by referring to Table LC, it is apparent the total difference in the sex of the participants as they engaged in the fire fighting behavior mode was statistically significant above the 1 per cent level of confidence, with 70.2 per cent of the male population engaged in

TABLE LB
 DISTRIBUTION OF THE SEXUAL DIFFERENCES OF THE
 PARTICIPANT POPULATION RELATIVE TO FIRE FIGHTING AND
 CALLING THE FIRE DEPARTMENT ACTIONS

Action	Male		Female		Total	
	Participant	Per Cent	Participant	Per Cent	Participant	Per Cent
Searched for Fire	45	17.2	29	9.1	74	12.8
Got Extinguisher	41	15.6	19	6.0	60	10.3
Fought Fire	67	25.6	31	9.7	98	16.9
Removed Fuel	9	3.4	10	3.1	19	3.3
Tried to Extinguish	14	5.3	9	2.8	23	4.0
Went to Fire Area	8	3.1	9	2.8	17	2.9
N =	184	70.2	107	33.5	291	50.2
Called F. D.	67	25.6	105	33.0	172	29.7
Had Others Call F.D.	24	9.2	24	7.5	48	8.3
Went to Fire Alarm	10	3.8	12	3.8	22	3.8
Pulled Fire Alarm	5	1.9	5	1.6	10	1.7
N =	106	40.5	146	45.9	252	43.5

TABLE LC

SIGNIFICANCE OF THE SEXUAL DIFFERENCES OF
THE PARTICIPANT POPULATION RELATIVE TO FIRE
FIGHTING AND CALLING THE FIRE DEPARTMENT ACTIONS

Action	Male Per Cent	Female Per Cent	$P_1 - P_2$	$SE_{P_1 - P_2}$	CR
Searched for Fire	17.2	9.1	8.1	4.23	1.91
Got Extinguisher	15.6	6.0	9.6	3.95	<u>2.43*</u>
Fought Fire	25.6	9.7	15.9	4.83	<u>3.29**</u>
Removed Fuel	3.4	3.1	0.3	2.17	0.14
Tried to Extinguish	5.3	2.8	2.5	2.49	1.00
Went to Fire Area	3.1	2.8	0.3	2.07	0.14
Total	70.2	33.5	36.7	6.01	<u>6.11**</u>
N =	184	101			
Called F. D.	25.6	33.0	7.4	5.83	1.27
Had Others Call F.D.	9.2	7.5	1.7	3.27	0.52
Went to Fire Alarm	3.8	3.8	0	0	0
Pulled Fire Alarm	1.9	1.6	0.3	1.65	0.18
Total	40.5	45.9	5.4	6.31	0.85
N =	106	146			

* Critical Ratio significant at or above the 5 per cent level of confidence.
**Critical Ratios significant at or above the 1 per cent level of confidence.

these responses, and only 33.5 per cent of the female population. It should be realized none of the sexual differences in the behavioral mode of called the fire department were statistically significant between the male and female members of the population when the time element was controlled with the removal of the first, second, or third action sequence. However, it should be recognized, there were sexual differences in the called the fire department behavior mode, when considered within the parameters of the first, second, or third action responses.

The review of the specific interview data sheets, indicated a variety of methods and equipment were utilized in the fire fighting behavior of the participants. The throwing of water was reported from drinking glasses, pans, and wastebaskets, being utilized most frequently, often in connection with activities involved with the physical removal of the burning objects from the premises. Attempts to remove furniture, primarily burning mattresses and chairs were often mentioned.

E. The Sequences of Actions of The Participant Population.

During the analysis of the data received on the questionnaires for this study, it was realized the comparison of the actions relative to the total participant population did not provide an understanding of the relationship between the first, second, and third actions. It was possible the preceding actions might have an important predetermining influence on the subsequent actions. Thus, it was considered important to investigate possible methods by which the sequences of actions of the participants

population could be quantified and described in relation to the transitional aspects of the actions.

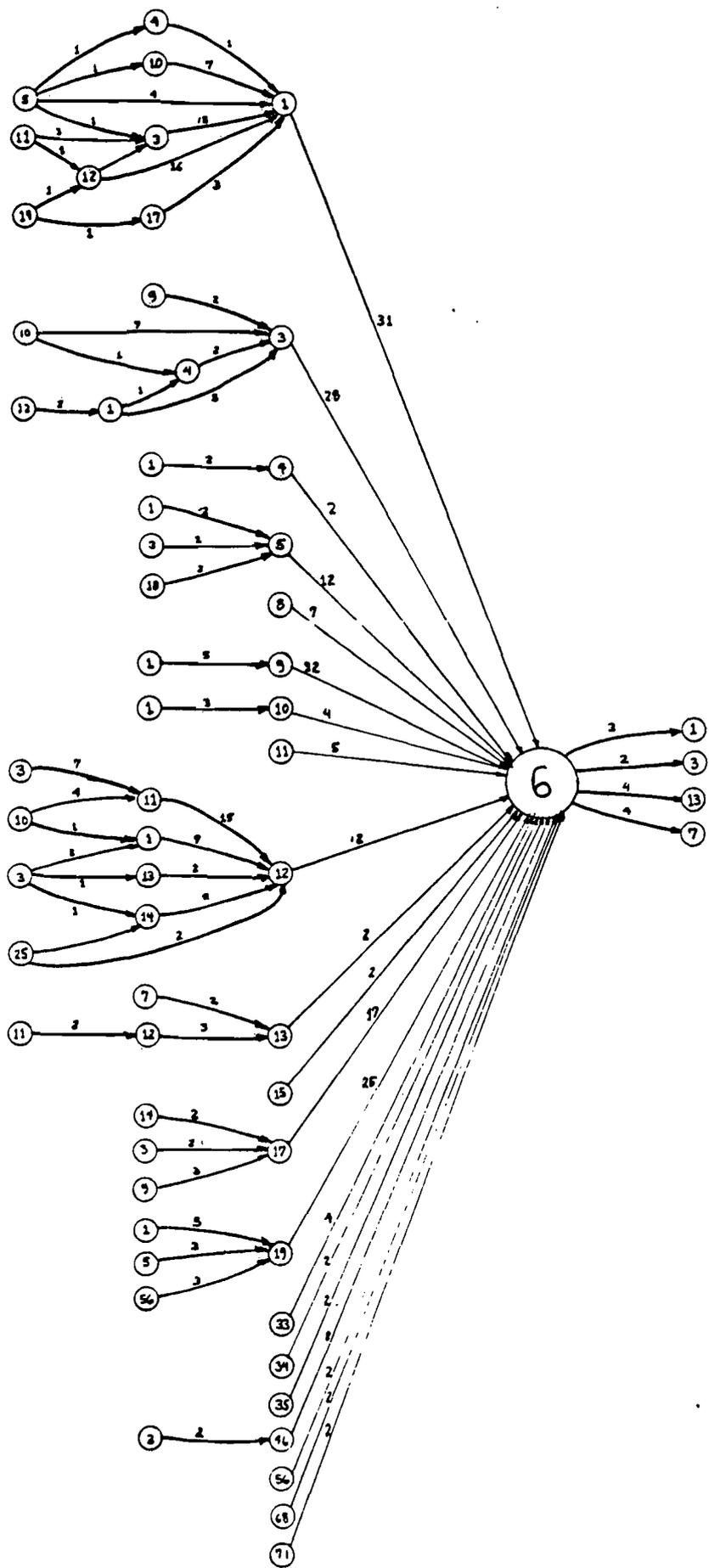
1. The Weighted Diagram.

The weighted diagram was found to be an acceptable means of presenting the action sequences of the individual participants. Each action taken by the participant represents a discrete state in the flow diagram, with the weighted diagram indicating the state of each action by an encircled code number. The code number was the identical number utilized for the coding of the questionnaire responses in the computer processing of the participants responses. The number of participants involved with the action is assigned as the weight to the directional arrow, which of course, is the total number of actions recorded for the particular action sequence. It would appear the obtaining of the participant actions with a minimum of five actions would increase the mathematical computations and analysis which could be performed with the weighted diagram. A greater frequency of actions would provide the order of cases and frequencies required for the effective use of mathematical techniques such as hierarchial clustering, and Markov Chains, with a transition frequency matrix.

Figure III presented on page 184 illustrates the weighted diagram developed to illustrate the behavioral sequences culminating in the absorbing state of "leaving the building", which involved a total of 380 actions. Relative to Figure 3, it should be obvious the encircled code number ⑥ is the action of, "leaving the building". The encircled code numbers following the action of leaving the building are: ① "Call the fire

department;" ③ "Notify other occupants;" ⑬ "Had someone else call the fire department;" and ⑦ "Entered the building." It would appear the use of the weighted diagraph and appropriate mathematical modeling techniques might be valuable in providing a more complete understanding of the sequences of actions within the total participant population.

Figure III



VI. THE EFFECT AND INFLUENCE OF SMOKE ON THE BEHAVIOR OF THE PARTICIPANT POPULATION

One of the primary objectives of this study was the determination of the influence of the visually observed smoke, and the olfactory indication of smoke production on the behavior of the participant population. It should be remembered the distribution and generation of the smoke spread in the fire incident as observed by the first arriving fire department officer was previously presented in Table VIII on page 36, and Table IX on page 37.

The influence of the smoke spread from the room or area of origin, through seven floors was presented in Section I of this report relative to the fire incidents. The first action of the participants has been examined in this section relative to the smoke spread in the incident involving the participants.

A. First Actions of The Participant Population and The Area of Smoke Spread.

The first action of the participant population is presented with the extent of smoke spread by the area and floors of the building in Table LI. The first action population as utilized in this table consisted of 580 persons, or 99.3 per cent of the total participant population. From an examination of Table LI it is apparent the majority of the participants consisting of 215 persons were involved with their first action in a fire incident in which smoke was observed to spread through one floor of the building, at the time of arrival of the fire department. However, it should be recognized and realized, the observation of the extent of the smoke spread, being conducted by the fire department officer, would in

TABLE LI
 DISTRIBUTION OF THE PARTICIPANT POPULATION RELATIVE TO SMOKE
 SPREAD AND FIRST ACTIONS

Actions	Area of Smoke Spread (Floors)									Total	Per Cent
	Room	1	2	3	4	5	6	7	Not Reported		
Notified Others	12	32	22	9	8	0	1	1	2	87	15.0
Searched for Fire	10	25	11	11	2	0	0	0	0	59	10.1
Called Fire Department	6	22	11	9	1	0	0	0	3	52	9.0
Got Dressed	0	7	15	6	9	1	1	4	4	47	8.1
Left Building	4	13	8	11	3	1	0	0	4	44	7.6
Got Family	3	18	15	2	1	0	0	1	4	44	7.6
Fought Fire	1	15	9	1	0	0	0	0	1	27	4.6
Got Extinguisher	7	8	7	2	0	0	0	0	3	27	4.6
Left Area	4	6	8	1	1	0	0	2	3	25	4.3
Woke Up	5	4	5	2	2	0	0	0	0	18	3.1
Nothing	2	5	2	2	0	0	0	0	5	16	2.7
Had Others Call F.D.	3	6	4	0	0	0	0	0	0	13	2.2
Got Personal Property	0	4	3	0	2	0	1	0	2	12	2.1
Went to Fire Area	1	10	0	1	0	0	0	0	0	12	2.1
Removed Fuel	0	8	1	1	0	0	0	0	0	10	1.7
Enter Building	3	2	2	1	1	0	0	0	0	9	1.6
Tried to Exit	0	2	3	3	1	0	0	0	0	9	1.6
Went to Fire Alarm	0	4	2	2	1	0	0	0	0	9	1.6
Telephoned Others - Relatives	1	3	3	0	0	0	0	0	0	7	1.2
Tried to Extinguish	1	6	0	0	0	0	0	0	0	7	1.2
Closed Door to Fire Area	2	2	1	0	0	1	0	0	0	6	1.0
Pulled Fire Alarm	1	3	1	0	0	0	0	0	0	5	0.9
Turned Off Appliances	1	3	0	1	0	0	0	0	0	5	0.9
Check on Pets	0	1	2	2	0	0	0	0	0	5	0.9
Other	6	6	3	1	4	2	1	1	1	25	4.3
N = 25	73	215	138	68	36	5	4	9	32	580	100.0
Range =	0-12, 1-32, 0-22, 0-11, 0-8, 0-1, 0-1, 0-4, 0-5,									5-87	
Per Cent =	12.5	37.1	23.8	11.7	6.2	0.9	0.7	1.6	5.5		
Per Cent of Participant Population = 99.3											

many situations be at a time extended beyond the time of any participant actions, including the initial or first action.

For the purpose of analysis in this study, it was decided to dichotomize the smoke spread variable into the participants exposed to smoke in fire incidents in which the smoke was limited in diffusion to the room of origin and one floor, as contrasted with the participants exposed to fire incidents in which the smoke spread from 2 to 7 floors in the building. Table LIA presents the first actions of the participant population, relative to the smoke spread in the dichotomized format. This analysis classified 292 participants in the more severe smoke spread situation of 2 to 7 floors, and 288 participants in the restricted smoke spread situations created by the fire incident in the building.

Table LIB presents the statistical analysis of the differences in the percentages of the participant population engaging in the various first actions relative to the smoke spread confined to the area of origin and 1 floor or the smoke spread occurring from 2 to 7 floors in the building. The significant differences in the first actions of the participant population relative to the smoke spread in the fire incident were all significant at the 1 per cent level of confidence. The difference in the first action of "got dressed", involved 13.7 per cent of the participant population in the fire incidents involving smoke spread from 2 to 7 floors, while only 2.4 per cent of the participants "got dressed" in the fire incidents in which smoke spread was limited to the room or 1 floor. It should be observed, however, the fire incidents with more extensive smoke spread may also be the fire incidents occurring at night which predisposes a greater predisposition for the action of getting dressed. A higher percentage of the participants "went to the fire area",

TABLE LIA

DISTRIBUTION OF THE PARTICIPANT POPULATION RELATIVE TO SMOKE SPREAD
AND FIRST ACTIONS

Actions	Area of Smoke Spread				Total	Per Cent
	Room & 1 Floor		Floors 2-7			
	Participants	Per Cent	Participants	Per Cent		
Notified Others	44	15.4	43	14.8	87	15.0
Searched for Fire	35	12.3	24	8.2	59	10.1
Called Fire Department	28	9.7	24	8.2	52	9.0
Got Dressed	7	2.4	40	13.7	47	8.1
Left Building	17	5.9	27	9.2	44	7.6
Got Family	21	7.3	23	7.9	44	7.6
Fought Fire	16	5.5	11	3.8	27	4.6
Got Extinguisher	15	5.2	12	4.1	27	4.6
Left Area	10	3.5	15	5.1	25	4.3
Woke Up	9	3.1	9	3.1	18	3.1
Nothing	7	2.4	9	3.1	16	2.7
Had Others Call F.D.	9	3.1	4	1.4	13	2.2
Got Personal Property	4	1.4	8	2.7	12	2.1
Went to Fire Area	11	3.8	1	0.3	12	2.1
Removed Fuel	8	2.7	2	0.7	10	1.7
Enter Building	5	1.7	4	1.4	9	1.6
Tried to Exit	2	0.7	7	2.4	9	1.6
Went to Fire Alarm	4	1.4	5	1.7	9	1.6
Telephoned Others - Relatives	4	1.4	3	1.0	7	1.2
Tried to Extinguish	7	2.4	0	0	7	1.2
Closed Door to Fire Area	4	1.4	2	0.7	6	1.0
Pulled Fire Alarm	4	1.4	1	0.3	5	0.9
Turned Off Appliances	4	1.4	1	0.3	5	0.9
Check on Pets	1	0.3	4	1.4	5	0.9
Other	12	4.2	13	4.5	25	4.3
N = 25	288	100.0	292	100.0	580	100.0
Range =	1-44		0-43		5-87	
Per Cent of Participant Population =	49.3		50.0		99.3	

TABLE LIB

SIGNIFICANCE OF THE DIFFERENCES IN THE FIRST ACTIONS OF PARTICIPANT
POPULATION RELATED TO SMOKE SPREAD

Actions	Area of Smoke Spread		P_1-P_2	$SE_{P_1-P_2}$	CR
	Room & 1 Floor Per Cent	Floors 2-7 Per Cent			
Notified Others	15.4	14.8	0.6	2.97	0.20
Searched for Fire	12.3	8.2	4.1	2.51	1.63
Called Fire Department	9.7	8.2	1.5	2.37	0.63
Got Dressed	2.4	13.7	11.3	2.27	<u>4.98**</u>
Left Building	5.9	9.2	3.3	2.20	1.50
Got Family	7.3	7.9	0.6	2.20	0.27
Fought Fire	5.5	3.8	1.7	1.74	0.98
Got Extinguisher	5.2	4.1	1.1	1.74	0.63
Left Area	3.5	5.1	1.6	1.68	0.95
Woke Up	3.1	3.1	0	0	0
Nothing	2.4	3.1	0.7	1.37	0.51
Had Others Call F.D.	3.1	1.4	1.7	1.22	1.39
Got Personal Property	1.4	2.7	1.3	1.19	1.09
Went to Fire Area	3.8	0.3	3.5	1.16	<u>3.02**</u>
Removed Fuel	2.7	0.7	2.0	1.07	1.87
Enter Building	1.7	1.4	0.3	1.00	0.30
Tried to Exit	0.7	2.4	1.7	1.04	1.63
Went to Fire Alarm	1.4	1.7	0.3	1.04	0.29
Telephoned Others - Relatives	1.4	1.0	0.4	0.90	0.44
Tried to Extinguish	2.4	0	2.4	0.90	<u>2.67**</u>
Closed Door to Fire Area	1.4	0.7	0.7	0.83	0.58
Pulled Fire Alarm	1.4	0.3	1.1	0.74	1.49
Turned Off Appliances	1.4	0.3	1.1	0.74	1.49
Check on Pets	0.3	1.4	1.1	0.78	1.41
Other	4.2	4.5	0.3	1.70	0.18
N = 25	288	292			

**Critical ratios significant at or above the 1 per cent level of confidence.

and also "tried to extinguish", the fire with the limited smoke spread incidents. This data seems logical since both of these first actions are actions involving a greater degree of emotional and physical discomfort in the more intense smoke spread incidents.

B. Evacuation Distance and Time for the Participant Population.

The evacuation distance, or travel distance of the participants was obtained for their movement from the area of the fire incident, and from the building. Table LII presents the comparison of the travel distance with the perceived time of the participants to completely evacuate the building. It should be emphasized the reported time was the estimated time perceived by the participant to have been involved in this type of activity.

1. Evacuation Time and Distance of The Participant Population.

Table LII presents the comparison of the evacuation distance, with the participant's perceived estimated time to complete the evacuation. It should be recognized that 431 participants, or approximately 73.8 per cent of the participant population reported an evacuation time, with 463 of the participants reporting an evacuation distance. Thus, approximately 79.3 per cent of the participant population reported an evacuation distance. It should be observed for these 431 participants, the mean evacuation time was 1.92 minutes. While the mean evacuation distance for the 463 participants was computed as 41.7 feet. Thus, it should be apparent the mean travel velocity for the participant population was approximately 21.7 feet per minute. It is apparent the relatively short mean evacuation distance is

TABLE LII
 DISTRIBUTION OF PARTICIPANT POPULATION RELATED TO EVACUATION DISTANCE
 AND EVACUATION TIME

Evacuation Time (min.)	EVACUATION DISTANCE (FEET)					Not Reported	Total	Per Cent of Participant Population
	1-15	16-25	26-45	46-99	100+			
0.0	3	2	1	2	-		8	1.7
0.1	10	8	2	2	1		23	3.9
0.2	9	4	2	6	1		22	3.8
0.3	2	2	8	2			14	2.4
0.4	1						1	.2
0.5	10	10	8	10	1		39	6.6
0.6		1			1		2	.3
0.8		1	1				2	.3
1.0	30	38	38	33	14	2	155	26.4
2.0	8	7	21	20	15	5	76	13.0
3.0	4	8	10	11	2	1	36	6.2
4.0	1	2	1	5			9	1.5
5.0	2	4	5	9	8	2	30	5.1
6.0		1					1	.2
7.0			1		1		2	.3
8.0					1		1	.2
10.0	1	2		1	2		6	1.0
15.0		1					1	.2
30.0	1				1	1	3	.5
Not Reported	15	14	8	4	2	110	153	26.2
N = 20	97	105	106	105	50	121	584	100.0
Per Cent of Participant Population =	16.6	17.9	18.1	17.9	8.5	20.9	100.0	--
M = 1.92	SE = 26.9		M = 41.7	SD = 21.8				
SE _M = 1.30	SE _{SD} = 0.92		SE _M = 1.01	SE _{SD} = 0.72				

a reflection of the predominance of single family residential buildings in the fire incident population of this study as previously presented in Table X, on page 39, in Section I.

The evacuation time of the participant population as previously indicated is an estimated time, influenced by all the psychological and emotional factors interacting with the participant during the evacuation. Thus, these time estimates must be recognized as the time as experienced by the participant during evacuation. However, while the distance traveled by the participant was checked by the fire department official at the scene, there was no practical or effective mechanism for the determination of the accuracy of the evacuation time. However, for the purposes of this study, the important variable would appear to be the fact the reported time estimate was the time perceived by the participant to complete the evacuation behavior.

2. Evacuation Distance and The Time of Occurrence of The Evacuation.

The evacuation distance is compared with the time of occurrence of the evacuation, defined by the minutes after the awareness of the fire incident when the evacuation behavior was initiated. It will be remembered, the means or stimulus by which the participants became aware of the fire incident were examined previously in Table XXXIV on page 85 of this report. The comparison of the evacuation distance relative to the time of occurrence of the evacuation is presented in Table LIIA. Upon examination of Table LIIA the alphabetical codes have the following meanings: AFF = After fire fighting; ACFD = After called the fire department; AFDA = After the fire department arrival; AFWO = After fire was out; ASAP = As soon as possible; BFDA = Before fire department arrival; and IMM = Immediately.

TABLE LIIA
 DISTRIBUTION OF PARTICIPANT POPULATION RELATED TO
 EVACUATION DISTANCE AND TIME OF EVACUATION

Time of Evacuation (Min. After Fire)	0-15'	16-25'	26-45'	46-99'	100+'	Not Reported	Total	% of Participant Population
0	1				1		2	.3
.2		1					1	.2
.5		2	1	1			4	.7
.75	1						1	.2
.25		1					1	.2
1.0	5		5	6	4	2	22	3.8
1.5	1	2					3	.5
2.0	5	8	7	9	4	2	35	6.1
3.0	5	4	2	9	2		22	3.8
4.0	2		4				6	1.0
5.0	5	7	8	3	6	1	30	5.1
6.0	2		2				4	.7
7.0			1				1	.2
8.0			1	1	1		3	.5
10.0	1	2	2	1		1	7	1.2
20.0		1			1		2	.3
25.0					1		1	.2
60.0				1			1	.2
AFF	1	3	2	2		1	9	1.5
ACFD	1	1	2	2			6	1.0
AFDA	2	2	10	6	2	2	24	4.1
AFWO		1		1	1		3	.5
ASAP	3	1	2	5	2		13	2.2
BFDA	4	7	7	7		1	26	4.4
IMM	20	16	19	21	10	3	89	15.2
Not Reported	38	46	31	30	15	106	266	45.9
N = 26	97	105	106	105	50	121	584	100.0
% of Participant Population	16.6	17.9	18.1	17.9	8.5	20.9	100.0	--
M = 4.07	SD = 17.6				M = 41.7	SD = 21.8		
SE _M = 1.46	SE _{SD} = 1.04				SE _M = 1.01	SE _{SD} = 0.72		

It should be observed the mean time for the occurrence of the evacuation consisted of 4.07 minutes after the participant became aware of the fire incident. The data on the time of occurrence of the evacuation was obtained from 318 participants or approximately 54.4 per cent of the total participant population. The range of times reported from the awareness of the fire incident until the initiation of the evacuation action varied from immediately, until 60 minutes, or after the fire was out. Tables LII and LIIA provide some basic information relative to the evacuation distance, evacuation time, and the time of occurrence of the evacuation, which provides a basis for the consideration of movement through smoke of the participant population.

C. Movement of The Participant Population Through Smoke.

The movement of the participant population through the smoke was of critical concern to this study. Approximately 366 members of this population, or approximately 62.7 per cent of the total participant population moved through smoke during the fire incidents included in this study. Table LIII presents the reported data relative to the distance moved for the participants. The greatest distance reported by any participant relative to movement through smoke was 400 feet. The mean distance for the 345 participants who reported a distance moved in feet, was 29.8 feet moved through the smoke. This mean movement through smoke distance contrasts with the mean evacuation distance of 41.7 feet as previously reported in Tables LII and LIIA. This difference of 11.9 feet between the mean evacuation distance for the participant population of 463 persons and the mean distance for the movement through the smoke was computed to be statistically significant above

TABLE LIII
 DISTRIBUTION OF PARTICIPANT POPULATION
 RELATIVE TO DISTANCE MOVED THROUGH SMOKE

Distance Feet	Participants	Per Cent
1 - 10	97	26.5
11 - 25	111	30.3
26 - 50	102	27.8
51 - 99	14	3.8
100 - 400	21	5.8
Not Reported	21	5.8
N = 6	366	100.0
$M = 29.8$ $SD = 28.9$ $SE_M = 1.39$ $SE_{SD} = 0.9$		
Per Cent of Participant Population = 62.7		

the 1 per cent level of confidence, with a Standard Error of the difference between the means of 1.72 which resulted in a critical ratio of 6.92.

1. The Movement Through Smoke of The Participant Population With and Without Previous Fire Experience.

Approximately 87 of the participants from the 366 persons that had moved through smoke had been involved in a previous fire experience prior to the fire incident involved in this study. These 87 participants were approximately 23.8 per cent of the subpopulation involved in movement through smoke. The mean distance moved through the smoke for the subpopulation with previous fire experience was 32.1 feet, and contrasts with the mean distance of the total subpopulation for movement through smoke of 29.8 feet. The rather limited population of 80 persons reporting the distance moved through the smoke with previous fire experience may have biased this data however.

Table LIIIA presents the comparison of the distance moved through the smoke of the subpopulations with previous fire experience and without previous fire experience. It should be observed that 279 of the 366 participants that moved through the smoke were without previous fire experience, which was approximately 76 per cent of the movement through smoke subpopulation.

The significance of the differences in the distances moved through the smoke for the subpopulations concerned with previous fire experience are presented in Table LIIIB. Upon examination of Table LIIIB it may be observed the differences in the percentages of the subpopulations relative to the distance moved through the smoke varied from a difference of 0.1 per cent to 5.9 per cent, and none of these differences were computed to be statistically significant. Thus, it must be assumed these differences

TABLE LIIIA

DISTRIBUTION OF PARTICIPANT POPULATION RELATIVE TO FIRE
EXPERIENCE AND DISTANCE MOVED THROUGH SMOKE

Distance Feet	Fire Experience Participant	%	No. Fire Experience Participants	%	Total	Per Cent
1 - 10	27	31.0	70	25.1	97	26.5
11 - 25	25	28.8	86	30.9	111	30.3
26 - 50	20	23.0	82	29.4	102	27.8
51 - 99	3	3.4	11	3.9	14	3.8
100 - 400	5	5.7	16	5.7	21	5.8
Not Reported	7	8.0	14	5.0	21	5.8
N = 6	87	100.0	279	100.0	366	100.0
Range =	3-27		14-86		14-111	
M = 32.1	SD = 10.9		M = 34.1	SD = 29.6		
SE _M = 1.22	SE _{SD} = 0.87		SE _M = 1.82	SE _{SD} = 1.29		
% of Participant Population =	14.9		47.8		62.7	

TABLE LIIIB
SIGNIFICANCE OF DIFFERENCES IN MOVEMENT
THROUGH SMOKE RELATIVE TO THE FIRE
EXPERIENCE OF PARTICIPANT POPULATION

Distance Feet	Fire Experience Per Cent	No Fire Experience Per Cent	$P_1 - P_2$	$SE_{P_1 - P_2}$	CR
1 - 10	31.0	25.1	5.9	5.42	1.09
11 - 25	28.8	30.9	2.1	5.65	0.37
26 - 50	23.0	29.4	6.4	5.51	1.16
51 - 99	3.4	3.9	0.5	2.35	0.21
100 - 400	5.8	5.7	0.1	2.85	0.03
Not Reported	8.0	5.0	3.0	2.85	1.05
	87	279			

were due to chance variations, and were not an outcome or result of previous fire experience or the lack of a previous fire experience.

When the mean distance moved for the two subpopulations relative to the previous fire experience are compared, there is a difference in mean distance moved of two feet. The statistical comparison of the significance of this difference resulted in a critical ratio of 0.91 which also was not statistically significant. Obviously, the null hypothesis was confirmed and accepted as a result of Table LIIIB.

2. The Movement Through Smoke of the Participant Population Relative to Previous Training.

The movement through the smoke population of 366 participants was analyzed relative to the participants who had previously received training, and the participants who had not previously received training. It was tentatively assumed the participants, who had previously received training would be more adaptable and thus probably moved a greater distance through the smoke than the participants without the previous training.

Table LIIIC presents the distribution of the distance moved through the smoke for the participants with previous training and the participants without previous training. It should be observed that 122 of the movement through the smoke subpopulation, or approximately one third of this subpopulation had received previous training. The mean distance moved for the subpopulation with previous training was 41.8 feet. This mean value, it should be remembered, is approximately equal to the mean evacuation distance of 41.7 feet previously presented in Table LII as computed from the total distance moved in fire incidents with and without smoke

TABLE LIIIIC
 DISTRIBUTION OF PARTICIPANT POPULATION
 RELATIVE TO PREVIOUS TRAINING AND
 DISTANCE MOVED THROUGH SMOKE

Distance Feet	Previous Training Participants	%	No Previous Training Participants	%	Total	Per Cent
1 - 10	31	25.4	66	27.0	97	26.5
11 - 25	37	30.3	74	30.3	111	30.3
26 - 50	28	22.9	74	30.3	102	27.8
51 - 99	7	5.8	7	2.9	14	3.8
100 - 400	12	9.8	9	3.8	21	5.8
Not Reported	7	5.8	14	5.7	21	5.8
N = 6	122	100.0	244	100.0	366	100.0
Range =	7 - 37		7 - 74		21 - 111	
	M = 41.8	SD = 25.8	M = 29.6	SD = 24.1		
	SE _M = 2.41	SE _{SE} = 1.71	SE _M = 1.58	SE _{SD} = 1.13		
% of Participant Population =	20.9		41.8		62.7	

conditions. This mean distance of 41.8 feet contrasts with the mean distance of the subpopulation without previous training which moved a mean distance of 29.6 feet. The difference between these mean distances consisted of 12.2 feet. This difference in the mean distances moved through the smoke for the subpopulations with and without previous training were statistically compared, with the computation of the standard error of the difference between the means of 2.88 and a critical ratio of 4.24, which is statistically significant above the 1 per cent level of confidence. Thus, it would appear the difference in the mean distance moved through the smoke between the two subpopulations was a significant difference and the Null Hypothesis is thus rejected in this comparison.

The significance of the differences for the distance moved through the smoke for the various percentages of the subpopulations were compared in Table LIIID. Upon examination of this table, it may be observed the range of the differences in the percentages of the two subpopulations relative to the distance moved through the smoke varied from 0.1 per cent to 6.0 per cent. Relative to the differences in the distances moved by the participants who had received previous training and the participants without previous training, the 6 per cent difference in the category from 100 to 400 feet, was statistically significant above the 5 per cent level of confidence.

3. The Movement Through Smoke of The Participant Population Relative to The Sexual Distribution.

The movement of the participant population through the smoke was analyzed relative to any significant differences in the movement through the smoke by the sex of the participants. Table LIIIE presents the distri-

TABLE LIID
SIGNIFICANCE OF DIFFERENCES IN MOVEMENT
THROUGH SMOKE RELATIVE TO PREVIOUS
TRAINING OF PARTICIPANT POPULATION

Distance Feet	Previous Training Per Cent	No Previous Training Per Cent	$P_1 - P_2$	$SE_{P_1 - P_2}$	CR
1-10	25.4	27.0	1.6	4.89	0.33
11-25	30.3	30.3	0	0	0
26-50	22.9	30.3	0.4	4.97	0.08
51-99	5.8	2.9	2.9	2.15	1.35
100-400	9.8	3.8	6.0	2.59	<u>2.32*</u>
Not Reported	5.8	5.7	0.1	2.57	0.04
	122	244			

* Critical Ratio significant at or above the 5 per cent level of confidence.

bution of the distance moved through the smoke for the male and female subpopulations. Related to the participants who moved through the smoke, there were 171 male participants or approximately 48.4 per cent of this subpopulation and 195 females consisting of 51.6 per cent of the subpopulation. A comparison of this sexual distribution with the sexual distribution in the total participant population of 319 females and 263 males by a chi-square analysis, indicated there was not a significant difference between the sexual distribution of the total participant population and the sexual distribution of the subpopulation which moved through the smoke.

The mean distance moved through the smoke for the 160 male participants was computed to be 34 feet, and the mean distance for the 185 female participants was computed as 33.4 feet. This difference in the mean distance moved through the smoke of 0.6 feet was compared statistically. The difference of 0.6 feet in the mean distance moved through smoke between the male and female participants when compared statistically resulted in a standard error of the difference between the means of 2.55, which computed to a critical ratio of 0.24 for the difference of 0.6 feet, which was not statistically significant.

Table LIIIF presents the comparison of the differences in the percentages of the male and female subpopulations relative to the distance moved through the smoke. The differences in the percentages of the two subpopulations varied from 0.6 per cent for the distance of 1 to 10 feet, and 5.2 per cent for the distance of 26 to 50 feet. As may be observed none of these differences were statistically significant, indicating no true significant difference existed for the distance moved through the smoke between the male and female members of the participant population in this study.

TABLE LIIIE

SEXUAL DISTRIBUTION OF PARTICIPANT POPULATION
RELATIVE TO DISTANCE MOVED THROUGH SMOKE

Distance Feet	Male	Per Cent	Female	Per Cent	Total	Per Cent
1 - 10	50	29.3	47	24.1	97	26.5
11 - 25	50	29.3	61	31.3	111	30.3
26 - 50	43	25.1	59	30.3	102	27.8
51 - 99	6	3.5	8	4.1	14	3.8
100 - 400	11	6.4	10	5.1	21	5.8
Not Reported	11	6.4	10	5.1	21	5.8
N = 6	171	100.0	195	100.0	366	100.0
Range =	11 - 50		10 - 61		14 - 111	
	M = 34.0 SE _M = 1.84	SD = 23.2 SE _{SD} = 1.31	M = 33.4 SE _M = 1.76	SD = 24.0 SE _{SD} = 1.25		
Per Cent of Participant Population =	29.3		33.4		62.7	

TABLE LIIIF
SIGNIFICANCE OF DIFFERENCES IN MOVEMENT
THROUGH SMOKE RELATIVE TO SEXUAL
DISTRIBUTION OF PARTICIPANT POPULATION

Distance Feet	Male Per Cent	Female Per Cent	P_1-P_2	$SE_{P_1-P_2}$	CR
1 - 10	29.3	24.1	5.2	4.61	1.13
11 - 25	29.3	31.3	2.0	4.80	0.42
26 - 50	25.1	30.3	5.2	4.68	1.11
51 - 99	3.5	4.1	0.6	2.00	0.30
100 - 400	6.4	5.1	1.3	2.42	0.54
Not Reported	6.4	5.1	1.3	2.42	0.54
	171	195			

4. Comparison of The Mean Distance Moved Through The Smoke for The Subpopulation of The Participant Population.

The mean distance moved through the smoke for the various subpopulations of the participant population examined in this section of the report have been summarized in Table LIIIG. The mean distance of the participant populations relative to evacuation distance, the participant population involved in the movement through the smoke, including the subpopulations with and without previous fire experience; with and without previous training, and the male and female subpopulations were all compared statistically. The statistical comparison of the means involved the computation of the difference in the means from the two subpopulations and the computation of the standard error of the difference in the means, and a critical ratio obtained by dividing the difference in the means by the standard error of the difference of the two means. The standard error of the difference in the means was determined with the following formula from Garrett's text:¹²

$$SE_{M_1 - M_2} = \sqrt{SE_{M_1}^2 + SE_{M_2}^2}$$

From an examination of Table LIIIG it is apparent there was a significant difference in the distance moved for the participant population in movement through smoke with a mean distance of 29.8 feet, when compared with the total participant population evacuation mean distance of 41.7 feet. This difference was significant above the 1 per cent level of confidence. Additionally, the only other difference in the mean distance moved occurred between the participants with previous training, and the participants without previous training. This difference in the mean travel distance of 12.2 feet between 41.8 feet for the participants with training, and 29.6 feet for those without training was statistically significant above the 1

¹² Garrett, Op. Cit., p. 213.

TABLE LIII
SIGNIFICANCE OF MOVEMENT THROUGH SMOKE
OF PARTICIPANT POPULATION

Population	Distance Moved M	$M_1 - M_2$	$SE_{M_1 - M_2}$	CR
Evacuation	41.7	11.9	1.72	<u>6.92</u> **
Smoke	29.8			
Previous Experience	32.1	2.0	2.19	
No Previous Experience	34.1			0.91
Previous Training	41.8	12.2	2.88	<u>4.24</u> **
No Previous Training	29.6			
Male	34.0	0.6	2.55	0.24
Female	33.4			

**Critical Ratios significant at or above the 1 per cent level of confidence.

per cent level of confidence.

5. The Movement Through Smoke of The Participant Population Relative to the Visibility of The Participants.

The 366 participants who moved through the smoke were compared relative to the distance they moved through the smoke, as previously presented in Table LIII, and the distance they could see through the smoke. These participants were classified relative to the distance they moved through the smoke being greater than the visibility distance, equal to the visibility distance, or less than the visibility distance. Examination of Table LIIII indicates 46.4 per cent of this subpopulation consisting of 170 participants moved through the smoke at a greater distance than the visibility distance. In contrast, only 68 participants, or approximately 18.6 per cent of the movement through smoke subpopulation moved through the smoke a distance which was less than the distance they could see in the smoke. Obviously, the remaining 128 participants moved through the smoke a distance equal to the distance they could see in the smoke.

Table LIIII presents the significance of these differences in the percentages of the participant population which moved through the smoke a greater distance than they could see, a distance equal to their visibility, or a distance less than they could see through the smoke. It is apparent from Table LIIII, the differences in the participant percentages were all significant differences for the following comparisons: The subpopulation consisting of 46.4 per cent which moved a distance greater than their visibility distance compared to the 35 per cent of the subpopulation which

TABLE LIIII

DISTRIBUTION OF PARTICIPANT POPULATION RELATIVE TO MOVEMENT THROUGH
SMOKE AND VISIBILITY DISTANCE

Distance Moved	Participants	Per Cent
Greater than Visibility	170	46.4
Equal to Visibility	128	35.0
Less Than Visibility	68	18.6
N = 3	366	100.0
Range =	68 - 170	
Per Cent of Participant Population = 62.7		

TABLE LIIII

SIGNIFICANCE OF DIFFERENCES RELATIVE TO THE PARTICIPANT POPULATION
MOVEMENT THROUGH SMOKE AND VISIBILITY

Greater than Visibility Per Cent	Equal to Visibility Per Cent	Less Than Visibility Per Cent	$P_1 - P_2$	$SE_{P_1 - P_2}$	CR
46.4	35.0		11.4	5.77	<u>1.97*</u>
46.4		18.6	27.8	6.98	<u>3.98**</u>
	35.0	18.6	16.4	6.83	<u>2.40*</u>
170	128	68			

*Critical ratios significant at or above the 5 per cent level of confidence.

**Critical ratio significant at or above the 1 per cent level of confidence.

moved a distance equal to their visibility. This difference was significant at the 5 per cent level of confidence. The 46.4 per cent which moved a distance greater than their visibility distance when compared with the 18.6 per cent of the subpopulation which moved a distance less than their visibility distance resulted in a significant difference in the populations above the 1 per cent level of confidence. Finally, the difference in the size of the subpopulations which moved a distance equal to their visibility distance and less than their visibility distance was also significant above the 5 per cent level of confidence.

The distribution of the visibility distance of the participant population as determined by the estimated distance from the participants is presented in Table LIIIIJ. The classifications relative to the visibility distance were established to be compatible with the data presented by Wood (14). It should be observed that specific measurements relative to the visibility distance in feet were presented for 322 of the 366 members of the participant population involved in the movement through smoke. The mean distance of the visibility through the smoke was computed to be 34.8 feet. An interesting comparison is possible with the visibility distance relative to the mean distance moved for the various subpopulations as previously presented in Table LIIIG. However, one should always remember with comparisons of the mean data for this subpopulation of 322 persons, with a standard deviation of 25.8, 68.26 per cent of this population or approximately 220 persons, had visibility distances ranging between 9 feet and 60 feet.

The visibility distance presented in Table LIIIIJ was in response to the inquiry as to the distance the participant could see at the time

TABLE LIIIIJ
DISTRIBUTION OF VISIBILITY DISTANCE THROUGH SMOKE OF PARTICIPANT
POPULATION

Visibility Distance (Feet)	Participants	Per Cent
0 - 2	33	10.2
3 - 6	55	17.2
7 - 12	65	20.2
13 - 30	102	31.7
31 - 36	7	2.2
37 - 45	12	3.7
46 - 60	24	7.4
> 60	24	7.4
	322	100.0
<p>M = 34.8 SD = 25.8</p> <p>SE_M = 1.44 SE_{SD} = 1.02</p>		
<p>Per Cent of Participant Population = 55.1</p>		

the participant moved through the smoke in the fire incident building. The movement of participants through the smoke is an important aspect of this study since such a relatively large percentage of the participant population, 366 participants, or approximately 62.7 per cent of the participant population moved through smoke. Most interesting was the information previously presented in Table LIIIIH which indicated 170 of the participants moved through the smoke at a greater distance than the visibility distance of the individual due to the smoke conditions existing in the fire incident building. Obviously, there were participants that attempted to move through the smoke and were forced to turn back. The examination of this, "turned back" behavior will be the next analysis area in this section of the report.

D. The Turned Back Behavior of The Participant Population.

Some of the participant population indicated in their movement through the smoke they were forced to turn back due to the effects of smoke, heat or both smoke and heat. This participant subpopulation involved in the turned back behavior consisted of a total of 107 participants or approximately 18.3 per cent of the total participant population and approximately 29.2 per cent of the 366 participants involved in the movement through the smoke.

1. The Turned Back Behavior of The Participant Population Relative to The Visibility Distance.

The visibility of the participants as estimated in feet by the participant

at the time of turning back is presented in Table LIV. Upon examination it is obvious data was reported on the visibility distance relative to the turning back behavior for only 85 of the 107 participants involved in this behavior. The mean visibility distance at the time of turning back for the 85 participants was 9.9 feet. It should be observed that 76.4 per cent of the subpopulation turned back when the visibility distance was 12 feet or less due to the smoke conditions. It should also be noted that 94 per cent of this subpopulation turned back when the visibility distance was 30 feet or less.

Table LIIIIJ previously presented the visibility distance for 322 members of the participant population when they moved through smoke, with a mean visibility distance of 34.8 feet. The mean visibility distance for the 85 participants who turned back was 9.9 feet. Thus, as might be expected the reported visibility distance of the participants when they were forced to turn back was considerably less than the mean visibility distance for the movement through the smoke. The statistical comparison of the significance of the difference in these mean differences resulted in a Standard Error for the difference of 1.48 and a Critical Ratio of 16.82, which is significant above the 1 per cent level of confidence.

2. The Turned Back Behavior of The Participant Population Relative to The Area of Smoke Spread.

The distribution of the reasons for the turned back behavior, compared with the area of smoke spread for the fire incident is presented in Table LIVA. The reasons for the turned back behavior have been classified relative to the effects of smoke, heat, or both smoke and heat. It will be observed

TABLE LIV
 DISTRIBUTION OF VISIBILITY DISTANCE THROUGH
 SMOKE AND TURNED BACK BEHAVIOR OF THE PARTICIPANT POPULATION

Visibility Distance Feet	Participants	Per Cent
0 - 2	27	31.8
3 - 6	19	22.3
7 - 12	19	22.3
13 - 30	15	17.6
31 - 36	1	1.2
37 - 45	0	0
46 - 60	4	4.7
> 60	0	0
	85	100.0
$M = 9.9$ $SD = 3.2$ $SE_M = 0.35$ $SE_{SD} = 0.25$		
Per Cent of Participant Population = 14.6		

TABLE LIVA
 DISTRIBUTION OF THE PARTICIPANT POPULATION
 RELATIVE TO SMOKE SPREAD AND TURNED BACK BEHAVIOR

Reason Turned Back	Room	1	2	3	4	5	6	7	Not Reported	Total	Per Cent
Smoke	7	21	17	9	1	0	2	0	9	66	61.8
Heat	0	1	1	1	0	0	0	0	1	4	3.7
Both	0	10	5	6	12	0	0	0	0	33	30.8
Not Reported	0	2	1	1	0	0	0	0	0	4	3.7
N = 4	7	34	24	17	13	0	2	0	10	107	100.0
Range =	0-7	1-34	1-17	1-9	0-12	0	0-2	0	0-9	4-66	
Per Cent =	6.5	31.8	22.4	15.9	12.1	1.9	0	9.4	100.0		

Per Cent of Participant Population = 18.3

that a majority of the participants who engaged in the turned back behavior, reportedly were forced into this behavior due to the effects of the smoke. It would appear the majority of the participants who reported turning back due to the effects of both heat and smoke, were also probably affected primarily by the smoke when one considers the very few participants effected solely by the heat. Apparently, only 4 participants were affected primarily by heat, about 3.7 per cent of the turned back behavior participant population.

The areas of smoke spread relative to the participants are presented in Table LIVB as dichomotized for the fire incidents in which the smoke spread was relatively limited, to the room or area of origin and 1 floor, as contrasted with the fire incidents with smoke spread from 2 through 7 floors. The subpopulation when dichotomized relative to the smoke spread had 41 participants or 38.2 per cent of the turned back behavior subpopulation in the limited smoke spread sample and 61.8 per cent of the participants in the more extensive smoke spread subpopulation. The differences in the percentages of the participants relative to the reasons for turning back varied from a difference of 1.9 to 12.2 per cent, and none of these differences were statistically significant as shown in Table LIVC.

3. The Sexual Distribution of The Participant Population Relative to The Turned Back Behavior.

The sexual distribution of the subpopulation of participants relative to their turned back behavior is presented in Table LIVD. Suprisingly the turned back behavior consisted of 57 males for 53.2 per cent of this subpopulation and 50 females for 46.8 per cent of the subpopulation.

TABLE LIVB

DISTRIBUTION OF THE PARTICIPANT POPULATION RELATIVE
TO SMOKE SPREAD AND TURNED BACK BEHAVIOR

Reason Turned Back	Area of Smoke Spread				Total Per Cent	
	Room and One Floor Participant	Per Cent	Floors Two-Seven Participants	Per Cent		
Smoke	28	68.4	38	57.7	66	61.8
Heat	1	2.4	3	4.5	4	3.7
Both	10	24.3	23	34.8	33	30.8
Not Reported	2	4.9	2	3.0	4	3.7
N = 4	41	100.0	66	100.0	107	100.0
Range =	1-28		2-38		4-66	
Per Cent of Participant Population =	7.0		11.3		18.3	

TABLE LIVC

SIGNIFICANCE OF THE DIFFERENCES RELATIVE TO THE
REASON FOR TURNED BACK BEHAVIOR AND SMOKE SPREAD

Reason Turned Back	Room & 1 Floor Per Cent	Floors 2-7 Per Cent	$P_1 - P_2$	$SE_{P_1-P_2}$	CR
Smoke	68.4	57.7	10.7	9.67	1.11
Heat	2.4	4.5	2.1	3.76	0.56
Both	24.3	34.8	10.5	9.19	1.14
Not Reported	4.9	3.0	1.9	3.76	0.51
	41	66			

Thus, more of the males were involved in the turned back behavior than the females, although the total participant population contained more females, and the subpopulation involved with the movement through smoke as previously presented in Table LIIIE involved more females. Thus, it may be observed that 9.7 per cent of the total participant population involved in the turned back behavior were males and 8.6 per cent of the total participant population engaged in the turned back behavior were females. It should be remembered, the males engaged in the movement through the smoke behavior consisted of 29.3 per cent of the total participant population, and the females involved with the movement through smoke behavior consisted of approximately 33.4 per cent of the total participant population. A Chi Square analysis of the sexual distribution for the male and female members of the movement through smoke subpopulation and the turned back behavior subpopulation resulted in a $X^2 = 2.40$, which is significant above the 5 per cent level of confidence. Thus, the difference in the sexual distribution of these subpopulations relative to these two behaviors is statistically significant as determined by the Chi Square analysis.

Table LIVE presents the statistically comparison of the differences in the male and female participants that engaged in the turned back behavior, relative to the reasons for the turned back behavior. These differences varied from 2.71 per cent to 8.96 per cent, and none of these differences were statistically significant. Thus, it would appear that none of the differences in the turned back behavior relative to the effects of heat, smoke or both heat and smoke were statistically significant for

TABLE LIVD
SEXUAL DISTRIBUTION OF THE PARTICIPANT POPULATION
RELATIVE TO THE TURNED BACK BEHAVIOR

Reason Turned Back	Male	Per Cent	Female	Per Cent	Total	Per Cent
Smoke	35	61.4	31	62.0	66	61.8
Heat	4	7.0	0	0	4	3.7
Both	16	28.1	17	34.0	33	30.8
Not Reported	2	3.5	2	4.0	4	3.7
N = 4	57	100.0	50	100.0	107	100.0
Range =	2-35		0-31		4-66	
Per Cent of Participant Population =	9.7		8.6		18.3	

TABLE LIVE
 SIGNIFICANCE OF DIFFERENCES IN REASONS FOR
 TURNED BACK BEHAVIOR RELATIVE TO SEXUAL
 DISTRIBUTION OF PARTICIPANT POPULATION

Reason Turned Back	Male Per Cent	Female Per Cent	P_1-P_2	$SE_{P_1-P_2}$	CR
Smoke	61.4	62.0	0.6	9.43	0.06
Heat	7.0	0	7.0	3.66	1.91
Both	28.1	34.0	5.9	8.96	0.66
Not Reported	3.5	4.0	0.5	3.66	0.14
	57	50			

the sex of the participants.

4. The Previous Training of The Participant Population and The Turned Back Behavior.

The participants who engaged in the turned back behavior were examined to determine if there was any significant difference between the participants with previous training and the participants without previous training relative to the reasons for initiating this behavior. Table LIVF presents the distribution of the participant population relative to the dichotomized subpopulations classified for the participants with previous training, and those without previous training. It is obvious 21 participants had received previous training prior to the occurrence of the fire incident which predicated their inclusion in the participant population. Additionally, 86 of the participants or approximately 80 per cent of the turned back behavior population had not received any previous training. As was apparent with the total turned back behavior subpopulation and the sexual distribution of this subpopulation the majority of the participants turned back due to smoke conditions, with the heat having the least effect upon participants.

Table LIVG presents the statistically comparison of the percentages of the participants with previous training and those without previous training relative to their reasons for engaging in the turned back behavior. As may be observed in Table LIVG, none of the Critical Ratios are significant at either the 5 or 1 per cent level of confidence. Thus, the Null Hypothesis is accepted and the variable of previous training appeared to not be significantly related to the reasons for the turned back behavior of the participants. It should be noted the relative small number of participants involved in the turned back behavior may have affected these statistical

TABLE LIVF
 DISTRIBUTION OF PARTICIPANT POPULATION RELATIVE
 TO PREVIOUS TRAINING AND TURNED BACK BEHAVIOR

Reason Turned Back	Previous Training		No Previous Training		Total	Per Cent
	Participant	Per Cent	Participant	Per Cent		
Smoke	15	71.4	51	59.3	66	61.8
Heat	1	4.8	3	3.5	4	3.7
Both	3	14.3	30	34.9	33	30.8
Not Reported	2	9.5	2	2.3	4	3.7
N = 4	21	100.0	86	100.0	107	100.0
Range =	1-15		2-51			
Per Cent of Participant Population =	3.6		14.7			

TABLE LIVG
SIGNIFICANCE OF DIFFERENCES IN REASONS FOR
TURNED BACK BEHAVIOR RELATIVE TO PREVIOUS TRAINING

Reason Turned Back	Previous Training Per Cent	No Previous Training Per Cent	P_{1-P_2}	$SE_{P_{1-P_2}}$	CR
Smoke	71.4	59.3	12.1	11.83	1.02
Heat	4.8	3.5	1.3	4.65	0.28
Both	14.3	34.9	20.6	11.24	1.83
Not Reported	9.5	2.3	7.2	4.59	1.57
	21	86			

computations.

5. The Previous Fire Experience of The Participant Population and The Turned Back Behavior.

The turned back behavior, as previously discussed appeared to be primarily influenced by the physical environmental conditions of the fire incident, primarily smoke and heat. It was thus assumed there might be some significance difference in the reasons for the turned back behavior if one examined the reasons given by the participants with previous fire experience as contrasted with the participants without previous fire experience. Table LIVH presents the reasons for the turned back behavior with the participants dichotomized relative to their having obtained previous fire experience and the participants without the previous fire experience. Upon examination of Table LIVH it is apparent the distribution of the previous fire experience and the non previous fire experience participants is identical to the distribution relative to previous training examined previously in Tables LIVF and G. Thus, 21 participants or approximately 19.6 per cent of the subpopulation had previous fire experience and 86 participants consisting of approximately 80.4 per cent of this subpopulation had not been involved with a fire incident prior to the incident reported in this study. It is also apparent the rank order of the reasons for the turned back behavior was identical for the total turned back population and the other subpopulations previously examined relative to training and sexual distribution. The smoke was the primary causitive factor for the turned back behavior, with both smoke and heat as the second factor in rank order, and the third factor was the heat.

Table LIVI presents the statistical comparison of the two subpopulations, concerned with the previous fire experience or the lack of previous fire

TABLE LIVH
 DISTRIBUTION OF PARTICIPANT POPULATION RELATIVE
 TO PREVIOUS FIRE EXPERIENCE AND TURNED BACK BEHAVIOR

Reason Turned Back	Previous Experience		No Previous Experience		Total	Per Cent
	Participants	Per Cent	Participants	Per Cent		
Smoke	13	62.0	53	61.6	66	61.8
Heat	2	9.5	2	2.3	4	3.7
Both	4	19.0	29	33.8	33	30.8
Not Reported	2	9.5	2	2.3	4	3.7
N = 4	21	100.0	86	100.0	107	100.0
Range =	2-13		2-53		4-66	
Per Cent of Participant Population =	3.6		14.7		18.3	

TABLE LIVI
SIGNIFICANCE OF DIFFERENCES IN REASONS FOR
TURNED BACK BEHAVIOR RELATIVE TO PREVIOUS FIRE EXPERIENCE

Reason Turned Back	Previous Experience Per Cent	No Previous Experience Per Cent	P_{1-P_2}	$SE_{P_{1-P_2}}$	CR
Smoke	62.0	61.6	0.4	11.83	0.03
Heat	9.5	2.3	7.2	4.59	1.57
Both	19.0	33.8	14.8	11.24	1.32
Not Reported	9.5	2.3	7.2	4.59	1.57
	21	86			

experience among the participants who participated in the turned back behavior. Upon examination of this table it is obvious that none of the differences in the two subpopulations are statistically significant at either the 5 or 1 per cent levels of confidence.

The examination of the influence of the smoke on the behavior of the participants revealed some interesting observations. The turned back behavior, involved a total of 107 participants or approximately 18 per cent of the total participant population. The turned back behavior occurred more frequently when the smoke spread in the fire incident was more extensive, extending from 2 to 7 floors as opposed to the area of origin and 1 floor.

When the area of smoke spread was examined relative to the first actions of the participant population, there was a significant difference in the first actions of, "getting dressed," with more participants engaging in this first action with more extensive smoke spread from 2 to 7 floors. In addition, more of the participants, "went to the fire area" and, "tried to extinguish," the fire when the smoke spread was limited to the area of origin or 1 floor.

The mean evacuation distance for the participant population was 41.7 feet and the mean time to complete this evacuation distance was 1.92 minutes. The mean time of occurrence for the evacuation, the time from the participant becoming aware of the fire incident, was 4.07 minutes. The time of occurrence of the evacuation agrees with the tendency toward the action of leaving the building from the first through the third actions as previously presented in Table XLVII on page 159 of this report.

A total of 366 participants which was 62.7 per cent of the total

Participant population moved through smoke. Thus, the presence of smoke if it is not of sufficient density or irritant quality to force the participants to turn back does not appear to deter the evacuation behavior. However, it should be remembered, that approximately one third of the participants who moved through the smoke, were forced to turn back.

VII. THE COMPARISONS WITH ASPECTS OF THE BRITISH 1972 STUDY

This study conducted in the urban area of Baltimore, Maryland, and the surrounding suburban Maryland and Virginia communities was patterned after the study completed by Wood, (14) in England in 1972. As previously reported in Section I, Wood participated in the design and planning for this study, primarily in relation to the development of the questionnaires for use by the fire department officials. This section of the report will attempt to provide meaningful comparisons of the these study results with the results of Wood's previous study.

A. Comparison of The Fire Incident Variables.

The variables related to the fire incident were compared between both studies. The variables of; Building Occupancy for The Fire Incidents, The Time of the Fire Incident, The Floor of Origin of The Fire Incident, and The Area of Smoke Spread in The Fire Incident Building were all compared.

1. Comparison of The Occupancy of Buildings.

The occupancies of the buildings involved in both studies relative to the occurrence of the fire incidents is presented in Table LVA. An examination of the rank order of the British occupancies involved dwellings, factories, shops, and apartments. While the four most frequent occupancies for the project people study consisted of dwellings, apartments, restaurants, schools and hotels. An examination of Table LVA indicated there were significant differences between the number of buildings in both studies relative to the British study having a greater percentage of factories, shops, and garages. While the greater percentage of dwellings, and

TABLE LVA
COMPARISON OF OCCUPANCY OF BUILDINGS

Occupancy	British Per Cent	U.S. Per Cent	P_1-P_2	$SE_{P_1-P_2}$	CR
Dwelling	50.6	63.6	13.0	3.19	<u>4.08**</u>
Apartments	6.4	20.9	14.5	1.94	<u>7.47**</u>
Factory	16.7	0.6	16.1	2.12	<u>7.59**</u>
School	0.7	1.5	0.8	0.60	1.33
Hotel	1.8	1.5	0.3	0.83	0.36
College	0.3	0.9	0.6	0.45	1.33
Office	0.6	0.9	0.3	0.53	0.57
Hospital	1.3	0.6	0.7	0.66	1.06
Restaurant	1.2	2.0	0.8	0.75	1.07
Shop	7.2	1.2	6.0	1.47	<u>4.08**</u>
Club	1.4	0.6	0.8	0.70	1.14
Garage	1.9	0.3	1.6	0.78	<u>2.05*</u>
	952	335			

* Critical Ratio significant at or above the 5 per cent level of confidence.
**Critical Ratios significant at or above the 1 per cent level of confidence.

apartments in the Project People study was also a statistically significant difference. All of these differences were statistically significant at the 1 per cent level of confidence with the exception of the difference in the percentage of garages in the British study which was significant at the 5 per cent level of confidence. Thus, it appeared the British study obtained more fire incidents from the nonresidential type of occupancy primarily the factories, shops and garages. It should be remembered the Project People study included only two manufacturing plants, two stores, and one service station.

2. Comparison of The Time Distribution for The Fire Incidents.

The time distribution of the 952 fire incidents in the British study and the 335 fire incidents in the Project People study are presented in Table LVB. It may be observed the rank order relationship of the time periods for both studies are similar, with the greatest percentage of incidents in the 1200 to 1800 time period, the second greatest percentage of incidents occurred during the 1800 to 2300 time period. The third greatest fire incident period for both studies was the 0600 to 1200 time period, and the time period with the lowest frequency of fire incidents was the 2300 to 0600 time period. The classification of the times of the fire incidents in Table LVB was presented with the four time periods, since this was the format utilized in Wood's (14) study. It should be noted the only significant difference relative to the percentage of fire incidents in any of the time periods, was the indication that only 14 per cent of the British fire incidents occurred between 2300 and 0600 while 21.4 per cent of the fire incidents in the Project People study occurred during this same early morning period.

TABLE LVB
COMPARISON OF THE TIME OF INCIDENT

Time of Incident	British Per Cent	U.S. Per Cent	$P_1 - P_2$	$SE_{P_1 - P_2}$	CR
0600 - 1200	22.4	23.0	0.6	2.68	0.22
1200 - 1800	38.2	33.8	4.4	3.09	1.42
1800 - 2300	25.4	21.8	3.6	2.75	1.31
2300 - 0600	14.0	21.4	7.4	2.34	<u>3.16**</u>
	952	335			

**Critical Ratio significant at or above the 1 per cent level of confidence.

3. Comparison of The Floor of Origin of The Fire Incident.

The floor of fire origin for the fire incidents relative to the 952 fire incidents in the British study and the 335 fire incidents in the Project People study were compared and analyzed in Table LVC. The classification of the floor of origin shown in this table is the classification procedure utilized in Wood's (14) study and thus, differs from the information presented previously in this study in Table VI in section I of this report. Upon examination of Table LVC it is apparent the rank order of the floor of fire origin is similar for both studies with the exception of the origin of the fire incidents in the basements in this study. The percentages of the fire incidents relative to the floors of fire origin differed in a statistically significant manner relative to the British study containing 64 per cent of their fire incidents originating on the first floor as contrasted with 45.1 per cent of the fire incidents in the Project People study originating on the first floor. This difference was significant above the 1 per cent level of confidence. Another significant difference involved the 15.8 per cent of the fires originating in basements in the Project People study as opposed to only 3 per cent of the British fires in the basements. The final significant difference was the difference between 22 per cent of the British fire incidents originating on the second floor as contrasted with 28.1 per cent of the fire incidents in the Project People study. This difference as shown in Table LVC was significant at the 5 per cent level of confidence.

4. Comparison of The Area of Smoke Spread in The Fire Incident Building.

The area of smoke spread in the fire incident buildings was previously presented for this study in Tables VIII and IX of section I of this report.

TABLE LVC
 COMPARISON OF THE FLOOR OF
 ORIGIN OF THE FIRE INCIDENT

Floor	British Per Cent	U.S. Per Cent	$P_1 - P_2$	$SE_{P_1-P_2}$	CR
Basement	3.0	15.8	12.8	1.56	<u>8.21**</u>
1	64.0	45.1	18.9	3.15	<u>6.00**</u>
2	22.0	28.1	6.1	2.72	<u>2.24*</u>
3	5.0	5.4	0.4	1.41	0.28
Other	6.0	5.6	0.4	1.50	0.27
	952	335			

* Critical Ratio significant at or above the 5 per cent level of confidence.
 **Critical Ratios significant at or above the 1 per cent level of confidence.

The percentage of fire incidents involving smoke spread for both this study and the British study are presented in Table LVD. It is apparent from examination of this table the percentage of fire incidents with smoke spread in the various categories of none, room, floor of origin, and other floors were all significant differences at either the 1 or the 5 per cent level of confidence. It is of interest to note the British study included a greater percentage of the fire incidents with no smoke spread, and incidents with the smoke spread confined to the room. While the Project People study indicated a greater percentage of incidents with smoke spread on the floor of origin and to other floors of the fire incident building. All of these differences were statistically significant to the 1 per cent level of confidence, with the exception of smoke spread to other floors which was significant at the 5 per cent level of confidence.

B. Comparison of The Participant Populations.

The participant population of Wood's (14) study consisted of 2193 individuals, 954 females or 43.4 per cent of the population, and 1239 males for 56.5 per cent of the population. Thus, this British study consisted of a total of 952 fire incidents, with a participant population of 2193 individuals. The Project People study as detailed in sections I and II of this report consisted of a total of 335 fire incidents and 584 participants.

1. Comparison of The Sexual Distributions of The Participants.

The sexual distribution of the two participant populations are presented in Table LVI. It should be observed, the British study had a male dominated population while the Project People study possessed a female dominated population. This table presents the comparison of the female and male populations for both studies, and it is apparent the differences

TABLE LVD
COMPARISON OF SMOKE SPREAD

Area	British Per Cent	U.S. Per Cent	$P_1 - P_2$	$SE_{P_1 - P_2}$	CR
None	12.0	6.0	6.0	1.99	<u>3.02</u> **
Room	33.0	14.8	18.2	2.92	<u>6.23</u> **
Floor of Origin	28.0	43.7	15.7	3.02	<u>5.20</u> **
Other Floors	27.0	35.5	8.5	2.94	<u>2.89</u> **
	952	318			

**Critical Ratios significant at or above the 1 per cent level of confidence.

in the percentages of participants of both sexes are statistically significant differences indicated above the 1 per cent level of confidence. It should be noted the differences in the male and female populations for both studies are almost identical, being 11.4 per cent for the females, and 11.3 per cent for the male members of the populations. As originally presented in Table XXIV on page 65 of this report, the Project People study had 319 female participants for 54.8 per cent of the participant population, and 263 males for 45.2 per cent of the participant population, with two participants that were not identified as to their sexual characteristics. Thus, the Project People study was predominately female with 54.8 per cent of the total participant population, while the British study was predominately male with 56.5 per cent of their participant population.

2. Comparison of The Ages of The Participant Populations.

The age distribution of the British and the Project People studies are presented in Table LVIA. The classifications utilized in this table are the age classifications utilized in Wood's (14) report. The age data previously presented in this report in Table XXV on page 67, was recomputed to prepare Table LVIA. It is obvious, age data was only available for 534 or 91.4 per cent of the total Project People participant population. The examination of Table LVIA indicates there were statistically significant differences in the percentages of the populations in two age brackets, the 20-29 year olds and the 40-49 year olds. Both of these differences were significant above the 1 per cent level of confidence. The difference in the 20-29 year old subpopulations involved a greater percentage of the Project People population, with a difference of 8.3 per cent between the two study populations. While the difference in the 40-49 year olds, involved

TABLE LVI
 COMPARISON OF THE PARTICIPANT
 POPULATIONS RELATIVE TO SEXUAL DISTRIBUTION

Sex	British		U.S.		$P_1 - P_2$	$SE_{P_1 - P_2}$	CR
	Participants	Per Cent	Participant	Per Cent			
Female	954	43.4	319	54.8	11.4	2.54	<u>4.49**</u>
Male	1239	56.5	263	45.2	11.3	2.58	<u>4.38**</u>
		2193		582			

$$\chi^2 = 23.6***$$

** Critical Ratio significant at or above the 1 per cent level of confidence.
 *** Chi-Square significant at or above the 1 per cent level of confidence.

TABLE LVIA
 COMPARISON OF THE PARTICIPANT
 POPULATIONS RELATIVE TO AGE DISTRIBUTION

Age	British Per Cent	U.S. Per Cent	$P_1 - P_2$	$SE_{P_1-P_2}$	CR
< 9	1.0	1.3	0.3	0.51	0.59
10 - 19	10.0	12.2	2.2	1.50	1.47
20 - 29	22.0	30.3	8.3	2.08	<u>3.99**</u>
30 - 39	23.0	21.7	1.3	2.05	0.63
40 - 49	21.0	15.4	5.6	1.97	<u>2.84**</u>
50 - 59	13.0	11.0	2.0	1.63	1.23
60 - 69	6.0	4.7	1.3	1.14	1.14
70 - 79	2.0	2.4	0.4	0.70	0.57
80 - 89	1.5	0.8	0.7	0.58	1.21
90 - 99	0.5	0.2	0.3	0.31	0.97

2193

534

**Critical Ratios significant at or above the 1 per cent level of confidence.

a greater percentage of the British population, 21.0 per cent, as opposed to the Project People 15.4 per cent, for a difference between the two study populations of 5.6 per cent. The other age difference between the two study populations varied from .3 per cent to 2.2 per cent, and none of these differences were statistically significant.

Thus, it would appear the British participant population contained more male participants, and was slightly older than the Project People participant population. While the Project People populations tended to be slightly younger, and included more female members in the participant population.

3. Comparison of The Participant Populations Relative to The Means of Awareness of The Fire Incident.

Table LVIB presents the comparison of the means of awareness, which alerted the members of the participant populations to the occurrence of the fire incident in both studies. The classification of the means of awareness was adopted from the British study. It should be noted this table reduced the means of awareness from the eleven classifications previously presented in Table XXXIV on page 85 for the Project People populations to the seven classifications for both populations. Thus the means of awareness for the Project People population were computed and reclassified for comparison within the classification of the means of awareness for the British study.

Examination of Table LVIB indicates the means of awareness of the two populations are generally similar, with the exception of the British classification of "Flame", which for the purposes of this comparison included the Project People classification of, "Saw Fire." The British population had 15 per cent of the participants alerted to the fire incident by the, "flame," while 8.1 per cent of the Project People population were

TABLE LVIB
 COMPARISON OF THE PARTICIPANT POPULATIONS
 RELATIVE THE MEANS OF AWARENESS OF THE FIRE INCIDENT

Means of Awareness	British Per Cent	U.S. Per Cent	$P_1 - P_2$	$SE_{P_1 - P_2}$	CR
Flame	15.0	8.1	6.9	1.64	<u>4.21</u> **
Smoke	34.0	35.1	1.1	2.27	0.48
Noises	9.0	11.2	2.2	1.41	1.56
Shouts & Told	33.0	34.7	2.7	2.25	1.20
Alarm	7.0	7.4	0.4	1.23	0.33
Other	2.0	2.8	0.8	0.70	1.14
	2193	569			

** Critical Ratio significant at or above the 1 per cent level of confidence.

alerted by the sight of the flames. This difference of 6.9 per cent in the percentages of the two populations was statistically significant above the 1 per cent level of confidence. The other differences in the means of awareness of the two populations varied from .4 per cent to 2.7 per cent and were not statistically significant differences at the 5 or 1 per cent levels of confidence. It should be observed most of the participants in both populations were alerted to the fire incident by the occurrence of smoke or by the notification of other participants.

C. Comparison of The Actions of The Participant Populations.

The first, second, and third actions of the participants from both studies were compared to determine any significant differences in the percentages of the populations participating in the various actions. The comparison of the actions was accomplished utilizing the intent of the meaning of the description of the action, even though there was slightly different wording utilized in the two studies. Additionally, some of the categories were not compared due to a complete absence of cases in one of the populations. The classifications of "telephoned others - relatives", "went to the fire alarm", "woke up", and "check on pets" from the Project People study, and the classifications of, "minimise risk", "organise evacuation", "request help from others", "give help to others", and "cover face with wet towel etc.", from the British study.

The British study included the classification, "Some fire fighting action", thus, the Project People study action classifications of "got extinguisher" and "tried to extinguish" were combined with the action

of "fought fire", to provide an equivalent classification. An example of classifications that were considered to be equivalent, even though differences in wording occurred, was the Project People classification of "notified others" considered to be equivalent to the British action of "warn other people".

1. Comparison of The Participant Populations Relative to Their First Actions.

The two participant populations were compared on a total of seventeen first actions which appeared to be comparable, from the total of twenty-nine first actions listed for the British population, and twenty-five first action classifications for the Project People participant population.

Table LVII presents the comparison of the first actions for both the Project People and the British participant populations, utilizing eighteen of the Project People action classifications. An examination of this table indicates ten significant differences in the participants from the two populations, relative to the first actions, with eight of the differences significant above the 1 per cent level of confidence, and two of the differences significant above the 5 per cent level of confidence.

Relative to these differences in the first actions, the British participants had a higher percentage of utilization of the following first actions than did the Project People participants: "fought fire," "went to fire area", "closed door to fire area", "pulled fire alarm", "turned off appliances". The Project People participants had a higher percentage of participants than the British population in the utilization of the following

TABLE LVII
 COMPARISON OF THE FIRST ACTIONS
 OF THE PARTICIPANT POPULATIONS

Actions	British Per Cent	U.S. Per Cent	P_1-P_2	$SE_{P_1-P_2}$	CR
Notified Others	8.1	15.0	6.9	1.38	<u>5.00**</u>
Searched for Fire	12.2	10.1	2.1	1.51	<u>1.39</u>
Called Fire Dept.	10.1	9.0	1.1	1.40	0.79
Got Dressed	2.2	8.1	5.9	0.85	<u>6.94**</u>
Left Building	8.0	7.6	0.4	1.27	<u>0.31</u>
Got Family	5.4	7.6	2.2	1.11	<u>1.98*</u>
Fought Fire	14.9	10.4	4.5	1.63	<u>2.76**</u>
Left Area	1.8	4.3	2.5	0.70	<u>3.57**</u>
Nothing	2.1	2.7	0.6	0.69	<u>0.87</u>
Had Others Call F.D.	2.8	2.2	0.6	0.76	0.79
Got Personal Property	1.2	2.1	0.9	0.55	1.64
Went to Fire Area	5.6	2.1	3.5	1.01	<u>3.47**</u>
Removed Fuel	1.2	1.7	0.5	0.53	<u>0.94</u>
Enter Building	0.1	1.6	1.5	0.30	<u>5.00**</u>
Tried to Exit	1.6	1.6	0	0	0
Closed Door to Fire Area	3.1	1.0	2.1	0.76	<u>2.76**</u>
Pulled Fire Alarm	2.7	0.9	1.8	0.70	<u>2.57*</u>
Turned Off Appliances	4.1	0.9	3.2	0.85	<u>3.20**</u>
N = 18	2193	580			

* Critical Ratios significant at or above the 5 per cent level of confidence.

**Critical Ratios significant at or above the 1 per cent level of confidence.

first actions: "Notified Others," "Got Dressed," "Got Family," "Enter Building," and "Left Area." The differences between the two participant populations were significant above the 1 per cent level of confidence for all the significant first actions with the exception of the significant differences in the first actions of "Got Family" and "Pulled Fire Alarm," which were significant above the 5 per cent level of confidence.

2. Comparison of The Participant Populations Relative to Their Second Actions.

The two participant populations were compared relative to their second actions as reported in both studies. There was not an indicated reduction in the size of the British population from the first action to the second action. However, as previously indicated in Table XLV on page 141 of this report, the Project People participant population utilizing a second action consisted of 506 participants, a reduction of 74 participants from the first action population. This reduction was the result of the methodology of the Project People study, which did not collect actions from the participants, once the participants had successfully evacuated the building, unless the participant was involved in reentry behavior. An examination of the British study report by Wood (14) indicated no reduction in the number of participants for the first, second, and third actions, while indicating an increase from the first to the third action in the action classification of "nothing," which in the British study was described with the following terminology: "Inaction (watch others, etc.)". Thus, it may be the increase in the percentage of the British participants for the second and third action classification of "nothing" consisting of 14.9 per cent for the second action, and 43.1 percent for the third action,

may be the actions by these participants following their evacuation from the building. Thus, the action following evacuation of the building being included in the British study and excluded from the Project People study provides this difference as primarily a methodological difference in both of these studies.

Table LVIIIA presents the comparison of the two participant populations relative to their second actions. It appears that ten of the action classifications have significant differences in the percentages of the participants which utilized the various actions. The British participant population had a higher percentage of utilization of the following second actions: "Fought Fire," "Nothing," "Went to Fire Area," "Enter Building," "Closed Door to Fire Area," and "Turned Off Appliances." Four of these six actions were also actions with a higher percentage of utilization by the British population as first actions, with a significant difference from the Project People population. The only significant differences not present as a first action with a higher percentage of the British population was the action classification of "Enter Building." The Project People participant population had a higher percentage of utilization of the following second actions: "Notified Others," "Called Fire Department," "Left Building," and "Got Family." Two of these actions were also significantly different in the percentage of participants utilizing these actions as first actions. These actions had a greater percentage of the Project People population involved as illustrated previously in Table LVII, and were the "Notified Others," and the "Got Family" actions.

TABLE LVIIA
 COMPARISON OF THE SECOND ACTIONS
 OF THE PARTICIPANT POPULATIONS

Actions	British Per Cent	U.S. Per Cent	P_1-P_2	$SE_{P_1-P_2}$	CR
Notified Others	3.6	9.6	6.0	1.06	5.66**
Searched For Fire	2.2	2.4	0.2	0.75	0.27
Called Fire Dept.	11.1	14.5	3.4	1.61	2.11*
Got Dressed	0.6	1.8	0.6	0.45	1.33
Left Building	8.8	20.9	12.1	1.57	7.70**
Got Family	3.6	5.9	2.3	0.98	2.34*
Fought Fire	18.3	12.8	5.5	1.89	2.91**
Left Area	2.1	2.8	0.7	0.73	0.96
Nothing	14.9	0	14.9	1.63	9.14**
Had Others Call F.D.	3.3	4.0	0.7	0.91	0.77
Got Personal Property	1.0	1.0	0	0	0
Went To Fire Area	3.2	1.0	2.2	0.82	2.68**
Removed Fuel	1.6	1.0	0.6	0.61	0.98
Enter Building	2.2	0.8	1.4	0.68	2.05*
Tried to Exit	1.3	2.4	1.1	0.61	1.80
Closed Door to Fire Area	4.0	0.2	3.8	0.89	4.26**
Pulled Fire Alarm	1.1	0.6	0.5	0.50	1.00
Turned Off Appliances	2.6	0.6	2.0	0.73	2.73**

N = 18

2193

506

* Critical Ratios significant at or above the 5 per cent level of confidence.

**Critical Ratios significant at or above the 1 per cent level of confidence.

3. Comparison of The Participant Populations Relative to Their Third Actions.

The participant population for the Project People study relative to third actions consisted of 365 participants, as previously indicated in Table XLVI on page 149. The third actions of the two populations from the British study and the Project People study are presented for comparison in Table LVII B. It should be noticed the action classifications were increased to twenty-one categories from eighteen to include the additional three classifications from the Project People participant population of, "Await the Fire Department," "Went to Balcony," and "Open Doors-Windows." These classifications were matched for the purposes of the comparisons in this table with the action classifications from Wood's (14) study of, "Await Rescue by Fire Brigade," "Move to a Safe Place (within Building)" and "Something Which Increases The Risk." The classification of "Open Doors-Windows," was included for "something which increases the risk,"¹³ since this was an example of actions included in this classification by Wood.

Examination of Table LVII B indicates there are ten of the twenty-one actions classifications which are statistically significantly different relative to the percentage of utilization by the two participant populations. The British population was statistically significantly higher in their utilization of the following third actions: "Nothing," "Went to Fire Area," "closed Door to Fire Area," and "Turned Off Appliances." The Project People population was statistically significantly higher in the utilization of the following third action classifications: "notified Others," "Called the Fire Department," "Left Building," "Had Others Call Fire Department,"

¹³Peter G. Wood, The Behavior of People in Fires. Borehamwood: British Fire Research Station, Fire Research Note 953, p. 46.

TABLE LVIIB
 COMPARISON OF THE THIRD ACTIONS
 OF THE PARTICIPANT POPULATIONS

Actions	British Per Cent	U.S. Per Cent	P_1-P_2	$SE_{P_1-P_2}$	CR
Notified Others	1.1	5.8	4.7	0.75	6.26**
Searched for Fire	0.7	0.8	0.1	0.47	0.21
Called Fire Dept.	8.5	12.7	4.2	1.63	2.57*
Got Dressed	0.2	0.3	0.1	0.25	0.40
Left Building	8.4	35.9	27.5	1.86	14.78**
Got Family	1.5	1.4	0.1	0.69	0.14
Fought Fire	12.4	15.0	2.6	1.88	1.38
Left Area	1.4	1.1	0.3	0.66	0.45
Nothing	43.1	0	43.1	2.73	15.79**
Had Others Call F.D.	2.1	4.1	2.0	0.87	2.30*
Got Personal Property	0.9	0.8	0.1	0.53	0.19
Went to Fire Area	1.2	0	1.2	0.56	2.14*
Removed Fuel	1.2	1.1	0.1	0.62	0.16
Enter Building	2.1	1.1	1.0	0.79	1.27
Tried to Exit	0.3	0.5	0.2	0.31	0.65
Closed Door to Fire Area	2.2	0.3	1.9	0.77	2.46*
Pulled Fire Alarm	0.2	0.5	0.3	0.25	1.20
Turned Off Appliances	1.6	0.3	1.3	0.66	1.97*
Await F.D.	0.5	3.6	3.1	0.53	5.84**
Went to Balcony	1.3	2.7	1.4	0.69	2.02*
Open Doors-Windows	0.8	1.1	0.3	0.50	0.60
N = 21	2193	365			

* Critical Ratios significant at or above the 5 per cent level of confidence.

**Critical Ratios significant at or above the 1 per cent level of confidence.

"Await Fire Department," "Went to Balcony."

It should be noted the action classification of "Fought Fire," did not show a statistically significant difference between the two participant populations as a third action although this action had been a predominate British action significantly different as both a first and second action. The differences between the two participant populations were statistically significant above the 1 per cent level of confidence for the differences in the third action classifications of "Notified Others," "Left Building," "Nothing," and "Await Fire Department." The other significant differences between the third action classifications presented in Table LVIIB were significant above the 5 per cent level of confidence.

The continuing significant difference by the first, second and third actions with a higher percentage of utilization by the Project People participants for the classifications of "Notified Others," and "Left Building" should be remembered. The continuation of this significant difference between the two participant populations for all three actions may indicate a cultural difference.

4. Comparison of The Participant Populations Relative to The First Actions of The Participants With Fire Experience.

Table LVIIC presents the comparison of the differences in the percentage of the participants from the British study and the Project People study who had previous experience in a fire incident prior to the fire incident included in the research study. It will be observed that 543 of the British participants, or approximately 24.8 per cent of the total British participant population had previous experience in a fire incident. Considering the Project People participant population,

TABLE LVIIC
 COMPARISONS OF THE FIRST ACTIONS OF FIRE EXPERIENCED PARTICIPANTS

Actions	British Per Cent	U.S. Per Cent	P_1-P_2	$SE_{P_1-P_2}$	CR
Notified Others	5.0	14.6	9.6	2.30	<u>4.17**</u>
Searched for Fire	14.0	12.2	1.8	3.05	<u>0.59</u>
Called Fire Department	10.0	9.8	0.2	2.67	0.07
Got Dressed	2.0	11.6	9.6	1.78	<u>5.39**</u>
Left Building	6.0	5.5	0.5	2.09	<u>0.24</u>
Got Family	2.0	6.1	4.1	1.52	<u>2.70**</u>
Fought Fire	19.0	8.4	10.6	3.30	<u>3.21**</u>
Left Area	1.0	3.0	2.0	1.08	1.85
Nothing	1.0	4.2	3.2	1.15	<u>2.78**</u>
Had Others Call F.D.	2.0	1.2	0.8	1.18	0.68
Got Personal Property	1.0	1.2	0.2	0.88	0.23
Went to Fire Area	8.0	3.6	4.4	2.27	1.94
Removed Fuel	1.0	1.2	0.2	0.88	0.23
Enter Building	0	0.6	0.6	0.28	<u>2.14*</u>
Tried to Exit	1.0	1.2	0.2	0.88	0.23
Closed Door to Fire Area	2.0	0.6	1.4	1.15	1.22
Pulled Fire Alarm	5.0	1.2	3.8	1.76	<u>2.16*</u>
Turned Off Appliances	4.0	0.6	3.4	1.56	<u>2.18*</u>
N = 18	543	165			

*Critical ratios significant at or above the 5 per cent level of confidence.

**Critical ratios significant at or above the 1 per cent level of confidence.

165 of the participants had experience in a previous fire incident which was approximately 28.3 per cent of this total participant population.

It should be observed that eight of these first action classifications had significant differences relative to the percentage of participants that participated in the various first actions for the fire experienced participants. The British participants had a higher percentage of utilization with the following first actions: "Fought Fire," "Pulled Fire Alarm," and "Turned Off Appliances." The Project People participants with fire experience had a higher percentage of utilization of the following first actions: "Notified Others," "Got Dressed," "Got Family," "Nothing," and "Enter Building." These differences in the percentage of participants relative to the first action classifications were statistically significant above the 1 per cent level of confidence with the exception of the following actions which were significant above the 5 per cent level of confidence: "Enter Building," "Pulled Fire Alarm," and "Turned Off Appliance." It should be remembered from Table XLIVF on page 125 of this report, there were no significant differences in the first action utilization by the members of the Project People population with and without previous fire experience. It should also be remembered from the comparison of the first actions of the total participant populations from both studies, previously presented in Table LVIII, all of these first actions were also statistically significantly different with the exception of the first action classification of "Nothing."

5. Comparison of The Participant Populations Relative to The First Actions of The Female Participants.

The first actions of the female participants from both the British and the Project People studies were compared, relative to the percentage of participants who utilized various first actions. Table LVIID presents

TABLE LVIID
 COMPARISONS OF THE FIRST ACTIONS OF THE FEMALE PARTICIPANTS

Actions	British Per Cent	U.S. Per Cent	P_{1-P_2}	$SE_{P_{1-P_2}}$	CR
Notified Others	10.0	13.8	3.8	2.00	1.90
Searched for Fire	11.0	6.3	4.7	1.90	<u>2.47*</u>
Called Fire Department	11.0	11.4	0.4	2.01	0.20
Got Dressed	3.0	10.1	7.1	1.37	<u>5.18**</u>
Left Building	9.0	10.4	1.4	1.86	0.75
Got Family	9.0	11.0	2.0	1.88	1.06
Fought Fire	8.0	7.4	0.6	1.72	0.35
Left Area	3.0	4.1	1.1	1.14	0.96
Nothing	2.0	2.8	0.8	0.94	0.85
Had Others Call F.D.	2.0	1.3	0.7	0.85	0.82
Got Personal Property	2.0	2.5	0.5	0.90	0.55
Went to Fire Area	3.0	2.2	0.8	1.06	0.75
Removed Fuel	1.0	2.2	1.2	0.73	1.64
Enter Building	0	0.9	0.9	0.29	<u>3.10**</u>
Tried to Exit	2.0	1.6	0.4	0.87	0.46
Closed Door to Fire Area	4.0	1.3	2.7	1.14	<u>2.36*</u>
Pulled Fire Alarm	1.0	0.6	0.4	0.60	0.66
Turned Off Appliances	5.0	0.9	4.1	1.25	<u>3.28**</u>
N = 18	954	318			

*Critical ratios significant at or above the 5 per cent level of confidence

**Critical ratios significant at or above the 1 per cent level of confidence

the comparison of the first actions by the female participants of both studies, and it should be remembered the female participants consisted of 54.8 per cent of the Project People participant population, and 43.4 per cent of the British participants as previously presented in Table LVI.

There were five first actions which resulted in a statistically significant difference in the percentage of utilization by the female participants for the two populations as compared in Table LVIID. The British female participants had a higher percentage of utilization for the following first actions: "Searched for Fire," "Closed Door to Fire Area," and "Turned Off Appliances." While the Project People female participants had a higher percentage of utilization of the following two first actions: "Got Dressed," and "Enter Building." It should be remembered, from Table LVII previously presented, that all of these first actions were also statistically significant between both total participant populations with the exception of the first action of, "Searched for Fire."

6. Comparison of The Participant Populations Relative to The First Actions of The Male Participants.

The comparison of the first actions of the male participants from both of the participant populations are presented in Table LVIIE. Examination of this table indicates there are eight of the first action classifications in which the percentage of utilization of the actions indicated a statistically significant difference between these two male participant populations.

The British male participants had a significantly higher utilization of the following first action classifications: "Called Fire Department," "Fought Fire," "Closed Door to Fire Area," and "Pulled Fire Alarm." The

TABLE LVIII
COMPARISON OF THE FIRST ACTIONS OF THE MALE PARTICIPANTS

Actions	British Per Cent	U.S. Per Cent	P_1-P_2	$SE_{P_1-P_2}$	CR
Notified Others	6.0	16.3	10.3	1.82	<u>5.66**</u>
Searched for Fire	13.0	14.9	1.9	2.30	0.83
Called Fire Department	10.0	6.1	3.9	1.97	<u>1.98*</u>
Got Dressed	2.0	5.8	3.8	1.10	<u>3.45**</u>
Left Building	7.0	4.2	2.8	1.67	1.68
Got Family	3.0	3.4	0.4	1.18	0.34
Fought Fire	20.0	14.6	5.4	2.66	<u>2.03*</u>
Left Area	1.0	4.6	3.6	0.85	<u>4.24**</u>
Nothing	2.0	2.7	0.7	0.97	0.72
Had Others Call F.D.	3.0	3.4	0.4	1.18	0.34
Got Personal Property	1.0	1.5	0.5	0.64	0.78
Went to Fire Area	8.0	1.9	6.1	1.72	3.55
Removed Fuel	1.0	1.1	0.1	0.67	0.15
Enter Building	0	2.3	2.3	0.43	<u>5.35**</u>
Tried to Exit	1.0	1.5	0.5	0.71	0.70
Closed Door to Fire Area	3.0	0.8	2.2	1.08	<u>2.04*</u>
Pulled Fire Alarm	4.0	1.1	2.9	1.25	<u>2.32*</u>
Turned Off Appliances	3.0	0.8	2.1	1.08	1.94
N = 18	1239	262			

*Critical ratios significant at or above the 5 per cent level of confidence.

**Critical ratios significant at or above the 1 per cent level of confidence.

male participants from the Project People study in contrast had a higher percentage of utilization of the following first actions: "Notified Others," "Got Dressed," "Left Area," and "Enter Building." It will be remembered from Table LVII, these first actions were all statistically significant between the total participant populations for both studies with the exception of the first action of "Called Fire Department." It should also be noticed the first actions which previously indicated a significant difference in the comparison between the total participant populations, and were not significant when comparing the male participants. These two first actions were the action classifications of "Got Family" and "Went to Fire Area."

These differences were statistically significant at both the 1 per cent and 5 per cent levels of confidence. The differences in the first action classifications of "Notified Others," "Got Dressed," "Left Area," and "Enter Building" were all significant above the 1 per cent level of confidence with the other four first actions being significant above the 5 per cent level of confidence.

7. Comparison of The Participant Populations Relative to The Reasons for The Reentry Behavior of The Participants.

The phenomenon of reentry as previously discussed in this report on pages 168 to 173, was also included in Wood's, (14) study. Table LVIIIF presents the comparison of the reasons for the reentry behavior of the participants engaging in this behavior from both studies. The classification in this table contains the eight categories utilized by Wood with three additions. The twenty reasons presented for the Project People participants in Table XLIX on page 169, were recomputed for these eleven categories. The 163 participants from the Project People study consisted of 27.9

per cent of the total participant population, while the 943 British participants consisted of 44.1 per cent of the British participant population.

Examination of Table LVIIF indicates that statistically significant differences in the percentages of the participants from both studies were found for all the reentry reasons with the exception of the reason of, "Save Personal Effects." The British participants had a higher percentage of providing the following reasons for their reentry behavior: "Fight Fire," "Observe Fire," "Shut Doors," "Await Fire Department," and "Fire Not Severe." The Project People Participants had a higher percentage of utilization of the reasons for reentry under the following classifications: "Call Fire Department," "Rescue Pets," "Assist Fire Department," "Notify Others," and "Assist Evacuation." The classifications of "Notify Others," "Assist Fire Department" and "Assist Evacuation" did not show up in the British responses, and the British reason of "Await Fire Department" did not occur in the Project People Participants' reasons for reentry.

8. Comparison of The Participant Populations Relative to Various Participant Behaviors.

The percentage of the participants from both populations relative to the percentage of participants involved in the various behaviors were compared in Table LVIIG. The following behaviors were considered in this comparative analysis: The evacuation from the fire incident building; The reentry of the fire incident building; The fire fighting activities; The movement of the participants through smoke; and the behavior of the participants in turning back due to heat or smoke in their evacuation efforts.

TABLE LVIIIF
 COMPARISON OF REASONS FOR REENTRY BEHAVIOR OF PARTICIPANTS

Reasons	British Per Cent	U.S. Per Cent	P_1-P_2	$SE_{P_1-P_2}$	CR
Fight Fire	36.0	22.2	13.8	4.02	<u>3.43**</u>
Observe Fire	19.0	11.0	8.0	3.25	<u>2.46*</u>
Save Personal Effects	13.0	17.2	4.2	2.91	1.44
Shut Doors	10.0	0.6	9.4	2.38	<u>3.95**</u>
Await Fire Department	9.0	0	9.0	2.26	<u>3.98**</u>
Call Fire Department	2.0	5.5	3.5	1.32	<u>2.65**</u>
Rescue Pets	2.0	7.4	5.4	1.40	<u>3.86**</u>
Fire Not Severe	5.0	1.2	3.8	1.74	<u>2.18*</u>
Notify Others	0	8.0	8.0	0.92	<u>8.69**</u>
Assist Fire Department	0	7.4	7.4	0.88	<u>8.41**</u>
Assist Evacuation	0	2.5	2.5	0.54	<u>4.63**</u>
N = 11	943	163			

*Critical ratios significant at or above the 5 per cent level of confidence.

**Critical ratios significant at or above the 1 per cent level of confidence.

TABLE LVIIG
 COMPARISON OF BEHAVIORS OF PARTICIPANT POPULATIONS

Behavior	British Per Cent	U.S. Per Cent	$P_1 - P_2$	$SE_{P_1 - P_2}$	CR
Evacuation	54.5	80.0	25.5	2.30	<u>11.09</u> **
Reentry	43.0	27.9	15.1	2.30	<u>6.57</u> **
Fire Fighting	14.7	22.9	8.2	1.74	<u>4.71</u> **
Moved Through Smoke	60.0	62.7	2.7	2.29	1.18
Turned Back	26.0	18.3	7.7	2.01	<u>3.83</u> **
	2193	584			

**Critical ratios significant at or above the 1 per cent level of confidence.

Relative to these five categories of participant behavior it may be observed the differences were statistically significant for four of the five behaviors. The British participants had a higher percentage of their total participant population involved in the behaviors of "reentry," and the "turned back" behavior. While the Project People participants had a higher percentage of the total participant population involved in the behaviors of: "Evacuation" and "Fire Fighting." It should be observed the difference in the participants relative to the movement through smoke was not significant with percentages of 60 and 62.7, for the two participant populations. It is of interest to note that a greater percentage of the Project People population left the building than in the British study. This difference may be a direct result of the differences previously indicated in Table LVA relative to the occupancies of the fire incident buildings involved in both studies, with the British study containing a significantly higher percentage of nonresidential buildings.

D. Comparison of The Effects of Smoke on The Participant Populations.

The variables of the movement of the Project People participants through the smoke and the turned back behavior of these participants, due to the effects of both heat and smoke were previously examined in section VI of this report. Table LVIIG previously presented the percentages of the participant population for both studies involved in these behaviors, with an approximately equal population involved in the movement through smoke behavior, and a higher percentage of the British population involved in the turned back behavior.

1. Comparison of The Visibility Distance for The Participant Populations Relative to Movement Through Smoke.

Table LVIII presents the visibility distance in feet, for the participant population involved in the movement through smoke, at the time the movement was initiated. It should be noted that 1316 British participants, and 322 Project People participants moved through smoke during their evacuation or related actions in the fire incident building. Relative to the visibility distance categories, these eight classifications were utilized in Wood's (14) report in Yards, and were converted to feet to enable the comparison of the data from both populations. Five of the eight visibility distance classifications indicated significant differences in the percentage of the participant population involved. The British population had higher percentages for the following visibility distances: "3 to 6 feet," "7 to 12 feet," and "above 60 feet." The Project People participants thus had a higher percentage of participants with a visibility distance of "13 to 30 feet" and "46 to 60 feet." All of these differences were significant above the 1 per cent level of confidence with the exception of the visibility distance of 7-12 feet, which was significant above the 5 per cent level of confidence. Thus, it would appear the visibility distance of the participants as they moved through smoke, would influence the distance the participants could move through the smoke.

2. Comparison of The Distance Moved Through Smoke for The Participant Populations.

The distance moved through the smoke, and the distance moved through the smoke relative to the visibility distance of the participants for the

TABLE LVIII

COMPARISON OF THE VISIBILITY DISTANCE FOR THE PARTICIPANT POPULATIONS
RELATIVE TO MOVEMENT THROUGH SMOKE

Visibility Distance (Feet)	British Per Cent	U.S. Per Cent	$P_1 - P_2$	$SE_{P_1 - P_2}$	CR
0 - 2	12.0	10.2	1.8	1.99	0.90
3 - 6	25.0	17.2	7.8	2.65	<u>2.94**</u>
7 - 12	27.0	20.2	6.8	2.73	<u>2.49*</u>
13 - 30	11.0	31.7	21.7	2.24	<u>9.69**</u>
31 - 36	3.0	2.2	0.8	1.03	0.78
37 - 45	3.0	3.7	0.7	1.08	0.65
46 - 60	3.0	7.4	4.4	1.21	<u>3.64**</u>
> 60	17.0	7.4	9.6	2.24	<u>4.29**</u>
	1316	322			

*Critical ratio significant at or above the 5 per cent level of confidence.

**Critical ratios significant at or above the 1 per cent level of confidence.

Project People population were previously examined in Tables LIIIIH and LIIIII. The distance of the participant movement through the smoke is presented in Table LVIIIA for both of the study participant populations. Upon examination of this table it is apparent there are significant differences in the percentage of the participants that moved the various distances. The British participants had a higher percentage of their population which moved according to the following distance classifications: "3-6 feet," "7-12 feet," "31-36 feet," and "above 60 feet." The Project People population had a higher percentage of their population which moved in the distance categories of: "13-30 feet," and "46-60 feet."

One of the most interesting observations relative to the movement through smoke, beyond the distance moved, is the relatively large percentages of the participant populations from both studies which moved through the smoke. As previously indicated in Table LVIIIG, 60 per cent of the British participants, and 62.7 per cent of the Project People participants moved through smoke.

3. Comparison of The Visibility Distance for The Participant Populations Relative to The Turned Back Behavior.

The turned back behavior, was a reversal in the direction of movement by the participant in the movement to an area of safety . The visibility distance of the participants at the time they engaged in the turned back behavior is presented for both participant populations in Table LVIIIB. It should be noted in this table the percentage of the participants who were forced to turn back for both populations. For the Project People study 85 of the 345 participants who moved through smoke had to turn back which was approximately 24.6 per cent of these participants. While for the British participants, 570 of the 1316 participants, or approximately

TABLE LVIIIA
COMPARISON OF THE DISTANCE MOVED THROUGH SMOKE FOR THE PARTICIPANT
POPULATIONS

Distance Moved (Feet)	British Per Cent	U.S. Per Cent	$P_1 - P_2$	$SE_{P_1 - P_2}$	CR
0 - 2	3.0	2.3	0.7	1.02	0.69
3 - 6	18.0	8.4	9.6	2.23	<u>4.30**</u>
7 - 12	30.0	17.1	12.9	2.71	<u>4.76**</u>
13 - 30	19.0	45.5	26.5	2.62	<u>10.11**</u>
31 - 36	5.0	2.0	3.0	1.25	<u>2.40*</u>
37 - 45	4.0	4.1	0.1	1.19	0.08
46 - 60	5.0	11.0	6.0	1.47	<u>4.08**</u>
> 60	15.0	9.6	5.4	2.10	<u>2.57*</u>
1316					

*Critical ratios significant at or above the 5 per cent level of confidence.

**Critical ratios significant at or above the 1 per cent level of confidence.

43.3 per cent of the participants who moved through smoke had to turn back.

Examination of Table LVIII B indicates for both populations the shorter visibility distances relative to the turned back behavior when compared with the visibility distances presented in Table LVIII, for the movement through the smoke. There were only three visibility distances with significant differences between the British and the Project People populations. The British population had a higher percentage of the participants with a visibility distance of "3-6 feet." While the Project People participants had a higher percentage of participants in the visibility categories of "13-30 feet" and "46-60 feet." These differences in the visibility distances of the participants between the two participant populations were statistically significant above the 1 per cent level of confidence.

TABLE LVIII B

COMPARISON OF THE VISIBILITY DISTANCE FOR THE PARTICIPANT POPULATIONS
RELATIVE TO THE TURNED BACK BEHAVIOR

Visibility Distance (Feet)	British Per Cent	U.S. Per Cent	$P_1 - P_2$	$SE_{P_1 - P_2}$	CR
0 - 2	29.0	31.8	2.8	5.31	0.53
3 - 6	37.0	22.3	14.7	5.57	<u>2.64**</u>
7 - 12	25.0	22.3	2.7	5.02	0.54
13 - 30	6.0	17.6	11.6	3.07	<u>3.78**</u>
31 - 36	0.5	1.2	0.7	0.90	0.77
37 - 45	1.0	0	1.0	1.10	0.91
46 - 60	0.5	4.7	4.2	1.16	<u>3.62**</u>
> 60	1.0	0	1.0	1.10	0.91
	570	85			

**Critical ratios significant at or above the 1 per cent level of confidence.

VIII. SUMMARY AND CONCLUSIONS

This section of the report is a summary of the procedures utilized in the study during both the investigative and analysis portions of the study.

A. Summary of The Study.

This study involved the interviewing of 584 participants by fire department officials at the scene of the fire incident. The study involved 335 fire incidents from eleven jurisdictions, including the Cities of Baltimore, College Park and Annapolis, Maryland, and Alexandria, Virginia; with the Maryland and Virginia suburban jurisdictions of Arlington County, Fairfax County, Prince William County, Montgomery County, Howard County, Baltimore County, and Anne Arundel County. The fire incidents involved in the study occurred between January 15, 1975, and April 30, 1976.

The analysis and study of the interview data from the 584 participants, in the 335 fire incidents involved the determination of the critical variables relative to the fire incidents involving: The occupancy of the building; The number of previous alarms in the building; The amount of smoke spread in the building; The area of fire origin; The extent of fire and smoke spread in the building; The time of the fire incident, and the height of the buildings involved in the fire incidents.

The participant population parameters were determined relative to the following demographic and empirical variables: The participant's sex; The participant's age; The participant's occupation; Previous training relative

to fire situations; Previous experience in fire incidents; The participant's location in the building at the time of the fire; The means by which the participants became aware of the fire incident; Persons with the participant; Time of the participant's presence in the building; and the belief of the participant in the safety of the building.

The first, second and third actions of the participants after becoming aware of the fire incident were analyzed and compared relative to differences in the selection and utilization of the first, second, and third actions. The variables of the participants relative to their distance from the fire, their belief in the safety of the building, the number of previous alarms in the building, and the extent of smoke spread were all compared with the selection of first actions. The selection and utilization of first actions were also compared relative to the participant's previous fire experience, and their previous training for fire incidents. The first, second, and third actions of the participants were also analyzed relative to any differences in the actions of the participants according to the sexual distribution of the participant population.

The various aspects of the participants movements through the smoke in the fire incidents were analyzed and compared. The first actions of the participants were considered relative to the smoke spread in the fire incident building. The evacuation time and the distance of evacuation movement for the total participant population and the participants that moved through smoke were compared. The evacuation distance relative to the time of occurrence of the evacuation were also compared. The distance of the participants movements through smoke were compared for the participants with and without previous fire experience, the participants with and without previous training, and the sexual distribution of the participants. The number of the participants who were forced to turn

back in their movement through the smoke were compared relative to the previous fire experience, the previous training and the sexual distribution of the population. The visibility distance of the participants was also compared with the movement through smoke and the turned back behavior of the participants.

The critical aspects of this study were compared with aspects of Wood's (14) study on the British population consisting of 952 fire incidents and 2193 participants. Data from both studies were compared relative to the characteristics of the fire incidents, the participant populations, and the actions of the participants. The occupancy of the fire incident building, the time of the fire incident, the floor of origin of the fire incident, and the extent of the smoke spread within the building, were compared for both studies. The reported sexual distribution, age distribution, and the means by which the participants became aware of the fire incident were compared for both of the participant populations. The actions of the participant population were compared from both studies relative to the first, second and third actions of the respective populations. The first actions of both populations were compared relative to the male and female members of the respective populations. The percentages of the populations relative to the reasons for reentry behavior were also compared. The occurrence of the reentry, fire fighting, evacuation, movement through smoke, and the turned back behavior for both populations were also compared. The visibility distance for both populations was compared relative to the movement through smoke and the turned back behavior.

B. Review of The Limitations of The Study.

As previously indicated on page 5 of this report the study was limited relative to eight important variables concerned with the selection of the

fire incidents, the participant population for the study, and the methodology of the study. These limitations are presented again as follows:

1. The study was limited to the geographical area composed of the metropolitan complex surrounding Washington, D.C. and Baltimore, Maryland.
2. The participants of the fire incidents were interviewed in varying time intervals following the fire incident dependent upon the type of fire department personnel conducting the interviews, and the jurisdiction involved in the fire incident.
3. The fire incidents selected for inclusion in the study had to initially be reported to the fire department, and secondly to be occupied at the time of occurrence of the incident.
4. The incidents selected by the participating jurisdictions occurred between January 15, 1975 and April 30, 1976.
5. The interviews were conducted by fire department personnel with varying interview experience in the study, in the various jurisdictions.
6. The local jurisdictions participated in the study for varying periods of time, with the final incident collection period from January to April, 1976 involving only eight of the original jurisdictions.
7. The fire incidents were selected for inclusion in the study by various criteria in the various jurisdictions involved in the study, relative to the availability of interviewing personnel, the time of the incident, and the occupancy involved in the fire incident.

8. Detailed in depth interviews were not conducted of the participants in the fire incidents, and no interviews were conducted of personnel involved in the fire incident who were physically injured, or emotionally upset.

C. Conclusions of The Study

The following conclusions have been developed and formulated from the results of this study as previously presented in this report. These conclusions are concerned with the following study elements: The Participant Population; The Actions of The Participant Population; The Effect and Influence of Smoke on the Behavior; and the Comparisons with The British 1972 Study:

1. The Participant Population

- a. The four most popular means of awareness of the fire incident for the participant population in rank order consisted of the following stimuli: "Smelled Smoke;" "Notified by Others;" "Noise;" and "Notified by Family." When the, "Notified by Family," and "Notified by Others," classifications were combined, the "Notified by Others," became the most prevalent means of awareness of the fire incident.

- b. The only statistically significant differences between the male and female members of the participant population relative to the means of awareness of the fire incident involved the male participants being notified by the stimuli of: "Noise," and the process of, "Saw Smoke."

- c. The participants located farther than 20 feet from the fire incident, had a higher percentage of becoming aware of the fire incident through the stimuli of: "Notified by Others," and, "Noise." The percentages of participants were determined to be statistically significant

from the participants located within 20 feet of the fire incident.

d. The participants located within 20 feet of the fire incident differed significantly from the participants located farther than 20 feet from the fire, with a greater percentage of the participants becoming aware of the fire incident by the stimulus of: "Saw the Fire."

2. The Actions of The Participant Population.

a. The four most popular first actions of the participant population in rank order were as follows: "Notified Others;" "Searched for Fire;" "Called the Fire Department;" and, "Got Dressed." The first actions of the participant population appeared to primarily involve communicative behavior, fire containment or control behavior, evacuation behavior, and behavior involving concern for personal possessions.

b. The statistically significant differences in the selection of first actions by the females in the participant population involved the following first actions: "Called the Fire Department," "Left Building;" and, "Obtain Family Members." The male members of the participant population had a greater percentage of utilization of the following first actions, which were statistically significantly different from the female first actions: "Searched for Fire," and "Obtain Extinguishers."

c. The statistically significant differences in the first actions of the participants with and without previous training involved the following first action with a higher percentage of use by the participants with previous training: "Got Extinguisher." The participants without previous training differed significantly from the participants with previous training relative to the following first actions: "Got Family," and "Went to Fire Area."

d. There were no statistically significant differences in the selection of first actions by the participants with previous fire experience and the

participants without previous fire experience.

e. The only statistically significant difference in the first actions of the participants who believed the building to be unsafe or safe, consisted of a greater percentage of the participants who believed the building to be unsafe utilizing the action of: "Tried to Exit."

f. The participant population located within 20 feet of the fire incident, differed significantly from the participants located farther than 20 feet from the fire with a greater percentage of these participants utilizing the action of; "Tried to Exit." The participants located farther than 20 feet from the fire differed significantly with a greater percentage utilization of the first action of; "Did Nothing."

g. The participants involved with the fire incident in buildings with known previous alarms during the preceeding year, selected with a higher percentage of the action of; "Left the Area." This difference from the participants in buildings without the previous alarms, was statistically significant.

h. The statistically significant differences between the participant population utilization of the first actions when compared to the selection of second actions involved the following first actions: "Notified Others;" "Searched for Fire;" "Got Dressed;" "Woke Up;" and, "Nothing." The second actions which differed significantly from the first actions with a greater percentage of the participant population, were as follows: "Called The Fire Department," and "Left The Building."

i. The statistically significant differences in the second actions of the participant population when the actions of the males and females

were compared, involved a greater percentage of the males utilizing the second actions of: "Fought Fire;" "Got Extinguisher;" and "Removed Fuel."

j. The four most popular second actions of the participant population in rank order were the following actions: "Left Building;" "Called The Fire Department;" "Notified Others," and, "Got Family."

l. There were 14 statistically significant differences in the participant population utilization of first and third actions. There was a higher percentage utilization for first actions of the following 9 actions: "Notified Others;" "Searched For Fire;" "Got Dressed;" "Got Extinguisher;" "Left Area;" "Woke Up;" "Nothing;" "Went to Fire Area;" and, "Got Family." The following 5 third actions were utilized by a greater percentage of the participants as third actions: "Leave The Building;" "Fought Fire;" "Await Fire Department Arrival;" "Go To Balcony;" and, "Removed by Fire Department."

m. There were 11 significant differences in the participant population utilization of second and third actions. There was a greater percentage of second action selection for the following 6 actions: "Notified Others;" "Got Dressed;" "Got Family;" "Got Extinguisher;" "Got Personal Property;" and, "Tried to Exit." The following 5 actions were utilized by a higher percentage of the participants as a third action: "Left Building;" "Fought Fire;" "Await Fire Department Arrival;" "Go To Balcony;" and, "Removed by Fire Department."

n. The only statistically significant difference in the utilization of third actions between the male and female members of the participant population, involved a greater percentage of the males utilizing the third action of, "Fought Fire." It should be noted the only significant differences between

the male and female members of the participant population relative to both second and third actions involved the actions concerned with the fire fighting type of behavior.

o. When the first, second, and third actions of the participant population were analyzed, the following actions experienced a decreasing trend in utilization from the first to the third action: "Notified Others;" "Searched for The Fire;" "Got Dressed;" and, "Got Family." The following actions experienced an increasing trend in utilization from the first to third actions: "Called the Fire Department;" "Left Building;" "Fought Fire;" and, "Had Others Call The Fire Department."

p. A total of 15.9 per cent of the participant population did not voluntarily evacuate the fire incident building. The most popular reason for nonevacuation was the action of, "Fire Fighting." An additional 19.6 per cent of this nonevacuation population could not evacuate due to the physical condition of the fire incident, primarily smoke.

q. The reasons for nonevacuation of the building, when compared between the male and female members of the participant population, resulted in one statistical significant difference with a higher percentage of male utilization of the action of, "Notify Others."

r. The four most popular reasons of the 27.9 per cent of the participant population, for engaging in the reentry behavior were as follows in rank order: "Fire Fighting;" "Get Personal Property;" "Check on Fire;" and, "Notify Others."

s. There were no statistically significant differences between the male and female members of the participant population engaged in reentry behavior relative to their reasons for the reentry.

t. There was no statistically significant difference in the occurrence of the reentry behavior when a family member was present or absence in the fire incident.

u. Fire fighting behavior was engaged in by 22.9 per cent of the participant population. The age distribution of the participants who engaged in fire fighting varied between the ages of 7 and 80 years. Approximately 73.8 per cent of the fire fighting population was between 18 and 47 years of age.

v. The fire fighting behavior population consisted of 62.7 per cent males and 37.3 per cent females. Considering the fire fighting behavior mode, including six actions, the male participation was significantly greater than the female. The male participants also utilized a higher percentage of the following two actions which were statistically significant: "Fought Fire;" and, "Got Extinguisher." There were no statistically significant sexual differences in the utilization of the behavior mode of, "Calling the Fire Department."

3. The Effect and Influence of Smoke on The Behavior.

a. The significant differences relative to the first actions of the participant population were compared with the area of smoke spread. The participants in fire incidents with the smoke spread limited to the area of origin and one floor, had a higher percentage of participants utilizing the following first actions: "Went to Fire Area;" and, "Tried to Extinguish." In contrast, the participants involved in fire incidents with smoke spread from 2 to 7 floors, had a higher percentage of the participants utilizing the first action of, "Got Dressed."

b. The mean time for the evacuation of the participant population was 1.92 minutes, with a mean evacuation distance of 41.7 feet. The mean time for the occurrence of the evacuation, from the initial awareness of the fire incident was 4.07 minutes.

c. The mean distance of movement for the participant population involved in the movement through smoke was 29.8 feet.

d. The difference between the mean evacuation distance for the participant population of 41.7 feet, and the mean distance of the movement through smoke of 29.8 feet, was a statistically significant difference.

e. There were no significant differences in the distance moved through smoke for the members of the participant population with previous fire experience, and the members without previous fire experience.

f. The members of the participant population with previous training had a higher percentage of the participants involved in movement through smoke for a distance of 100 to 400 feet, when compared with participants without previous training.

g. There were no significant differences between the male and the female members of the participant population which moved through smoke, relative to the distance moved through the smoke.

h. The mean distance moved through smoke for the participants with previous training of 41.8 feet, and the distance of 29.6 feet for the participants without previous training was statistically significant.

i. There were three significant differences in the percentages of the participant population which moved through smoke relative to the distance moved and the visibility distance. The percentage of the population which moved through the smoke a distance, equal to the visibility distance, and less than the visibility distance were all statistically significant.

j. The mean visibility distance through smoke for the involved participant population was 34.8 feet.

k. The participant population involved in the movement through smoke consisted of 366 individuals or approximately 62.7 per cent of the participant population. Approximately 107 of these participants, or approximately 29.2 per cent of the total participant population had to turn back.

l. The mean visibility distance at the time of initiation of the turned back behavior for the involved participants consisted of 9.9 feet. The difference between the mean visibility distance of 9.9 feet at the initiation of the turned back behavior and the mean visibility distance of 34.8 feet for the movement through smoke was statistically significant.

m. The participant population involved in the turned back behavior involved 57 male and 50 females, or approximately 53.2 per cent and 46.8 per cent of the participant population involved in this behavior.

n. There were no significant differences relative to the reason for the turned back behavior from heat, smoke, or both heat and smoke, and the extent of the smoke spread in the fire incident building.

o. There was a statistically significant difference as determined by the Chi-Square analysis between the 9.7 per cent of the male participant population and the 8.6 per cent of the female participant population involved in the turned back behavior when compared with the 29.3 per cent of the male participant population and 33.4 per cent of the female participant population involved in the movement through smoke behavior.

p. There were no significant differences in the percentages of the participant population engaged in the turned back behavior, relative to the sex of the participants, the previous training, or the previous fire experience of the participants. Approximately one-third of the participants

involved in the movement through smoke were involved in the turned back behavior.

4. The Comparisons With Aspects of The British 1972 Study.

a. The four most popular occupancies of the British study in rank order were as follows: "Dwellings," "Factories," "Shops," and "Apartments." The four most popular occupancies of the Project People study in rank order were: "Dwellings," "Apartments," "Restaurants," and both, "Schools and Hotels."

b. The statistically significant differences between the occupancies in both studies, indicated the British study had a greater percentage of "Factories," "Shops" and, "Garages." The Project People study had a greater percentage of "Dwellings," and, "Apartments."

c. The rank order of the percentage of the fire incidents relative to the time of occurrence for both studies was as follows: The highest percentage of incidents occurred between 1200 to 1800. The next highest percentage of fire incidents occurred from 1800 to 2300. While the third highest number of fire incidents occurred between 0600 to 1200. The time interval from 2300 to 0600 had the least number of fire incidents in both studies. The only statistically significant difference between the number of fire incidents in the time periods, concerned the 21.4 per cent of the Project People fire incidents in the 2300 to 0600 time period.

d. The comparison of the floor of fire origin had 3 significant differences between the two studies. The Project People study had a higher percentage of fire incidents originating in the basement and the second floor. While the British study had a greater percentage of fire incidents with the fire origin on the first floor.

e. There were 4 significant differences concerned with the extent of the smoke spread in the fire incidents from both studies. The British study

had a higher percentage of fire incidents with, "No Smoke Spread," and the smoke spread confined to the, "Room or Area of Origin." While the Project People study had a greater percentage of fire incidents with smoke spread involving the, "Floor of Origin," and, "Other Floors." A total of 79.2 per cent of the Project People fire incidents involved smoke spread of one or more floors.

f. The participant population in the British study appeared to be predominately male with 56.5 per cent of the participants. The Project People participant population in contrast was female dominated with 54.8 per cent of the participant population. These sexual differences between the participant populations in both studies were statistically significant by the Chi-Square Analysis.

g. The distribution of the ages of the participants in both studies were compared and there were two significant differences between the populations. The British study had a greater percentage of participants in the 40 to 49 age group. The Project People study had a higher percentage of participants in the 20 to 29 age range. It thus appeared the British participant population was slightly older, and contained more male participants than the Project People participant population.

h. The means of awareness by which the participant population became aware of the fire incident were compared for both populations. The rank order of the means of awareness was identical for the first and second stimuli for both studies involving "Smoke" and "Being Told." There was only 1 significant difference in the means of awareness between the two populations. This significant factor was the difference between the 15 per cent of the British population and the 8.1 per cent of the Project People population which became aware of the fire incident by, "Flame."

i. There were 10 significant differences in the first actions

between the two studies. The British population had a higher percentage of utilization of the following 5 actions: "Fought Fire;" "Went to Fire Area;" "Closed Door to Fire Area;" "Pulled Fire Alarm;" and, "Turned Off Appliances." The Project People population had a greater percentage of utilization of the following 5 first actions: "Notified Others;" "Got Dressed;" "Got Family;" "Enter Building;" and, "Left Area."

j. There were also 10 significant differences in the second actions between the two populations. The British participants had a greater percentage of participants selecting the following 6 actions: "Fought Fire;" "Nothing;" "Went to Fire Area;" "Enter Building;" "Close Door to Fire Area;" and, "Turned Off Appliances." The Project People population had a higher percentage of participants using the following 4 actions: "Notified Others;" "Called the Fire Department;" "Left Building;" and, "Got Family."

k. There were another 10 significant differences in the third actions between the participant populations in the two studies. The British participants had a greater percentage of utilization of the following 4 actions: "Went to Fire Area;" "Closed Door to Fire Area;" "Turned Off Appliances;" and, "Nothing." The Project People population had a higher percentage of utilization of the following 6 third actions: "Notified Others;" "Called the Fire Department;" "Left the Building;" "Had Others Call The Fire Department;" "Await the Fire Department;" and, "Went to Balcony."

l. Approximately 24.8 per cent of the British participant population had previous fire experience, while 28.3 per cent of the Project People participants had previous fire experience. There were 8 significant differences in the first actions of the participant populations with

previous fire experience from both studies. The British previous fire experience population had a greater percentage of participants using the following 3 first actions: "Fought Fire;" "Pulled Fire Alarm;" and, "Turned Off Appliances." The Project People previous fire experience populations had a greater percentage of participants using the following 5 first actions: "Notified Others;" "Got Dressed;" "Got Family;" "Nothing," and, "Enter Building."

m. There were 5 significant differences between the first actions of the female participant populations from both studies. The British female participants had a higher percentage of utilization of the following 3 first actions: "Searched for Fire;" "Closed Door to Fire Area;" and, "Turned Off Appliances." The Project People female participants had a greater percentage of utilization of the first actions of: "Got Dressed," and, "Enter Building."

n. There were 8 statistically significant differences in the first actions of the male participant populations from both studies. The British male population had a higher percentage of utilization of the following 4 first actions: "Called the Fire Department;" "Fought Fire;" "Closed Door to Fire Area;" and, "Pulled Fire Alarm." The Project People male population had a higher percentage of utilization of the following 4 first actions: "Notified Others;" "Got Dressed;" "Left Area;" and, "Enter Building."

o. Approximately 27.9 per cent of the Project People participant population engaged in reentry behavior. The British study had a reentry population consisting of 44.1 per cent of the total participant population. There were 10 significant differences in the reasons for the reentry

behavior between the populations in both of these studies. The British population had a higher percentage of participants with the following reasons for reentry: "Fight Fire;" "Observe Fire;" "Shut Doors;" "Await Fire Department;" and, "Fire Not Severe." The Project People population had a higher percentage of participants with the following reasons for reentry: "Notify Others;" "Assist Evacuation;" "Assist Fire Department;" "Rescue Pets;" and, "Call the Fire Department."

p. There were 4 significant differences in the behavior modes between the two participant populations. The British population had a higher percentage of the participants engaged in the reentry behavior and the turned back behavior. While the Project People population had a higher percentage of the participants engaged in the Fire Fighting and Evacuation Behavior. There was no significant difference in the percentage of the populations involved in the movement through smoke, with 60 per cent of the British population and 62.7 per cent of the Project People Population.

q. There were 5 significant differences in the visibility distances relative to the movement through smoke for the two populations. The British participants had a higher percentage of their participants with visibility distance of: "3 to 6", "7 to 12", and "above 60 feet". The Project People population had a higher percentage of participants with visibility distances at the time of moving through smoke of: "13 to 30", and, "46 to 60 feet".

r. There were 5 significant differences in the distance moved through the smoke for both populations. The British population had a higher percentage of participants moving as follows: "3 to 6", "7 to 12", and, "above 60 feet". The Project People population in contrast had a higher percentage of persons moving, "13 to 30 feet", and "46 to 60 feet".

s. The turned back behavior involved 24.6 per cent of the Project People participant population, and 43.3 per cent of the British participant population.

t. There were 3 significant differences in the visibility distance at the time of the turned back behavior between the two populations. The British participant population had a higher percentage of participants with a visibility distance of: "3 to 6 feet". The Project People participant population had a greater percentage of participants with a visibility distance of: "13 to 30 feet" and, "46 to 60 feet".

D. Recommendations for Further Study

The following recommendations are a result of the analysis phases of this study, and primarily consists of insights and assumptions that occurred during the study.

a. The Weighted Diagram, the Transition Frequency Matrix, and Markov Chains should be examined for possible usefulness in the analysis of the sequence of actions of participants.

b. Additional detailed analysis considering the possibility of significant differences in the actions of participants when analyzed according to the participants occupation and the age of the participants might be useful.

c. The design of future studies might provide additional data by attempting to control the variations in the physical environment of the building and occupancy by studying fire incidents in one or two selected types of occupancies.

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