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A Fire Safety Evaluation System for Board and Care Homes

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Final Report

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Foreword

This project was initiated in 1977 in response to a request from the Administration on Developmental Disabilities of the Department of Health and Human Services. It provided the funding necessary to develop a flexible set of fire safety evaluation techniques for small group homes housing persons who are mentally retarded or who have other developmental disabilities.

After a series of well publicized tragic fires in board and care homes for frail elderly and mentally ill persons, the Health Care Financing Administration of the Department of Health and Human Services requested in 1980 that the project be expanded to cover all types and sizes of board and care homes. This report covers both large and small facilities and a wide range of disabilities.

The project staff was greatly aided by the advice and cooperation of many people. Providers welcomed us into their facilities; state officials conducted a field test on our behalf; many experts volunteered their time, providing us with advice and filling out forms we provided. The experts who were members of our two major consulting panels contributed many hours of intense effort over a long period of time, without remuneration.

The project staff is appreciative of all the support and assistance it has received and recognizes that such support and assistance was vital to the success of this project.

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Abstract

Board and Care Homes for residents with mental retardation, the infirmities of age, or mental illness are a new type of occupancy, and model fire safety codes do not have requirements specifically for this type of occupancy. In support of efforts to write model codes for this occupancy, a Fire Safety Evaluation System has been developed. It can be used for determining if a home has fire safety equivalent to that obtained by meeting the requirements of a given code. The system was calibrated for use with a proposed chapter of the Life Safety Code. There are three sets of requirements: one for small dwelling units, one for large facilities, and one for apartment houses. Within each set, there are four levels of evacuation capability of the residents and staff -- prompt, moderate, slow, and impractical, each with a different requirement for fire safety features, so that homes with more capable residents will not be required to have as many fire safety features to meet the desired level of safety. A novel rating system is described for determining the evacuation capabilities of the residents with available staff assistance. A field test is described.

Key words: Apartments; board and care homes; developmental disabilities; egress; elderly persons; evacuation; fire safety; Fire Safety Evaluation System; handicapped; mental retardation; residential buildings.

1. INTRODUCTION AND BACKGROUND

1.1 Overview

The current trend in housing persons with physical, mental, or emotional disabilities, who do not live with their families, is away from institutions and toward community-based housing. A major impediment to this trend has been the lack of a generally accepted set of fire safety requirements which not only provide adequate life safety for residents, at minimal cost, but also do not unnecessarily interfere with such program goals as the maintenance of a non-institutional environment. The purpose of the project described in this report was to support efforts to meet this need.

This project was initiated in 1977 in response to a request from the Administration on Developmental Disabilities of the Department of Health and Human Services (HHS), to the Center for Fire Research (CFR) of the National Bureau of Standards (NBS). The project originally focused on developing fire safety evaluation methods specifically for small group homes for people with developmental disabilities. The residents of these homes include those with mental retardation, cerebral palsy, epilepsy, and autism. An expansion of the project was undertaken in 1980 at the request of the Health Care Financing Administration, HHS. The methods are now designed to cover all types of Board and Care Homes, including those housing the elderly and the mentally ill, and also larger homes, in addition to the originally targeted small group homes for the developmentally disabled.

The basic fire/life safety recommendations for all types of board and care homes, used in this report, are contained in a proposed Chapter 21 to the Life Safety Code prepared by the Residential Subcommittee of the Committee on Safety to Life of the National Fire Protection Association (NFPA). The proposed Chapter 21 is contained in Appendix A of this report and is being considered and reviewed following normal NFPA procedures.

Residents of board and care homes differ greatly in their ability to evacuate the home in the event of fire. Thus the level of building fire protection features, needed to provide a given level of life safety, will vary with the nature of the residents' capabilities and the availability of staff to assist those with reduced capabilities. The proposed Chapter 21 accommodates this variation in need by incorporating the concept of four different levels of building fire protection features and by providing criteria for estimating the difficulty of evacuating any specific home in order to determine which level of fire protection features is needed by that facility.

The Center for Fire Research (CFR) of the National Bureau of Standards (NBS) has previously developed a Fire Safety Evaluation System for Health Care Facilities (FSES/HC). The original FSES/HC provides a method of evaluating alternative combinations of fire protection features. It is used to determine if the alternative combinations provide the level of life safety that would be attained by strict adherence to code specifications in Chapter 10 of the 1973 Life Safety Code [1].[1] Appendix C of the 1981 Life Safety Code contains a slightly modified version of the FSES/HC for use with the 1981 Code [2]. Similarly, CFR developed the Fire Safety Evaluation System for Board and Care Homes (FSES/B&C) to provide more flexibility in achieving the level of fire safety that would be attained by strict adherence to the specifications in the proposed Chapter 21 for Board and Care Homes.

A draft FSES/B&C was submitted in January 1982 to NFPA as a proposal for inclusion in the next edition of its Life Safety Code as Appendices F and G of the Code. Appendices B and C of this report contains the FSES/B&C with modifications suggested by the Residential Subcommittee.

The FSES/B&C has two distinct parts. One part is a novel subsystem for measuring the difficulties that can be expected in evacuating a facility in a fire. It involves determining an "Evacuation Difficulty Score" based on resident and staff capabilities. The other part provides a subsystem for estimating the amount of fire protection, from a life safety standpoint, provided by the building that houses the residents. Three different sections of this subsystem are provided for estimating the level of building safety: one for small dwelling units, one for large facilities, and one for apartment buildings housing a group home unit.

1.2 Scope

This section defines the type of residence to which the FSES/B&C can be applied. It describes the relationship of the proposed Chapter 21 (and the FSES/B&C) to existing code provisions. Background information is also provided regarding current code applications and enforcement for this occupancy type.

1.2.1 Definition of a Board and Care Home

The board and care occupancy classification covers a wide variety of resident types and building structures. The features that are used to distinguish this classification are:

[1]Numbers in brackets refer to literature references listed at the end of this report.

- The residents do not comprise a family unit.

- The residents have some form of impairment, mental and/or physical, which may or may not detract from their abilities to respond to a fire emergency. These disabilities may be developmental in origin, stem from old age, be from an accident or result from previous alcohol or drug addiction.

- The residents receive some form of personal assistance from staff, in addition to room and board. The services and supervision received are less than those provided in a hospital, nursing home, or mental institution.

- The homes do not provide medical treatment or care beyond what a parent normally provides for his/her children.

A large number of the residents of board and care homes have been "deinstitutionalized"; that is, they have been discharged from institutional settings such as state mental hospitals or veterans' hospitals and have been placed into these smaller, community-based residences. The facilities designated as board and care homes may be variously referred to as halfway houses, boarding homes, unlicensed nursing homes, group homes, hotels for the elderly, adult boarding and residential facilities, sheltered care homes, etc. The structures used range from small one-story homes to high-rise buildings. It has been estimated that there are approximately 300,000 such facilities in the U.S., housing about two million residents [3]. Further information is needed regarding this rapidly growing type of occupancy, and in fact, the Department of Health and Human Services has commissioned the Denver Research Institute to develop background information on this type of facility [4].

1.2.2 Code Applications

The 1981 Edition of the NFPA Life Safety Code does not contain a chapter specifically designed to cover the board and care occupancy type, although it reserves space for such a chapter (Chapter 21) for future editions. Thus it has been necessary to apply provisions from other chapters, such as those dealing with health care occupancies or lodging houses, to such residences. The chapters on Health Care Occupancies (Chapter 12 and 13) assume that residents are mostly incapable of self-preservation and accordingly provide a high level of fire protection; the chapters on Hotels (Chapters 16 and 17) and Lodging and Rooming Houses (Chapter 20) assume a non-disabled population, and therefore have less stringent requirements.

For a small percentage of board and care facilities, evacuation of the homes in fire emergencies may be impractical and the Chapters on Health Care Occupancies are appropriate. On the other hand, for a portion of the homes, the residents can evacuate rapidly and the requirements in the Chapters for Lodging or Rooming Houses, and for Hotels are appropriate. However, in many homes the capabilities of its residents typically do not fit either category; that is, unlike nursing home residents, these residents have some significant capability of contributing to their own self-preservation in a fire emergency, but not at the level of non-disabled persons. Thus, while the health care requirements may be too strict, the requirements for lodging houses may be too lenient.

The criteria available to date to evaluate the fire safety of board and care homes have been, on the whole, unsatisfactory and this has often resulted in overly strict standards being applied. This has caused numerous problems: prohibitive costs, destruction of the desired homelike ambience, and lax or inconsistent enforcement of standards by officials who are

reluctant to close down what otherwise appears to be a well-operated facility. On the other hand, inadequate fire safety can result in tragedy as evidenced by a series of fatal fires in these homes [5-11].

The proposed Chapter 21 prepared by the Residential Subcommittee is an attempt to provide a model code that provides a high level of safety at minimal cost by tailoring the fire protection requirements to the number of residents and to their capability to evacuate with staff assistance. The proposed Chapter 21 contains graduated sets of proposed requirements for each of three sizes of facilities based on the number of residents: the most lenient set for small and large facilities corresponds to the requirements in the lodging house and hotel chapters, respectively, and the most stringent set corresponds to the requirements in the health care chapters. The relationship between the requirements in the proposed Chapter 21 and the requirements in the Life Safety Code is graphically depicted in Figure 1. The four Levels of Requirements in Figure 1 correspond to four levels of evacuation capability (or evacuation time) of the residents (with staff assistance). While the requirements of the proposed Chapter 21 are quite similar to the corresponding requirements in the Life Safety Code, they are not identical because of the nature of the operation of board and care homes. (Graduated sets of requirements are also recommended for evaluating, from a fire safety standpoint, the suitability of an apartment building to house a board and care home in one of its apartments.)

LEVEL OF REQUIREMENTS	SIZE OF FACILITY: SMALL 16 or Less	MEDIUM 17-30	LARGE 31 or More
LEVEL A	similar to boarding house	substantially less than hotel	approximates hotel
LEVEL B	more than boarding house	less than hotel	approximates hotel
LEVEL C	substantially more than boarding house	approximates hotel	approximates hotel
LEVEL D	approximates health care	HEALTH CARE	HEALTH CARE

Figure 1. Relationship of Recommendations to Life Safety Code Requirements

1.3 Need for the Project

In June 1977, the Health Care Financing Administration (HCFA) of the Department of Health and Human Services (HHS) issued regulations for federally supported small Intermediate Care Facilities for the Mentally Retarded (ICFs/MR) [12]. These regulations permit use of the lodging house requirements of the Life Safety Code for an ICF/MR with 15 or fewer beds, provided that all residents have been certified by a qualified physician or psychologist to be (1) ambulatory, (2) receiving active treatment, and (3) capable of following directions and

taking appropriate action for self-preservation under emergency conditions. (There is a general agreement that this requirement is consistent with the intent of the Life Safety Code.) In the absence of such certification, or if there are more than 15 residents, the more restrictive institutional requirements for Health Care Facilities must be met. Recognizing that neither of these two sets of requirements are appropriate for facilities housing residents of intermediate capabilities, the Administration on Development Disabilities (ADD) requested the Center for Fire Research of the National Bureau of Standards to undertake the program described in this report, and ADD provided funding for the program to address the problem of fire safety in small board and care homes for the developmentally disabled.

By October 1980, there were several highly publicized fires in large board and care homes with elderly and mentally ill residents. The Health Care Financing Administration requested that the project be expanded to cover all types and sizes of board and care homes, including the whole range of housing for the elderly and for the mentally ill.

Fire protection features of the building are only one aspect of fire safety. The actions and capabilities of the building occupants are also important. While the FSES/B&C in this report measures this behaviorial aspect, a guidance manual was prepared in a companion project to assist operators in upgrading fire safety through proper planning and training of residents [13].

1.4 Logic and Structure

1.4.1 Level of Safety

Fire safety regulations do not provide total or absolute fire safety but they can and should provide a high level of safety. The Life Safety Code published by the National Fire Protection Associaton is the model code used in setting fire safety requirements for facilities receiving federal funding under Medicare and Medicaid.

An important assumption throughout this program has been that future provisions of the Life Safety Code would require combinations of fire protection features that would provide a level of safety comparable to:

1. The level of protection provided under the Health Care Occupancy requirements of the Life Safety Code to the patients in nursing homes when a timely evacuation cannot be assured.

2. The level of protection provided under the Lodging or Rooming House requirements of the Life Safety Code to the residents of ICF/MR's when there are 15 residents or fewer, all of whom are certified as ambulatory, receiving active treatment, and capable of self-preservation.

1.4.2 Alternate Approaches to Achieving Safety

There are three major factors that determine the level of fire safety in a board and care home after an unwanted fire has been ignited:

1. The capabilities/disabilities of the residents which are a function of their disabilities and their training.

2. The capabilities of the staff to assist the residents.

3. The fire protection features of the building.

The fire safety of the home can be upgraded by addressing any of these factors or any combination of these factors. Decreasing the number of residents with significant disabilities will permit a more rapid evacuation. Similarly, if the residents need substantial staff assistance, increasing the number of staff on duty will permit a more rapid evacuation. Fire protection features will keep the escape routes safer for a longer period of time and/or will permit the evacuation to start earlier through early warning.

A major goal was to develop a system that would permit the upgrading of the fire safety of a board and care home by addressing any one of these factors as well as any combination. This goal has been met.

1.4.3 Evacuation Difficulty

As was stated in Section 1.2.2 Code Applications, in developing the proposed Chapter 21, the Residential Subcommittee attempted to develop a model code that provides a high level of safety at minimal cost by tailoring the fire protection requirements to the number of residents and to their capability to evacuate with staff assistance. The chapter defines four levels of capability:

Prompt. Evacuation capability equivalent to that envisioned for the general population in the Life Safety Code criteria for Residential Occupancies covered under Chapters 16, 17, 18, 19, 20 and 22. This is normally accepted as the ability to relocate all of the endangered occupants to a point of safety within approximately three minutes from alarm or other alerting signal.

Moderate. Groups that can successfully execute evacuation and relocate to a point of safety in approximately 5 minutes longer than that defined as prompt evacuation.

Slow. Groups that can successfully execute evacuation and relocate to a point of safety in approximately 10 minutes longer than that defined as prompt evacuation.

Impractical. Groups that cannot successfully execute evacuation and relocate to a point of safety within approximately 10 minutes longer than that defined as prompt evacuation.

The residential chapters of the 1981 Life Safety Code such as Chapter 16, New Hotel Occupancies; Chapter 17, Existing Hotels; and Chapter 20, Lodging or Rooming Houses; assume that the guests, without staff assistance, have a prompt evacuation capability. It, therefore, follows that the requirements of those chapters are appropriate for Board and Care Homes having residents and staff with a prompt evacuation capability. (This is consistent with the regulation that permits the use of the Lodging or Rooming House requirements in small ICF/MR's when all the residents are ambulatory and capable of self-preservation.) Similarly, the health care occupancies chapters assume that evacuation or relocation of the patients is impractical. Since the requirements in the health care chapters are designed for large buildings, it, therefore, follows that the requirements of these chapters are appropriate for large Board and Care Homes having residents and staff with an impractical evacuation capability.

1.4.4 Equivalency Concept

1.4.4.1 Need for Flexibility

The proposed Chapter 21 as printed in Appendix A of this report provides a usable set of fire safety specifications. However, the Life Safety Code considers a building to meet the Code if the building has a level of safety equal to or greater than that achieved by meeting all the specifications in the code -- that is, if it has equivalent safety. The problem is how to determine if this equivalency is achieved. The Fire Safety Evaluation System for Board and Care Homes (FSES/B&C, printed in Appendices B and C) was developed to determine if fire safety equivalent to that required by Chapter 21 is attained.

The FSES/B&C can be important if a home exceeds the requirements of Chapter 21 in some respects but fails to meet one or more specific specifications. It does provide a technique for evaluating tradeoffs. If the total safety provided is sufficient, expensive retrofits can be avoided.

1.4.4.2 Procedure for Determining Equivalency

The program staff had previously developed a Fire Safety Evaluation System for Health Care Facilities (FSES/HC). This system is now Appendix C of the 1981 Life Safety Code. The FSES/HC provides a procedure for determining if a hospital or nursing home provides the level of fire safety equivalent to that attained by meeting all the applicable specifications in the Code. Failure to pass the requirements of the FSES/HC means failure to demonstrate equivalency but this does not necessarily mean failure to attain equivalency; other methods of demonstrating equivalency may be used. However, passing the requirements of the FSES does demonstrate equivalency and means that the requirements of the Code are met.

1.4.4.3 Scoring the Buildings

1.4.4.3.1 Safety Parameters

The basic approach to determining the fire safety of a building is to rate the building on a number of safety parameters that bear upon the safety of the residents. These safety parameters correspond to sets of fire safety features. For example, the safety parameter "Manual Fire Alarm" covers two safety features: the alarm system; and the possible connection to the fire department or to an approved central station.

The safety parameters are designed to constitute a complete assembly of all the basic building factors determining the level of safety in the home for which equivalency could be expressed. (There are a few Life Safety Code requirements which must be considered explicitly and for which no equivalent alternative was developed, e.g., the specifications of the National Electric Code. These requirements are listed separately from the safety parameters.) The building is given a numerical score for each safety parameter and weighted sums of these scores are used to determine if the building meets the fire safety requirements.

1.4.4.3.2 Redundant Safety Subsystems

A basic principle of the Life Safety Code is that there will be a redundancy of protection so that the failure of a single protection device or method will not result in a major failure of the entire safety system. In addition, the development of a redundant approach, as used in this safety evaluation system, avoids the pitfall of traditional approaches to developing grading systems where all of the elements are considered independent of each other and a single total score determines acceptability. Under such a system, it is possible to achieve a passing score even if one or more critical elements are missing. On the other hand, this evaluation system requires sufficient fire safety features to provide the required level of life safety in each of three fire safety subsystems -- Fire Control, Egress, and Refuge. In addition, there is a General Fire Safety Requirement which is the traditional total score.

1.4.5 Modular Nature of the FSES/B&C

The FSES/B&C is composed of two subsystems which can be considered two separate modules as needed:

1. A subsystem or module for estimating the evacuation capability (or evacuation difficulty) -- Appendix B.

2. A subsystem or module for estimating the level of building fire protection -- Appendix C.

The proposed Chapter 21 prepared by the Residential Subcommittee defines the four levels of evacuation capability as presented in section 1.4.3. One way of determining which level of evacuation capability is appropriate is to use the first module of the FSES/B&C (Appendix B). However, the authority having jurisdiction may approve other methods of determining that level. Once the level is determined, the building may be evaluated by use of the inflexible specifications of the proposed Chapter 21 (Appendix A) or by the more flexible FSES/B&C subsystem for estimating the level of fire protection (Appendix C).

1.4.6 Steps to be Used in Evaluating Fire Safety in Board and Care Homes

Refer to Sections 1.4.6.1 or 1.4.6.2 or 1.4.6.3 or 1.4.6.4, depending upon the nature and size of the facility.

1.4.6.1 Steps in Evaluating the Fire Safety of a Small Board and Care Home

STEP 1. DETERMINE THE EVACUATION CAPABILITY AND DETERMINE LEVEL OF REQUIREMENTS

1. Make decision based on definitions in proposed Chapter 21, Section 21-1.3, on pages 73-75 and Section 21-2.2 on pages 75 and 77.

or

2. Use the Procedure for Determining Evacuation Capability in Appendix B on pages 94 to 114.

STEP 2. EVALUATE THE BUILDING AND DETERMINE IF IT HAS SUFFICIENT FIRE SAFETY

1. Use Table 21-1 of Appendix A on page 76.

or

2. Use Fire Safety Evaluation Worksheet for a Small Dwelling Unit in Appendix C on pages 117 to 131.

1.4.6.2 Steps in Evaluating the Fire Safety of a Large Board and Care Home

STEP 1. DETERMINE THE EVACUATION CAPABILITY AND DETERMINE LEVEL OF REQUIREMENTS

1. Make decision based on definitions in proposed Chapter 21, Section 21.-1.3, on pages 73-75 and Section 21-2.2 on page 75 and 77.

or

2. Use the Procedure for Determining Evacuation Capability in Appendix B on pages 94 to 114.

STEP 2. EVALUATE THE BUILDING AND DETERMINE IF IT HAS SUFFICIENT FIRE SAFETY

1. Use Tables 21-2 and 21-3 of Appendix A on pages 83 and 85.

or

2. Use Fire Safety Evaluation Worksheet for a Large Residential Facility in Appendix C on pages 133 to 153.

1.4.6.3 Steps in Evaluating the Fire Safety of a Board and Care Home in an Apartment Building

STEP 1. EVALUATE FIRE SAFETY OF APARTMENT UNIT HOUSING BOARD AND CARE HOME AND DETERMINE LEVEL OF REQUIREMENTS

1. Use procedures for evaluating fire safety of each small board and care home housed in the apartment building as given in Section 1.4.6.1 of this report.

2. This step will determine if the apartment unit has sufficient fire safety and will provide a Level of Requirements for the next step.

3. This procedure can only be used if number of residents in the unit is 16 or less. The system cannot be used if there are more than 16 residents per unit.

STEP 2. EVALUATE THE REMAINDER OF THE APARTMENT BUILDING AND DETERMINE IF IT HAS SUFFICIENT FIRE SAFETY

1. Use requirements in Section 21-4 of Appendix A, pages 91 and 92.

or

2. Use Fire Safety Evaluation Worksheet for an Apartment Building Used to House a Board and Care Home in Appendix C, pages 155 to 176.

1.4.6.4 Evaluating the Fire Safety of a Board and Care Home that Meets The Requirements of Chapters 12 or 13 of the Life Safety Code.

If a Board and Care Home meets the nursing home requirements of Chapter 12 (New Health Care Occupancies) or Chapter 13 (Existing Health Care Occupancies), as appropriate, it is considered to have sufficient fire safety for any level of evacuation capability or any level of requirements.

1.4.7 Justification for Approach

When the original Fire Safety Evaluation System for Health Care Facilities (FSES/HC) was developed, the whole approach was novel and, therefore, to some extent suspect. The technical report by Nelson and Shibe [14] gave a detailed justification for the structure of the System. The background descriptions in the Nelson and Shibe report apply equally in justifying the new FSES/B&C.

1.5 Need for Additional Work

While systems development is completed, additional work is needed if the proposed additions to the Life Safety Code are to be adopted and enforced by regulatory agencies. Assistance must be given to the NFPA as it evaluates, refines, and modifies the recommendations for inclusion in the Life Safety Code; administrative and audit policies need to be developed; surveyors need to be trained; key members of regulatory bodies should be briefed; etc.

While the development of the recommended fire safety evaluation system was based on the available research of the field, judgment was used where research data were not available. Additional research data are vital in upgrading the FSES B&C and are important in obtaining its wide acceptance and use.

2. ORIENTATION AND PROBLEM DEFINITIONS

2.1 First Year of Program

The original objective of this program was to address fire safety requirements for small group homes for the developmentally disabled. While the project staff had extensive training and experience in fire engineering, fire safety and the behavioral sciences, it had no experience with the operation of group homes and was unfamiliar with recent technical advances in the field of managing and habilitating mentally retarded persons. It was imperative to gain the needed information early in the project.

It quickly became obvious that group homes for the developmentally disabled vary greatly in terms of:

1. the architecture of the building;
2. the disabilities of the residents;
3. the level of services provided;
4. the size of operation;
5. the style of operation;
6. the goals of providers; and
7. the level of fire safety.

Since it was important that the recommendations cover as wide a range of homes as possible, the project staff visited a wide variety of homes. During this first phase of the orientation period, the staff visited over 60 homes in six states plus the District of Columbia. Discussions were held at these homes with owners, managers and staff. Fire drills were observed at several of the homes.

The second phase of this orientation included continued visits to homes. However, the major thrust was an in depth study of nine group homes in eight states -- four of these states were visited during the initial orientation [15]. This study provided data on fire drills (at eight of the nine homes) and on the activity (room use) patterns of the residents. (The residents tended to use rooms in the same pattern as typical families in their private residences.) Other information obtained included floor diagrams, reports of minor fire incidents in the homes, staffing patterns, and information about the residents, and their capabilities and Adaptive Behavior Test scores.

The recent technical literature in the fields of mental retardation and development disabilities is very large, indeed. To assist us in making use of that literature, a grant was given to the Waisman Center of the University of Wisconsin. It conducted a comprehensive search and review of the research literature related to mental retardation, cerebral palsy, epilepsy, autism and multiple handicapping conditions. Its report described the consensus of available research and information on the functional capabilities of developmentally disabled persons [16]. It also contained a summary description of nine different scales that measure adaptive behavior including the one called the Adaptive Behavior Scale. However, none of these

were developed to measure the ability of residents to evacuate in case of fire. The project staff of the Waisman also served as informed consultants and suggested several approaches for measuring the capabilities of developmentally disabled residents to evacuate their homes in fire emergencies.

2.2 Problem Definition

2.2.1 Fire Safety Evaluation System

Prior to the decision to initiate and fund this program, the Center for Fire Research had developed the Fire Safety Evaluation System for Health Care Facilities (FSES/HC). From the beginning of the program there was an implied assumption that NBS would develop a method of evaluating the fire safety of the group home that is similar to the FSES/HC.

2.2.2 Major Findings from the Orientation

As the staff became oriented to the problem several items became clear:

1. Small group homes tend to be located in buildings that architecturally are like large private homes. In fact, many group homes are located in former private residences.

2. Small group homes are also sometimes located in apartments in apartment houses otherwise having a typical mix of residents.

3. Large board and care facilities tend to be located in buildings typical of very large residences, dormitories, hotels and apartment-hotels. Many of these large board and care facilities were previously motels, seasonal hotels or nursing homes.

4. In all size ranges, some of the buildings were converted from other uses and some were newly constructed for this purpose.

5. The competence of the residents in group homes, from the standpoint of their ability to evacuate in fire emergencies, ranges from that found in the general population to that found in nursing homes.

6. The fire safety regulations applied to group homes vary from state to state.

7. The only relevant Federal regulation was that for ICF/MR's, as published just prior to the start of the program (see section 1.3) [12]. At least one state, Minnesota, was using the same requirements. (ICF/MR's are intermediate care facilities for mentally retarded and other developmentally disabled residents participating in state Medicaid programs.)

8. Many leaders in the field of developmental disabilities strongly believe that providing group home residents with a homelike ambience is an important factor in their care, training and habilitation.

9. It is difficult and expensive to meet the Health Care Occupancy requirements of the Life Safety Code and still have a homelike ambience. For example, the requirements for standard code conforming exits preclude the use of residential type stairways.

10. In many cases where they are required, the Health Care Occupancy requirements are greater than those needed to provide many group homes the level of safety normally provided other occupancies by following the Life Safety Code.

11. None of the existing measurement instruments or measurement techniques designed for use with mentally retarded people is useful or relevant for measuring the ability of a group home resident to evacuate a building in a fire emergency.

2.2.3 Basic Approach to Providing Safety

Safety in a fire is a function of two factors that relate to time.

1. As a dangerous fire progresses or grows through time, the environment becomes less tenable or more dangerous.

2. Residents must take action to protect themselves -- e.g. to evacuate -- before the environment becomes too lethal or otherwise too dangerous.

Fire safety or fire protection features of buildings are designed to prolong the time before the environment becomes dangerous and to assist the residents in taking actions to protect themselves. For example: fires spread more slowly with non-flammable walls than with flammable walls; and adequate stairway location and capacity help a rapid evacuation.

Safety is a function of the time provided by the building for self-preservation action by the occupants and the time required by the occupants to take these actions. For any given level of safety, a change in either the safety features of the building or the capabilities of the occupants can, up to a point, be compensated by change in the other.

2.2.4 Preliminary Problem Definition

Based on the information obtained during the orientation, and the general background and judgment of the program staff, it was decided to develop a Fire Safety Evaluation System as follows.

The system would contain two subsystems: one to estimate the evacuation capabilities of the residents, and the other to evaluate the fire safety features of the building. For any given level of evacuation capabilities, there would be a required level of fire protection features. The development of each of these two subsystems was expected to be a major technical challenge.

It was expected that the subsystem to evaluate the fire protection features of the building would be composed of at least two parts: one for evaluating homes that are like private residences (small facilities) and one for homes that are like hotels or dormitories (large facilities). It was decided to develop the part for small facilities first. It was recognized that something special would need to be developed for homes in apartment houses.

Since Fire Safety Evaluation Systems evaluate the level of safety of a building as compared with the level prescribed by a code, and the existing Life Safety Code did not yet contain a chapter specifically for Board and Care Homes, it was necessary for the project staff to develop a set of criteria for this comparison. The original FSES/B&C was designed to provide a similar level of safety as the established occupancy chapters of the Life Safety Code using similar fire protection strategies and equipment.

It was clear that a rating scale for rating the residents was needed. However, the project staff, with the assistance of the specialists at the Waisman Center, was unable to find any measurement instrument that would serve the purpose and there was no precedent to follow in the fire safety field.

3. SYSTEM DEVELOPMENT - OVERVIEW

3.1 Overview of the Research Effort

The research effort in developing the Fire Safety Evaluation System for Board and Care Homes involved seven major tasks:

1. Orientation, problem definition and development of system outline. (This task was described in Section 2 above.)

2. Development of the subsystem for estimating evacuation difficulty of group homes for the developmentally disabled. (See Section 4.)

3. Development of the subsystem for evaluating the fire protection features of small buildings. (See Section 5.)

4. Calibration of the two major subsystems -- determining the amount of fire protection needed for each level of evacuation difficulty. (See Section 7.)

5. Expansion of the two subsystems to cover larger buildings and additional types of disabled populations. (See Sections 4 and 5.)

6. Field test of the system. (See Section 6.)

7. Modification of the system to make it completely compatible with a proposed new occupancy chapter for Board and Care Homes in the Life Safety Code.

Tasks 2, 3, and 4 are the three tasks involved in the development of the system that has been called the Fire Safety Evaluation System for Group Homes for the Developmentally Disabled. After the system was extended to cover larger buildings and additional types of disabled populations (Task 5) the total system was called the Fire Safety Evaluation System for Board and Care Homes (FSES/B&C).

3.2 Use of Professional Judgment

The tasks involved in systems development were all heavily dependent on professional judgment. The professional judgment of the project staff was supplemented and supported in a formal manner. Each of these tasks -- the development of the two major subsystems and the calibration -- involved a similar sequence of steps to best utilize expertise to support the project staff. The details of the sequence of steps are described in subsequent sections; the general approach is outlined below.

1. The project staff prepared preliminary versions of the subsystem or calibration tables without numerical values.

2. Staff prepared a form to obtain the judgments of a related group of experts.

3. The group of experts filled out the form and, thereby, gave us their judgments.

4. The project staff analyzed the responses of the experts and from these responses developed numerical values for the subsystem or calibration table.

5. A new panel of experts reviewed and discussed the subsystem or calibration table and made recommendations for changes. This review included an evaluation of the characteristics of facilities and/or groups of individuals which would meet the various performance levels defined by the subsystems.

6. Staff and/or original group of experts considered changes suggested by the panel, made changes considered appropriate, and recycled the results through the panel.

In each of the tasks, there were several cycles of the panel suggesting changes, the staff making changes, and the staff presenting the changes to the panel. During these iterations, the staff made changes based on the suggestions of the panel, new technical information, and more experience with the subsystem. A major source of new technical information was Task 6 -- the field test of the system. Other major sources were field investigations of major relevant fires and the ongoing research at NBS.

While there were many similarities in the process, there were also variations. Each task will be more fully described in later chapters.

There are several reasons why a project such as this relies heavily on professional judgment.

1. The technical state-of-the-art does provide only limited objective, technically-based procedures for determining fire safety in board and care homes.

2. Alternative sets of fire safety features provide differential fire protection for different building occupants and for different fire scenarios. For example, one fire protection approach may offer better than average protection to occupants of the room of origin while another approach may offer better than average protection to occupants of bedrooms remote from the fires. A judgment is required regarding the overall safety provided to the individual resident and the group as compared with the safety objectives inherent in the Code.

3. There is a limited, but growing, technical base to provide guidance on the effectiveness of fire protection features, singly and in combinations, from a life safety standpoint. There was still a need, however, to rely heavily on professional judgment for estimates of effectiveness.

The advice and other assistance of experts, consultants and consulting panels is needed to supplement the knowledge and judgment of the project staff. The project staff was selected because of its relevant background, knowledge, technical skills and presumed good judgment. However, it would be impossible for any small group of experts to have the knowledge, experience and broad perspective that a wider range of experts would have. Furthermore, it is always advantageous to have a somewhat technically detached review of the work of any large project by experts who are less intimately involved with the project.

On the other hand, the panels were kept informed of recent relevant research results in the area of fire research so that their professional judgment would be based on and influenced by the latest available technical information.

3.3 Delphi Group

A group of 14 experts from the Center for Fire Research who were not assigned to the program served as a panel to provide guidance in the selection of preliminary numerical values representing the relative importance of various fire safety features of buildings and of fire safety hazards. Details regarding the function and composition of this group are contained in Appendix E.

3.4 Peer Consulting Panels

NBS staff worked in close cooperation with two peer consulting panels -- one concentrating on the human behavior aspects of the system (the Human Behavior Consulting Panel) and the other on the fire safety engineering aspects (the Fire Protection Consulting Panel). There was overlapping membership on the panels to facilitate communications between the two panels. The approach was to select for these panels acknowledged experts of diverse background, who were either known to NBS staff through personal contact or who were highly recommeded by knowledgeable persons. (The use of these formal panels did not preclude, of course, consultation with additional experts.)

The modus operandi was for the panel to raise questions or to make suggestions. The staff would carefully consider the questions and suggestions, make changes as seemed appropriate, and would present the changes to the panel at its next meeting. Due to the many interrelations and interactions throughout the system, non-trivial changes were made only after careful study.

While the Peer Review Panel was the formal mechanism for an independent review, drafts of the system were widely circulated and comments from all sources were given careful consideration. However, no changes were made without concurrence of the panel.

Initially the two peer groups met separately, but as the subsystems neared completion, the groups met jointly to consider the system as a whole. Appendix D contains a listing of the panel members. The Fire Protection Consulting Panel met on January 31-February 1, 1980 and June 11-12, 1980. The Human Behavior Consulting Panel met on June 20-21, 1978, June 11-12, 1979 and June 26-27, 1980. Joint meetings were held on September 8-10, 1980, April 14-15, 1981 and November 9-11, 1981. A special panel of experts (including some of the regular panel members as well as some persons without prior experience regarding the system) met on October 14-16, 1981, approximately a month prior to the final joint panel meeting in November 1981. This special panel was primarily charged with reviewing a proposed calibration for the system in light of case studies presented from the field test of the system.

It should be emphasized that the role of these panels was not confined to review and critique of a largely completed system, but, rather, involved participation in the development of the system at important junctures.

While the contributions of the panels were invaluable and strongly influenced the final product, the responsibility for the system remained with the program staff.

4. SUBSYSTEM FOR ESTIMATING EVACUATION DIFFICULTY OF BOARD AND CARE HOMES

4.1 Basic Guidelines

In the preliminary problem definition stage, it was tentatively decided that the measure of evacuation difficulty should be a ratio of two scores: (1) a measure of the evacuation problems of the residents; and (2) a measure of the capability of the staff to provide assistance. As the system development progressed, this decision became firm.

In developing the measures of the capabilities of the residents and the staff, several basic considerations helped shape the measurement systems.

1. Conservatism - Take into consideration behaviors or events which are unlikely to occur, but not those whose probability of occurrence is extremely low.

   Fire codes are written in consideration of the relatively few fires that create a serious threat to life and property. This appropriately conservative, worst-case perspective was used in devising the Evacuation Difficulty Score. When there is specific evidence that some problem in evacuating the residents may occur, the measure of evacuation difficulty is computed on the assumption that the problem will occur, even though the event is unlikely. Thus, the E-Score is related not to an average evacuation time, but to an evacuation time when anticipated problems might arise. In choosing the factors to use in determining the E-Score, there was a need to give consideration to all the scenarios raised by records of past fires and to the judgment of a wide range of experts.

   On the other hand, absolute safety cannot be assured, and it is impossible to consider every conceivable problem, no matter how unlikely. There was a need to be conservative but realistic.

2. Useability and Accuracy - Develop a method for estimating evacuation difficulty that is both easy-to-use and accurate.

   One of the most challenging aspects of developing evaluation or measurements systems is achieving the proper balance between the sometimes conflicting goals of useability and accuracy. A relatively simple and straightforward method of estimating evacuation difficulty is desirable so that the system will not be difficult to use or understand. On the other hand, it is also desirable to create a system which distinguishes all significant differences in evacuation difficulty. An attempt to account for all the factors contributing to evacuation difficulty naturally tends to increase the complexity of the system.

3. Performance-basis - Base ratings on observed behaviors which are relevant to behavior in a fire situation.

   This directive is key to the system; in some ways, it assists in achieving both the goals of useability and accuracy.

The fact that ratings are based on observed behaviors can contribute to the ease with which the resident ratings can be audited, and thus increases the useability of the system. While the rules for obtaining the ratings of the residents will be set by the regulatory authority having jurisdiction, we can assume that the ratings will be assigned by professionals in the health care field who are familiar with the residents. The regulatory authority needs to be able to audit or confirm these ratings. This is one of the reasons it is important that the ratings be based on observable behavior to the greatest degree feasible. For example, one of the categories is: (the resident) initiates and completes evacuation promptly in a fire drill. The regulatory authority can easily observe if the resident responds properly in a fire drill.

By using observable behaviors as the basis for rating residents, it is possible to more clearly define the rating task. For example, the rater is not asked to engage in vague conjecture as to whether a resident "might" resist assistance during a fire emergency; rather he is asked to base the rating for this factor on these specific criteria: there must be evidence of resistance on the part of the resident in a past incident, the staff needed to use physical force to overcome the resistance, and the incident must not be such a special situation that it would probably not be indicative of behavior in fire.

There are other aspects of the rating procedure which may be regarded as increasing the complexity of the task for the rater. For example, the taking of a sleeping medication would be an observable behavior easily determined by the rater. However, the rater does not directly use this behavior but must relate it and other factors such as hearing impairment to a behavior with direct relevance for the fire situation, namely the resident's "waking response to alarm".

The following sections show how the various components of the evacuation difficulty subsystem evolved and provide descriptive and explanatory information regarding these components.

4.2 System for Rating Residents

4.2.1 Original Structure of the Worksheet for Rating Residents

By the end of the basic orientation period, it was decided to develop a system for evaluating the capability of the occupants of the homes -- residents and staff -- to evacuate in fire emergencies. The first step in developing such a system was to develop a system for estimating the relevant capabilities/disabilities of each resident.

It was clear that traditional IQ and other academic predictors were completely inappropriate. These tests are directed at such skills as: ability to think abstractly, vocabulary, and immediate memory span. More performance oriented measures were needed. An analysis was made of the Adaptive Behavior Scale followed by reviews of eight other related performance scales. This effort led to the conclusion that these scales were of the type that would be of value but were not sufficiently directed to evacuation skills. A decision was made to develop a measuring instrument specifically for our FSES.

A draft of a possible worksheet was produced by the program staff. It incorporated suggestions by the project staff at the Walsman Center. At the first meeting of the Human Behavior Consulting Panel, the items on the draft worksheet were discussed in some depth but the panel was not shown the work-sheet; the staff was more interested in general concepts and new ideas rather than criticism of details. After the panel meeting, the draft worksheet was revised. A copy of the revised worksheet is presented in Figure 2.

4.2.2 Pilot Application of the Worksheet

In December 1978, there was a fire in the state school at Ellisville, Mississippi. The administration permitted us to interview staff, and each resident -- survivors and fatalities -- on the floor of the fire was rated by three staff members working as a group with the assistance of an NBS staff member. The three staff members had no difficulty in obtaining agreement on the ratings. This exercise uncovered ambiguities in fine points of the definitions which were corrected. More importantly, two of the factors appeared to discriminate between those who were injured or died and those who escaped uninjured. See Figure 3.

It is interesting to note that a scale on mobility did not discriminate between the injured and non-injured. In the rescue efforts by staff, priority was given to rescuing the residents that used wheelchairs. This might have balanced their greater inherent risk.

The results of this exercise gave the project staff confidence that they were proceeding in the right direction.

4.2.3 Initial Assignment of Values to the Categories

4.2.3.1 Overview

To convert the worksheet in Figure 2 to a working document, it was necessary that scores be assigned each factor category. These scores represent the relative importance of that circumstance in increasing the difficulty or duration of the evacuation process. A score of 0 means that this circumstance does not represent a significant evacuation burden for the staff; a score of 20 means that there may be a need for the full services of one staff member to assist that resident for one evacuation cycle; intermediate values means that there may be a need for one staff member to assist the resident during part of his evacuation time or that the type of staff assistance required is such that the staff member could be assisting more than one resident of this type simultaneously.

The values for the scores were arrived at by a consensus process which relied primarily on the professional judgments of NBS staff, the panel, and other behavioral and fire protection experts.

4.2.3.2 Paired Comparison

In order to obtain a first cut of values for these scores, a "paired comparison exercise" was conducted. A form was prepared where each category in Figure 2 was paired with all other categories. (Two versions of the form were distributed so that each item of each pair would appear first half the time.) Respondents were asked to consider each item in a pair as representing the significant characteristic of an otherwise high functioning (or relatively competent) mentally retarded adult: the pair of items, therefore, defined a pair of adults. If two similar group homes, each with one vacancy were available, the respondents were asked to

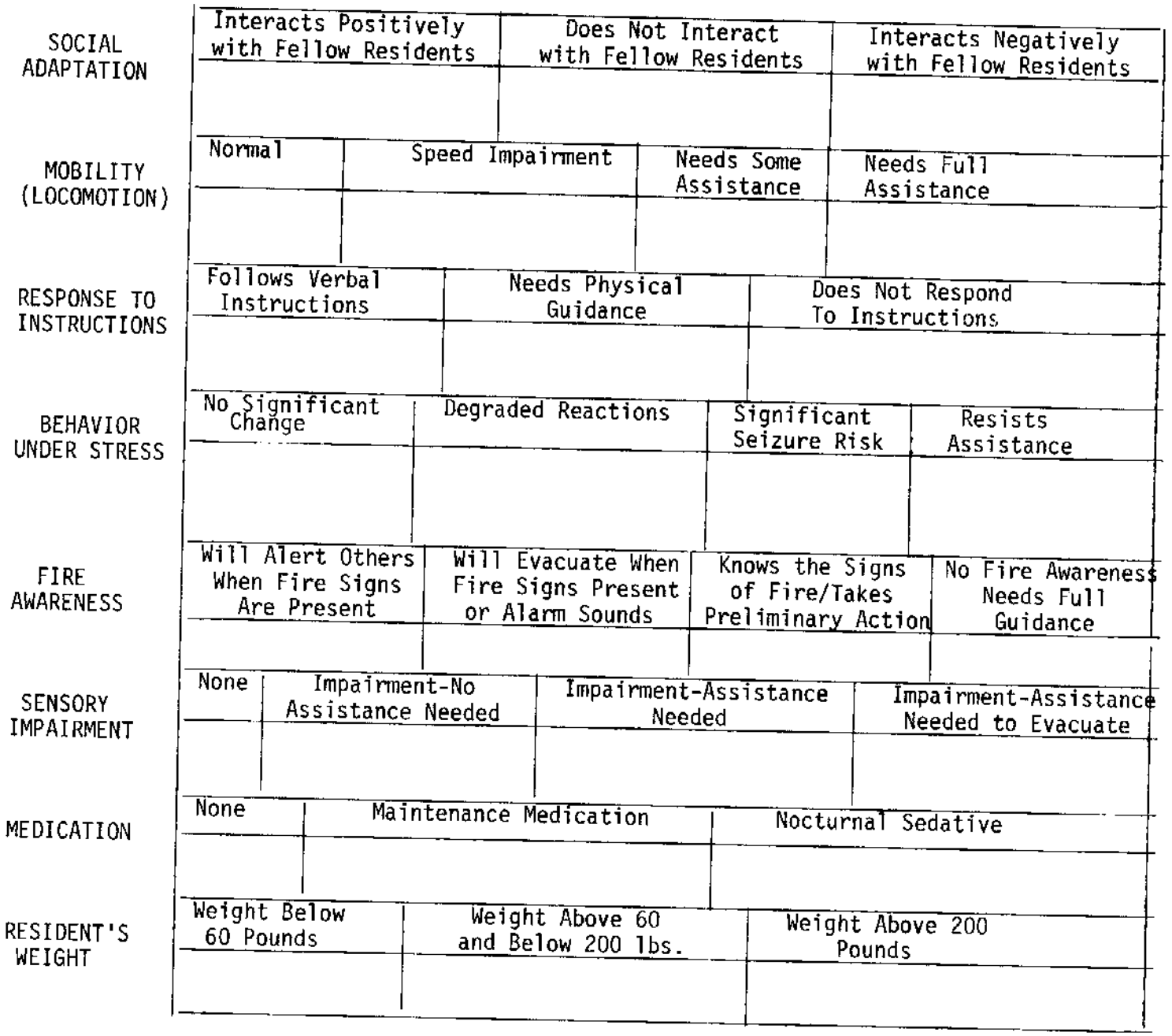

Figure 2. Early Version of Resident Rating Worksheet

RESPONSE TO INSTRUCTIONS

	Follows Verbal Instructions		Needs Physical Guidance		Does Not Respond To Instructions	
Dead & Injured	30*	71%**	5	12%	7	17%
Not Injured	20	95%	1	5%	0	0%

N=63

FIRE AWARENESS***

	Will Alert Others When Fire Signs Are Present		Will Evacuate When Fire Signs Pres. Or Alarm Sounds		Knows The Signs Of Fire/Takes Preliminary Action		No Fire Awareness/ Needs Full Guidance	
Dead & Injured	7	17%	7	17%	2	5%	26	62%
Not Injured	9	43%	6	29%	2	10%	4	19%

N=63

* The number of residents in the two wards involved in the fire who fell in this category.

** Percent in the death and injury category who have the specified capability.

*** This factor was superceded by "Response to Fire Drills" in the final version of the worksheet.

Figure 3. Differences between Casualties and Non-Casualties in Ellisville Fire

determine which person of the pair they would assign to the group home with the higher level of fire protection.

The forms were distributed to a variety of people in the field of developmental disabilities including the Human Behavior Consulting Panel. Some recipients made additional copies of our form and mailed these to their colleagues. Twenty completed forms were returned. Thurstone's Law of Comparative Judgment (Case V) [17] was used to compute scale values for each of the categories. This is a technique specifically developed to scale items based on data from paired comparison judgments.

4.2.3.3 Review by Panel

The results of the Paired Comparison Exercise were presented to the Human Behavior Consulting Panel. Upon examining the results, it recommended that the categories for each of the factors could be classified into four groups based on need for staff assistance:

1. No significant fire evacuation problem, requires no staff assistance
2. Requires limited staff assistance during part of the evacuation,
3. Requires substantial guidance during the entire evacuation,
4. Requires substantial physical assistance during the entire evacuation,
    a. Assistance from one staff member
    b. Assistance from more than one staff member

4.2.3.4 Minimum Score

As the total system developed, it became apparent that every resident should be given a minimal disability score because the difficulty of supervising the evacuation increases as the size of the group evacuating increases, even if all residents are capable of self-evacuation.

The minimum score on one factor was defined to be one and the other scores were adjusted so that the score for those needing substantial physical assistance would be 20. This makes a 20 to 1 ratio between the score for a resident needing substantial physical assistance and the score for one needing no assistance. This ratio was discussed and endorsed by the consulting panel.

4.2.4 Field Tests for Rater Agreement

An obvious limitation in the use of any rating scale is the reliability of the ratings or rater reliability, that is, whether the ratings would likely to be the same or different if the residents were rated by a different rater.

A basic assumption throughout the project was that satisfactory rater reliability could be obtained if the ratings were based on past performance or actions of the residents rather than on rater judgments, intuitions and predictions. A good clear set of instructions is also vital.

It was always recognized that complete agreement among raters should not be expected. First, the raters may not have observed similar behavior. Second, there is a judgment component. The goal is to have sufficient agreement that confidence in the system is justified.

The most direct way of evaluating rater reliability is to have each resident in test facilities rated by two or more raters. The agreement among the raters can be determined.

Three tests of rater reliability were conducted while the system was under development:

a. Mail Survey

Copies of the worksheet and an explanatory instruction manual and glossary were mailed to a variety of leaders and professionals in the field. They were requested to send the forms to a variety of facilities where two or more knowledgeable staff members would rate some of the residents. It was stressed that we wanted two or more raters to rate the same resident. A majority of the responses were anonymous.

An analysis of the ratings showed that when the ratings of two raters for the same resident were compared, there were more differences (less inter-rater reliability) for the "Behavior Under Stress" factor than for the other factors. There were also a number of comments from the raters criticizing this factor. The definitions in the glossary were modified to make that factor more dependent on observed behavior and less on speculation.

b. Northern Virginia Training Center

The Northern Virginia Training Center (NVTC) assisted us by having a number of residents rated by two or more staff members. Again, the inter-rater reliability was analyzed.

Examination of the data indicated that the primary source of concern regarding the reliability in the data were systemmatic rater biases. In other words, for a given factor, some raters will tend to make ratings that are more severe than most persons rating the same residents while other raters will tend to make ratings that are less severe. There are two sources for these biases. First, raters make discrepant interpretations of the factors and factor categories, and, second, they base their ratings on different observed resident behaviors due to differences in shifts worked, duration of employment, occupational roles, and so forth. Fortunately, both these sources of bias can and should be alleviated through the following means.

Varying interpretations of factors and factor values can be reduced through a careful development of an instruction manual/glossary. Although the project staff was told that the glossary was concise and very readable, discussions with raters at NVTC and their comments on the worksheets revealed that misinterpretations were still very common. One problem was that there was too much information to be learned and retained through a casual reading. The reliability (and, consequently, the accuracy) of ratings should improve substantially when the raters are given one or two class sessions on how to use the form. When that is not feasible, thoughtfully constructed

self-instruction training materials should be an acceptable alternative. (Development of these materials is a future task.) Some improvement in decreasing misinterpretation was possible by refining the worksheet and the glossary: this has been done.

The problem of rater "biases" due to the observation of different behavior can be mitigated by having raters share information as part of the rating procedure.

While these steps should significantly improve rater reliability, some variation will still remain.

c. Montgomery County, Pennsylvania

The two previous studies were limited to a study of the resident rating factors. In Montgomery County, homes run by six different private organizations were rated for evacuation difficulty using the resident rating form. The scores of the residents were summed and the total was divided by a score for the staff availability. The resulting "E" score represented the evacuation difficulty. The resulting data provided two types of information. First, numerical values of "E" were associated with actual group living situations. Second, reviews of the data with representatives of these organizations revealed a series of systemmatic errors in using the system.

Except for the "Behavior Under Stress" factor, the agreement among the raters was fairly good. Kohen's Kappa (uncorrected for chance agreement) was used to measure this agreement [18]. The average Kappa was .60 including the Kappa for "Behavior Under Stress." Although no additional rater reliability tests have been conducted as the system was modified and refined, it is assumed that the reliability of the final version is at least as high as for the version tested. This assumption should be verified by future tests.

Changes were made to the "Behavior Under Stress" factor to improve rater reliability and are discussed in Section 4.2.7

4.2.5 Changes to Accommodate a Wider Variety of Facilities

In anticipation of and in response to the October 1980 request to expand the FSES to handle larger buildings and a wider range of disabled residents, two efforts were undertaken:

1. development of a simplified system for evaluating evacuation capability of residents of larger homes to help keep down the effort needed to use the system; and

2. modifications of the worksheet, as needed, to properly evaluate the elderly and the mentally ill.

Efforts to develop simplified systems for evaluating the evacuation capabilities of residents failed to produce an alternative acceptable to the Human Behavior Consulting Panel. As we developed simpler systems, the system inevitably gave more conservative results. This conservatism would likely lead to unnecessary costs and unnecessary degradation of the desired homelike ambience and thus was unacceptable. Also, as the project progressed, it became

apparent that the need for the simplified procedure would be less than was at first expected. All large buildings (i.e., more than 30 residents) must meet at least the requirements for a slow evacuating group of residents, and the cost of upgrading to meet the requirements for a group of residents for which evacuation is impractical will sometimes not be great. There is no need to determine an E-Score if the fire safety requirements are based on evacuation being impractical. Therefore, it may be easier to upgrade the building than to control the capabilities/disabilities of the residents.

An analysis of the applicability of the worksheet for evaluating the frail elderly and the mentally ill indicated that the worksheet could be used satisfactorily for both disabilities but that the worksheet lacked a direct measure of the residents' ability to wake up. This variable had been included as an important component of the ability to respond to fire drills. However, since the elderly and mentally ill are more likely than the mentally retarded to be sedated or hard of hearing, it was decided to add an additional variable to the system to explicitly measure waking response to alarms.

4.2.6 Evaluation of the Individual Factors

For several years the individual factors on the Worksheet for Rating Residents were modified and refined. These changes were based on:

1. comments of the Human Behavior Consulting Panel;
2. comments of the Fire Protection Consulting Panel;
3. results from field studies;
4. problems in developing precise definitions for the glossary;
5. need to extend the worksheet to cover the frail elderly and the mentally ill.

4.2.7 Changes in Factors During System Development

Each of the factors in the preliminary Worksheet for Rating Residents (Figure 2) was changed during system development. In most cases there were several changes for a specific factor. This section contains the rationale for some of the more significant changes.

"Behavior Under Stress" was dropped for two related reasons: (1) in the test of rater reliability (see section 4.2.4), there was insufficient agreement among raters on this factor; and (2) the factor could not be judged solely on observations of performance. In place of this factor, the raters are asked to base ratings on examples of resident performance on a typically "bad" day, a day in which they are likely to be operating under stress.

Seizure Risk was a category under Behavior Under Stress. The main concern leading to its inclusion in the preliminary worksheet was to reflect the increased evacuation difficulty posed by epileptic seizures. In the final worksheet this is covered by the Impaired Consciousness factor. The Human Behavior Consulting Panel was concerned that the penalties for epilepsy were too severe because epileptic seizures are not likely during a fire. The staff was unable to document a single case of an epileptic seizure during a fire evacuation or fire drill. (We did find a case of a seizure after a successful evacuation.) As a result, the resident is rated as

a risk only if he/she has had six episodes in three months or there is a specific reason to expect a seizure to be caused by the stress of a fire; that is, the resident is one of those epileptics whose seizures are caused by stress. One episode every two weeks means that there is one short episode of several minutes every 336 hours and, therefore, an episode is unlikely to occur during any given fire. Therefore, the system is still very conservative.

The Social Adaptation factor was included to measure if a resident might be disruptive during an evacuation. As fire incidents were investigated, the only disruptive behavior reported was an absolute refusal to evacuate. Accordingly, the factor was redefined to measure that behavior more directly, i.e., "Risk of Resistance".

Fire awareness was designed to measure the resident's ability to initiate and complete an evacuation promptly with no assistance, supervision or advice. As the project progressed, two additional related actions were added, "Chooses and Completes Backup Strategy", and "Stays at Designated Location". These three items are so related that they are combined into a single factor on the worksheet.

Sensory Impairment was dropped on the advice of the Human Behavior Consulting Panel because it is covered in a more behavior based way by the other factors. For example, if blindness impairs Response to Fire Drills, there will be a penalty, but if it does not, there will be no penalty.

"Medication" was included because of its effect on waking to an alarm. This was temporarily dropped when the program was directed at the mentally retarded because of difficulties with the factor and the low use of sleeping pills with the mentally retarded. When the system was expanded to include the mentally ill, it was reintroduced as a more performance oriented factor, "Waking Response to Alarm".

"Resident's Weight" was included to measure the need for extra help or in the case of children the need for less staffing. The possibility of less staffing for small children was quickly rejected by the consulting panel. The factor was rewritten several times and finally was designed to directly measure "Need for Extra Help".

4.2.8 Combining Factors on Worksheet

The Worksheet for Rating Residents contains scores on seven factors (see p. 96 in Appendix B). The Evacuation Assistance Score is determined by selecting the one highest score on the seven factors. The need for assistance is largely determined by the most serious disability. For example, a resident with impaired mobility requiring full assistance would not need additional assistance if he also failed to have the intellectual ability to choose and complete a backup strategy. While there may be combinations of disabilities where the second disability might significantly add to the need for assistance, it did not appear that the extra precision would justify adding to the complexity of the system. The Human Behavior Consulting Panel concurred in this decision.

4.3 The Evacuation Difficulty Score

4.3.1 Introduction

As stated in Section 4.1, the measure of evacuation difficulty is the ratio of two scores:

(1) a measure of the evacuation problems of the residents (see Section 4.2 for the system for rating individual residents); and

(2) a measure of the capability of the staff to provide assistance as described below.

The system for rating staff is contained in the "Worksheet for Calculating Evacuation Difficulty Score" in Appendix B on page 107.

4.3.2 Alarm Systems

The effectiveness of the staff is dependent on their ability to become aware of the fire in order to respond to the emergency in a timely fashion. Since the staff may be asleep or physically remote from the fire (e.g., in the basement doing laundry), an automatic alarm system is necessary to assure a properly rapid response. In order to give credit for a satisfactory automatic alarm system, the system must be sufficiently loud and automatically activated by a satisfactory detector.

The loudness requirements are:

1. minimum of 55 dBA at ear level in all locations inside and outside the building where staff are allowed to go and still be available to help evacuate the building.

2. if staff are allowed to sleep, a minimum of 70 dBA at pillow level in any area where they may be asleep.

3. any volume required by the authority having jurisdiction to make the alarm easily noticeable where background noise interferes with alarm audibility.

The minimum volumes are based on the work of Nober, Pierce and Well [19]. They found that sleeping adults would rapidly (9.5 $\pm$ 3.8 seconds) awake to a 70 dBA simulated alarm and that they would rather quickly (52 $\pm$ 25 seconds) successfully dial a telephone call to the fire department.

The alarm must be activated by one or both of the following:

Smoke dectector
Sprinkler system

Another part of the Fire Safety Evaluation System for Board and Care Homes (FSES/B&C) evaluates the fire protection features of the building (see Appendix C). Smoke detectors, sprinklers and alarm systems receive credit, if installed, as valuable fire protection features in that subsystem. In this section, these same items are given credit for a different function -- that is, for enhancing the value of the staff. While the two functions are generally

treated separately, there is a requirement that in order for any smoke detector or sprinkler system to receive credit as fire protection features in Appendix C, it must activate the alarm.

4.3.3 Determining Capability of Staff

There is no simple reliable method of scoring the differential capabilities of staff members to help disabled residents evacuate in a fire emergency. Relevant factors include: (1) weight, (2) strength, (3) skill in physically transferring a resident from bed to wheelchair, and (4) ability to communicate with the residents in a way to elicit cooperation. It was decided that the ability of the staff members would be rated simply as satisfactory (full credit) or unsatisfactory (no credit).

The effectiveness of the staff is dependent on their ability to become aware of the fire and to respond to the emergency.

Sleeping staff members obviously cannot respond as rapidly as fully awake staff. However, based on the work of Nober, Pierce and Well [19], sleeping adults can be relied on to respond rapidly to alarms. Sleeping staff are assigned 80% of maximum score (i.e., 16 points) if there is a satisfactory alarm system as described in the previous section. If there is not a satisfactory alarm system, sleeping staff are assigned 10% of maximum score (i.e., 2 points). Staff in a standby assignment who can respond in a timely fashion but not necessarily immediately (e.g., they are permitted to shower) are assigned the same points as sleeping staff (i.e., 16 points with acceptable alarm and 2 points without).

Awake on duty staff are assigned the maximum score of 20 points if there is an acceptable automatic alarm system. Without the alarm system, a staff member is assigned 10 points if he/she remains in the area where the residents are because the staff member is likely to become aware of the fire in a timely fashion. If there is not an acceptable alarm system and the staff member is permitted to be relatively remote from the resident, he/she is assigned two points. Examples of being relatively remote are: doing laundry in the basement, and doing bookkeeping in the office. This grading system is summarized on the Worksheet for Calculating Evacuation Difficulty Score in Appendix B on page 105.

4.3.4 Weighting Factor for Vertical Distance

As the system for determining the need for evacuation assistance evolved, it became apparent that, all other things being equal, it is less difficult to evacuate a one story building than a typical two story home. Similarly, it is more difficult to evacuate a building when two flights of stairs separate a bedroom and its nearest exit to the outside. This factor was introduced into the system for evaluating small dwellings as a weighting factor or multiplier: .8 if a one story building; 1.0 if one flight of stairs separates the bedrooms from the exit; and 1.2 if more than one flight of stairs separates any bedroom from its nearest exit. (See table at top of fourth page of Worksheet for Calculating Evacuation Difficulty Score in Appendix B on page 108).

In evaluating a large facility (17 or more residents) or in evaluating an individual apartment or an apartment building, the weighting is 1.0. (In the rare cases where an individual apartment unit requires ascending or descending stairs to go from any bedroom to the corridor, the weighting is 1.2.)

4.3.5 Calculating the Evacuation Difficulty Score

The resident score total is calculated by summing the scores for all the individual residents. The staff score total is calculated by summing the scores for all the staff on duty during the period of minimal staffing or highest Evacuation Difficulty Score. (If the number of residents and staff present varies throughout the day, it may be necessary to check on more than one time period to find the period of highest evacuation difficulty score.) The Resident Score Total is divided by the Staff Score Total and the Quotient is multiplied by the Weighting Factor for Vertical Distance from bedroom to exits as described in the previous section (see Worksheet for Calculating Evacuation Difficulty Score in Appendix B on page 108). The result is the Evacuation Difficulty Score.

4.4. Additional Requirements

The subsystem for determining Evacuation Difficulty Score is based on several assumptions. It is assumed that the staff has been trained and that fire drills are conducted frequently and these are requirements for using the system. Other requirements are that the staff can handle every resident and that there is always sufficient staff to handle the individual evacuation needs of each resident (e.g., two staff members are sometimes needed to handle some difficult cases). Specific questions, as listed below, are included in the system to assure these requirements are met. They must be answered affirmatively if the subsystem for estimating evacuation difficulty is to be used. If the questions are not answered affirmatively, then the specifications and definitions of Chapter 21 and 31 can still be used to determine if the facility meets fire safety requirements.

The questions that must be answered affirmatively in order to use the subsystem for Determining Evacuation Assistance Score (E-Score) in Appendix B are:

1. Has a protection plan been developed and written and have all staff members counted in the calculation of E-scores been trained in its implementation?

2. Is the total available staff at any given time able to handle the individual evacuation needs of each resident who may be in the residence?

3. Can every staff member counted in the calculation of E-scores meaningfully participate in the evacuation of every resident?

4. Are all staff members counted in the calculation of E-scores required to remain in the residence with only the exceptions listed in the Instruction Manual?

5. Were at least 6 fire drills conducted during the last year? (There are special requirements of one per month for the first year of operation.)

5. SUBSYSTEM FOR EVALUATING THE FIRE PROTECTION FEATURES OF THE BUILDING

5.1 Relationship to Other Projects

5.1.1 HUD Project

The development of the Fire Safety Evaluation System for Board and Care Homes was conducted concurrently with a project to develop a related system to evaluate the fire safety of multifamily housing for the Department of Housing and Urban Development (HUD). To minimize cost and the time commitment of our expert panels, and to maximize the similarity of the two systems to evaluate the safety of residences (i.e., to minimize the proliferation of different systems), many of the early efforts to develop systems to evaluate the building were conducted as a single project.

An interim report on the HUD project was published in September 1982 as NBSIR 82-2562, "A System for Fire Safety Evaluation for Multifamily Housing," by H.E. Nelson and A. J. Shibe [20].

5.1.2 NPS Project

As the development of the subsystem for evaluating large buildings (17 or more residents) neared the testing stage, a project was started to assist the National Park Service (NPS) to evaluate the fire safety of lodgings in the National Parks. The NPS project provided the funding for an additional cycle of refinement of the subsystem for large buildings and for insuring a high level of similarity between the subsystem for Board and Care Homes and the system for evaluating the safety of hotel-like lodges in the parks.

5.2 Development of System

During the orientation period described in Section 2, the staff became knowledgeable about the variety of buildings used to house group homes for the developmentally disabled, and they analyzed the similarities and differences among group homes and the similarities and differences between this group of buildings and health care facilities (i.e., hospital and nursing homes).

5.2.1 Safety Parameters

Based on the survey and analysis of the characteristics of buildings housing Board and Care Homes, on the scope and coverage in the Life Safety Code for similar structures, and on the knowledge and experience of the staff in developing the Fire Safety Evaluation System for Health Care Facilities (FSES/HC), the staff selected two preliminary sets of safety parameters; one set for detached single family type residential structures and one set for apartment type and hotel/dormitory type residential structures.

For each safety parameter, two or more levels or categories were defined. Each category corresponded to a condition specifically identified as a level of performance in the Life Safety Code and/or likely to be encountered in existing or future Board and Care Homes and each category differed from all other categories in a significant way. For example, one parameter was defined to be manual fire alarms and the three categories were: no acceptable alarm; an acceptable alarm; an acceptable alarm with an automatic connection to the fire department or to an approved central station. For some fire safety features related to building services or

utilities, only two categories were defined: "met" and "not met". These fire safety features were included in the final FSES B&C as special requirements for which an evaluation method has not yet been developed. One example is compliance with the National Electric Code.

5.2.2 Safety Parameter Evaluation

The goal was to develop a system for evaluating the fire safety of a building by obtaining weighted sums of the point values of the individual safety parameters. Therefore, each category of each parameter had to be assigned a point value. The preliminary values were assigned by a Delphi type group. This approach was used to bring informed judgment and experience together to assess the relative impact of each of the parameters on general safety and on four aspects of safety. (See Section 5.2.3 Redundant Safety Subsystems).

Each member of the group was provided with copies of an initial matrix similar to the ones shown in Figures 4 and 5. Each person then evaluated the relative importance with respect to fire safety of each item in the entire matrix of parameter categories without consultation with other members of the group. The members of the Delphi group were advised that the goal of the project was to develop a system for residential facilities that was parallel to the Fire Safety Evaluation System for Health Care Facilities. See Appendix E for a more detailed discussion of this operation and its methodological base.

5.2.3 Redundant Safety Subsystems

A basic principle of fire protection is that there must be a redundancy of protection so that the failure of a single protection device or method will not result in failure of the entire safety system. In addition, the development of a redundant approach, as used in this safety evaluation system, avoids the pitfall of traditional approaches sometimes used in grading systems where all of the elements are considered mutually exclusive of each other and a single total score determines acceptability. It is possible under such a system to fail to detect the absence of a critical element. The evaluation system establishes redundancy on the basis of in-depth coverage of the principal fire safety methodologies. The original redundant methodologies used in the system were those related to fire safety through General Fire Safety, and the subsystems Fire Development, Fire Containment, Emergency Egress, and Emergency Refuge. As the project progressed, the values assigned to Fire Development and Fire Containment were quite similar and the two were combined to form a single redundancy system, Fire Control.

The original redundant methodologies were chosen after analysis of residential fire safety using decision trees, especially the National Fire Protection Association's Fire Safety Concepts Tree [21,22].

The decision tree approach divides fire protection into two groups of elements: "Manage Fire" and "Manage Exposed." Those elements related to "Manage Fire" (i.e., the control of fuel and arrangement, compartmentation, and other mechanisms of containment of fire and its impacts, extinguishment suppressions and other means of terminating fire development) were incorporated into Fire Control.

"Manage Exposed" (i.e., the provision of safe location of refuge either by evacuation or by establishment of safe areas of refuge) was subdivided into two redundancy methodologies, Emergency Egress and Emergency Refuge.

"What is the relative impact on the general (or overall) life safety of the occupants of a detached single family (or rooming house) type of structure of each of the items identified in this matrix?"

CONSTRUCTION	COMBUSTIBLE					NONCOMBUSTIBLE		
Building Heights	WOOD FRAME		ORDINARY		HEAVY TIMBER			
	UNPROT.	PROT.	UNPROT.	PROT.		UNPROT.	PROT.	FIRE RES.
1 Story								
2 Story								
Over 2 Story								

HAZARDOUS AREAS	STRUCTURALLY ENDANGERING			NOT STRUCTURALLY ENDANGERING			
	NO PROT.	SINGLE PROT.	DOUBLE PROT.	NO PROT.	SINGLE PROT.	DOUBLE PROT.	NO HAZ. AREAS

SMOKE CONTROL	NO CONTROL	SMOKE PARTITIONS		MECHANICALLY ASSISTED AUTO			
		MANUAL	AUTOMATIC	BY ZONE	BY UNIT	CORRIDORS	

MANUAL FIRE ALARM	NO ALARM	MANUAL ALARM	
		w/o F.D. CONN	w/F.D. CONN

SMOKE DETECTION AND ALARM	NONE	SINGLE STATION	INTER. CONNECTED SYSTEM

AUTOMATIC SPRINKLERS	NONE	LIVING UNITS ONLY	CORR. ONLY	CORR. & HAB. SPACE	TOTAL

LIVING UNIT PARAMETERS

INTERIOR FINISH WITHIN LIVING UNITS -F.S.=FLAME SPREAD RATINGS-	SPECIAL HAZARD	FLAME SPREAD RATINGS			
		<200	>75 ≤200	>25 ≤75	≤25

INTERIOR ARRANGEMENT OF LIVING UNIT(S)	MULTI-LEVEL			SINGLE LEVEL	
	OPEN STAIRS ETC.	LEVELS CUT OFF			
		MANUAL CLOSING	AUTO CLOSING		
			<20MIN >20 MIN		

EGRESS FROM LIVING UNIT(S)	MULTI-LEVEL			SINGLE LEVEL	
	SINGLE ROUTE	MULTI ROUTE	EACH LEVEL	SINGLE ROUTE	MULTI ROUTE

Figure 4. Delphi Form - Small Facilities

"What is the relative impact on the general (or overall) life safety of the occupants of a hotel or a dormitory type residential structure of each of the items identified in the matrix?"

1. CONSTRUCTION	COMBUSTIBLE				NONCOMBUSTIBLE				
	WOOD FRAME		ORDINARY		HEAVY				
BUILDING HEIGHTS	UNPROT.	PROT.	UNPROT.	PROT.	TIMBER	UNPROT.	PROT.	FIRE RESIS.	
1 Story									
2 Story									
3-6 Story									
Over 6 Story									

2. HAZARDOUS AREAS	STRUCTURALLY ENDANGERING			NOT STRUCTURALLY ENDANGERING			NO HAZARDOUS AREAS
	NO PROT.	SINGLE PROT.	DOUBLE PROT.	NO PROT.	SINGLE PROT.	DOUBLE PROT.	

3. SMOKE CONTROL	NO CONTROL	SMOKE PARTITIONS		MECHANICALLY ASSISTED AUTO		
		MANUAL	AUTOMATIC	BY ZONE	BY UNIT	CORRIDORS

4. MANUAL FIRE ALARM	NO ALARM	MANUAL ALARM	
		w/o F.D. CONN.	w/F.D. CONN.

5. SMOKE DETECTION	NONE	SINGLE STATION		INTERIOR CONNECTED SYSTEM	
		LIVING UNITS ONLY	UNITS & CORR.	LIVING UNITS	TOTAL SYSTEM

6. AUTOMATIC SPRINKLERS	NONE	LIVING UNITS ONLY	CORR. ONLY	CORR. & HAB. SPACE	TOTAL

LIVING UNIT PARAMETERS

7. INTERIOR FINISH WITHIN LIVING UNIT(S)	SPECIAL HAZARD	FLAME SPREAD RATINGS			
		<200	>75 ≤200	>25 ≤75	≤25

8. INTERIOR ARRANGEMENT OF LIVING UNIT(S)	MULTI-LEVEL			SINGLE LEVEL	
	OPEN STAIRS ETC.	LEVELS CUT OFF		PARTITIONED	UNPARTITIONED (i.e., Single Room)
		MANUAL CLOSING	AUTO CLOSING <20 MIN	AUTO CLOSING >20 MIN	

9. EGRESS FROM LIVING UNIT(S)	MULTI-LEVEL			SINGLE LEVEL	
	SINGLE ROUTE	MULTI ROUTE	EACH LEVEL	SINGLE ROUTE	MULTI ROUTE

MULTI-UNIT/EXTRA & INTER UNIT PARAMETERS

10. SEPARATION WALLS (LIV. UNIT FROM OTHER-LIV. UNITS AND/OR COMMON SPACES)	NONE OR INCOMPLETE	<20 MIN	>20 MIN <1 HOUR	≥1 HOUR
11. SEPARATION DOORS	NO DOOR	<20 MIN F.R.	≥20 MIN F.R.	≥20 MIN F.R. & CLOSER

12. EMERGENCY MOVEMENT ROUTES (Quality)	<2 STANDARD ROUTES	MULTIPLE ROUTES			
		DEFICIENT	w/o HORIZ.	HOR. EXIT	DIRECT EXIT FROM LIVING UNIT

13. EXIT ROUTE	D.E. >100'	D.E. 35'-100'	NO D.E. >35' & TRAVEL IS:			
			>150'	100-150'	50-100'	<50'

14. INTERIOR FINISH (EGRESS ROUTES)	SPECIAL HAZARD	FLAME SPREAD RATINGS			
		<200	>75≤200	>25<75	<25

15. VERTICAL OPENINGS	OPEN (OR INCOMPLETE ENCLOSURE)			ENCLOSED		
	THRU 4 OR MORE FLRS	2-3 FLRS	1 FLR	<1 HR	≥1 HR<2 HR	≥2 HR

Figure 5. Sample Delphi Form-Large Facilities

Each member of the Delphi groups judged the importance of each safety parameter relative to the separate fire safety methodologies of Fire Development, Fire Containment, Emergency Egress, and Emergency Refuge. The Delphi results were processed and analyzed by the project staff at NBS and then reviewed in subsequent conference meetings of the Delphi group. By this process, the parameters that have a significant impact on each of the redundant methodologies were identified. It was found that many of the parameters affect more than one of the methodologies. In the judgment of the group, Sprinklers, Separations of Living Units, Vertical Openings, and Protection of Hazardous Areas impact on all four. Table 2 in each of the worksheets in Appendix C shows the breakdown in terms of which parameters apply to which methodologies, where Fire Development and Fire Containment are combined as Fire Control.

5.2.4 Fire Protection Consulting Panel

The project staff worked with the Fire Protection Consulting Panel in the development of the system. The members of the Panel were carefully selected so that they would be very competent in fire protection, highly respected, and knowledgeable in a wide variety of areas related to the project.

The role of the Panel was to provide an independent in-depth review of the work of the staff and to provide the insights of the experts on the Panel to the project. They first met after the staff had developed a preliminary form for rating the structure and after preliminary values for the parameter categories were assigned based on the advice of the Delphi Panel. Meeting dates are listed in Section 3.4 and the Panel members are listed in Appendix D.

In their first meeting in 1980, their focus was on small board and care homes (16 or fewer residents) and on apartment buildings for both the HUD project and the Board and Care Project -- some Board and Care Homes are located in apartment units of apartment houses. After the project expanded in October 1980 to include larger homes and the whole range of board and care home residents, the panel directed its attention to larger facilities.

5.2.5 Computer Analysis

The evaluation system is theoretically capable of evaluating each of over 600 million combinations of the 11 safety parameters and variations for large buildings. Most of these combinations would provide an obviously poor level of fire safety and/or would not be recommended for either new buildings or retrofit. It is important that the only combinations passing the system are those that provide a satisfactory level of fire protection.

A computer program was written to aid in the evaluation of the proposed system as well as to analyze potential proposed changes. This program generates all alternative combinations of building safety features that the system will indicate as acceptable. (To simplify the computer output, the following combinations are not printed: the combination is the same as one that is printed except that for one or more parameters, the point score is higher than in the printed combination. When reviewing the printed combinations, these unprinted combinations are obviously acceptable and printing them would make the output harder to analyze.)

By using the computer output, the evaluator can review all acceptable solutions for upgrading a given building configuration and can be assured that the selection of combinations to be reviewed is the complete set and not an unintentionally biased subset. The printouts of the combinations of safety features can be analyzed by an experienced individual to establish acceptability of solutions. From the computer printout, it is easy to determine those combina-

tions that just miss being acceptable solutions. The computer generated building configurations were used by the staff and the Peer Consulting Panels to evaluate if the system gives acceptable evaluations. The computer analysis was used as part of an iterative process of changing and checking in an effort to refine the system.

A very similar computer program was used in developing a "System for Fire Safety Evaluation for Multifamily Housing" which was developed for the Department of Housing and Urban Development. That version of the computer program is described and documented in Appendix C of the report of that project [20]. Details and program tapes of the specific programs for board and care may be obtained from the project staff.

5.2.6 Field Test

In Section 6, a field test of the total system is described. The results of the field test helped in improving and refining the system for evaluating the buildings. While the computer analysis permitted the determination of all combinations of fire safety features that are acceptable, a focused analysis of those combinations found in the field led NBS staff to suggest additional changes for consideration by the Peer Consulting Panels. Furthermore, the comments, suggestions and information provided by the field investigation led to refinements in the definitions. The information led directly to the addition of a category to the smoke detection parameter of small buildings -- a system of hallway detection augmented by single station detection in bedrooms. It also led to the refinement of the categories in the Egress parameter in the Worksheet for a Small Dwelling Unit. All of these changes were approved by a consensus of the panels and the NBS staff.

5.2.7 Calibration of the System with the Proposed Chapter 21

The original FSES/B&C was developed prior to the development of the proposed Chapter 21. From the original FSES/B&C, a set of fire safety criteria in more traditional code format and language was prepared that was consistent with the fire safety provided by the FSES/B&C. These criteria were available to and reviewed by the Residential Subcommittee of the NFPA Committee on the Safety to Life and by a special task force appointed by the NFPA to assist the subcommittee in preparing a draft of the proposed Chapter 21. Once the proposed Chapter 21 was available, the Fire Safety Evaluation System for Board and Care Homes was modified to be completely consistent with the proposed Chapter 21 and was calibrated with it.

The proposed Chapter 21 contains a number of sets of requirements based on:

1. Type of structure (small dwelling unit, large residence and apartment building used to house a board and care home).

2. Evacuation difficulty.

3. Number of floors or stories at or above grade.

4. In the case of apartments, whether the apartment building is new construction or an existing building.

For each type of structure there is a table of Safety Parameter Values. (Table 1 of the appropriate worksheet on page 118, page 134, or page 156.) For any given combination of number of residents, level of evacuation difficulty, and number of floors, each of the safety

parameters has a category that corresponds to the requirement in the proposed Chapter 21. The circled values in Figure 6 show the requirement of the proposed Chapter 21 for a small dwelling unit housing residents capable of a prompt evacuation -- i.e, the least restrictive level of requirements. The circled values in Figure 6 are transferred to the appropriate unshaded blocks in Figure 7. Where the block contains a ÷2, one-half the value in Figure 6 is entered. The four columns are each summed. These four sums are the four values in the table of Mandatory Requirements (Table 3) for level A in the Worksheets for Small Dwelling Units in Appendix C. Figure 8 shows the numerical values for each safety parameter for each set of requirements for the FSES/B&C. The first column in Figure 8a contains a summary of the information in Figure 6. Thus, Figure 8 presents the information for each of the 20 combinations of characteristics in a more compact format than 20 tables similar to Figure 6.

It should be noted that the values in Figure 8 correspond to fire protection features that meet the minimal requirements of the proposed Chapter 21. It, therefore, follows that:

1. A facility that just meets the minimum applicable requirements in Chapter 21 will score exactly the minimum required score as stated in the Table 3 of the appropriate Worksheet of the FSES/B&C in Appendix C, pages 120, 136, and 158.

2. Any building that meets the requirements of the proposed Chapter 21 will pass the FSES/B&C. Conversely, if the facility fails the FSES/B&C, there is no need to check to see if it meets the corresponding set of specifications in the proposed Chapter 21 -- it cannot pass.

5.2.8 Range of Resident Disabilities

This system was developed to provide a procedure for evaluating homes providing shelter to a variety of residents. In developing the subsystem for evaluating buildings, attention was not given to specific disabilities of the residents. The only concern was for evacuation delays which are measured by the E-Score. Therefore, the subsystem should apply to residences housing all types of disabilities that are properly handled by the subsystem for estimating evacuation difficulty in Board and Care Homes.

Table 1. Safety Parameter Values — Small Dwelling Unit

Parameter	Parameter Values						
1. CONSTRUCTION / FIRE RESISTANCE	Exposed Structural Members	Protected (20 Min.)	Fire Resistant (1 Hour)				
	⓪	1	3				
2. HAZARDOUS AREAS	Double Deficiency		Single Deficiency		None or No Deficiency		
	-7		-4		⓪		
3. MANUAL FIRE ALARM	None	w/o F. D. Notif.	w/ F.D. Notif.				
	0	①	2				
4. SMOKE DETECTION & ALARM	None	Limited Warning / Single Lev. Det.	Warning to All Bedrooms		Total Coverage System		
			Every Lev. Det.	Plus Det. in Each Bedrm.			
	-4	0	②	3	4		
5. AUTOMATIC SPRINKLERS	Non-Sprinklered	Sprinklered					
	⓪	8					
6. INTERIOR FINISH	Flame Spread Ratings						
	>75 ≤ 200	>25 ≤ 75	≤25				
	ⓝ	-1	0				
7. SEPARATION OF SLEEPING ROOMS	Unprotected Vertical Opening		Protected Vertical Opening-D				
	None or Incomplete	Smoke Resisting	None or Incomp.	Smoke Resisting	20 Min.	20 Min. Auto Closing	
	-6	-4(0)C	-2	⓪	1(0)A	2(0)A	
8. EGRESS — EGRESS ON ALL SLEEPING LEVELS	< 2 Remote Routes		2 Remote Routes Unseparated	2 Remote Routes Separated	Direct Exit from Each Bedrm.		
	w/o Alt. Means	w/Alt. Means					
	-1	0	1(0)B	2(0)B	3(0)B		
EGRESS NOT ON ALL SLEEPING LEVELS	Primary Route Not Protected			Primary Route Protected			
	< 2 Remote Routes		2 Remote Routes	< 2 Remote Routes		2 Remote Routes	
	w/o Alt. Means	w/Alt. Means		w/o Alt. Means	w/Alt. Means		
	-4	-3	0	-1	⓪	2(0)B	

NOTES:
A — Use (0) if parameter 1 is 0 and parameter 5 is 0.
B — Use (0) if parameter 7 is based on a "no door" situation.
C — Use (0) if door is 20 min. and has automatic closer.
D — Consider 1 level building as having a protected vertical opening.

Figure 6. Safety Parameter Values

Table 2. Individual Safety Evaluations

PARAMETER	FIRE CONTROL	EGRESS	REFUGE	GENERAL SAFETY
1. CONSTRUCTION	0		0	0
2. HAZARDOUS AREAS	0	÷2 0	0	0
3. MANUAL FIRE ALARM	÷2 0.5	(1) A 1		1
4. SMOKE DETECTION & ALARM	÷2 1	2	÷2 1	2
5. AUTOMATIC SPRINKLERS	0	÷2 0	0	0
6. INTERIOR FINISH	÷2 -1.5			-3
7. SEPARATION OF SLEEPING ROOMS		0	0	0
8. EGRESS FROM DWELLING		0		0
TOTAL	S_1 = 0	S_2 = 3	S_3 = 1	S_4 = 0

A - Max value of manual fire alarm for egress is 1.

Figure 7. Individual Safety Evaluations

LEVEL A - SMALL FACILITIES

Figure 8a

Requirements for Safety Parameter Values in Proposed Chapter 21

NUMBER OF RESIDENTS	16 OR LESS	16 OR LESS	16 OR LESS	16 OR LESS
TYPE OF BUILDING	SMALL	SMALL	SMALL	SMALL
FLOORS	NO RESTRICTION	NO RESTRICTION	NO RESTRICTION	NO RESTRICTION
EVACUATION DIFFICULTY	A PROMPT	B MODERATE	C SLOW	D IMPRACTICAL
SAFETY PARAMETER				
1. CONSTRUCTION FIRE RESISTANCE	0	0	1	3
2. HAZARDOUS AREAS	0	0	0	0
3. MANUAL FIRE ALARM	1	1	1	1
4. SMOKE DETECTION & ALARM	2	2	2	2
5. AUTOMATIC SPRINKLERS	0	0	0	0
6. INTERIOR FINISH	-3	-1	-1	-1
7. SEPARATION OF SLEEPING ROOMS	0	0	1	2
8. EGRESS	0	2	2	2

Figure 8b

Requirements for Safety Parameter Values in Proposed Chapter 21

NUMBER OF RESIDENTS	30 OR LESS	30 OR LESS	30 OR LESS	NO RESTRICTION
TYPE OF BUILDING	LARGE	LARGE	LARGE	LARGE
FLOORS	1 OR 2*	1 OR 2*	1 OR 2*	NO RESTRICTION
EVACUATION DIFFICULTY	A PROMPT	B MODERATE	C SLOW	D IMPRACTICAL
SAFETY PARAMETER				
CONSTRUCTION	-2	-1	-2	2
HAZARDOUS AREAS	0	0	0	0
MANUAL FIRE ALARM	2	2	2	3
SMOKE DETECTION & ALARM	2	2	2	2
AUTOMATIC SPRINKLERS	0	0	0	0
SEPARATION OF SLEEPING ROOMS	0	2	2	3
EXIT SYSTEM	0	0	0	0
EXIT ACCESS	0	0	0	0
INTERIOR FINISH	1	1	1	1
VERTICAL OPENINGS	0	0	0	0
SMOKE CONTROL	0	0	0	2

*Facilities with more than two floors must meet the requirements for C-slow or greater.

Figure 8c

Requirements for Safety Parameter Values in Proposed Chapter 21

NUMBER OF RESIDENTS	NO RESTRICTION	NO RESTRICTION	NO RESTRICTION	NO RESTRICTION
TYPE OF BUILDING	LARGE	LARGE	LARGE	LARGE
FLOORS	1	2	3 - 6	OVER 6
EVACUATION DIFFICULTY	C SLOW	C SLOW	C SLOW	C SLOW
SAFETY PARAMETER				
CONSTRUCTION	-1	-2	0	2
HAZARDOUS AREAS	0	0	0	0
MANUAL FIRE ALARM	2	2	2	2
SMOKE DETECTION & ALARM	2	2	2	2
AUTOMATIC SPRINKLERS	0	0	0	0
SEPARATION OF SLEEPING ROOMS	2	2	2	2
EXIT SYSTEM	0	0	0	0
EXIT ACCESS	0	0	0	0
INTERIOR FINISH	1	1	1	1
VERTICAL OPENINGS	0	0	0	0
SMOKE CONTROL	2	2	2	2

Figure 8d

Requirements for Safety Parameter Values in Proposed Chapter 21

NUMBER OF RESIDENTS	NO RESTRICTION	NO RESTRICTION	NO RESTRICTION	NO RESTRICTION
TYPE OF BUILDING	NEW APARTMENT	NEW APARTMENT	NEW APARTMENT	NEW APARTMENT
FLOORS	1 - 2	1 - 2	3 - 6	>6
EVACUATION DIFFICULTY	A PROMPT B MODERATE C SLOW	D IMPRACTICAL	NO RESTRICTION	NO RESTRICTION
SAFETY PARAMETER				
CONSTRUCTION	0	2	2	2
HAZARDOUS AREAS	0	0	0	0
MANUAL FIRE ALARM	2	2	2	2
SMOKE DETECTION & ALARM	2	2	2	2
AUTOMATIC SPRINKLERS	0	0	0	0
SEPARATION OF UNITS	4	4	4	4
EXIT SYSTEM	0	0	0	2
EXIT ACCESS	0	0	0	0
INTERIOR FINISH	-1	-1	-1	-1
VERTICAL OPENINGS	1	1	1	1
SMOKE CONTROL	2	2	2	2

Figure 8e

Requirements for Safety Parameter Values in Proposed Chapter 21

NUMBER OF RESIDENTS	NO RESTRICTION	NO RESTRICTION	NO RESTRICTION	NO RESTRICTION
TYPE OF BUILDING	EXISTING APARTMENT	EXISTING APARTMENT	EXISTING APARTMENT	EXISTING APARTMENT
FLOORS	1 - 2	1 - 2	3 - 6	>6
EVACUATION DIFFICULTY	A PROMPT B MODERATE C SLOW	D IMPRACTICAL	NO RESTRICTION	NO RESTRICTION
SAFETY PARAMETER				
CONSTRUCTION	0	2	2	2
HAZARDOUS AREAS	0	0	0	0
MANUAL FIRE ALARM	2	2	2	2
SMOKE DETECTION & ALARM	2	2	2	2
AUTOMATIC SPRINKLERS	0	0	0	0
SEPARATION OF UNITS	2	2	2	2
EXIT SYSTEM	0	0	0	2
EXIT ACCESS	0	0	0	0
INTERIOR FINISH	-1	-1	-1	-1
VERTICAL OPENINGS	1	1	1	1
SMOKE CONTROL	2	2	2	2

6. TESTS OF THE SYSTEM

6.1 Need for Tests

Appendices A, B, and C contain many novel features. Appendix A, the proposed Chapter 21 recommended by the Residential Subcommittee, introduces the concept of four levels of evacuation difficulty based on estimated maximum time to evacuate. It also contains the basic fire safety requirements for a new type occupancy. Appendix B contains a specially designed system for estimating residents' capabilities in fire emergencies. Appendix C contains a special subsystem developed to measure the equivalency of the fire safety features of the building with the proposed Chapter 21. With these and other novel features it is reasonable to ask, "Will the system work in the field as we expect?" Until there is evidence that the system is workable and provides satisfactory answers, adoption of the system can be neither expected nor recommended.

This chapter contains a discussion of two studies designed to provide evidence that the FSES/B&C is a practical tool and when used with the proposed Chapter 21 provides a level of safety comparable to that provided other occupancies by following the Life Safety Code. The first study is a field test of the FSES/B&C. The second study is an analysis of several major fires in Board and Care Homes.

6.2 Methodological Considerations

One way of evaluating the combined system contained in Appendices A, B, and C is to use it to rate existing buildings and to decide if the ratings are reasonable: that is, to see if the buildings that meet the requirements are properly safe and if those that fail are not satisfactorily safe. The problem is to obtain a satisfactory determination of the safety independent of the combined system in Appendices A, B, and C. In other words, an independent criterion for evaluating the safety of the building is needed. In the two studies described in the following sections, the independent criteria were: (1) the judgment of experts knowledgeable in fire safety and experts knowledgeable in the care of disabled people, and (2) the performance of the building in a fire emergency. While both of these independent criteria have their methodological limitations, these criteria are useful in testing the system.

In testing hypotheses or systems, one never really proves the hypothesis is correct or that the system properly works in all potential applications. Rather, one fails to show the hypothesis is wrong or fails to find the system does not properly work. Each time good results are obtained (that is, we fail to find problems when testing part or all of our system), confidence is increased.

Another methodological concern is that the interpretation of the test results required subjective judgments.

Information from the field test, described in the next section, was used to refine or modify the FSES/B&C. Additional refinements were suggested by the peer review panels and the Residential Subcommittee of the NFPA Committee on the Safety to Life. Therefore, the draft system which was tested and the final system do differ. It is not believed that the differences are such that they would significantly affect the conclusions from the test.

In the field test, efforts were made to obtain information from the homes in a nonregulatory context to offset the desire of operators to minimize their problems. Information obtained and judgments made as part of a regulatory process may differ.

6.3 Field Test

6.3.1 Introduction

A field test of the Fire Safety Evaluation System for Board and Care Home (FSES/B&C), including the Procedure for Determining Evacuation Difficulty, was conducted during the summer of 1981. A total of 151 facilities in eight geographically dispersed states (California, Maryland, Massachusetts, Iowa, Montana, Oklahoma, Texas and Virginia) were studied and evaluated. The work was carried out through grants to the State Fire Marshal's offices in five of the states, through a grant to the Department of Health in one state, and by the voluntary contribution of the American Health Care Association in Texas and Virginia. A listing of the participants in the field test is contained in Appendix F.

6.3.2 Objectives

The field test had two major goals: to determine the appropriateness of using the FSES for evaluating the fire safety of a facility and to uncover difficulties in the use of the system.

Specifically the field test had the following five objectives:

1. To estimate how accurately the FSES/B&C measures the difficulty of evacuating board and care homes and the fire protection capabilities of the buildings.

2. To identify areas where the FSES/B&C could be improved.

3. To identify problems in applying the portions of the FSES/B&C that rate the protection features of the building to a wide variety of buildings.

4. To identify problems in applying the portions of the FSES/B&C that determine the Evacuation Difficulty Score to a wide variety of disabled residents of board and care homes.

5. To identify any points which were not clear or possibly conflicting in the explanatory material accompanying the FSES/B&C worksheets and scoresheets.

6.3.3 Training

A workshop was conducted on May 12 and 13, 1981, at NBS to train the field teams both in the nature and use of the FSES/B&C and in the specific data collection formats and procedures designed by the NBS staff. A second workshop was conducted on August 27, 1981 to train additional teams. The field test teams, hereafter called grantees (although some teams received no financial support from NBS), were composed of two persons: one concerned with building parameters and one concerned with rating residents. All participants were given overview and background information regarding the FSES/B&C. Guidance was also provided regarding procedures for selecting test facilities and observing fire drills. Depending upon the nature of his or her field test assignment, each participant in the first training session was assigned to one of two workshops, "building parameters and their definitions" or "the system for rating residents and staff," for more detailed discussions of the relevant data forms.

6.3.4 Criteria for Selection of the Facilities for the Field Test

A goal of the study was to identify problems in applying the FSES/B&C to a wide variety of homes and residents. There was no intention of extrapolating the results to provide a profile of the homes in the country. Therefore, the following guidelines were given to the grantees for use in selecting Board and Care Homes to include in the field test:

1. The sample does not have to be statistically representative of facilities found in the state.

2. The sample should maximize the variety in types of residents. Facilities that serve the mentally retarded, mentally ill, and elderly should be included. Also, more specialized facilities were of interest, for example, half-way houses for drug abusers and group homes for autistic adults.

3. Particular attention should be given to including a large proportion of facilities that serve more severely disabled residents. (These facilities provide a more critical and valuable test of the FSES, but are also less frequently found.)

4. A varied sample of building types should be represented, for example, detached dwellings, apartments, converted hotels and motels, large-scale "adult" homes, and custom-designed buildings. Facilities which serve 12 or fewer residents should comprise the bulk of the sample, perhaps 75 percent or so.

5. Unlicensed as well as licensed facilities should be included.

6.3.5 Research Tasks

Grantees were responsible for using forms specially designed by the NBS project staff for this field study to collect the raw data needed to meet the test objectives. In addition, grantees also needed to make some professional judgments and to document the reasoning behind those judgments with supporting data. For example, one of these forms contains the following question: "Is there anything about this building and its fire safety features that is not properly evaluated by this system? Explain." The research tasks involved gathering background information on the facility, specific data on the protection features of the building, and information on the capabilities of staff and resident.

Where possible, fire drills were observed and documented.

A key task for the field teams was to judge whether or not the facility had proper safety.

6.3.5.1 General Information About Board and Care Homes

Grantees provided such general information about facilities as: requirements for admission, resident referral sources, licenses held, costs to residents, and organizational affiliations.

6.3.5.2 Tasks Involved in Gathering Data on the Protection Features of the Building

The team member responsible for the building data was instructed to collect the data for the FSES/B&C as though he or she were conducting a normal inspection. The member also supplied supplemental information that explained the ratings given the buildings, and described any problems encountered in using the system.

1. The grantee rated the protection features of the building using the appropriate portion of the FSES/B&C.

2. The grantee provided detailed descriptions of operational problems that occurred in rating the building using the FSES/B&C, especially problems resulting from inconsistencies or ambiguities in the explanatory material accompanying the worksheets.

3. The grantee provided written descriptions and photographs, as appropriate, of both the features assessed using the FSES/B&C and other features that should also be assessed by the FSES/B&C, because they seemed relevant to protecting the occupants of the building from fire.

4. The grantee provided simple floor plans of the buildings. The egress routes used by the residents in the fire drills were shown on these floor plans.

5. The grantee provided professional judgment regarding how well the FSES/B&C ratings of protection features measured the actual expected performance of the building in protecting occupants from a fire.

6.3.5.3 Tasks Involved in Gathering Data on Evacuation Performances of Residents and Staff

For the most part, collecting human performance data involved discussions with the management and staff of the facilities. Grantees characterized the residents using the Worksheet for Rating Residents in Appendix B and provided supporting information for those ratings. The specific tasks were as follows:

1. The grantee met with management or staff in order to fill out the FSES/B&C forms for rating residents and staff and to compute the evacuation difficulty scores for the facilities.

2. The grantee met with management or staff to obtain data supporting the ratings on the FSES/B&C forms. These data included (a) a functional description of each resident, that is, what the resident is capable and incapable of doing, (b) a clinical description of each resident's disability, and (c) the services received by each resident from the facility and from outside sources.

3. The grantee used this information to help make judgments regarding how well the techniques for rating performance of the residents measured the actual expected performance of the residents and staff during a fire emergency. The grantee evaluated both whether the FSES ratings of individual residents seemed to represent their individual capabilities to evacuate and whether the FSES/B&C rating of the evacuation performance of the facility as a whole seemed to represent the group's capability.

6.3.5.4 Tasks Involved in Gathering Data from Fire Drills

Where possible, fire drills were conducted and observed. Collecting data from fire drills required much flexibility on the part of grantees. They needed to vary arrangements depending upon how the facility usually conducted drills, and the willingness of the management and staff to assist. In general, the role of the grantees was to observe a drill that was taking place for training purposes, and the normal procedures used by the facility for conducting the drill were followed. In one-third of the facilities studied, the research team was unable to observe any fire drills. This was frequently due to the fact that the residents were away at school or workshops at the time of the site visit. Some other reasons given for not conducting a fire drill were that it was not customary to hold fire drills (not required for licensure), concern for the possibility of harm to the frail elderly, or the alarm system was not currently operative. During the drill, the observers used cassette recorders to record the start and stop times and descriptions of the activities that occurred. After the drill, grantees held a meeting with observers and facility staff who participated in the drill in order to reconstruct the series of events that occurred during the drill. The events of the drill were then "mapped" on a floor plan using a format provided by NBS. Tapes were played back to obtain the amounts of time consumed by the events of the drill.

A second "Worksheet for Rating Residents" was filled out for each resident participating in the fire drill. The resident was scored on each of the rating factors according to his or her actual performance in the fire drill.

Grantees examined the times used during the fire drills in relation to what might have been expected on the basis of the individual resident ratings and the E-Score for the facility. Reasons for unexpectedly short or long times were documented where possible.

6.3.6 Profile of the Sample

The final sample consisted of 151 facilities from eight geographically dispersed states. The goals of obtaining both a wide variety of building structures and resident types were met (see Figures 9-11). The sample included both structures designed and built especially for use as residential care facilities, and the following types of structures converted for board and care use: ordinary single family residence, mansion, motel, school, hospital, nursing home, and historic building. Some of these structures had an institutional appearance; however, the majority were decidely "homelike" in appearance, with the exception of such features as lighted exit signs and/or exterior fire escapes. About four-fifth of the facilities would be classified as "small," that is, housing 16 or less residents. Facilities were designated as being for mentally retarded, mentally or emotionally ill, or elderly persons. There was also a small sampling of facilities which house those recovering from alcohol or drug addiction. Some facilities, particularly the larger ones, had a mixture of resident types.

As anticipated, designations such as "mentally retarded" or "elderly," by themselves, did not provide a good indication of the difficulty of evacuating a facility. Even in a relatively homogeneous setting, such as a small facility for mentally retarded children, there was considerable variation in those characteristics of the residents that are relevant to evacuation capability. Some mentally retarded residents had additional disabilities such as epilepsy, mobility impairment, sensory impairment, and autism. Similarly, facilities designated as for the elderly contained residents which varied greatly in their physical, mental, and emotional characteristics.

Figure 9

Distribution of Number of Residents per Facility in Field Test Sample

Small Facilities		Large Facilities	
No. of Residents	No. of Facilities	No. of Residents	No. of Facilities
2	4	18	2
3	3	19	1
4	11	20	4
5	18	22	1
6	21	24	2
7	19	25	2
8	26	30	1
9	1	35	2
10	8	36	1
11	1	37	1
12	6	40	1
13	3	54	1
14	2	60	1
15	4	65	1
16	1	73	1
		300	1
	128 Total		23 Total

Figure 10. Distribution of Minimum Number of Staff per Facility in Field Test Sample

Minimum Number of Staff	Number of Facilities
0	8
1	106
2	32
3	4
Unknown	1
	151 Total

Figure 11. Number of Facilities in Field Test Sample with Various Resident Types

Resident Type	Number of Facilities
Mentally Retarded	63
Mixed (varying combinations of other types listed and autistic)	35
Elderly	20
Mentally Ill	19
Drug and/or Alcohol Abuse	7
Juvenile Problems	7
	151 Total

The term "minimum number of staff" in Figure 10 refers to the fewest number of staff allowed to be present in the facility when residents are present. In our sample, this number was generally one or two; in a few cases, residents could be present in the building without the presence of staff.

6.3.7 Analysis of Results and Changes in the FSES/B&C

6.3.7.1 Fire Drill Results and Analysis

It is obvious that the Evacuation Difficulty Score (E-Score) received by a facility should bear some relationship to the time it takes to evacuate a building in a fire drill. (See Section 4.3 for a discussion of the derivation of E-Scores.) It is to be expected that facilities with high Evacuation Difficulty Scores would take longer to evacuate in fire drills than those with lower Evacuation Difficulty Scores. However, it must be considered that the Evacuation Difficulty Score is designed to predict evacuation performance for that small percentage of times where things, that could reasonably be expected to go wrong, do in fact go wrong. The observed fire drills tended to occur under somewhat ideal conditions -- residents were awake, staff had foreknowledge, there were no fire effects such as smoke and heat, etc. Therefore, one should expect a linear correlation between E-Scores and fire drill times but not necessarily a very high correlation.

A single fire drill time by itself covers only some of the problems which could be encountered in a real emergency. For example, in one small facility, the total time to evacuate the facility in a daytime drill was 30 seconds -- an encouragingly short evacuation time. However, a detailed examination of residents' descriptions reveals many potential problems that might arise in a less than ideal situation. These descriptions include: refusal in the past to participate or cooperate fully in fire drills, heavy daily sedation, assaultive behaviors, and the need for several verbal and physical prompts to carry out staff instructions. Thus, it is quite conceivable that in an actual fire the evacuation could take considerably longer than 30 seconds.

Of 99 drills, 82 were analyzed to compare the facility E-Score with the time it took for the last resident to reach a place of safety. This comparison was not made in the other 17 drills because the data was incomplete or inconsistent. For this analysis, the E-Score was adjusted for the time at which the fire drill occurred; e.g., total staff score was based on staffing at time of drill rather than night-time staffing. Hence, many of the adjusted E-Scores are lower than the E-Score calculated for time of greatest risk.

For the most part the drill times were low -- only 10 of 82 drills took more than two minutes. (Furthermore, a majority of the facilities had both rapid evacuation and low E-Scores -- 51 of 82 drills had evacuaion times of 120 seconds or less and also E-Scores of 1.5 or less after adjustment for the time at which the fire drill occurred.) There was a tendency, as expected, for the higher E-Scores to be associated with a slower evacuation time. However, there were eight facilities that either had a slow evacuation with a low E-Score, or a rapid evacuation with a high E-Score. These are shown in Figure 12 with small squares. A low E-Score paired with a relatively high drill evacuation time would indicate a problem with the system itself or errors in the rater's use of the system. A high E-Score paired with a relatively low fire drill time may be acceptable, since the E-Score appropriately represents a "worst case" perspective, but it is a flag suggesting that the discrepancy be investigated. The eight cases where E-Scores and fire drill times do not seem consistent are discussed below.

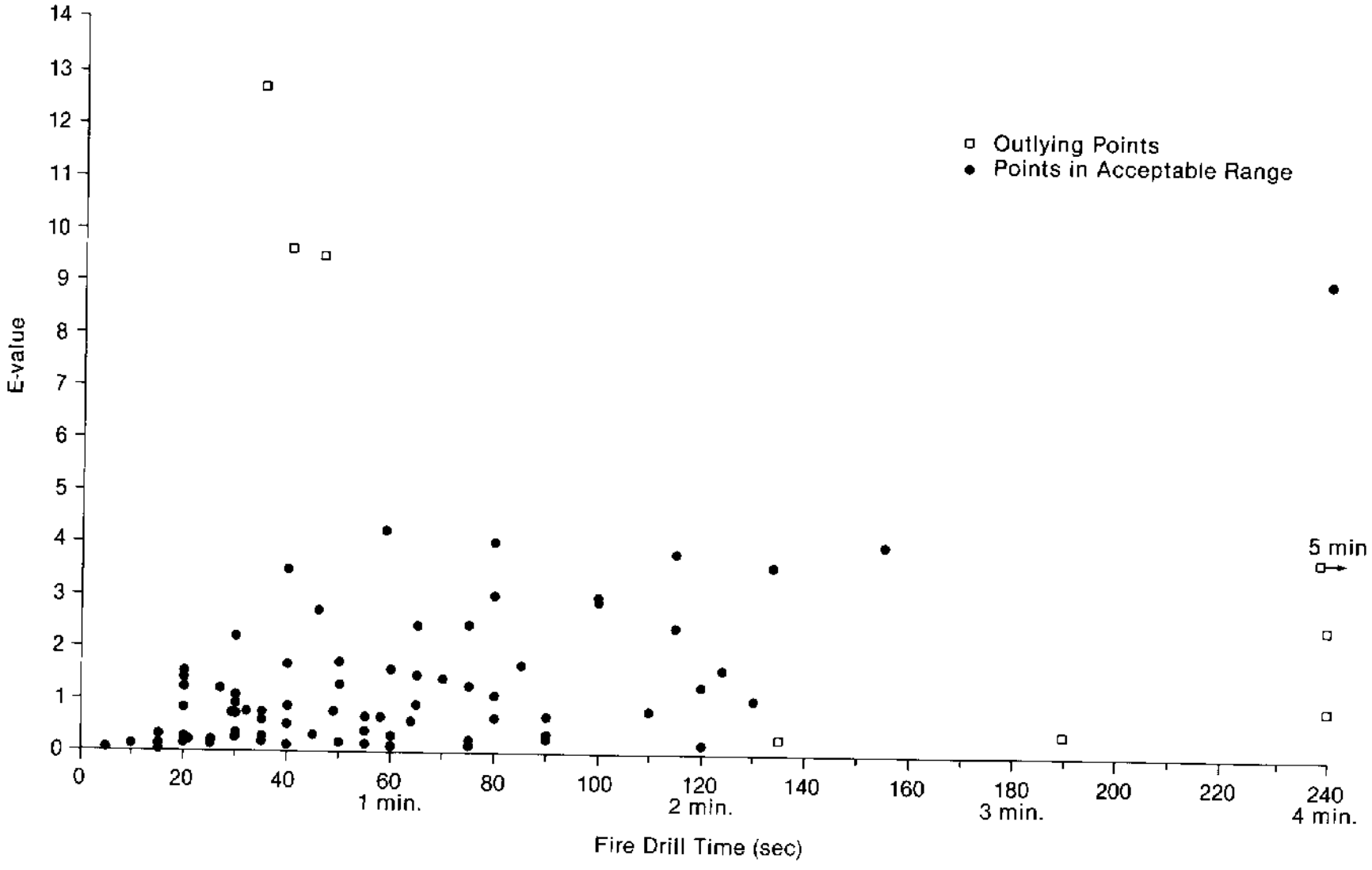

FIGURE 12. COMPARISON OF FIRE DRILL TIMES AND E-SCORES

In all three cases where the E-Values were very high, compared with daytime evacuation time, the "alarm effectiveness" factor used to assign credit to the staff was classified as "not assured" giving a point value of two for each member of the staff. The effect of these low scores is to heavily penalize facilities for not having an effective alarm system, and this was the intent of the system's designers. Thus, the very high E-Scores for these facilities is considered correct. The lack of a good alarm system did not have a detrimental effect on drill time in daytime situations with awake and aware staff, and, therefore, the low drill times were to be expected.

There were five cases where the drill times were high relative to the E-Scores for a daytime situation. These outcomes stemmed primarily from either the large number of residents in the facility or a lack of experience with fire drills. However, in each case, the system contains features which would prevent the assignment of an inappropriately low building safety level for the facility in an actual rating situation.

For example, in one of these cases, 16 staff were counted in the calculation of a daytime E-Score. This large a staff count significantly lowered the E-Score. Two-thirds of these staff members were kitchen and housekeeping help whose availability for providing assistance did not significantly speed up the evacuation time for the 73 ambulatory, elderly residents. The system recognizes the inherently greater difficulty in evacuating large facilities and would not permit anything less than a Level C building safety level regardless of the E-Score. (See Table 3 in Fire Safety Evaluation Worksheet for a Large Residential Facility in Appendix C, page 136.) Further, in an actual rating situation, the facility would be rated for the period of greatest risk -- nighttime, when there were only two staff available -- and would receive a much higher E-Score.

There were three small facilities with low E-Scores and high drill times. The key factor in each case was a lack of experience with fire drills. Two of the homes had never conducted a drill before, and the third had had "only two or three drills in six or seven years." The system prohibits a building safety level being assigned to these facilities based on the E-Score: one of the prerequisites for using the E-Score for determining evacuation difficulty is that the the home conduct six fire drills per year (or, for homes in operation less than a year, monthly drills), and this requirement had not been met. Furthermore, if there had been drills, the ratings of the residents on the Response to Fire Drills factor could have been based on observed behavior, as intended in designing the system, and would have been more accurate.

6.3.7.2 Analysis of Residents' Capabilities

In the field test, considerable information was obtained about the residents in addition to the data on the Worksheet for Rating Residents. This additional information includes an estimate of rate of movement. In studying this information, it was noticed that many residents were rated as "Needs Full Assistance or Very Slow" on mobility when they were ambulatory and were sufficiently fast to safely evacuate in a typical fire emergency. This led to a rewriting of the requirements for classifying a resident as very slow. The requirements were changed from ability to "travel 150 feet in 90 seconds" to "prepare him or herself to leave, and then travel to the exit (or an area of refuge) in 150 seconds."

We also added a new category "Slow" with three penalty points for those who require 90 to 150 seconds to prepare to leave and then travel to the exit. (This change also reflected an increased concern for the time needed to prepare to evacuate and the distance to be traveled.)

Residents in this category can evacuate without assistance but may, in fact, be given some assistance or supervision. Three points, a low penalty, was deemed sufficient because in a severe emergency, these residents probably would not require much staff time. The peer consulting panels approved this change and the supporting logic.

6.3.7.3 Analysis of Building Safety Features

A key task of the field teams was to respond to the question: "Does this facility (considering both the safety features and the evacuation capability of the group) have life safety equivalent to the requirements of the Life Safety Code for a boarding home with 15 transient guests? Explain. If not, what changes would you recommend to attain equivalent fire safety at minimal cost?" The grantees were not given the minimum scores for passing the system (i.e., the three tables of Mandatory Requirements in the three Worksheets in Appendix C) so they responded to this question without knowing if the facility passed the FSES/B&C.

The staff compared the comments with tentative values for the minimum scores. Many of the facilities did not meet their tentative minimum scores and were also judged deficient by the field test team. Emphasis was placed on studying and analyzing the upgradings suggested by the grantees.

Facilities passing the FSES/B&C were generally judged by the field team to have at least the safety of an acceptable boarding house. Suggestions for upgrading tended to improve the safety features to a level where the building passes the FSES/B&C. However, the analysis did lead to several changes in the FSES/B&C:

1. The point value for sprinklers in small facilities was revised from 4 to 8 and its weighting for Egress was changed from one to one-half. Sprinklers are not required by the proposed Chapter 21 and the Mandatory Requirements are based on a facility without sprinklers. This change only affects combinations of safety features that includes sprinklers. It does permit sprinklers to compensate for a more serious set of deficiences, but it does not eliminate or otherwise affect any of the options available to non-sprinklered buildings.

2. Smoke detectors were given half credit instead of no credit for Refuge.

3. The parameter, Separation of Sleeping Rooms from Exit Access for Large Facilities, was rewritten. (This was rewritten again after the last meeting of the Peer Consulting Panels.)

6.3.7.4 Analysis of Field Team Comments

Field team members were asked the following questions:

1. [] YES [] NO Is there anything about this building and its fire safety features that is not properly evaluated by this system? Explain.

2. [] YES [] NO Is there anything about the staff or residents and their ability to evacuate the building that is not properly evaluated by this system? Explain.

The tally in regard to these questions was:

Question 1:	No - 115	Question 2:	No - 109
	Yes - 32		Yes - 37
	Unanswered - 4		Unanswered - 5

Some observations regarding the above responses are as follows:

Sometimes when the questions were answered "yes", the team member was using this opportunity to express criticisms of the building or management set-up for the facility and was not really criticizing the evaluation system itself. In these cases, the defects described by the team member were already accounted for or penalized by the system.

Many of the "yes" answers were in reference to the same point. For example, if the field team member did not like the fact that the system does not specify proper procedures for cigarette smoking, this would lead to a "yes" answer to question one for each of the facilities surveyed by this person.

Some of the questions raised would be more properly covered by administrative regulations issued by the authority having jurisdiction, than by adjusting the evaluation system itself through additions or by increasing the specificity of the system requirements. For example, in one facility, an aged relative of the owner, who was also living in the home, required a great deal of assistance from staff during the evacuation. An administrative regulation could, in a case like this, clearly specify that such a relative be counted along with the other "official" residents in the E-Score.

Other problems raised were: rapid turnover of the resident population (as in alcohol treatment centers) and evaluation of residents by staff without clinical training. Obviously, administrative guidelines will need to be developed to determine under what circumstances the E-Score must be recalculated and who should be responsible for a final determination of resident scores. Since the board and care occupancy encompasses a wide range of situations, variation in these guidelines is to be expected.

Concern was frequently expressed about the quality or relevance of the fire drills conducted. The underlying question is whether or not the system goes far enough in guaranteeing that facilities will properly train residents and staff in evacuation procedures. The system as it stands influences training in two major ways: (1) by specifying the minimum frequency of drills necessary for the facility to be able to use the E-Score procedure, and (2) through the last rating factor on the Worksheet for Rating Residents. This factor rates residents on their performance in fire drills with regard to the three basic evacuation skills (see Appendix B).

The system does not require that there be unannounced drills or night-time drills, which might represent more realistic, challenging conditions. Again, it is felt that any additional requirements for fire drills such as these should be left to the discretion of the authority having jurisdiction.

The conduct of fire drills is a very sensitive question since, in some cases, owners and staff are concerned about physical and/or psychological harm accruing to residents as a result of drills. It is important that the exact nature of the individual facility be understood before more specific training and drill procedures be worked out. The National Bureau of

Standards has published a guidance manual [13] to assist owners in choosing optimal approaches for their particular facilities.

Discussions with the field teams indicated that the definitions related to hazardous areas were ambiguous and several of the "yes" answers were a reflection of this ambiguity. The definitions were clarified.

Several comments reflected a difference in the value given some safety features by the project staff and some of the field teams. Specifically, the project staff, with the concurrence of the peer consulting panels, did not give any credit for heat detectors, institutional width corridors and doors, or exit illumination.

Practical considerations limited the amount of training given the field teams and the number of training aids available. Some of the raters erroneously gave credit for non-functioning safety features, not realizing that the system does not permit this. As a result, one rater gave credit for a locked door providing direct exit from the bedroom to the outside. Another gave credit for a pair of smoke barrier doors that did not close properly. Both commented that the system should not permit such ratings. Future training programs should emphasize that non-functioning safety features are not to be credited.

There were several comments about the credit for two stairways, both leading to the interior of the first floor in small facilities. Major changes were made to accommodate this concern. The recommended version requires for full credit: two routes leading to two separate building exit doorways, and at least one route that provides a path of travel to the outside without traversing any corridor space exposed to unprotected vertical openings or common living spaces.

One building failed to have a telephone in the building with which to call the fire department. This building also lacked every other fire safety feature except bedroom doors and windows. The likelihood of a home without a telephone passing the system was considered sufficiently small that the requirement for a telephone was not added.

One rater commented that there is no penalty for highly combustible furnishings. Additions to Chapter 31 of the Life Safety Code prepared by the Residential Subcommittee do include a requirement for cigarette ignition resistance for newly installed upholstered furniture. If this recommendation is included in the next edition of the Life Safety Code, it can be added as an additional requirement in the FSES/B&C.

6.4 Analysis of Fatal Fires

Several states have recently developed and adopted fire regulations for Board and Care Homes. Some of these regulations require considerably more fire protection features than required by the proposed Chapter 21. One way of checking if Chapter 21 or the FSES/B&C calibrated to it are too lenient is to investigate fires with unfortunate outcomes and determine if any of the buildings involved would have passed the proposed requirements.

Eight well known fires with at least 5 fatalities each were investigated: Point Pleasant, New Jersey; Keansburg, New Jersey [5]; Bradley Beach, New Jersey [6]; Detroit, Michigan [7]; Washington, D.C. (Lamont Street) [8]; Pioneer, Ohio [9]; Connellsville, Pennsylvania [10]; and Farmington, Missouri [11]. None of these buildings would have met the proposed Chapter 21 requirements.

Several experts who investigated these fires were asked to estimate the life saving effect of adding selected sets of fire protection features to the building with which they were familiar.

Each of the 8 buildings failed to meet the minimum requirements for a Lodging or Rooming House, or Hotel, as appropriate. The panel was asked to predict the likelihood of fatalities if the building did meet the requirements of the 1976 Life Safety Code for Residential Occupancies (i.e., Lodging Houses and Hotels). Five of the 8 buildings had less than 30 residents. The members felt -- with 90 percent confidence (i.e., they believed there was a 90 percent chance they were right) for each incident -- that if three of these buildings met the Code for Boarding Houses, there would have been no fatalities. For the fourth building, if it met code, the fatalities would have been cut in half -- again with a 90 percent confidence. For the fifth building, no judgment was made because the building could not be brought up to code without changing the basic characteristics of the building. The panel decided -- with at least an 80 percent confidence in each case -- that there would have been no fatalities if the three remaining buildings with more than 30 residents met the requirements of the 1976 Life Safety Code for Hotels.

The proposed Chapter 21 contains all the requirements in the 1976 Life Safety Code for Lodging Houses when there are less than 30 residents, and all the requirements for Hotels when there are more than 30 residents. It also requires smoke detectors on each level.

As noted above, for one of the incidents, meeting the 1976 Life Safety Code requirements for Lodging Houses, would probably have saved only half the fatalities. The panel agreed -- with 80 percent confidence -- that meeting the same Code and also having a smoke detector in the area would have saved all the residents.

The above analysis is based on the assumption that all residents are trained to respond to a fire alarm and, as a group, can evacuate rapidly -- i.e., in less than three minutes. When this is not true, the fire safety requirements in the proposed Chapter 21 are more severe. The eight disasters studied revealed no shortcoming in the proposed Chapter 21. Therefore, there is no evidence that the requirements are too lenient.

7. CALIBRATION OF BUILDING SAFETY LEVELS WITH EVACUATION DIFFICULTY

7.1 Introduction

In the problem definition stage (see Section 2.2) it was decided to develop two subsystems: one to estimate the evacuation capabilities and the other to evaluate the fire safety features of the building. For any given level of evacuation capability, there would be a required level of fire protection features. This section contains a discussion of the process of setting the required fire protection features for each level of evacuation capability. This task is called calibration.

7.2 Basic Assumptions and Decisions

7.2.1 Anchor Points

During the problem definition stage, two tentative assumptions were made regarding the calibration:

1. One level of evacuation capability approximates the evacuation capabilities normally found in buildings covered by the residential chapters of the Life Safety Code (that is, Chapters 16, 17, 18, 19, 20 and 22 of the 1981 Edition). In these cases, the level of fire protection found in those chapters should apply.

2. Another level of evacuation capability approximates the evacuation capabilities normally found in nursing homes. In these cases, the level of fire protection in the health care chapters of the Life Safety Code should apply.

These anchor points are consistent with the proposed Chapter 21 prepared by the Residential Subcommittee.

7.2.2 Evacuation Cycles

Although final calibration could not be completed until the two major subsystems were fully developed, development of an integrated system depended, in part, on a preliminary calibration. For this reason, the Human Behavior Consulting Panel discussed the calibration several times as they considered various versions of the subsystem for estimating evacuation capability.

During panel discussions, the concept of evacuation cycles was used. An evacuation cycle was considered to be the unit of time necessary for a staff member to evacuate a non-mobile resident who cannot significantly assist in his/her own rescue. Due to the variations in length of escape routes, competence and strength of the staff members, and the characteristics of the residents, an evacuation cycle is of necessity a random variable. However, it was a concept that was useful for facilitating the discussions. Also, the Evacuation Difficulty Score (E-Score) could be considered a rough measure of the maximum number of anticipated evacuation cycles that an evacuation might take.

The panel tentatively agreed that a home, with an E-Score of one or less and 16 or less residents, would be evacuated rapidly -- in a time interval no greater than that required to evacuate a lodging home with 15 or less transient residents. While the transient residents

might have more innate abilities, the residents of a Board and Care Home would have more familiarity with the building and more training.

The panel further agreed that the level of protection currently required for nursing homes also should be required whenever it is no longer reasonable to expect a timely evacuation from the building. The panel tentatively agreed that this point occurred in the range of 3.5 to 4.5 evacuation cycles or an E-Score of 3.5 to 4.5.

7.2.3 Building Sizes

The Life Safety Code classifies transient lodgings as: Lodging or Rooming Houses if there are 15 or fewer guests; and hotels if there are 16 or more guests. Early in the program, the staff recommended that the requirements for Small Board and Care Occupancies cover homes with 16 or fewer residents. This recommendation was based on: the observation that some homes were designed to have four groups of four residents each within the home; and the fact that there was no known rationale for selecting 15 rather than 16 for the break point in the Lodging or Rooming Houses definition. The panels accepted the recommendation.

The staff recognized that homes with 20-30 residents were often architecturally and operationally different from larger buildings. These homes were more like very large homes or homes with additions, and less like buildings designed as hotels. From a fire protection standpoint, these homes needed more fire protection features than small board and care homes but, if the residents were relatively capable, did not require all the fire protection features needed by a large hotel in order to maintain any given level of safety. The project staff recommended special requirements for homes with 17 to 30 residents at the fall 1981 meetings of the various panels; the panels accepted the proposal.

7.3 Obtaining a Consensus of Judgments

The calibration by its nature is a judgmental process. In Section 3.2 of this report, a six step procedure was outlined to best utilize available experts to support the project staff when system development depends upon professional judgments. These steps as they apply to the calibration are:

1. The project staff prepared preliminary versions of the calibration tables without numerical values. The tables essentially appeared like Table 3 in the Fire Safety Evaluation Worksheet for a Small Dwelling Unit (see Appendix C, page 120), with the exception that there were five levels of fire safety requirements in the calibration tables instead of four. These levels and their definitions were:

   Level I - Moderate warning, partially protected exits. Building is in explicit compliance with the requirements for a boarding or lodging house as set forth in Chapter 11-5 of the 1976 edition of the Life Safety Code. The base fire safety system (for which all alternatives must be equal or equivalent) provides moderate warning through a smoke detector, on each level, that can be heard in all sleeping rooms and the protection of the exit from fires on a lower level. This base case does not require any inherent building fire resistance or installed extinguishing systems.

Level II - Increased warning or egress/rescue capabilities. The base building arrangement for this level is a building meeting the base requirements for Level I and, in addition, it either has a total detection system (i.e., detectors in each room that sound a building fire alarm system) or has two separate routes from each level to a safe area outside the building.

Level III - Increased warning and egress. The Level III base case is a building meeting the base case requirements for Level I and having, in addition, both a total detection system and two separate exit routes from each floor.

Level IV - Refuge potential while awaiting rescue. This level increases the level of safety to that of a building meeting the base case for Level I with the addition of total detection, two separate exit routes from each floor, and a moderate degree of structural fire resistance (i.e., at least 15 to 20 minutes).

Level V - Protection of residential custodial care facility. This level is intended to provide safety approximate to that provided by a small health care facility housed in a dwelling type structure meeting the requirements for an existing residential custodial care facility in Chapter 10 of the 1976 edition of the Life Safety Code.

2. The staff prepared a form to obtain the judgments of a group of experts -- namely, the members of the Human Behavior Consulting Panel and the Building Fire Safety Panel. The form contained 17 computer generated examples of combinations of staff and residents with E-Scores of approximately 0.5, 1.0, 2.0, 3.0, 4.0, 4.5, and 5.0. Fourteen of these examples had six residents each and three of these examples had ten residents. An eighteenth combination was composed of 16 capable residents and one sleeping staff member (an E-Score of 1.0). Four of the examples had one awake staff member; the remaining 14 had two sleeping staff members.

3. The following procedure was done by working through the mail without assembling the group of experts. Each of the 18 combinations of residents and staff was rated by each expert on an 11 point scale. Five of the points were the five levels defined above. Four of the points were between pairs of adjacent levels defined above. One point represented less fire protection than the lowest defined level and one point represented more fire protection than the highest defined level.

Thirteen panel members responded. Each of the thirteen panel members differed from the majority on at least one of the 18 examples. Each of them was requested to explain in writing his or her rationale for one or more of his or her judgments that differed from the majority. The results and the rationales were summarized and distributed to the entire group of experts. The experts were asked to review the results, to review the rationales and to re-rate the 18 examples on the 11 point scale. In the second cycle, the ratings were slightly more conservative but there was no significant shift. The results of the second cycle are shown in Figure 13. (This includes the first round ratings of 3 raters who did not respond on the second round.)

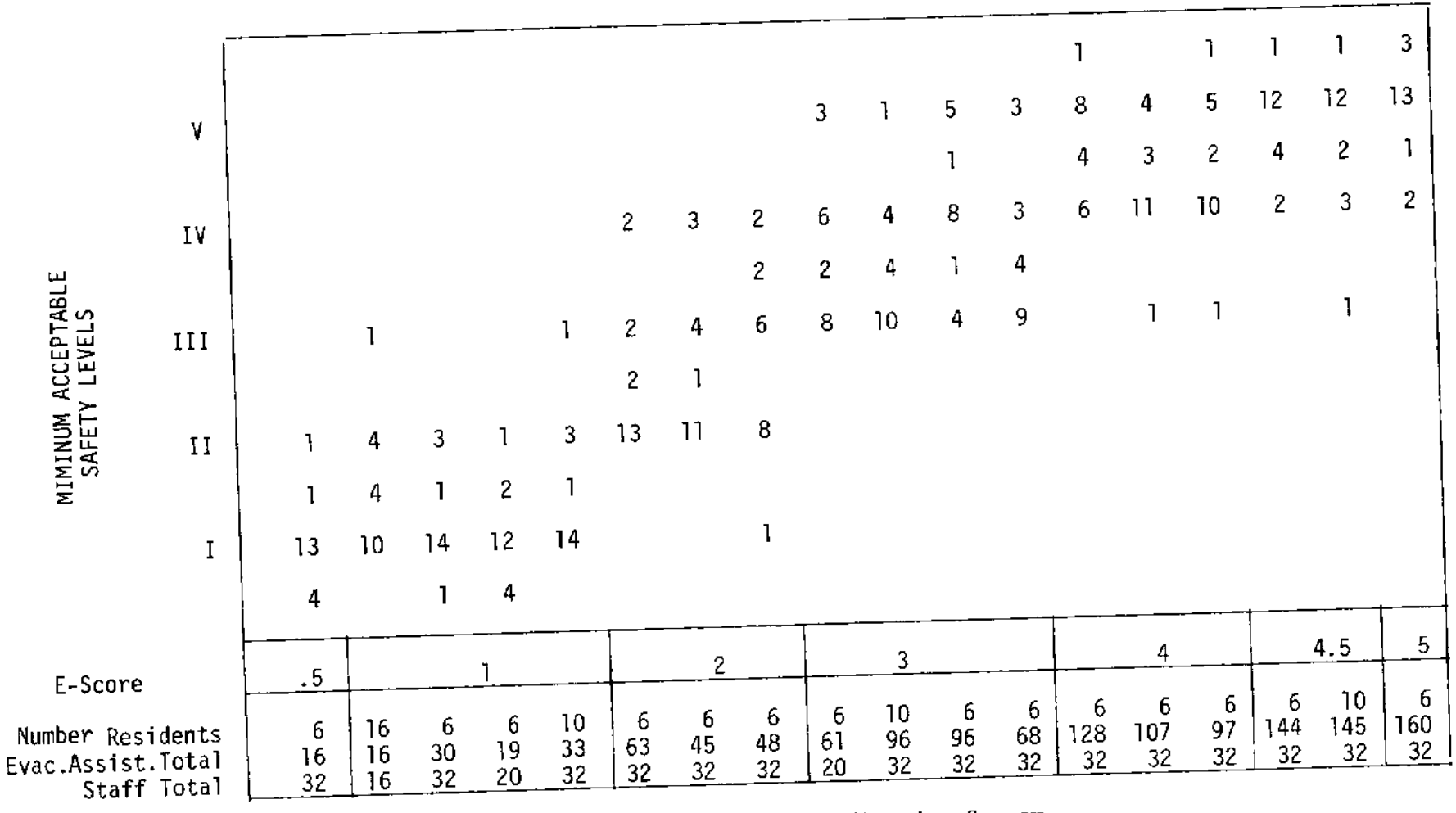

Figure 13. Results of Calibration Survey

The experts were also asked to judge the maximum E-Score for each of the five defined levels of fire protection. The results of that exercise were not used except for heeding a very strong recommendation by one expert to decrease the number of levels. (The number of levels was decreased by one (to four) by dropping Level II and modifying Level III. The four levels were endorsed at the next joint meeting of the Building Fire Safety Panel and the Human Behavior Consulting Panel.)

4. The project staff analyzed the responses of the experts and calculated the following tentative values for calibration:

Level	E-Score
I	0 to 1.0
II	> 1.0 to 1.8
III	> 1.8 to 2.6
IV	> 2.6 to 3.6
V	> 3.6

These were changed during the calibration process.

7.4 Recommendation of Calibration Panel

A new panel of experts reviewed and discussed the calibration table and made recommendations for changes. This new panel -- called the Calibration Panel -- is identified by name in Appendix D. There was a deliberate attempt to have a mixture of experts with previous in-depth knowledge of the system (i.e., member of previous panels) and experts with no previous association with the development of the system.

The Calibration Panel met for three days in October 1981, as the field test was nearing completion. Actual facilities -- including floor diagrams -- were presented to the panel with actual and with fictional groups of residents and staff. The fictional cases were developed to illustrate possible break points between the levels on the calibration table. For some of the fictional cases, evacuation times computed by the Escape and Rescue Model for Board and Care Homes (see Appendix G) were also presented to the panel.

Prior to the meeting of the Calibration Panel, the number of levels of requirements was cut from five to four as recommended by the Building Fire Safety Panel.

As the Calibration Panel reviewed the specific cases, the conservatism of the system for rating residents became increasingly apparent. For example, residents who can and will evacuate but have not yet demonstrated a mastery of an alternate strategy, are given four points even though they are unlikely to have difficulty evacuating. The Panel consistently rejected borderline cases based on the preliminary calibration (adjusted for the change in number of levels) as being too conservative. They recommended the following values for calibration which are the values in Section 21-1.3.1 of the proposed Chapter 21. (See Appendix A of this report.)

Level	E-Score
A	0 to 1.5
B	> 1.5 to 3.0
C	> 3.0 to 5.0
D	> 5.0

8. OPERATING FEATURES

The proposed Chapter 21 for the Life Safety Code prescribes a set of fire protection features of the building prepared by the Residential Subcommittee of the NFPA Committee on the Safety to Life for inclusion in the Life Safety Code. Chapter 31 of the Life Safety Code prescribes a set of required operating features such as conducting fire drills; proposed amendments to this chapter are included at the end of Appendix A, pages 92 and 93. The proposed Chapter 21 was developed with the assumption that the facility will follow the Operating Procedures of Chapter 31 with the proposed additions.

The proposed amendments to Chapter 31 were developed to make the total package of recommendations complete. The value of some of the requirements in the proposed Chapter 31 is obvious and consistent with generally accepted safety practices and/or with other requirements already in the Life Safety Code; for example, the requirement for fire drills. One of the requirements warrants some discussion.

The proposed amendment includes the requirement that an exit must be used in fire drills if it is to be considered as an exit in rating the building. Residents of burning buildings often are killed or injured when they fail to use the egress route that is more remote from the fire. There are two main reasons for this:

1. The remote route is not safe or is not usable. For example, it has been hypothesized that elderly residents in the Bradley Beach, New Jersey [6] fire were unable to negotiate a steep outside ladder in the escape route.

2. The remote route is not sufficiently familiar to the residents so in an emergency they fail to remember it. In stressful situations people, in general, will choose only familiar exit routes and those whose mental functioning is poor are likely to use only those routes used in fire drills. For example, in the Keansburg, New Jersey fire, the residents in the second floor woman's wing were not drilled in the use of the back exit, the fire blocked the main stairs, several women failed to exit and died, and no residents used the back exit [5].

9. FUTURE ACTIVITIES

9.1 Introduction

The fire safety requirements in the proposed Chapter 21 of the Life Safety Code developed by the Residential Subcommittee of the NFPA Committee on the Safety to Life (see Appendix A) and the Fire Safety Evaluation System for Board and Care Homes (FSES/B&C) proposed in this report (see Appendices B and C) can help provide the residents of board and care homes adequate fire safety at a reasonable cost, and with minimum interference with the programmatic goals of the homes. However, additional work is needed for these to be adopted and used by regulatory bodies. This will require the efforts of various groups. In this chapter, the tasks are outlined with only minimal reference regarding who may undertake the tasks.

9.2 Adoption by NFPA for Inclusion in the Life Safety Code

Most local, state and Federal authorities will not adopt new fire safety requirements until they are adopted by some model code or the adoption by the model code appears assured. Throughout the development program, the target model code has been the Life Safety Code published by the National Fire Protection Association (NFPA). The NFPA technical committees are now considering the proposed Chapter 21 and the FSES/B&C for inclusion in the 1984 edition of the Life Safety Code. The NFPA review process includes careful study by the appropriate committees, modification of the NBS submission as deemed necessary, prepublication of a draft for public comments, and a response to each public comment. This review involves a substantial workload.

9.3 Administrative and Audit Policies

Adoption of any new set of fire safety requirements requires establishing rules for its adoption. Some of the decisions or rules that need to be considered cover the following questions:

1. Who shall be permitted to rate the capabilities of the residents? What government agency should be responsible for the accuracy of these ratings?

2. How often are residents rated? Should the ratings be more frequent for the elderly than for the mentally retarded?

3. Is it necessary to recompute the E-Score each time there is a new resident?

4. How severely should a high functioning new resident's score be increased during the period he is learning the fire drill procedures of the home?

5. Are waivers to be permitted and, if so, what kind? What is the waiver procedure?

6. Are there any minimal training or experience requirements for those who will evaluate the fire safety of the building?

Since there is a wide variety of Board and Care Homes, decisions must be made for each type of facility; and they need to be flexible enough to accommodate special situations.

9.4 Training and Training Aids

Appendices B and C are intended to be complete, clearly written and unambiguous. However, the average user does not have the time, patience, and technical background to properly learn the requirements solely from reading and studying them. For example, the National Fire Protection Association is continually conducting courses so that fire professionals can better understand the Life Safety Code. They also publish the Life Safety Code Handbook to make it easier for people to use the Life Safety Code. When the Fire Safety Evaluation System for Health Care Facilities was adopted by the Health Care Financing Administration (HCFA) of the Department of Health and Human Services (HHS), over 400 experienced state surveyors were trained in a week long course. It should be expected that a majority of potential users will undoubtedly need training, more readable documentation, or other assistance to fully appreciate and understand the new recommended fire safety procedures and requirements for Board and Care Homes.

HHS has taken a first step in familiarizing the fire safety community with the FSES/B&C by giving a grant to the National Fire Protection Association (NFPA), and by asking NBS to assist the NFPA staff in becoming knowledgeable about the NBS work. Similar programs should be established to familiarize providers. In-depth training courses and self-instructional materials are also needed.

9.5 Additional Testing

The tests described in Section 6 were designed, coordinated and analyzed by the same group at NBS that developed the FSES/B&C and the basis for the proposed Chapter 21. Some local and state, or other groups may wish to conduct their own tests as part of a process to better understand or refine the procedures prior to adoption; this first hand experience should increase confidence in the appropriateness of the requirements.

Additional tests to determine rater reliability of the final form and glossary for rating residents would provide improved data for evaluating the rating procedure. (See Section 4.2.4.)

9.6 Simplification of the FSES/B&C

In developing the FSES/B&C, a major concern was to keep it as simple as possible. Despite a continuous -- and basically successful -- effort to avoid unnecessary complications, using the system for evaluating evacuation difficulty for very large buildings appears to be a formidable task.

Not only is there a need to keep the records of a large number of residents current, but the regulatory authority may require a recomputation of the E-Score each time a new resident arrives and each time a current resident becomes more disabled.

Attention could be given either to simplifying the system itself when evaluating large facilities or to developing procedures and aids to make it easier to maintain the required records (e.g., make use of a personal computer).

9.7 Research

9.7.1 Need for Additional Research

In the development of the material in Appendices B and C, an effort was made to use the available research base of the field. For example, the NBS Delphi Group and the Fire Protection Consulting Panel were informed of the results of the full scale NBS fire tests to determine the response of smoke detection in rooms and hallways to bedroom and patient room fires before they made their recommendations regarding the value of ionization, photoelectric, and heat detection [23]. Similarly, they were informed of the results of studies to determine the impact of sprinkler protection on smoke production before they made their recommendations regarding the value of sprinklers on the protection of egress routes [24]. A continuation of this research effort is important in obtaining wide acceptance and use of the FSES/B&C.

As the FSES B&C and proposed Chapter 21 are evaluated and/or are used, suggestions for revisions, improvements and corrections should be anticipated. About one year after the final inclusion of the recommendations into the Life Safety Code, the deadline will pass for recommended changes for the next edition of the Life Safety Code. An improved technical base will enhance the evaluation of these suggested changes.

9.7.2 General Areas for Future Research

A key concept in this work is that: (1) a building provides a relatively safe egress for an assured period of time for all anticipated fires; (2) a group of residents and staff can with good assurance evacuate a given building in a known period of time; and (3) a board and care home has satisfactory safety if the "maximum" evacuation time is less than the "minimum" time available for safe egress. Additional research is needed so that more technically supported estimates of these times are available.

Much of current fire research will contribute toward improving procedures for estimating the time available for safe egress in fire emergencies. The application of this research to estimating safe egress times for residential buildings is not an active research area. The human factor research related to estimating time necessary for disabled residents to evacuate has never had substantial funding and currently there is no known funding for this research.

10. SUMMARY

There is a unique class of building occupancy comprised of board and care homes. This class of occupancy involves residents with a wide range of capabilities, various staff to resident ratios, a multitude of types and sizes of structures, and varying installed fire safety features. At present, most codes do not recognize this occupancy class. Application of any of the traditional occupancy classes will either fail to assure sufficient safety or demand high levels of protection that result in excessive over design for many homes. The National Fire Protection Association (NFPA) has recognized this problem and is developing a set of requirements for this occupancy to be published as Chapter 21 of the next edition of the Life Safety Code.

Many of these homes are in existing buildings built for other purposes. If a specification oriented code is applied to a wide variety of these homes, there will be difficult, expensive, and often unnecessary retrofit problems. To help avoid such problems and to provide a rational method for considering alternative approaches, a Fire Safety Evaluation System for Board and Care Homes (FSES/B&C) has been developed.

Fire Safety Evaluation Systems, including the Fire Safety Evaluation System for Board and Care Homes, are designed to evaluate the level of safety of a building as compared to the level prescribed by an established code. Their use permits tradeoffs among fire safety features. In addition, the FSES/B&C contains a procedure for relating the time needed for the emergency evacuation of a board and care home to the level of fire protection features needed by that home. Specifically, the FSES/B&C includes a subsystem for rating the staff and residents on evacuation capability (see Appendix B) and a separate subsystem for evaluating the fire protection features of the building (see Appendix C).

Appendix C contains three subsystems for evaluating the fire safety of:

- small dwelling units housing 16 or fewer residents
- large residential facilities
- apartment houses containing board and care homes in one or more individual apartment units.

Within each subsystem are several levels of fire protection where the higher levels of protection are applied to homes housing more disabled residents.

The FSES/B&C has been proposed to the NFPA for inclusion in the Life Safety Code, as a means of establishing equivalence to the requirements of the proposed Chapter 21 developed by the Resedential Subcommittee of the Committee on Safety to Life of the National Fire Protection Association.

Since fire safety evaluation systems evaluate the level of safety of a building as compared with the level prescribed by a code, and since the existing Life Safety Code did not yet contain a chapter specifically for board and care homes, it was necessary for the project staff to develop a set of criteria for this comparison. The set of criteria selected was designed to provide a similar level of safety as other occupancy chapters of the Life Safety Code using similar fire protection strategies and equipment. Subsequently, the Residential Subcommittee of the NFPA Committee on the Safety to Life prepared a proposed Chapter 21 after

reviewing the NBS criteria. The proposed Chapter 21 agreed in general with the NBS criteria with some differences. The FSES/B&C was adjusted to be used with the proposed NFPA Chapter 21.

If an adopted code of regulations is exactly as the draft of the proposed Chapter 21 printed in Appendix A of this report, the Fire Safety Evaluation System is directly applicable as printed in Appendices B and C. Otherwise, it may be necessary to generate new sets of "mandatory" values for Table 3 in the affected Fire Safety Evaluation Worksheet using the method described in Section 5.2.8.

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APPENDIX A
PROPOSED CHAPTER 21 AND ASSOCIATED ADDITIONS TO
CHAPTER 31 AND APPENDIX A OF LIFE SAFETY CODE

Chapter 21. Residential Board and Care Occupancies

Section 21-1. General Requirements

21-1.1 Application

21-1.1.1 This code has differing requirements for the several types of residential occupancies; thus, the Code has several residential occupancy chapters, Chapters 16 through 23.

21-1.1.2 All facilities whether staffed or unstaffed, classified as Residential Board and Care Occupancies shall conform to the requirements of this Chapter. This Chapter is divided into four sections as follows:

(a) Section 21-1 General.

(b) Section 21-2 Small Facilities. (i.e., Sleeping accommodations for not more than 16 persons).

(c) Section 21-3 Large Facilities (i.e., Sleeping accommodations for 17 or more persons).

(d) Section 21-4 Apartment Buildings with Board and Care Occupancies.

21-1.1.3 Objective and Concept. The objective of this Chapter is to provide a reasonable level of safety to individuals within Residential Board and Care Occupancies by reducing probability of injury and loss of life from the effects of fire, with due consideration for the operational function of the facility; capabilities and limits of the residents; the presence, availability, and capability of facility staff; as well as traditional fire safety features. The object of the several levels of criteria presented is to provide the appropriate degree of fire control and fire containment, to prevent the advance of fire effects to the extent necessary for the building occupants to have sufficient time to become aware of the fire threat and to execute emergency evacuation to a point of safety. This includes any assistance by the staff if any of the residents need assistance or direction in completion of actions necessary for their safety.

21-1.1.4 The provisions of Section 5-12 do not apply to this chapter.

21-1.2 Mixed Occupancies.

21-1.2.1 Where another type of occupancy occurs in the same building as residential board and care occupancy, the requirements of 1-4.5 of this Code shall apply.

Exception No. 1: Occupancies that are completely separated from all portions of the building used for residential board and care facility and its exit system by construction having a fire resistance rating of at least two hours.

Exception No. 2: Apartment buildings housing residential board and care occupancies in conformance with section 21-4. In such facilities any safeguards required by Section 21-4 that are more restrictive than those for other housed occupancies apply only to the extent prescribed by Section 21-4.

21-1.3 Definitions.

Residential Board and Care Occupancy. A building or part thereof that is used for the lodging and boarding of four or more residents not related by blood or marriage to the owners or operators to provide personal care services, but not to provide nursing care. Following are examples of facilities that normally classify as Residential Board and Care Occupancies.

(a) A group housing arrangement for physically or mentally handicapped persons who normally work in the community, attend school in the community, attend church in the community or otherwise use community facilities.

(b) A group housing arrangement for physically or mentally handicapped persons who are undergoing training in preparation for independent living, for paid employment or for other normal community activities.

(c) A group housing arrangement for the elderly that provides personal care services but that does not provide nursing care.

(d) Facilities for social rehabilitation, such as those used for the treatment of alcoholism, drug abuse, or mental health problems, that contain a group housing arrangement, and that provide personal care services but do not provide nursing care.

(e) Other group housing arrangements that provide personal care services but not nursing care.

Personal Care. "Personal care" means protective care with or without watchful oversight of a resident who does not have an illness or a condition which requires chronic or convalescent medical or nursing care with a 24-hour responsibility for the safety of the resident when in the building. Protective care with or without watchful oversight may include a daily awareness by the management of the resident's functioning, his or her whereabouts, the making and reminding a resident of appointments, the ability and readiness to intervene if a crisis arises for a resident, supervision in areas of nutrition, and medication and actual provision of transient medical care.

Evacuation Capability. Evacuation capability is the capability of the group, residents and staff, to evacuate the building or relocate from the point of occupancy to a point of safety. The evacuation capability shall be determined by the authority having jurisdiction. The basis for the evaluation shall be that time at which evacuation is considered to be most difficult. The following levels of evacuation capability are recognized by this Chapter:

(a) Prompt. Evacuation capability equivalent to that envisioned for the general population in the Life Safety Code criteria for Residential Occupancies covered under Chapters 16, 17, 18, 19, 20 and 22. This is normally accepted as the ability to relocate all of the endangered occupants to a point of safety within approximately three minutes from alarm or other alerting signal.

(b) Moderate. Groups that can successfully execute evacuation and relocate to a point of safety in approximately 5 minutes longer than that defined as prompt evacuation.

(c) Slow. Groups that can successfully execute evacuation and relocate to a point of safety in approximately 10 minutes longer than that defined as prompt evacuation.

(d) Impractical. Groups that cannot successfully execute evacuation and relocate to a point of safety within approximately 10 minutes longer than that defined as prompt evacuation.

One method for evaluating the evacuation capability of a group is presented in Appendix B of this report. When using this method, quantitative definitions of evacuation capability shall be:

(1) Prompt - Evacuation difficulty score is not greater than 1.5.

(2) Moderate - Evacuation difficulty score is greater than 1.5 but not greater than 3.

(3) Slow - Evacuation difficulty score is greater than 3 but not greater than 5.

(4) Impractical - Any evacuation difficulty score greater than 5.

Point of Safety. A point of safety is a location that meets one of the following:

a. Is exterior to and away from the building.

b. Is within a building of any construction protected throughout by an approved automatic sprinkler system and is either:

(1) Within an exit enclosure meeting the requirements of Chapter 5, or

(2) Within another portion of the building which is separated by smoke barriers of at least a 20 minute fire resistance rating and that portion of the building has access to a means of escape or exit conforming to the requirements of Chapter 5 which does not require return to the area of fire involvement.

c. Is within a building of Type I, Type II(222) or (111), Type III(211), Type IV, or Type V(111) construction and is either:

(1) Within an exit enclosure meeting the requirements of Chapter 5, or

(2) Within another portion of the building which is separated by smoke barriers of at least a 20 minute fire resistance rating and that portion of the building has access to a means of escape or exit conforming to the requirements of Chapter 5 which does not require return to the area of fire involvement.

Resident. A person who is receiving personal care and resides in a Residential Board and Care Facility.

Staff. A person who provides personal care or services, supervision or assistance to residents.

Section 21-2 Small Facilities.

21-2.1 General.

21-2.1.1 Scope. This Section applies to Residential Board and Care Occupancies providing sleeping accommodations for 16 or fewer residents. Where there are sleeping accommodations for 17 or more residents, the Occupancy will be classed as a Large Facility. The requirements for Large Facilities are in Section 21-3.

21-2.1.2 The requirements of this Section are applicable to new construction and existing buildings according to the provisions of Section 1-4 of this Code.

21-2.2 Level of Requirements Based on Evacuation Capability. Small Facilities shall comply with the requirements listed in Table 21-1 as defined in this Section on the following basis:

(a) Facilities housing groups capable of prompt evacuation shall meet or exceed the requirements for Level A.

(b) Facilities housing groups not capable of prompt evacuation but capable of moderate evacuation shall meet or exceed the requirements for Level B.

(c) Facilities housing groups not capable of prompt or moderate evacuation but capable of slow evacuation shall meet or exceed the requirements for Level C.

(d) Facilities housing groups classed as impractical to evacuate shall meet or exceed the requirements for Level D.

Exception No. 1: Small Residential Board and Care Occupancies found to have equivalent safety. One method for determining this equivalency is given in

TABLE 21-1. Minimum Requirements for Small Board and Care Occupancies

	Basic Minimum Requirements by Building Level* Maximum Number of Residents - 16			
	LEVEL A	LEVEL B	LEVEL C	LEVEL D**
1. CONSTRUCTION (See Item 1 of notes)	Exposed structural members.		Protected *** (20 min.).	1-hr. fire *** resistant.
2. MEANS OF EMERGENCY ESCAPE (See Item 2 of notes)	One primary route and one emergency alternate means.	Two remote routes, one is primary and separated.		
3. PROTECTION OF VERTICAL OPENINGS (See Item 3 of notes)	Stairs or other vertical openings protected to prevent exposure to sleeping floors. Fire resistance of at least 20 minutes.			
4. PROTECTION FROM HAZARDOUS AREAS (See Item 4 of notes)	Any hazardous areas are protected per Item 4 of notes.			
5. INTERIOR FINISH (See Item 5 of notes)	Class A, B, or C for walls and ceilings. No special requirements for flooring materials.	Class A or B for walls and ceilings. No special requirement for floor covering materials.		
6. MANUAL FIRE ALARMS (See Item 6 of notes)	Local fire alarm or equivalent ability to alert and arouse occupants.			
7. SMOKE DETECTION AND ALARM (See Item 7 of notes)	At least one smoke detector on each level with sufficient alarm audibility to be heard in each bedroom.			
8. EXTINGUISHMENT REQUIREMENTS (See Item 8 of notes)	Any sprinklers are installed per Item 8 of notes.			
9. SEPARATION OF SLEEPING ROOMS (See Item 9 of notes)	Smoke resisting.		20 minute fire resistance.	20 minute fire resistance doors automatic closing on smoke detection.
10. OPERATIONAL REQUIREMENTS (See 31-9)	All staff members and all residents required to participate in regular fire drills that familiarize all participants with both primary and alternative emergency procedures.			

* See 21-2.2 (Exception 1) for guidance on determination of equivalent alternatives.

** See 21-2.2 (Exception 2) for alternative use of health care facility requirements.

*** See Item 1-a of notes for classification of construction with full or partial sprinkler systems.

Appendix C of this report.

Exception No. 2: Facilities meeting the nursing home requirements of Chapter 12 for New Health Care Occupancies or Chapter 13 for Existing Health Care Occupancies.

Exception No. 3: Facilities complying with Section 21-3.

NOTES FOR TABLE 21-1.

Item 1. Construction Requirements for Small Facilities.

a. Small facilities are of construction types defined in NFPA 220, Standard Types of Building Construction, except as modified herein. The requirements in Table 21-1 are interpreted as follows:

(1) Sprinklered Construction. If a building housing a small residential board and care facility is partially covered by automatic sprinklers, the construction classification is based on the fire resistance of the unsprinklered portion(s) of the building. If the building is provided with a complete automatic sprinkler system, the construction is considered equivalent to that provided by a 1-hour fire resistance rating.

(2) Inaccessible Spaces. Unfinished, unused, and essentially inaccessible loft, attic, or crawl spaces are not considered in determining the construction classification.

b. Exposed Structural Members. No sheathing or fire resistance rating is required.

c. Protected (20 Min.). Buildings where the interior is fully sheathed with lath and plaster, gypsum board, or equivalent protection. Also, any type of construction where all portions of the bearing walls, bearing partitions, floor constructions, roofs, and all columns, beams, girders, trusses or similar bearing members either have an inherent fire resistance or are finished, encased, or otherwise treated to provide a minimum of at least a 20 minute fire resistance.

Exception: Buildings with the only exposed steel or wood serving as columns and support beams (but not joists) located in the basement area, will be considered as fully sheathed.

d. One-hour fire resistance. Buildings conforming with the definition of Type I, Type II (111), Type III (211), Type IV or Type V (111) construction.

Item 2. Means of Emergency Escape for Small Facilities.

a. One Primary Route and One Alternative Means.

(1) Every sleeping room has access to a primary route of escape so located as to provide a safe path of travel to the outside of the building without traversing any corridor or space exposed to an unprotected vertical opening. Where the sleeping room is above or below a level of exit discharge, the primary means is an enclosed interior stairway, an exterior stairway, or a horizontal exit.

(a) An enclosed interior stairway is physically separated from all spaces not on the floor of the sleeping room. The stairway discharges to the outside without traversing any spaces other than a protected lobby or corridor. The separation has a fire resisting capability of at least 20 minutes. Doors are at least equivalent to 1 1/4 inch thick bonded wood core construction. The stairway enclosure shall also comply with requirements of 5-2.2.2.2. All openings into the enclosure on floors other than the highest floor housing sleeping rooms are protected with smoke detector operated automatic or self-closing doors having a fire resistance comparable to that

required for the enclosure. Where the enclosure serves as the primary route for more than one sleeping room floor, the enclosure separates the stairway from all floors served.

(b) Exterior stairs may be of combustible construction.

(2) In addition to the primary means there is one emergency alternative means of escape for each sleeping room. This route includes either:

(a) A door or stairway providing a means of unobstructed travel to the outside of the building at street or ground level, or

(b) an outside window in the room operable from the inside without the use of tools and providing a clear opening of not less than 20 inches (50.8 cm) in width, 24 inches (60.9 cm) in height, and 5.7 square feet (.53 square m) in area. The bottom of the opening is not more than 44 inches (111.76 cm) above the floor.

Exception: If the bedroom has a door leading directly outside of the building with direct access to grade, that door is considered to fulfill the requirements for both a primary route and alternative means for that bedroom.

b. Two Remote Routes, One is Primary and Separated.

(1) Two Remote Routes. To meet the requirement for two remote routes, each bedroom has access to two routes leading to two separate building exit doorways.

(2) Primary and Separated Routes. To meet the requirement for a primary and separated route, the route provides a path of travel to the outside of the building without traversing any corridor space exposed to unprotected vertical openings or common living spaces (e.g., living rooms, kitchens, etc.). The other route provides an alternative path of travel to the outside.

c. Common Requirements for Means of Emergency Escape. The following requirements apply to all elements in the means of emergency escape as applicable:

(1) No exit route will be considered as complying with the minimum criteria for acceptance unless emergency evacuation drills are regularly conducted using that route in accordance with the requirements of Section 31-9.3.

(2) No required path of travel to the outside from any room is through another room or apartment not under the immediate control of the occupant of that space nor through a bathroom or other space subject to locking.

(3) No door in the path of travel of a means of egress is less than 28 inches (71.12 cm) wide.

Exception: Bathroom doors may be 24 inches (60.96 cm) wide.

(4) Every closet door latch is such that it can be readily opened from the inside in case of emergency.

(5) Every bathroom door lock is designed to permit the opening of the locked door from the outside in an emergency.

(6) Exterior doors may be swinging or sliding and are exempt from the requirements of 5-2.1.1.4.1.

Item 3. Protection of Vertical Openings for Small Facilities.

Vertical openings are protected so that no primary exit route is exposed to an unprotected vertical opening. A vertical opening is considered protected if the opening is cut off or enclosed in a manner that provides fire resistance

capability of at least 20 minutes. Any doors in the opening are 1 3/4 inch thick bonded wood core construction or equivalent and are automatic closing on detection of smoke or self-closing. (See Item 2.a.(1) for requirements when an enclosed interior stairway is involved.)

Item 4. Protection From Hazardous Areas in Small Facilities

a. A hazardous area is any space that contains a storage or other activity having fuel conditions exceeding that normal to a one or two family dwelling and possessing the potential for a fully involved fire.

b. Examples of hazardous areas include, but are not limited to:

(1) Areas for cartoned storage, food or household maintenance items in wholesale or institutional type quantities and concentrations.

(2) Massed storage areas of resident's belongings.

Exception: Areas containing approved, properly installed, and maintained furnaces and heating equipment; furnace rooms, cooking, and laundry facilities are not classed as hazardous areas on the basis of such equipment.

c. If a hazardous area is on the same floor as, and is in or abuts, a primary egress route or a sleeping room the hazardous area protection consists of:

(1) An enclosure with a fire resistive rating of at least 1-hour with a self-closing or smoke operated automatic closing fire door having a fire protection rating of at least 3/4 hour, or

(2) Sprinkler protection of the hazardous area and a separation that will resist the passage of smoke between the hazardous area and the exposed sleeping area or primary exit route. Any doors in such separation are self closing or automatic closing on smoke detection. The closing device is not required for hazardous spaces where the nature of the space is such that the door is kept closed at all times.

d. Other hazardous areas are protected by either:

(1) A fire resistant enclosure that has approximately 20 minutes fire resistance construction with a self-closing or smoke detector operated automatic closing door at least equivalent to 1 3/4-inch solid core construction.

(2) Sprinkler protection of the hazardous area regardless of enclosure.

Item 5. Interior Finish for Small Facilities.

Interior finish on walls and ceilings of occupied space is in accordance with Table 21-1 and as defined in Section 6-5. There are no requirements for interior floor finish.

Exception: Exposed portions of structural members complying with requirements of Type IV (2HH) construction may be permitted.

Item 6. Manual Fire Alarms for Small Facilities.

A fire alarm system is installed and meets one or more of the following requirements:

a. The requirements of Section 7-6 for manual fire alarm systems.

b. A smoke detection system that meets or exceeds the requirements of Item 7 and includes at least one manual activation station per floor arranged to sound the smoke detector system alarm.

c. There is no fire alarm system that meets the requirements of a or b above, but the facility is of such a small size that in the opinion of the authority having jurisdiction a vocal call will be heard by all occupants. Normally, such a facility does not have more than 2 levels, including basements, and not more than 8 residents, all sleeping on the same floor.

Item 7. Smoke Detection and Alarm Systems for Small Facilities.

Approved smoke detectors, meeting the requirements of NFPA 74, Standard for Household Fire Warning Equipment, and powered by the house electrical service, are installed on each floor level including basements, but excluding crawl spaces and unfinished attics. When activated, the required detectors initiate an alarm which is audible in all sleeping areas.

Item 8. Extinguishment Requirements for Small Facilities.

a. Where sprinkler protection is provided the automatic sprinkler system is installed in accordance with:

(1) NFPA 13, Standard for Installation of Sprinkler Systems, or

(2) NFPA 13D, Standard for the Installation of Sprinkler Systems in One and Two-Family Dwellings and Mobile Homes.

b. Partial sprinkler systems involving more than 6 sprinklers shall comply with the above requirements except for extent of the coverage.

c. Sprinkler piping serving not more than 6 heads for any location may be connected directly to a domestic water supply having a sufficient capacity to meet the water supply for those sprinklers (as required by NFPA 13 or NFPA 13D, as appropriate). An indicating shut-off valve is installed in an accessible location on the supply side of the connection of the domestic water supply serving that area and the sprinkler system.

d. Any sprinkler system involving more than two sprinklers is provided with an alarm that will sound on the discharge of water from one or more sprinklers. This may be accomplished with a water flow alarm or through the sounding of the building fire alarm. If the alarm is by water flow alarm, that alarm has sufficient audibility to be heard in all sleeping areas in the building.

Item 9. Separation of Sleeping Rooms in Small Facilities.

a. The requirements for separation of sleeping rooms set forth in Table 21-1 are interpreted as follows:

Exception: Sleeping arrangements not in bedrooms may be provided for non-resident staff members provided the audibility of the alarm at the sleeping area is sufficient to awaken the staff who might be asleep.

(1) Smoke Resisting. Sleeping rooms are separated from corridors or other common spaces of the building by walls and doors that are capable of resisting the passage of smoke. There are no transfer grills, louvers, or operable transoms or other air passages penetrating the wall except properly installed heating and utility installations. Doors are provided with latches or other mechanisms suitable for keeping the doors tightly closed. Glass viewing panels may be used in doors or partitions without limits on size or type.

(2) 20-Minute Fire Resistance. Sleeping rooms are separated from corridors or other common spaces of the building by separations meeting the requirements of (1) above and have at least 20 minute fire resistance rating or equivalent. This rating is considered to be achieved if fire resistance is demonstrated by acceptable tests or if the partitioning is sheathed on both sides with lath and plaster, gypsum board or equivalent sheathing. Doors have

at least a 20 minute fire protection rating. Doors are considered as having such fire resistance if they are 1-3/4 inch (4.45 cm) solid core wood construction or any other arrangement of equal or greater stability and fire integrity. The thermal insulation capability of the door is not considered. Hollow sheet steel doors are considered to meet the 20 minute requirement. Any vision panels are of wired glass, not exceeding 1296 sq. in. (0.84 sq. m.) of area each, installed in approved frames.

Exception: Partitions and doors meeting the requirements of (1) above where automatic sprinklers are provided on both sides of the partition.

(3) 20-Minute Fire Resistance, Doors Automatic Closing on Smoke Detection. Sleeping rooms are separated in accordance with (2) above and the doors to all bedrooms are automatic closing. Automatic closing doors are considered acceptable if the doors have an arrangement that holds them open in a manner such that they will be released by a smoke detector operated device (e.g., magnetic or pneumatic hold open device) prior to the passage of significant smoke from the space of fire origin into the corridor or from the corridor into the protected room. Smoke detectors for operation of such doors are either integral with the door closers, mounted at each door, or operated from a total smoke detector system covering both the room and corridor. Any vision panels are of wired glass, not exceeding 1296 sq. in. (0.84 sq. m.) of area each, installed in approved frames.

(4) Self-closing devices for doors on individual rooms are considered to meet the requirements for automatic door closing when it can be established that the doors:

a. are constantly kept in the normally closed position except for the passage of occupants, or

b. are provided with traditional self-closing mechanisms and have occupant controlled locks such that access is normally (other than emergency) restricted to the occupants or staff personnel.

c. do not have any automatic closing mechanisms but one of the following conditions exists.

1. The corridors involved are under continual direct observation by staff during all times residents are in the facility. The level of observation equals or exceeds that provided by staff at nursing stations in hospitals.

2. The corridors involved are not under continual direct observation by staff but the building (or zone) involved is provided with a smoke detection and alarm system that covers the corridors, common spaces, and bedrooms. The alarm system is so arranged as to give immediate alarm to all the occupants and to staff available to respond.

Exception: Smoke detectors are not required in bedrooms when staff is always awake and can respond to any bedroom within 30 seconds of alarm.

3. The building is provided with a complete automatic sprinkler system.

Section 21-3 Large Facilities

21-3.1 General

21-3.1.1 Scope. This Section applies to Residential Board and Care Occupancies providing sleeping accommodations for 17 or more residents. Normally, facilities having sleeping accommodations for 16 or fewer residents will be evaluated in accordance with Section 21-2, Small Facilities. However, facilities meeting the requirements of this Section are considered to meet the requirements of Section 21-2.

21-3.1.2 The requirements of this Section are applicable to new construction and existing buildings according to the provisions of Section 1-4 of this Code.

21-3.2 Level of Requirements Based on Evacuation Capability. Large Facilities shall comply with the requirements listed in Table 21-2 as defined in this Section on the following basis:

(a) Large Facilities of one or two stories housing groups of 30 or fewer residents, capable of prompt evacuation, shall meet or exceed the requirements of Level A.

(b) Large Facilities of one or two stories housing groups of 30 or fewer residents not capable of prompt evacuation but capable of moderate evacuation, shall meet or exceed the requirements of Level B.

(c) Large Facilities of more than two stories, or housing groups of more than 30 residents capable of prompt or moderate evacuation, shall meet or exceed the requirements for Level C.

(d) Large facilities housing any number of residents where the group is not capable of prompt or moderate evacuation but capable of slow evacuation, shall meet the requirements for Level C.

(e) Large Facilities housing any number of residents where the group is not capable of prompt, moderate, or slow evacuation (i.e., classed as impractical to evacuate), shall meet or exceed the requirements of Level D.

Exception No. 1: Large Residential Board and Care Occupancies found to have equivalent safety. One method for determining this equivalency is given in Appendix C of this report.

Exception No. 2: Facilities meeting the requirements of Chapter 12 for New Health Care Occupancies or Chapter 13 for Existing Health Care Occupancies.

TABLE 21-2. Minimum Requirements for Large Board and Care Occupancies

	Basic Minimum Requirements by Building Level*			
	LEVEL A	LEVEL B	LEVEL C	LEVEL D**
MAXIMUM NUMBER OF RESIDENTS	30	30	NO LIMIT	NO LIMIT
1. CONSTRUCTION (See Item 1 of notes)	See Table 21-3.			
2. MEANS OF EGRESS (See Item 2 of notes)	Meets requirements of Item 2 of notes including: At least 2 exits per floor. (See Item 2-d of notes for exception.) Maximum travel distance - 100 ft. from room doors to exits; 35 ft. dead ends in corridors. (See Item 2-f of notes for details and exceptions.)			
3. PROTECTION OF VERTICAL OPENINGS (See Item 3 of notes)	30 minutes.			
4. PROTECTION FROM HAZARDOUS AREAS (See Item 4 of notes)	Any hazardous areas are protected per Item 4 of notes.			
5. INTERIOR FINISH (See Item 5 of notes)	Class B for walls and ceilings and Class II for floor coverings in exit and exit access system, except no requirement for existing floor coverings. Class B for walls and ceilings in other areas. No requirements for floor coverings in other areas.			
6. MANUAL FIRE ALARM (See Item 6 of notes)	Local manual fire alarm system is installed per Item 6 of notes.			System with fire department notification
7. SMOKE DETECTION & ALARM (See Item 7 of notes)	Detection coverage of enclosed corridors and common spaces.			
8. EXTINGUISHING SYSTEM (See Item 8 of notes)	Any sprinklers are installed and extinguishers maintained per Item 8 of notes.			
9. SEPARATION OF SLEEPING ROOMS FROM EXIT ACCESS (See Items 9 and 11 of notes)	Door hardware per Item 11 of notes.	All bedroom doors require means that give a high expectation that doors will be closed at time of fire.		
	Walls-smoke resisting	Walls 20 minutes		Walls 1 hour (20 minutes existing)
	Doors-smoke resisting	Doors 20 minutes		Doors 20 minutes
10. SMOKE CONTROL (See Item 10 of notes)	No special requirements		Smoke barriers on each sleeping room floor.	
11. UTILITIES, HVAC	Utilities comply with the provisions of Section 7-1. Heating, ventilating and air conditioning equipment complies with the provisions of section 7-2.			
12. ELEVATORS, DUMBWAITERS AND VERTICAL CONVEYORS	Elevators, dumbwaiters, and vertical conveyors comply with the provisions of section 7-4.			
13. RUBBISH CHUTES, INCINERATORS AND LAUNDRY CHUTES	Rubbish chutes, incinerators, and laundry chutes comply with the provisions of section 7-5.			
14. OPERATIONAL REQUIREMENTS (see 32-9)	All staff members and residents are required to participate in regular drills that familiarize all participants with both primary and alternative emergency procedures.			

* See 21-3.2 (Exception 1) for guidance on determination of equivalent alternatives.

** See 21-3.2 (Exception 2) for alternative use of health care facility requirements.

NOTES FOR TABLE 21-2.

Item 1. Construction Requirements for Large Facilities

Construction requirements shall be determined in accordance with Table 21-3. The types of construction are those defined in NFPA 220, Standard Types of Building Construction. In Table 21-3, some building constructions are noted as "fully sheathed". Buildings where the interior is fully sheathed with lath and plaster, gypsum board or equivalent sheathing are considered to meet the requirement for this type of facility.

Any building of Type I or Type II (222 or 111) construction may include roofing systems involving combustible supports, decking, or roofing provided: (1) the roof covering meets Class A requirements in accordance with NFPA 256, Fire Tests for Roof Coverings, and (2) the roof is separated from all occupied portions of the building by a noncombustible floor assembly having at least a 2-hour fire resistance rating which includes at least 2 1/2 in. (6.35 cm) of concrete or gypsum fill. To qualify for this exception, the attic or other space so developed shall either be unused or protected throughout by an approved automatic sprinkler system.

For the purpose of this parameter, stories shall be counted starting at the primary level of exit discharge and ending at the highest occupied level. For the purposes of this section, the primary level of exit discharge of a building shall be that floor which is level with or above finished grade of the exterior wall line for 50 percent or more of its perimeter. Building levels below the primary level shall not be counted as a story in determining the height of a building.

Item 2. Means of Egress for Large Facilities

a. General Egress Requirements

(1) No means of egress is considered as complying with the minimum criteria for acceptance unless emergency evacuation drills are conducted using that means in accordance with section 31-9.3.

(2) Floors below the level of exit discharge used only for mechanical equipment, storage, and service operations have exits appropriate to the occupancy in accordance with other applicable sections of this Code.

(3) The same stairway or other exit required to serve any one upper floor may also serve other upper floors.

Exception: No inside open stairway, escalator, or ramp may serve as a required egress from more than one floor, unless it conforms to 6-2.2.3.4.

b. Types of Exits

(1) Exits or exit components are in accordance with Chapter 5, and consist of one or more of the following types:

(a) Doors to outside at ground level, in accordance with 5-2.1.

(b) Doors to exit passageways or tunnels, when such are in accordance with 5-2.7.

(c) Interior stairs, in accordance with 5-2.2.

(d) Smokeproof towers, in accordance with 5-2.3.

(e) Horizontal exits, in accordance with 5-2.4.

(f) Outside stairs, in accordance with 5-2.5.

TABLE 21-3 Minimum Construction Requirements for Large Board and Care Facilities

TYPE OF CONSTRUCTION	Highest Story Used for Residential Board and Care Occupancy				
	1-Story	2-Story	3-4 Story	5-6 Story	Over 6-Story
I or II(222)	D	D	D	D	D
II(111)	D	C D(AS)	C D(AS)	C D(AS)	C(AS)
II(000)	C D(AS)	C* D(AS)	C*(AS)	C*(AS)	NP
III(211)	C D(AS)	C D(AS)	C	C	C(AS)
III(200)	A,C* D(AS)	C* C(AS)	C*(AS)	C*(AS)	NP
IV(2HH)	C D(AS)	C D(AS)	C(AS)	C(AS)	C(AS)
V(111)	C D(AS)	C D(AS)	C(AS)	C(AS)	NP
V(000)	A,C* D(AS)	C* C(AS)	C*(AS)	NP	NP

A Permitted for Level A facilities whether or not facility is sprinklered.
C Permitted for Level A, B, or C facilities whether or not facility is sprinklered.
C* Permitted for Level A, B or C facilities if facility is fully sheathed.
C*(AS) Permitted for Level A, B, or C facilities if facility is both fully sheathed and sprinklered.
C(AS) Permitted for Level A, B, or C facilities if facility is sprinklered.
D Permitted for Level A, B, C, or D facilities whether or not facility is sprinklered.
D(AS) Permitted for Level A, B, C, or D facilities if facility is sprinklered.
NP Not permitted for board and care facility use.

(g) Ramps, in accordance with 5-2.6.

(h) Exit passageways, in accordance with 5-2.7.

(i) Existing stairs or fire escapes not complying with 5-2.2, or complying or not complying with 5-2.9 where continued use of such is approved by the authority having jurisdiction.

c. Capacity of Means of Egress

(1) Exits, arranged as specified elsewhere in this Section of the Code, are sufficient to provide for the occupant load on the basis of one person per 140 sq. ft. (13.0 sq. m) gross floor area, or on the maximum probable population of any room or section, whichever is greater, as follows:

(a) Doors, including those which are three risers or 24 in. (60.96 cm) above or below ground level, Class A ramps, and horizontal exits - 100 persons per unit of exit width.

(b) Stairs and other types of exits not included in (a) above - 75 persons per unit of exit width.

(2) Street-floor exits shall provide units of exit width as follows, occupant load being determined as above:

(a) One unit for each 100 persons street-floor capacity for doors and other level exits, including those that are 24 in. (60.96 cm) or three risers above or below ground level.

(b) One unit for each 75 persons street-floor capacity for stair or other exits requiring descent to ground level.

(c) One and one-half exit units for each two-unit required stair from upper floors discharging through the street floor.

(d) One and one-half exit units for each two-unit required stair from floors below the street floor discharging through the street floor.

(3) Every floor below the level of exit discharge has exits sufficient to provide for the occupant load of that floor on the basis of 100 persons per exit unit for travel on the same level, 75 persons for upward travel, as up stairs.

(4) Upper-floor exits shall provide numbers of units of exit width sufficient to meet the above requirements.

d. Number of Exits

(1) The number of exits is in accordance with Table 21-2.

(2) Any room having a capacity of fewer than 50 persons with an outside door at street or ground level may have such outside door as the single exit from the room provided that no part of the room or area is more than 50 ft. (15.24 m) from the door measured along the natural path of travel.

e. Arrangement of Exits

Access to all required exits shall be in accordance with Section 5-5.

Exception: Up to the first 35 ft. (10.67 m) of exit travel from a corridor room door may be along a corridor with exit access only in one direction (dead end).

f. Measurement of Travel Distance to Exits

(1) Exits of types listed above are so located that it will not be necessary to travel more than 100 feet (30.48 m) from the door of any room to reach the nearest exit. Travel distance is measured in accordance with Section 5-6.

Exception No. 1: Travel distance may be increased by 50 feet (15.24 m) in buildings provided with a complete automatic sprinkler system.

Exception No. 2: Travel distance to exits may be increased to 150 ft. (45.72 m) if the exit access and any portion of the building which is tributary to the exit access are protected throughout by an approved automatic sprinkler system. In addition, the portion of the building in which the 150-ft (45.72 m) travel distance is permitted shall be separated from the remainder of the building by construction having a fire resistance rating of not less than 1 hour for buildings up to four stories in height, and 2 hours for buildings four or more stories in height.

Exception No. 3: Travel distance to exits may be up to 200 ft. (60.96 m) for exterior ways of exit access arranged in accordance with 5-5.3.

g. Protection of Exit Route

Access is provided from any resident use area to at least one means of egress which is separated from all other rooms or spaces by walls and doors that equal the requirements for separation of bedrooms from corridors specified in Table 21-2, Item 9.

Exception No. 1: Rooms or spaces provided with an automatic sprinkler system.

Exception No. 2: Rooms or spaces provided with a smoke detection and alarm system connected to activate the building evacuation alarm specified in Table 21-2, Item 6. Furnishings, finishes, and furniture, in combination with all other combustibles within the space, are of such minimum quantity and are so arranged that a fully developed fire is unlikely to occur.

h. Illimination of Means of Egress. Every public space, hallway, stairway, or other means of egress is provided with illumination in accordance with Section 5-8.

i. Emergency Lighting. Emergency lighting is provided in accordance with Section 5-9 for facilities with more than 30 residents.

Exception: Where each resident room has a direct exit to the outside of the building at ground level.

Item 3. Protection of Vertical Openings for Large Facilities

(a) Every stairway, elevator shaft, or other vertical opening is enclosed or protected in accordance with 6-2.2 or otherwise satisfies the requirements of Section 2-9.

Exception No. 1: Unprotected vertical openings connecting not more than three floors, used only for board and care home purposes, in accordance with the conditions of 6-2.2.3.

Exception No. 2: An atrium in accordance with 6-2.2.3.

Exception No. 3: A building with a complete approved automatic sprinkler system in accordance with Section 7-7, where every resident use area has direct access to an exterior exit without passing through any public corridor.

Exception No. 4: One-story stairs that connect two levels within a single dwelling unit, resident room or suite located above the level of exit discharge.

(b) Any required exit stair which is so located that it is necessary to pass through the lobby or other open space to reach the outside of the building is continuously enclosed down to the lobby level, or to a mezzanine within the lobby.

(c) Floors below the level of exit discharge do not have unprotected openings to floors used for Residential Board and Care purposes.

Item 4. Protection from Hazards in Large Facilities

a. All areas having a degree of hazard greater than that normal to sleeping and living areas shall be effectively protected as specified in Section 6-4.

b. Hazardous areas include, but are not limited to:

Boiler and heater rooms Laundries Repair shops	Rooms or spaces used for storage of combustible supplies and equipment in quantities deemed hazardous by the authority having jurisdiction.

c. In any situations where the total potential fire severity of the hazardous area may defeat the basic integrity of the exposed building framing and any enclosing separation (i.e., is structurally endangering), both the separation and automatic fire extinguishing system are provided.

Item 5. Interior Finish for Large Facilities

Interior finish on walls, ceilings and floors is in accordance with Table 21-2, and as defined in Section 6-5.

Exception No. 1: Previously installed floor coverings, subject to the approval of the authority having jurisdiction.

Exception No. 2: Exposed portions of structural members complying with the requirements of Type IV (2HH) construction may be permitted.

Item 6. Manual Fire Alarms for Large Facilities

a. Manual fire alarm systems are installed in accordance with Section 7-6 and have the following features:

Exception: Level A, B, or C facilities where each occupant room has a direct exit to the outside of the building and the building is three or fewer stories in height.

(1) Sounding devices are of such character and so located as to alert all occupants of the building or section thereof endangered by fire.

(2) A manual fire alarm station is provided at the main desk or other convenient central control point under continuous supervision of responsible staff.

b. In Level A, B, or C facilities additional manual alarms (as specified in Section 7-6) may be omitted where there are other effective means (such as complete automatic sprinkler or automatic fire detection systems) for notification of fire.

c. Presignal systems are prohibited.

d. When required by Table 21-2, there are provisions for the immediate notification of the public fire department in accordance with 7-6.3.4.

Item 7. Smoke Detection and Alarms for Large Facilities

a. All detectors required by Table 21-2 refer to automatic smoke detectors.

b. To meet the requirements for smoke detector coverage of enclosed corridors and common spaces, such spaces shall be provided with smoke detector installations in accordance with NFPA 72E, Standard on Automatic Fire Detectors.

Exception No. 1: Common spaces provided with automatic sprinkler systems.

Exception No. 2: Corridors and other spaces open to corridors when all of the following conditions exist: (a) the corridors are under continual direct observation by staff during all times residents are in the building; (b) the level of observation equals or exceeds that normally provided by staff at nursing stations in hospitals; and (c) the corridor is not separated from the point of observation by doors which may be closed.

Exception No. 3: Unenclosed corridors; a corridor, balcony, colonade, or other arrangement where one side along the long dimension of the passageway is fully or extensively open to the exterior at all times.

Item 8. Extinguishment Requirements for Large Facilities

a. Where an automatic sprinkler system is installed, either for total or partial building coverage, the system is in accordance with the requirements of NFPA 13, Standard for the Installation of Sprinkler Systems.

Exception No. 1: The criteria of NFPA 13D, Standard for the Installation of Sprinkler Systems in One-and Two Family Dwellings and Mobile Homes, may be used in all portions of the building where the characteristics of the occupancy are comparable with residential fire potentials.

Exception No. 2: Automatic sprinklers may be omitted in small compartmented areas such as closets not over 24 sq. ft. (2.23 sq.m) and bathrooms not over 55 sq. ft. (5.11 sq. m) provided such spaces are finished with lath and plaster, gypsum board, or materials of equivalent fire resistance.

b. Portable fire extinguishers are provided near hazardous areas. Such fire extinguishers are maintained as specified in the NFPA 10, Standard for Portable Fire Extinguishers

Item 9. Requirements for Separation of Sleeping Rooms in Large Facilities

a. The requirements for separation of sleeping rooms in Table 21-2 are interpreted as follows:

(1) Walls, Smoke-Resisting. Sleeping rooms are separated from corridors or other common spaces by walls, partitions, or other construction that resist the passage of smoke. There are no louvers, transfer grills, operable transoms, or other air passages penetrating the wall except properly installed heating and utility installations. Vision panels may be installed without respect to glass type or size.

(2) Walls 20 min. Sleeping rooms are separated from corridors or other common spaces by walls or partitions, meeting the requirements of (1) above, which have at least a 20-minute fire resistance rating. This rating will be considered achieved if the fire resistance rating is demonstrated by acceptable tests or if the walls or partitions are sheathed on both sides with lath and plaster, gypsum board, or equivalent sheathing. Any vision panels are of wired glass, not exceeding 1296 sq. in. (0.84 sq. m.) of area each, installed in approved frames.

Exception: Partitions meeting the requirements of (1) above where automatic sprinklers are provided on both sides of the partition.

(3) Walls, 1-hour. Sleeping rooms are separated from corridors or other common spaces by walls or partitions meeting the requirements of (1) above, which have at least a 1-hour fire resistance rating. Any vision panels are of wired glass, not exceeding 1296 sq. in. (0.84 sq. m.) of area each, installed in approved frames.

(4) Doors, Smoke-Resisting. Doors, in walls or partitions that separate sleeping rooms from corridors or other common spaces, are of construction meeting the requirements of (1) above, and are provided with latches or other mechanisms suitable for keeping the doors tightly closed. Vision panels may be installed without respect to glass type or size.

(5) Doors, 20-min. Doors meet the requirements of (4) above, and have at least a 20-minute fire protection rating. Doors will be considered as having such a fire protection rating if they are 1-3/4 in. (4.45 cm) solid core wood construction or any other arrangement of equal or greater stability and fire integrity. The thermal insulation capability of the door does not need to be considered. Hollow sheet steel doors are considered to meet the 20-minute fire protection rating requirement. Any vision panels are of wired glass, not exceeding 1296 sq. in. (0.84 sq. m.) of area each, installed in approved frames.

Exception: Doors meeting the requirements of (4) above where automatic sprinklers are provided on both sides of the door.

b. High expectation of door closing (or being closed at time of fire) is considered as met under any of the following conditions:

(1) Such doors are provided with automatic closing release mechanisms actuated by smoke detectors.

(2) Doors are provided with traditional self-closing mechanisms and have occupant controlled locks such that access is normally (other than emergency) restricted to the occupants or staff personnel.

(3) Doors do not have any automatic closing mechanisms but one of the following conditions exists.

(a) The corridors involved are under continual direct observation by staff during all times residents are in the facility. The level of observation equals or exceeds that provided by staff at nursing stations in hospitals.

(b) The corridors involved are not under continual direct observation by staff but the building (or zone) involved is provided with a smoke detection and alarm system that covers the corridors, common spaces, and bedrooms. The alarm system is so arranged as to give immediate alarm to all the occupants and to staff available to respond.

Exception: Smoke detectors are not required in bedrooms when staff is always awake and can respond to any bedroom within 30 seconds of alarm.

(c) The building is provided with a complete automatic sprinkler system.

Item 10. Smoke Control for Large Facilities

a. The smoke control requirements in Table 21-2 are interpreted as follows:

(1) No special requirements. Smoke barriers to divide each sleeping floor are not required.

(2) Smoke Barriers on Each Sleeping Floor. Smoke barriers meeting the requirements of Section 6-3 are provided to divide all sleeping room floors into at least two sections. Smoke dampers are not required. Each section has sufficient corridor or other accessible space to provide a minimum of 6 sq. ft. per resident for each resident on the floor. Occupants on each side of the smoke barrier have access to an exit without passing through the smoke barrier.

Exception: Buildings without enclosed corridors, where every sleeping room or suite has a direct exit to grade or to an unenclosed exterior balcony with direct access to an exterior exit or smoke proof tower.

Item 11. Doors in Level "A" Large Facilities

a. Doors in separations either:

(1) Have a means that gives a high expectation that doors will be closed at time of fire per note 9; or

(2) have occupant controlled locks, such that access is normally (other than emergency) restricted to occupants or housekeeping personnel.

21-4 Suitability of an Apartment Building to house a Board and Care Occupancy

21-4.1 General

21-4.1.1 Scope. This Section applies to apartment buildings that have one or more individual apartments used as a Board and Care Occupancy. This Section determines the suitability of such buildings to house a Residential Board and Care Facility. The suitability of such buildings for apartments not used for Board and Care Occupancies is covered in Chapters 18 or 19, as appropriate.

21-4.1.2 Requirements for individual apartments used as a Residential Board and Care Occupancy are specified in Section 21-2, Small Facilities. Egress from the apartment into the common building corridor shall be acceptable egress from the Board and Care Facility.

21-4.1.3 The suitability of the apartment building for housing a Board and Care Occupancy shall be based on conformance with the requirements of Chapters 18 or 19, as appropriate and as modified herein.

Exception No. 1: Apartment buildings found to have equivalent safety to that required for housing of the Residential Board and Care Facility. One method for determining this equivalency is given in Appendix C of this report.

Exception No. 2: Where the level of care is sufficient to classify the occupancy as a Health Care Facility, the requirements of Chapters 12 or 13, as appropriate may be substituted for the requirements of this section.

21-4.2 Construction. In addition to the requirements in Chapters 18 or 19, as appropriate, apartment buildings housing Residential Board and Care Facilities shall conform to the construction requirements in Table 21-3. In evaluating the construction requirements, the height of the building shall be considered as the height of the Residential Board and Care Facility above grade regardless of the total height of the building.

21-4.3 Means of Egress. The requirements of Section 18-2 or 19-2, as appropriate, apply to all parts of the exit system serving the apartment(s) used as a Residential Board and Care Facility.

21-4.4 Protection of Vertical Openings. The requirements of Section 18-3.1 or 19-3.1 apply, as appropriate.

21-4.5 Protection from Hazards. The requirements of Section 18-3.2 or 19-3.2 apply, as appropriate, to the entire building except the apartment(s) actually used for the Residential Board and Care Facility. Protection of hazardous areas in that apartment shall be in accordance with Section 21-2 of this Chapter.

21-4.6 Interior Finish. The requirements of Section 18-3.3 or 19-3.3 apply, as appropriate, to all parts of the egress system serving the apartment(s) used as a Residential Board and Care Facility.

21-4.7 Detection, Alarm and Communication Systems. The requirements of Sections 18-3.4 or 19-3.4 apply, as appropriate, throughout the entire building except the apartment(s) used for the Residential Board and Care Facility. The detection, alarm and communication systems requirements for the Residential Board and Care Facility shall be in accordance with Section 21-2.

21-4.8 Extinquishment Requirements. The requirements of Sections 18-3.5 or 19-3.5 apply, as appropriate, to all portions of the building except the apartment(s) used as the Residential Board and Care Facility. The requirements for extinguishment protection in the apartment(s) used for the Board and Care Facility shall be in accordance with Section 21-2.

Exception: If the apartment building is based on options 3 or 4, of Chapters 18 or 19, as appropriate, the automatic sprinkler protection requirements of those options apply within the apartment(s) used for the Residential Board and Care Facility in the same manner as other portions of the building unless Section 21-2 requires a higher degree of automatic sprinkler protection.

21-4.9 Corridors. The requirements of Sections 18-3.6 or 19-3.6 apply, as appropriate, to all corridors serving the Residential Board and Care Facility including that portion of the corridor wall separating the Residential Board and Care Facility from the common corridor.

21-4.10 Subdivision of Building Spaces. The requirements of Sections 18-3.7 or 19-3.7 apply, as appropriate, to those stories with apartment(s) used as Residential Board and Care Facilities.

21-4.11 Building Services

21-4.11.1 Utilities. Utilities shall comply with the provisions of Section 7-1.

21-4.11.2 Heating, Ventilating and Air Conditioning. Heating, ventilating, and air conditioning equipment shall comply with the provisions of Section 7-2.

21-4.11.3 Elevators, Dumbwaiters, and Vertical Conveyors. Elevators, dumbwaiters, and vertical conveyors shall comply with the provisions of Section 7-4.

21-4.11.4 Rubbish Chutes, Incinerators, and Laundry Chutes. Rubbish chutes, incinerators, and laundry chutes shall comply with the provisions of Section 7-5.
Section 31-9 Board and Care Homes

31-9.1 Evacuation Plan. The administration of every Residential Board and Care Facility shall have in effect and available to all supervisory personnel written copies of a plan for the protection of all persons in the event of fire and for their evacuation to areas of refuge and from the building when necessary. The plan shall include special staff actions including fire protection procedures needed to ensure the safety of any resident and shall be amended or revised upon admission to the home of any resident with unusual needs. All employees shall be periodically instructed and kept informed respecting their duties and responsibilities under the plan. Such instruction shall be reviewed by the staff at least bi-monthly. A copy of the plan shall be readily available at all times within the facility.

31-9.2 Resident Training. All residents capable of assisting in their evacuation shall be trained in the proper actions to take in the event of a

fire. This training shall include actions to take if the primary escape route is blocked. If the resident is given rehabilitation or habilitation training, training in fire prevention and actions to take in the event of a fire, shall be a part of the rehabilitation training program. Residents shall be trained to assist each other in case of fire to the extent their physical and mental abilities permit them to do this without additional personal risk.

31-9.3 Fire Exit Drills. Fire exit drills shall be conducted at least six times per year, two times a year on each shift. Twelve drills shall be conducted the first year of operation. The drills may be announced in advance to the residents. The drills shall involve the actual evacuation of all residents to a selected assembly point and shall provide residents with experience in exiting through all exits required by the Codes. Exits not used in any fire drill shall not be credited in meeting the requirements of this code for Board and Care Homes.

Exception No. 1: Actual exiting from windows shall not be required to meet the requirements of this section: opening the window and signaling for help shall be an acceptable alternative.

Exception No. 2: If the Board and Care Home has an evacuation capability rating of impractical, those residents who cannot meaningfully assist in their own evacuation or who have special health problems need not actively participate in the drill. Section 31-4 applies in such instances.

31-9.4 Smoking and Furnishings

Where smoking is permitted, non-combustible, safety type ash trays or receptacles shall be provided in convenient locations.

A21-2.1.1 The exceptions specifically authorized for Residential Board and Care Occupancies in no way limit or prohibit any other use or application of the equivalency concepts set forth in Section 1-5 or elsewhere in this Code.

APPENDIX B

A Procedure for Determining Level of Facility Requirements

Separate subsystems are provided for:

a. Rating the evacuation capabilities of individual residents.

b. Computing the relative level of evacuation difficulty faced by the occupants of a given facility. This includes rating the Promptness of Response for the staff, introducing an adjustment for number of floors, and calculating an Evacuation Difficulty Score.

Procedure for Determining Level of Facility Requirements

Step 1 For each resident, complete one copy of Worksheet 1, Worksheet for Rating Residents. Follow the instructions on the Worksheet. Use the Instruction Manual for Rating Residents for further guidance and definitions of terms.

Step 2 For each facility complete one copy of Worksheet 2, Worksheet for Calculating Evacuation Difficulty Score (E-Score) through Scoresheet 2C. Follow the instructions on the Worksheet. Use the Instruction Manual for Calculating Evacuation Difficulty Score for further guidance and definitions of terms.

Step 3 Use Scoresheet 2D of Worksheet 2 to determine Level of Facility Requirements based on the E-Score from Step 2 and the number of residents.

1 SIDE 1

Worksheet for Rating Residents

Complete one Worksheet for each resident.
Read Instruction Manual before filling out this form.
Base ratings on commonly observed examples of poor performance.

Resident's Name _____ Rater _____

Facility _____ Date _____

_____ _____

WRITE ANY EXPLANATORY REMARKS YOU MAY WISH TO MAKE HERE:

1 SIDE 2

Worksheet for Rating Residents

Read Instruction Manual before filling out this form.
Base ratings on commonly observed examples of poor performance.

1A RATING THE RESIDENT ON THE RISK FACTORS

Rate the resident on each of the factors below by checking the one circle in each risk factor that best describes the resident. For the first six factors, write the scores for the circles you checked in the appropriate score boxes in the far right column. For "response to fire drills", write the three checked scores in the large circles. Write the sum of the 3 scores in the large box on the right.

					SCORE BOXES
Risk of Resistance (Check only one)	Minimal Risk ○ score = 0	Risk of Mild Resistance ○ score = 6	Risk of Strong Resistance ○ score = 20		
Impaired Mobility (Check only one)	Self-Starting ○ score = 0	Slow ○ score = 3	Needs Limited Assistance ○ score = 6	Needs Full Assistance or Very Slow ○ score = 20	
Impaired Consciousness (Check only one)	No significant Risk ○ score = 0	Partially Impaired ○ score = 6	Totally Impaired ○ score = 20		
Need for Extra Help (Check only one)	Needs at Most One Staff ○ score = 0	Needs Limited Assistance from 2 Staff ○ score = 30	Needs Full Assistance from 2 Staff ○ score = 40		
Response to Instructions (Check only one)	Follows Instructions ○ score = 1	Requires Supervision ○ score = 3	Requires Considerable Attention/May Not Respond ○ score = 10		
Waking Response to Alarm (Check only one)	Response Probable ○ score = 0	Response Not Probable ○ score = 6			

Response to Fire Drills (Without Guidance or Advice From Staff)	Initiates and Completes Evacuation Promptly	Yes ○ score = 0	No ○ score = 8	○ +	
	Chooses and Completes Backup Strategy	Yes ○ score = 0	No ○ score = 4	○ +	
	Stays at Designated Location	Yes ○ score = 0	No ○ score = 6	○	SUM OF THESE THREE ITEMS

1B FINDING THE RESIDENT'S OVERALL NEED FOR ASSISTANCE

Compare the numbers in the 7 score boxes you have filled in. Take the *one highest* score from the score boxes and write it in this box:

EVACUATION ASSISTANCE SCORE

Base ratings on commonly observed examples of poor performance

The Evacuation Difficulty Index has been designed to minimize speculation about how residents might perform in an actual fire emergency by basing ratings on already observed performance. Instead of speculating, raters who are not familiar enough with a resident to confidently provide ratings should consult with someone who has observed the resident on a daily basis.

Due to the stress of a real fire emergency, some residents are likely to perform more poorly than they are capable of doing. Therefore, ratings based on commonly observed examples of poor performance provide the best readily available indication of behavior that may be degraded due to the unusually stressful conditions of an actual fire. All persons naturally tend to be less capable on some days, and the ratings should be based on examples of resident performance on a typically "bad" day. Ratings should not be based on rare instances of poor performance.

1A. Risk Factors (refer to Worksheet 1)

1. Risk of Resistance

This means that there is a reasonable possibility that, during an emergency evacuation, the resident may resist leaving the group home.

Unless there is specific evidence that resistance may occur, the resident should be rated as "minimal risk."

Specific evidence of resistance means that staff have been required to use some physical force in the past. However, an episode of resistance should not be counted if it resulted from a situation that was different enough from a real fire emergency so that the incident probably does not predict behavior in a real fire emergency. For example, an incident when a resident refused to leave his bedroom to visit his parents would probably not predict behavior in a real fire emergency and would not be counted as specific evidence. Resistance may be active (for example, the resident may have struck a staff member or attempted to run away) or passive (for example, the resident may have "gone limp" or hid from staff members). Mere complaining or arguing is not considered as resistance.

a. Minimal risk. This means that there is no specific evidence to suggest that the resident may resist an evacuation.

b. Risk of mild resistance. This means that there is specific evidence that the resident may mildly resist leaving the group residence.

Examples of specific evidence that a resident should be rated in this category are as follows:

(1) The resident has mildly resisted instructions from staff. Further, the resistance was brief or easily overcome by one staff member, and occurred in a situation similar enough to a fire emergency to predict that the behavior could recur during a fire emergency.

or

(2) The resident has hidden from the staff in a situation similiar enough to a fire emergency to predict that the behavior could recur during a real fire emergency. However, once found, the resident offered no further resistance.

c. Risk of strong resistance. This means that the resident may offer resistance that requires the full attention of one or more staff members.

Examples of specific evidence that suggest that a resident should be rated in this category are as follows:

(1) The resident has struggled vigorously in a situation similar enough to a fire emergency to predict that the behavior could recur during a fire emergency.

or (2) The resident has totally refused to cooperate in a situation that is similar enough to a fire emergency to predict that the behavior could recur during a real fire emergency.

or (3) The resident has hidden in a situation that is similar enough to a real fire emergency. Moreover, once found, the resident continued to offer resistance.

2. Impaired Mobility

This means that the resident is physically limited in his or her ability to leave the home. The rating should reflect the present physical environment in the building where the resident lives and should be based on the resident laying awake on his/her bed. The resident is rated according to how easily he or she can leave, given: the presence of physical barriers that hinder movement (such as stairs), the resident's ability to get out of bed or chairs he or she normally uses, and so forth. The resident should be given credit for being able to use devices that aid movement (for example, wheelchairs, walkers, crutches, and leg braces). However, the rater may only give credit for such devices if they are always available for an emergency evacuation.

The resident should be rated on his or her ability to use the most accessible route out of the home. For example, a resident who is "self-starting" when he uses the back door, but who "needs limited assistance" to get out the front door would be rated as "self-starting."

The rater should test the resident when he/she is under the influence of any routine medication that slows the resident's movement.

When the resident needs physical assistance to make a timely evacuation, the amount of assistance required is based on the categories defined below. Physical assistance means that the staff member must use some strength to assist the resident. Guiding or directing the resident by giving gentle pushes or leading by the hand is not considered physical assistance.

a. Self-starting. This means that the resident is physically able to start and complete an evacuation without physical assistance.

b. Slow. This means that the resident prepares him or herself to leave and travels to the exit (or an area of refuge) at a speed significantly slower than normal. Specifically the resident is rated "slow" if he/she cannot prepare him or herself to leave, and then travel from his/her bedroom to the exit (or area of refuge) within a period of 90 seconds.

c. Needs limited assistance. This means that the resident may require some initial or brief intermittent assistance, but can accomplish most of the evacuation without assistance. (The total time required to physically assist the resident should not exceed the amount of time typically required in the examples listed below.)

The following are a few examples of capabilities that fall within this category:

The resident would be physically able to start and complete an evacuation, EXCEPT THAT . . .

(1) The resident needs help to get into a wheelchair.

or (2) The resident needs help to descend stairs that are present in the building.

or (3) The resident needs help to get out of bed.

or (4) The resident needs help to open a door.

d. Needs full assistance or very slow. This means that the resident needs "full assistance" or is "very slow" as defined in this section:

Needs full assistance. The resident needs full assistance if either (1) the resident may require physical assistance from a staff member during most of the resident's evacuation or (2) the total time required to physically assist the resident is equal to or greater than the time required in the examples below.

The following are a few examples of capabilities that fall within this category:

(1) The resident may need to be carried from the building.

or (2) The resident needs help to get into a wheelchair and must be wheeled out of the building.

or (3) The resident needs help to get into leg braces and needs help to descend steps.

Very slow. The resident is rated "very slow" if the time necessary for the resident to prepare him or herself to leave, and then travel from his/her bedroom to the exit is so long that the staff cannot permit the resident to evacuate unassisted. Specifically, the resident is rated very slow if he/she cannot prepare him or herself to leave, and then travel to the exit (or area of refuge) in 150 seconds.

3. Impaired Consciousness

This means that the resident could experience a partial or total loss of consciousness in a fire emergency.

Unless there is specific evidence that loss of consciousness may occur during a fire emergency, the resident should be rated as "no significant risk."

Specific evidence means that the resident has experienced some temporary impairment of consciousness of short duration (seconds or minutes) six or more times during the three months preceding the rating of the resident. Regardless of frequency, if there is specific evidence that loss of consciousness may be caused by the stress of a fire emergency or the periods of loss of consciousness are for substantial periods of time, the resident should be rated as having impaired consciousness. An episode of partial loss of consciousness should be counted only if the impairment was severe enough to significantly interfere with the resident's ability to protect him or herself. Do not count episodes where the loss of consciousness was the result of a temporary medical problem (e.g., a severe infection).

a. No significant risk. This means that the resident is not subject to loss of consciousness or that the resident has had fewer than six episodes of consciousness loss (partial and total) during the three months preceding the ratings.

b. Partially impaired. This means that the resident has had at least six episodes of consciousness loss in the last three months, and that the most severe of these episodes was only a partial loss of consciousness, that is, the resident would still be able to participate somewhat in his or her own evacuation.

Examples of specific evidence that a resident should be rated in this category include loss of consciousness resulting from mild (partial or petit mal) seizures, dizzy spells, intoxication or any other partially incapacitating impairment of consciousness.

c. Totally impaired. This means that the resident has had at least six episodes of consciousness loss in the last three months, and that the most severe of these episodes was a total or severely incapacitating loss of consciousness, that is, the resident would require the full assistance of at least one staff member to get out of the building.

Examples of specific evidence that a resident should be rated in this category include losses of consciousness resulting from severe (generalized or grand mal) seizures, fainting spells, intoxication, or other total or severely incapacitating loss of consciousness.

4. Need for Extra Help

This means that there is specific evidence that more than one staff member may be needed to evacuate the resident.

Specific evidence means that two or more persons have been previously needed to assist the resident, and that the resident could require assistance from two persons in a real fire emergency.

When rating the resident on whether there is a need for additional assistance, the rater should disregard the presence of staff members who appear unusually strong or weak. (For example, a young male staff member who is exceptionally strong or an unusually small staff member would be disregarded when rating the resident on Need for Extra Help.)

a. Needs only one staff. This means that there is no specific evidence that the resident might need help from two or more persons in a fire emergency.

b. Needs limited assistance from 2 staff. This means that the resident might require some initial or brief intermittent assistance from two persons, but will otherwise need help from no more than one person.

The following are a few examples of capabilities that fall within this category:

The resident would require help from no more than one person EXCEPT THAT . . .

(1) The resident needs two persons to get into a wheelchair.

(2) The resident needs two persons to descend stairs that are present in the building.

c. Needs full assistance from 2 staff. This means that the resident might require assistance from two persons during most of the resident's evacuation from the building.

The following are a few examples of capabilities that fall within this category:

(1) The resident may need to be carried from the building and this would require two persons.

(2) The resident would need two persons to get into a wheelchair and to get the wheelchair down a flight of stairs.

or (3) The resident may vigorously resist an evacuation and two persons would be required to get the resident out of the building.

5. Response to Instructions (Staff-directed Evacuation)

This means the resident's ability to receive, comprehend and follow through with simple instructions.

Residents often do not respond equally well to all staff members. Therefore, residents should be rated on their responses to staff members whose directions they are least likely to follow.

a. Follows instructions. This means that the resident can usually be depended on to receive, comprehend, remember and follow simple instructions.

b. Requires supervision. This means that the resident is generally capable of following instructions, but is not dependable. Therefore, the resident may need to be guided, reminded, reassured or otherwise accompanied during his or her evacuation, but will not require the exclusive attention of a staff member. (For example, a staff member can simultaneously lead two or more residents who fit this classification.)

This category includes elderly persons who sometimes show early signs of senile dementia or cerebral arteriosclerosis (for example, confusion, disorientation, frequent "misplacement" of possessions) and young children who cannot be depended on to follow through with instructions.

Some examples of resident capabilities that fall within this category are as follows:

The resident is generally capable of follwing instructions EXCEPT THAT . . .

(1) The resident is deaf or hearing impaired and sometimes misinterprets communications from staff using sign language.

or (2) The resident sometimes forgets instructions after a brief period of time.

or (3) The resident is sometimes distracted or confused and fails to follow through with instructions.

or (4) The resident is sometimes groggy and may fail to listen carefully or follow through with instructions.

or (5) The resident is sometimes uncooperative without apparent good reason.

or (6) The resident is elderly and sometimes becomes "lost" in a familiar place.

or (7) The resident is a young child who may become frightened and not follow through with instructions.

c. Requires considerable attention or may not respond. This means that the resident may fail to receive, understand or follow through with instructions, that is, the resident may not respond to instructions or general guidance. Therefore, the resident may require most of the attention of a staff member during his or her evacuation.

Some examples of resident capabilities that fall within this category are as follows:

(1) The resident sometimes does not understand simple instructions.

or (2) The resident may not respond to instructions from a particular staff member.

or (3) The resident is sometimes emotionally upset and is therefore unwilling to follow instructions.

or (4) The resident is deaf or hearing impaired and the staff cannot communicate reliably with the resident.

or (5) The resident is very forgetful, easily confused or easily distracted.

6. Waking Response to Alarm

This means that the fire alarm may fail to awaken the resident.

a. Residents should be rated as "response probable" unless any of the following four conditions is true:

(1) The building does not have an alarm system meeting the requirements of Chapter 21, or the alarm is not very loud where the resident sleeps (doors should be closed and barriers kept in place when testing the loudness of the fire alarm).

or (2) Medication taken by the resident before retiring differs in type or increased amount from the medication taken for waking hours.

or (3) The resident has a readily apparent hearing impairment or the resident removes his or her hearing aid when sleeping.

or (4) There is some specific evidence that the resident may be an exceptionally sound sleeper. (Examples of specific evidence are: the resident did not wake up during some particularly loud clamor or racket, and, staff members have had to vigorously shake the resident to awaken him or her.)

b. When any of the four conditions is true, then the resident should be rated as "response not probable" unless the resident's ability to wake up has been demonstrated. The demonstration of the resident's ability to wake up to the fire alarm should be conducted after the first half-hour of sleep and during the first three hours of sleep. Also, the resident's ability to wake up to the alarm should be demonstrated on two different nights under usual conditions (for example, without hearing aid, under usual medications, and so forth). Also, the resident should be alert enough to follow simple instructions within one minute of waking up. In order to avoid awakening other residents, a device that makes a sound that is similar to, but not louder than the fire alarm may be used (for example, an alarm clock can be used instead of a bell alarm).

(1) Response probable. This means that none of the four conditions is true for the resident, or, when any of the conditions is true, the resident's ability to wake up has been demonstrated.

(2) Response not probable. This means that one or more of the conditions is true for the resident, and that either the resident has not been tested for his or her ability to wake up to the fire alarm, or the resident failed to demonstrate his or her ability to wake up to the alarm.

7. Response to fire drills (self-directed evacuation): This relates to the resident's ability to leave the building as demonstrated by the resident's performance during fire drills.

It covers his or her ability to make decisions but does not relate to mobility which is covered in a separate factor. For example, a resident may only need assistance in transferring from bed to wheelchair but otherwise can promptly initiate and complete an evacuation. Such a resident would get a "yes" for "Initiates and Completes Evacuation Promptly" (0 points) and would be rated "Needs Limited Assistance" on the "Impaired Mobility" factor (6 points).

Components of a self-directed evacuation. There are three basic tasks that a resident must perform reliably and without instructions or supervision in order to receive the most favorable rating on this factor:

Initiates and completes evacuation promptly. The resident must have demonstrated a proper response to an alarm or warning of a fire by starting and completing the evacuation without unnecessary delay.

Chooses and completes back-up strategy: The resident must have demonstrated the ability to select an alternative means of escape or take other appropriate action if the primary escape route is blocked.

Stays at designated location: The resident must have demonstrated that he/she will stay at a designated safe location during fire drills. (The whereabouts of already evacuated residents needs to be confirmed to avoid dangerous return trips to look for residents who may have returned to buildings.)

The resident shall be credited with being able to perform a task only when the resident has been specifically trained or instructed in the desired task and has demonstrated the desired response in at least three of the last four fire drills for which the skill was tested.

When the skill has not been tested in four fire drills, the resident shall be credited only when the resident has demonstrated the desired response during the last two opportunities to test the skill.

Ratings must be based on the resident's demonstrated performance. Any resident who has not been trained using fire drills must be given the higher scores.

Residents must be rated assuming that a fire might find them in a common situation where they are least likely to respond well to an emergency. For most residents, this will be their evacuation ability after being awakened at night. The rating should not include difficulties in actually awakening the resident, because of the large differences in how easy it is to wake up the same individual at various times of the night.

a. Initiates and Completes Evacuation Promptly. Some examples of resident capabilities that score "no" for this item are:

(1) The resident may not react to the alarm until alerted by a staff member.

or (2) The resident spends an excessive amount of time preparing to leave (for example, getting dressed, seeing what everyone else is doing).

or (3) The resident has a hearing impairment and therefore must be alerted by a staff member.

or (4) The resident is sometimes upset or confused and therefore may seek out a staff member before evacuating.

or (5) The resident will reliably start an evacuation, but is easily distracted and requires some supervision.

b. Chooses and Completes Back-up Strategy. Residents that score "no" on this item will be those unlikely to select a good course of action if the primary escape route cannot be used: that is, they have not been trained to find alternative escape routes, find an area of refuge or perform other appropriate action. An example of resident capabilities that score "no" for this item is:

The resident lacks the conceptual ability to understand about fire hazards and blocked escape routes, and therefore needs supervision.

c. Staying at a Designated Location In a Safe Area

Some examples of residents' capabilites that score "yes" for this item are:

(1) The resident has been specifically trained to remain at a designated location in a safe area, and has demonstrated this ability without the presence of staff members in three of the last four fire drills.

or (2) The resident is physically immobile, and therefore cannot leave the designated location.

or (3) The group home uses a motor vehicle (for example, a van or bus), another house, or another building remote and detached from the home as the designated location, and the resident has demonstrated in three of the last four fire drills that he or she will remain there without the presence of a staff member.

or (4) The resident may tend to wander, but a reliable resident has been assigned to keep the "wandering" resident at the designated location without using any force or coercion. Further, this arrangement has been demonstrated as effective in at least three of the last four fire drills.

Some examples of residents that score "no" for this item are:

(1) The resident has not been trained to stay at a designated location without any staff supervision.

or (2) The resident has been trained to stay without staff supervision at a designated location, but has failed to demonstrate this capability in three of the last four fire drills.

2 Worksheet for Calculating Evacuation Difficulty Score (E-Score)

BEFORE FILLING OUT THIS WORKSHEET:

- Please read the Instruction Manual
- Make sure you have the completed "Worksheets for Rating Residents" (Step 1)
- Determine whether the requirements for using the Evacuation Difficulty Index have been satisfied by checking the one box to the left of each question below that shows whether the answer to the question is "YES" or "NO".

☐ YES	☐ NO	1. Has a protection plan been developed and written and have all staff members counted in the calculation of E-scores been trained in its implementation?
☐ YES	☐ NO	2. Is the total available staff at any given time able to handle the individual evacuation needs of each resident who may be in the residence?
☐ YES	☐ NO	3. Can every staff member counted in the calculation of E-scores meaningfully participate in the evacuation of every resident?
☐ YES	☐ NO	4. Are all staff members counted in the calculation of E-scores *required* to remain in the residence with only the exceptions listed in the Instruction Manual?
☐ YES	☐ NO	5. Were at least 6 fire drills conducted during the last year?

When the answers to all the above questions are "YES", the requirements for using the Evacuation Difficulty Index are satisfied.

THIS WORKSHEET IS FILLED OUT FOR THE STAFF "SHIFT"

FROM_____ TO_____

(You must fill out this worksheet for the time of day, week, etc. when the ratings for the combination of staff and residents yields the highest E-score. This period of time will usually be late at night. When it is not obvious which time period has the highest E-score, complete a separate worksheet for all candidate time periods and use the one having the highest E-score.)

EVALUATOR_____ DATE_____

FACILITY_____

2A

Finding the Total Resident Score

1. List each resident's name in the scoresheet opposite (Scoresheet 2-A).
2. For each resident, transfer the Evacuation Assistance Score (Part 1B) from his/her Worksheet for Rating Residents (Step 1).
3. Add the Evacuation Assistance Scores for all the residents and write the answer in the appropriate space at the bottom of Scoresheet 2-A.

Scoresheet 2-A	
RESIDENT SCORES	
Resident's name	Evac. Assist. Score.
Evacuation Assistance **TOTAL**	

2B
Finding the Staff Shift Score

1. In Scoresheet 2-B (opposite), list the names of staff members who are required to remain in the group home during the time period (shift) specified on the front page of this worksheet.

2. Determine whether the effectiveness of the alarm system is rated as "assured" or "not assured" as explained in the Instruction Manual.

3. Using the appropriate "assured" or "not assured" column in the table below, find each staff member's *Promptness of Response Score* for the time period specified. Write each staff member's score in the appropriate space in Scoresheet 2-B opposite.

4. Add the staff members' *Promptness of Response scores* and write the total in the appropriate space in Scoresheet 2-B.

PROMPTNESS OF RESPONSE SCORES		
Staff Availability	Alarm Effectiveness	
	Assured	Not Assured
Standby or asleep	16	2
Immediately available	20	2
Immediately available & closeby	20	10

Scoresheet 2-B STAFF SCORES	
Staff name	Promptness of Response Score
Staff Shift TOTAL	

Note: If the facility is a large residential facility, staff members may be responsible for assisting the residents in a fire-smoke zone, but may also have responsibilities for residents in other fire-smoke zones. See the glossary for Step 2 for the special procedure for assigning Promptness of Response Scores.

2C

Finding the Home's Evacuation Difficulty Score

1. Rate the home on the factor below by checking the circle that best describes the home.

	Vertical Distance from Bedrooms to Exits.		
	All BR on floors with direct exits	Any BR one floor from exit	Any BR two or more floors from exit
Small Dwelling	◯ score = 0.8	◯ score = 1.0	◯ score = 1.2
Large Facility or Apartment	◯ score = 1.0		

Note: Small Dwellings Have 16 or Less Residents

2. Write the score for the category you checked in the appropriate box In Scoresheet 2-C below.

3. Compute the E-score as shown in Scoresheet 2-C:
   a. Multiply the *Resident Score Total* by the score for *Vertical Distance from Bedrooms to Exits.*
   b. Divide the answer by the *Staff Shift Score* to find the *Evacuation Difficulty Score (E-score).*

Scoresheet 2-C. **CALCULATION OF E-SCORE**

Resident Score Total ☐ X Vertical Distance From Bedrooms to Exits ☐

Staff Score Total ☐ = E-SCORE ☐

4. Determine and Record Level of Facility Requirements appropriate to the calculated E-score, use Scoresheet 2-D.

Scoresheet 2-D

For facilities with 30 or less residents:	
E-Score	**Level of Facility Requirements**
≤1.5	A
>1.5, ≤3.0	B
>3.0, ≤5.0	C
>5.0	D

For facilities with over 30 residents:	
E-Score	**Level of Facility Requirements**
≤ 5.0	C
> 5.0	D

LEVEL OF FACILITY REQUIREMENTS ☐

REQUIREMENTS FOR USING THE EVACUATION DIFFICULTY INDEX (E-SCORE)

While the use of the Evacuation Difficulty Index allows determination of the level of fire safety need for a variety of staff and resident combinations, the system is valid only when the following underlying requisites are satisfied.

1. HAS A PROTECTION PLAN BEEN DEVELOPED AND WRITTEN AND HAVE ALL STAFF MEMBERS COUNTED IN THE CALCULATION OF E-SCORES BEEN TRAINED IN ITS IMPLEMENTATION?

   Regardless of the staff's everyday competencies, they cannot be relied on to innovate effective life safety actions under the extreme stress and time limitations of an actual fire emergency. Regardless of the building's protection features, staff must have a valid and practiced plan of action that can be immediately put into effect in an emergency. The protection plan should include the following features: (a) a description of all available evacuation, escape and rescue routes and the procedures and techniques needed to evacuate all the residents using the various routes, and (b) the fundamental knowledge about fire growth, containment and extinguishment needed to make reasonable judgements about action priorities and viable egress routes.

2. IS THE TOTAL AVAILABLE STAFF AT ANY GIVEN TIME ABLE TO HANDLE THE INDIVIDUAL EVACUATION NEEDS OF EACH RESIDENT WHO MAY BE IN THE BOARD AND CARE HOME?

   In a well-protected building, it would be possible to have an E-score which is passing in relation to the rating values for the fire protection features of the building, and still not have the total situation acceptable under this system. This would be the case where a resident is present who requires assistance from 2 staff members, but only one staff member is present. Thus, a facility must not only have a passing E-score, but the situation must be such that every resident can be evacuated by available staff.

   Exception: This requirement is waived when the following conditions are true: (1) The building meets the criteria for building safety level D; and (2) for any time when the question is answered "NO", (a) the resident whose evacuation needs cannot be handled is in a bedroom or other room that provides adequate refuge from fire outside the room, and (b) there is at least one staff member present who can close the door to the room. Example: A very heavy resident is in a safety level D building with one staff member who cannot transfer the resident from his bed to his wheelchair. Although the staff member cannot meet all the resident's evacuation assistance needs, the problem only arises when the resident is in his bedroom which provides adequate refuge.

3. CAN EVERY STAFF MEMBER COUNTED IN THE CALCULATION OF E-SCORES PARTICIPATE MEANINGFULLY IN THE EVACUATION OF EVERY RESIDENT?

   For example, a staff member, due to his or her own disability, may be unable to assist one or more physically disabled residents, and therefore, cannot be included in the calculation of the E-score. However, if a staff member's disability does not limit his or her ability to assist the residents, then the staff member may be included.

4. ARE ALL STAFF MEMBERS COUNTED IN THE CALCULATION OF E-SCORES REQUIRED TO REMAIN IN THE DWELLING UNIT WITH ONLY EXCEPTIONS LISTED IN THE INSTRUCTION MANUAL?

The procedure described in this appendix for calculating an Evacuation Difficulty Score is based upon the assumption that the facility is always staffed when residents are in the building except as described below. Unstaffed buildings, not covered by these exceptions, may be assigned an evacuation capability level based on the demonstrated ability of the residents to meet the criteria of 21-1.3 without staff assistance.

The exceptions are as follows:

Exception a: Residents who receive only the most favorable ratings on the Worksheet for Rating Residents may be present in the dwelling unit without the presence of staff members.

Exception b: A staff member may be at a location outside of the dwelling unit when his/her ability to respond to a fire emergency from the location is roughly equivalent to his/her response ability from within the dwelling unit. In determining equivalency, the regulatory authority should consider: (1) whether the alarm meets the minimum loudness criteria (see the Instructions Manual for Calculating Evacuation Difficulty Scores) at the locations outside the dwelling unit or whether another staff member who is required to remain in the dwelling unit can immediately notify the outside staff member of a fire emergency, (2) travel time to the dwelling unit, (3) detection of fire cues (e.g. smoke, noises) from the locations outside the dwelling unit, and (4) whether the staff member will be immediately notified about which area has the fire emergency, if the outside staff member is required to report to fire emergencies in more than one dwelling unit or fire zone.

The authority having jurisdiction can grant partial credit (not to exceed the Delay of Response Score that the staff member would receive when required to remain in the dwelling unit) for staff members who are permitted to be at locations outside the dwelling unit, but who have an ability to respond promptly.

5. WERE AT LEAST 6 FIRE DRILLS CONDUCTED IN THE LAST YEAR?

Any home in operation for less than one year should have had as many fire drills as months of operation to meet the requirement for proper number of fire drills. (Requirement is for 12 drills the first year and six all other years.)

INSTRUCTION MANUAL FOR CALCULATING THE EVACUATION DIFFICULTY SCORE

Areas of Application of Evacuation Difficulty Score

A. Small Dwelling Units (housing 16 or less persons) The evacuation difficulty score is based on all of the housed residents and the available staff measured in accordance with the criteria for evaluating residents and staff in this instruction manual.

B. Large Residences (housing more than 16 residents) The evacuation difficulty score may be calculated on the basis of the entire building as with small dwelling units or on the basis of individual fire/smoke zones: The procedure providing the better, (i.e., lower) evacuation difficulty score may be used. A fire/smoke zone is a portion of the building separated from all other portions of the building by building construction having at least one hour fire resistance and/or smoke partition conforming to the requirement of Section 6-3 of the Life Safety Code for smoke barriers of at least 20 minutes fire resistance. Zoning of the facility is also permitted in non-fire resistive sprinklered buildings provided the construction separating one zone from another is sound and smoke resistant.

   If a building is zoned, each zone shall be separately evaluated. Its evacuation difficulty score is based on the residents of that zone and the staff that is available to that zone in accordance with the staff availability criteria in this instruction manual.

   When the area of application is by zone, a separate evaluation is to be made of zones that include common use spaces where the residents of more than one zone congregate for meals, recreation, or other purposes. In such cases, adjust the resident evacuation assistance scores as appropriate to reflect the needs residents would have under such conditions.

Finding Staff Shift Score (refer to worksheet 2B)

If it is not obvious which time period has the highest E value, complete a separate worksheet for all candidate time periods and use the one having the highest E-value.

Alarm Effectiveness

This factor concerns whether smoke detector activated alarm devices are loud enough to dependably alert staff to a fire emergency.

a. Assured - to be rated "assured", the alarm shall be "easily noticeable" in all locations where staff are allowed to go, regardless of their ratings on the promptness of response factor. To be "easily noticeable", the alarm shall be a minimum of 55 dBA measured at ear level. However, in order to be "easily noticeable", the authority having jurisdiction may require the alarm to be louder than 55 dBA where background noise interferes with alarm audibility. For example, the alarm may need to be more than 55 dBA in order to be loud enough to be heard over the noise of a washing machine in the laundry, a television in the living room, and so forth.

   In addition, if there are staff who are allowed to sleep, the alarm shall be a minimum of 70 dBA measured at "pillow" level in any area where they may be asleep.

   The alarm must be activated by one or both of the following:

   Smoke Detectors

   Sprinkler System

If the facility has smoke detectors meeting the requirement of Chapter 21, the smoke detectors must activate the alarm. If the facility has a sprinkler system whose fire safety properties are considered in the fire safety evaluation of the building, activation of the sprinkler system must activate the alarm.

b. Not Assured - The alarm does not satisfy the conditions specified under "assured."

The loudness of the alarms is determined with doors, normally closed during the time period being rated, being closed, and with any other barriers that reduce the loudness of the alarms in place.

Staff Availability

This factor concerns whether there are circumstances when staff may be less able to respond appropriately or may be delayed in their response to a fire emergency.

Staff members shall be included in the ratings only if they are required to remain within the residence*, if they sleep less than 100 feet from all locations in the portion of the facility being evaluated, and if their travel time to any location in the portion of the facility being evaluated does not exceed 1 minute.

a. Standby or asleep - This means that the staff member does not have specific duties that assure an immediate response to the alarm, but that the staff member is otherwise available to assist in a timely manner. This category includes live-in staff who may be asleep, showering, or otherwise unable to respond immediately.

b. Immediately available - This means that the staff member is required to be available to offer immediate assistance, but is not required to remain in close proximity to the residents. For example, the staff member would be allowed to wash clothes or do bookkeeping.

c. Immediately available and closeby - This means that the staff member, in addition to satisfying the requirement for immediately available, is also required to remain in close proximity to the residents except for brief periods of time.

If the home is a Large Residential Facility and has multiple fire-smoke zones, some staff may have responsibilities for residents outside the fire-smoke zone being evaluated. If their duties include rescue of residents in the fire zone being evaluated, they may be assigned partial or full promptness of response scores. The authority having jurisdiction shall assign the points based on the proximity of the staff members to the zone and the nature of their duties in a fire emergency. This credit shall be given only if there is a smoke detection system that will alert the staff member and a system or procedure for promptly informing the staff member of the general location of the fire.

Residents may be assigned responsibilities similar to staff in assisting other residents during fire emergencies. The authority having jurisdication may assign these residents up to 8 promptness of response points based on their capabilities and responsibilities.

*Exceptions to this requirement are listed in the Requirements for Using the Evacuation Difficulty Index.

Finding the Home's Evacuation Difficulty Score (refer to worksheet 2c)

Vertical Distance from Bedrooms to Exits

This factor concerns the increased risk resulting from resident bedrooms that are located where residents must travel through another floor in order to get outside of the small dwelling.

Certain critical terms are defined as follows:

Direct Exit

This means that there is no more than one step between the inside of the dwelling and either (1) ground level outside or (2) a level area outside the dwelling that is at least 32 square feet (2.97 sq. m.). This level area might be a porch, or a stairway landing. When the vertical distance is greater than one step, a ramp may be used to satisfy this criterion.

Vertical distance.

This refers to the greatest number of floors that separates any resident bedroom from its nearest direct exit.

a. All bedrooms on floors with direct exits. This means that every room where residents sleep is on a floor with at least one direct exit.

Some examples of buildings that fall within this category follow:

(1) A one-story house without bedrooms in the basement.

or (2) A two-story house without bedrooms on the second floor.

or (3) A split-level house with direct exits at each level.

or (4) A two-story house with bedrooms on the second floor that has an external stairway from the second floor with a landing at the second floor which is greater than 32 square feet (2.97 sq. m.).

b. Any bedroom one floor from exit. This means that there is at least one room where residents sleep where the shortest vertical distance to a direct exit is one floor.

Some examples of buildings that fall within this category follow:

(1) A two-story building with bedrooms on the second floor and/or the basement.

or (2) A one-story house where all the exits have stairs that lead to grade, without a landing, or porch of 32 square feet (2.97 sq. m.).

c. Any bedroom 2 or more floors from exit. This means that there is at least one room where residents sleep where the shortest vertical distance to a direct exit is two or more floors.

Some examples of buildings that fall within this category follow:

(1) A three story house with bedrooms on the third floor and no external fire escape.

or (2) A three story house with bedrooms on the third floor and a fire escape, but the landing to the fire escape is less than 32 square feet (2.97 sq. m.).

If the board and care home is located in an apartment house and the unit containing the group home requires ascending or descending stairs to go from any bedroom to the exit to the corridor, assign a score of 1.2 for Vertical Distance from Bedrooms to Exits. Note, this special scoring of this rare type of apartment is not noted on the Worksheet. In all other apartments, the score for Vertical Distance from Bedrooms to Exits equals one.

APPENDIX C - A SYSTEM FOR EVALUATING THE FIRE SAFETY OF BUILDINGS HOUSING BOARD AND CARE HOMES

This Appendix describes a procedure for determining if a combination of fire safety features in a Board and Care Home, with a known evacuation capability of its residents, provides a level of safety equivalent to that provided by the Life Safety Code for Residential and Health Care Occupancies. A procedure for determining evacuation capability for Board and Care Homes is described in Appendix B. The material in the Appendix does not repeat definitions in the 1981 Life Safety Code but rather references the appropriate paragraph or section in Chapters 1-31 of the Code.

Separate subsystems are provided for:

1. Evaluating the fire safety protection in a Small Dwelling Unit.

2. Evaluating the fire safety protection in a Large Residential Facility.

3. Evaluating the suitability of an Apartment Building to House a Board and Care Home.

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Part 3.	Suitability of an Apartment Building to House a Small Dwelling Unit	155

Jan. 14, 1983

Fire Safety Evaluation Worksheet for a Small Dwelling Unit

Facility Identification_____

Evaluator_____ Date_____

(Complete one worksheet for each individual residence or apartment used as a board and care home. A small dwelling unit normally means a capacity for 16 or less residents.)

First complete Table 1 on page 2. Continue with Table 2 on page 3 and Tables 3 and 4 on page 4. Then return to this page to obtain the Equivalency Conclusions.

TURN TO NEXT PAGE

PART 1E. EQUIVALENCY CONCLUSIONS

Complete Tables 1-4 before doing this part.

1. [ ] All of the checks in Table 4 are in the "YES" column. The level of fire safety is at least equivalent to that prescribed by the Life Safety Code.*

2. [ ] One or more of the checks in Table 4 are in the "NO" column. The level of fire safety is not shown by this system to be equivalent to that prescribed for small dwelling units.

* The equivalency covered by this worksheet includes the majority of considerations covered by the Life Safety Code. There are a few considerations that are not evaluated by this method. These must be separately considered. These additional considerations are covered in the "Facility Fire Safety Requirements Worksheet." One copy of this separate worksheet is to be completed for each facility.

Facility Fire Safety Requirements Worksheet

Considerations	Met	Not Met
Complies with the applicable requirements of Chapter 31 (Operating Features).		

PART 1A. DETERMINE SAFETY PARAMETER VALUES — USE TABLE 1

Select and circle the safety value for each safety parameter in Table 1 that best describes the conditions in the facility. Choose only one value for each of the 8 parameters. If two or more values appear to apply, choose the one with the lowest point value.

Table 1. Safety Parameter Values — Small Dwelling Unit

Parameter	Parameter Values						
1. CONSTRUCTION / FIRE RESISTANCE	Exposed Structural Members	Protected (20 Min.)	Fire Resistant (1 Hour)				
	0	1	3				
2. HAZARDOUS AREAS	Double Deficiency		Single Deficiency		None or No Deficiency		
	-7		-4		0		
3. MANUAL FIRE ALARM	None	w/o F. D. Notif.	w/ F.D. Notif.				
	0	1	2				
4. SMOKE DETECTION & ALARM	None	Limited Warning/ Single Lev. Det.	Warning to All Bedrooms		Total Coverage System		
			Every Lev Det	Plus Det. in Each Bedrm.			
	-4	0	2	3	4		
5. AUTOMATIC SPRINKLERS	Non-Sprinklered	Sprinklered					
	0	8					
6. INTERIOR FINISH	Flame Spread Ratings						
	>75 ≤ 200	>25 ≤ 75	≤25				
	-3	-1	0				
7. SEPARATION OF SLEEPING ROOMS	Unprotected Vertical Opening		Protected Vertical Opening-D				
	None or Incomplete	Smoke Resisting	None or Incomp.	Smoke Resisting	20 Min.	20 Min. Auto Closing	
	-6	-4(0)C	-2	0	1(0)A	2(0)A	
8. EGRESS — EGRESS ON ALL SLEEPING LEVELS	< 2 Remote Routes		2 Remote Routes Unseparated	2 Remote Routes Separated	Direct Exit from Each Bedrm.		
	w/o Alt. Means	w/Alt. Means					
	-1	0	1(0)B	2(0)B	3(0)B		
EGRESS NOT ON ALL SLEEPING LEVELS	Primary Route Not Protected			Primary Route Protected			
	< 2 Remote Routes		2 Remote Routes	< 2 Remote Routes		2 Remote Routes	
	w/o Alt. Means	w/Alt. Means		w/o Alt. Means	w/Alt. Means		
	-4	-3	0	-1	0	2(0)B	

NOTES:
A — Use (0) if parameter 1 is 0 and parameter 5 is 0.
B — Use (0) if parameter 7 is based on a "no door" situation.
C — Use (0) if door is 20 min. and has automatic closer.
D — Consider 1 level building as having a protected vertical opening.

PART 1B COMPLETE INDIVIDUAL SAFETY EVALUATION — USE TABLE 2.

1. Transfer each of the 8 circled safety parameter values from Table 1 to every unshaded block in the line with the corresponding safety parameter in Table 2. Where the block is indicated ÷2 enter only ½ the value shown in Table 1.

2. Add the four columns, keeping in mind that any negative numbers deduct.

3. Transfer the resulting values for S_1, S_2, S_3, and S_4 to Table 4 on page 4 of this worksheet.

Table 2. Individual Safety Evaluations

PARAMETER	FIRE CONTROL	EGRESS	REFUGE	GENERAL SAFETY
1. CONSTRUCTION				
2. HAZARDOUS AREAS		÷2		
3. MANUAL FIRE ALARM	÷2	(1) A		
4. SMOKE DETECTION & ALARM	÷2		÷2	
5. AUTOMATIC SPRINKLERS		÷2		
6. INTERIOR FINISH	÷2			
7. SEPARATION OF SLEEPING ROOMS				
8. EGRESS FROM DWELLING				
TOTAL	S_1 =	S_2 =	S_3 =	S_4 =

A - Max value of manual fire alarm for egress is 1.

PART 1C DETERMINE MANDATORY REQUIREMENTS — USE TABLE 3.

1. Use the Level of Requirements Based on Evacuation Capability (See Scoresheet 2D in Appendix B) to select the proper row of Table 3. Circle the appropriate values.
2. Transfer the circled values from Table 3 to the blanks marked S_a, S_b, S_c, and S_d in Table 4.

Table 3. Mandatory Requirements

Level of Requirements	Control Requirement (S_a)	Egress Requirement (S_b)	Refuge Requirement (S_c)	General Fire Safety Requirement (S_d)
A	0.0	3.0	1.0	0.0
B	1.0	5.0	1.0	4.0
C	2.0	6.0	3.0	6.0
D	4.0	7.0	6.0	9.0

PART 1D EQUIVALENCY EVALUATION

1. Perform the indicated Subtractions in Table 4. Enter the differences in the appropriate answer blocks.
2. For each row check "YES" if the value in the answer block is zero or greater. Check "NO" if the value in the answer block is a negative number.

Table 4. Equivalency Evaluation

							YES	NO
Control Provided	(S_1)	minus	Required Control	(S_a)	≥ 0	S_1 □ − S_a □ = □		
Egress Provided	(S_2)	minus	Required Egress	(S_b)	≥ 0	S_2 □ − S_b □ = □		
Refuge Provided	(S_3)	minus	Required Refuge	(S_c)	≥ 0	S_3 □ − S_c □ = □		
General Fire Safety	(S_4)	minus	Required Gen. Fire Safety	(S_d)	≥ 0	S_4 □ − S_d □ = □		

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GLOSSARY FOR WORKSHEET FOR EVALUATING A SMALL DWELLING UNIT

This glossary is provided to assist in completing the Fire Safety Evaluation Worksheets for determining the suitability of small dwelling units to house board and care facilities. The instructions for the mechanisms of completing the worksheet are included in the worksheet itself. They are not repeated in this glossary. This glossary provides expanded discussion and definitions for the various items in the worksheet to assist the user when questions of definition or interpretation arise. To the maximum extent possible, the glossary does not repeat the definitions already existing in the Life Safety Code but rather references the appropriate paragraph or section in Chapters 1-31 of the 1981 Life Safety Code.

Area of Application

The evaluation shall be completed covering the entire home including spaces that are not used by the residents of the board and care home. Row houses, townhouses, or other forms of independent living units having all of their entrances and exits completely separate from any other unit may be calculated as small dwelling units when they are separated from any abutting living units. Such separation shall be by fire resistive partitions or walls having at least one hour fire resistance rating and extending to the roof if it is non-combustible or through the roof if the roof or its covering is of combustible material.

For dwelling units (i.e., apartments) in general use apartment houses, this worksheet shall be used to evaluate the dwelling unit (apartment) being used as the board and care home. The remainder of the apartment building shall be evaluated using the worksheet for Suitability of Apartment Buildings to House a Board and Care Home. When evaluating an apartment unit, consider the common corridor as equivalent to the outside in evaluating egress routes. Also, when evaluating egress routes give credit to a window only if it can be used in an emergency evacuation.

Maintenance

All protection systems, requirements, arrangements and procedures shall be maintained in a dependable operating condition, and a sufficient state of readiness, and shall be used in such a manner that the intended safety function or hazard constraint is not impaired. Otherwise, they shall receive no credit in the evaluation.

Safety Parameter Table (General Discussion)

The safety parameters are a measure of those building factors that bear upon or contribute to the safety of those persons who may be in the building at the time of a fire.

Each of the safety parameters is to be analyzed, and the safety value for each parameter that best describes the condition in the building is to be identified. Only one value for each of the parameters is to be chosen. If two or more appear to apply, the one with the lowest point value shall be used.

1. Construction

Small facility construction types are defined as:

a. Exposed Structural Members. Some or all structural members have no sheathing or fire resistance rating.

b. Protected (20 Min.). Buildings where the interior is fully sheathed with lath and plaster, gypsum board, or equivalent protection. Also, any type of construction where all portions of the bearing walls, bearing partitions, floor constructions, roof, and all columns, beams, girders, trusses or similar bearing members either have an inherent fire resistance or are finished, encased, or otherwise treated to provide a minimum of at least a 20 minute fire resistance.

Exception: Buildings with the only exposed steel or wood serving as columns and support beams (but not joists) located in the basement area, will be considered as fully sheathed.

c. One-hour fire resistance. Buildings conforming with the definition of Type I, Type II (111), Type III (211), Type IV or Type V (111) construction.

Exception: Sprinklered Construction. If a building housing a small residential board and care facility is partially covered by automatic sprinklers, the construction classification is based on the fire resistance of the unsprinklered portion(s) of the building. If the building is provided with a complete automatic sprinkler system, the construction is considered equivalent to that provided by a 1-hour fire resistance rating.

Note: Inaccessible Spaces. Unfinished, unused, and essentially inaccessible loft, attic, or crawl spaces are not considered in determining the construction classification.

2. Hazardous Areas

The assignment of charges for hazardous areas is a four-step process.

Step 1. Identify Hazardous Areas. A hazardous area is any space that contains a storage or other activity having fuel conditions exceeding that normal to a single family dwelling and possessing the potential for a fully involved fire.

Examples of hazardous areas include, but are not limited to, areas for storage of food or household maintenance items in wholesale or institutional type quantities and concentrations; storage area for residents' belongings - areas similar to storage locker facilities in apartment buildings; and other areas where the quantities of combustible or flammable materials exceed an amount equivalent to normal household furnishings.

Exception: Areas containing approved, properly installed, and maintained furnaces and heating equipment, cooking, and laundry facilities are not classed as hazardous areas on the basis of such equipment.

Step 2. Determine What is Exposed.

a. Primary Exit Route. Hazardous area is on the same floor as, and is in or abuts, a primary exit route. (A primary exit route is a normal means of egress that may involve interior or exterior stairs, corridors, doors, or other common means of movement through and out of a residential building.)

b. Sleeping Area. Hazardous area is on the same floor as, and is in or abuts, the sleeping area (room).

Step 3. Determine the Fire Protection Provided.

a. Sprinkler Protection. The hazardous area is protected by sprinklers or other appropriate automatic extinguishing system.

b. Smoke Resisting Separation. The hazardous area is separated from exposed sleeping areas and primary exit routes by a separation that will resist the passage of smoke. Any doors in such separation are self-closing or automatic closing on smoke detection. The closing device is not required for hazardous spaces where the nature of the space is such that the door is kept closed at all times.

c. 20 Minute Fire Resistive Enclosure. A fire resistant enclosure that has approximately 20 minutes fire resistance construction with a self-closing or smoke detector operated automatic closing door at least equivalent to 1 3/4-inch solid core construction. The closing device is not required for hazardous spaces where the nature of the space is such that the door is kept closed at all times.

d. 1 Hour Fire Resistive Enclosure. An enclosure with a fire resistive rating of at least 1-hour with a self-closing or smoke operated automatic closing fire door having a fire protection rating of at least 3/4 hour. The closing device is not required for hazardous spaces where the nature of the space is such that the door is kept closed at all times.

Exception: Sprinkler protection of the hazardous area and a separation that will resist the passage of smoke between the hazardous area and the exposed sleeping area or primary exit route qualifies as 1-hour fire resistance. Any doors in such separation are self-closing or automatic closing on smoke detection.

Step 4. Determine Degree of Deficiency and Assign Parameter Values. The parameter value is finally determined on the basis of what is exposed and the level of protection provided. Figure C-1 provides a matrix type table to be used to determine the degree of deficiency to be used in assigning charges to this parameter.

In some situations, more than one hazardous area with the same or differing levels of deficiency will exist. The charge assigned is based on the single most serious charge for hazardous area found.

3. Manual Fire Alarm

a. None. There is no manual fire system, or the system is incomplete and does not meet the requirements necessary for a higher scored category.

b. W/O F.D. Notification. The credit for this level of protection is to be given for any installation that meets one of the following definitions of a manual fire alarm for small facilities.

(1) A fire alarm system is installed and meets the requirements of section 7-6 for manual fire alarm systems.

	NO SPRINKLERS			SPRINKLERED PROTECTION	
	FIRE RESISTIVE		UNENCLOSED	SMOKE RESISTIVE	UNENCLOSED
	20 MIN	1-HR		SEPARATION	
DOES NOT EXPOSE SLEEPING AREA OR EGRESS ROUTES	NO DEF.	NO DEF.	SINGLE DEFICIENCY	NO DEFICIENCY	NO DEFICIENCY
EXPOSES SLEEPING AREA OR EGRESS ROUTES	SINGLE DEF.	NO DEF.	DOUBLE DEFICIENCY	NO DEFICIENCY	SINGLE DEFICIENCY

Figure C-1. HAZARDOUS AREAS - DEGREE OF DEFICIENCY

(2) A smoke detection system powered by the house electrical service and meeting or exceeding the requirements of NFPA 74-1980 Household Fire Warning Equipment is installed on each floor level including basements, but excluding crawl spaces and unfinished attics. When activated, the required detectors initiate an alarm which is audible in all sleeping areas.

(3) There is no fire alarm system that meets either of the requirements above, but in the opinion of the authority having jurisdiction, the facility is of such a small size that a vocal call would be heard by all occupants. Normally, such a facility does not have more than 2 levels, including basements, and not more than 8 residents, all sleeping on the same floor.

c. W/F.D. Notification. There is a manual fire alarm system meeting the requirements of section 7-6 including fire department notification as defined in paragraph 7-6.3.4.

4. Smoke Detection and Alarm

A detection system as used herein is one based on the use of smoke detectors. No recognition is given for thermal detectors. The detection system categories are as follows:

a. None. There are no smoke detectors in the building or, if any are present, they do not meet the requirements necessary for a higher scored category.

b. Single Level Detection, Limited Warning. There are one or more detectors in the building but they do not meet the criteria for every level detection set forth in c., below. Detectors credited in this category may be any approved smoke detector and may be of the single station type. At least one detector must be located in the corridor or similar common space (lobbies, lounges, or other spaces that cannot be closed off) in the immediate vicinity of each separate sleeping area. If there is more than one sleeping area, each such area must be protected to obtain this credit.

c. Every Level Detection, Every Bedroom Warning. This credit applies where there is at least one detector in a single level building and one detector on each level of a multi-level building that meets the requirements of NFPA 74-1980, Household Fire Warning Equipment, and is powered by the house electrical service. When

activated, the required detectors initiate an alarm which is audible in all sleeping areas.

d. Every Level (Item c) Plus Single Station Detection in Each Bedroom. To receive this credit, the requirements of c., above, must be met in full with the addition of at least one single station detector in each bedroom or other sleeping area.

e. Total Coverage System. A minimum of a detector in each occupied room or other habitable space and throughout any basements, storage areas (other than normal clothing closets), or combustible loft spaces. To qualify as a total system, there must be a manual fire alarm system in the building and the operation of any smoke detector must automatically operate the manual fire alarm system evacuation alarm for the entire building.

5. Automatic Sprinklers

a. Non-Sprinklered. No credit is given if there are no sprinklers or if sprinklers, though present, are not sufficient to qualify for the sprinklered category.

b. Sprinklered. The building is sprinklered in accordance with NFPA 13-1980 for light hazard occupancy or NFPA 13D-1980, where appropriate, and is equipped with an automatic alarm initiating device that will activate the building manual fire alarm system or otherwise sound an alarm sufficiently audible to be heard in all sleeping areas.

6. Interior Finish

Interior finish on walls and ceilings of occupied spaces is defined in Section 6-5. There are no requirements for interior floor finish. No consideration is included in the safety parameter value for any finish with a flame spread rating greater than 200 or for any material not rationally measured by the ASTM E84 test. Materials not rationally measured include: foam plastics, asphalt impregnated paper and/or materials capable of inducing extreme rates of fire growth and rapid flashover. In any case where these materials are involved, the resultant risk is considered beyond the capacity of this evaluation system and will require individual appraisal.

Note: 1/4 inch or thicker plywood can be considered as having a flame spread of 200 or less.

Note: Exposed wood open joist construction or other exposed wood construction areas shall be charged as Class C Interior Finish, in addition to any charges under safety parameter 1, Construction.

Note: If a space is classified as hazardous under parameter 2, Hazardous Areas, no additional charge shall be made as the result of interior finish in such areas.

7. Separation of Sleeping Rooms

The classification of separation of sleeping rooms is categorized under the groups headed "Unprotected Vertical Openings" and "Protected Vertical Openings". A facility is classed as having protected vertical openings if there are no vertical openings (as in a single level building) or if the opening is cut off or enclosed in a manner that provides fire resistance capability of at least 20 minutes. Any doors in the opening have equivalent fire and smoke resisting capabilities and are automatic closing on detection of smoke or self-closing.

a. None or Incomplete. The charge for none or incomplete is assessed in any case where the separation of sleeping rooms from corridors and common spaces is insufficient to meet any of the other classifications in this parameter.

b. Smoke Resisting. Sleeping rooms are separated from corridors or other common spaces of the building by walls and doors that are capable of resisting the passage of smoke. There are no transfer grills, louvers, or operable transoms or other air passages penetrating the wall except properly installed heating and utility installations. Doors are provided with latches or other mechanisms suitable for keeping the doors tightly closed. Glass viewing panels may be used in doors or partitions without limits on size or type.

c. 20-Minute. Sleeping rooms are separated from corridors or other common spaces of the building by separations meeting the requirements of b. above and have the capability of resisting fire for at least 20 minutes. This rating is considered to be achieved if fire resistance is demonstrated by acceptable tests or if the partitioning is sheathed on both sides with lath and plaster, gypsum board or equivalent sheathing. Doors are capable of resisting fire for at least 20 minutes. Doors are considered as having such fire resistance if they are 1-3/4 inch (4.45 cm) solid core wood construction or any other arrangement of equal or greater stability and fire integrity. The thermal insulation

capability of the door is not considered. Hollow sheet steel doors are considered to meet the 20 minute requirement. Any vision panels are of wired glass, not exceeding 1296 sq. in. (0.84 sq. m) of area each, installed in approved frames.

Exception: Partitions and doors meeting the requirements of b. above where automatic sprinklers are provided on both sides of the partition.

d. 20-Minute Fire Resistance, Doors Automatic Closing on Smoke Detection. Sleeping rooms are separated in accordance with c. above and the doors to all bedrooms are automatic closing. Automatic closing doors are considered acceptable if the doors have an arrangement that holds them open in a manner such that they will be released by a smoke detector operated device (e.g., magnetic or pneumatic hold open device) prior to the passage of significant smoke from the space of fire origin into the corridor or from the corridor into the protected room. Smoke detectors for operation of such doors are either integral with the door closers, mounted at each door, or operated from a total smoke detector system covering both the room and corridor.

8. Egress

Egress on All Sleeping Levels

A building shall be considered as having egress on all sleeping levels if: (1) the entire building is on a single level, or (2) all guest rooms used for sleeping are on a level having an exit door.

a. Primary Route. A normal means of egress that may involve interior or exterior stairs, corridors, doors, or other common means of movement through and out of a dwelling unit.

(1) Protected. A primary route is classed as "Protected" if it provides a path of travel to the outside of the building without traversing any corridor or space exposed to an unprotected vertical opening. Also, where the sleeping room is above or below the level of exit discharge, the primary means is an enclosed interior stairway, an exterior stairway, or a horizontal exit.

(2) Unprotected. A primary route is classed as "Unprotected" if it does not meet the requirements for "Protected".

b. < 2 Remote Routes. The egress capability is classified as "< 2 Remote Routes" if each bedroom does not have access to two routes leading to two separate building exit doorways.

(1) W/Alternative Means. Alternative means exist where in addition to the primary route there is one emergency alternative means of escape for each sleeping room. This route includes either:

(a) A door or stairway providing a means of unobstructed travel to the outside of the building at street or ground level.

(b) An outside window in the room operable from the inside without the use of tools and providing a clear opening of not less than 20 inches (50.9 cm) in height, and 5.7 square feet (.53 square meters) in area. The bottom of the opening is not more than 44 inches (111.76 centimeters) above the floor.

Exception: If the bedroom has a door leading directly outside of the building with direct access to grade, that door is considered to fulfill the requirements for both a primary route and alternative means for that bedroom.

c. 2 Remote Routes. To meet the requirement for two remote routes, each bedroom has access to two routes leading to two separate building exit doorways.

(1) Separated. To meet the requirement for "2 Remote Routes Separated", each bedroom must: (1) have access to two routes leading to two separate building exit doorways, and (2) have at least one route that provides a path of travel to the outside of the building without traversing any corridor space exposed to unprotected vertical openings or common living spaces (e.g., livingrooms, kitchens, etc.).

(2) Unseparated. The 2 remote routes do not meet the requirements for the classification "Separated".

d. Direct Exit from Each Bedroom. To be credited, each bedroom must have a door operable by the room occupant(s) that opens directly to grade without more than one step, or have a ramp to grade, or have an external porch or landing with external stairs or other suitable access to grade.

Some buildings have a non-sleeping occupants' use area on a floor without any exit to the outside on that floor, and the building otherwise qualifies to receive credit for direct exits or for two remote exits. To receive credit for direct exits or for two remote exits, there must be either a protected egress route or two remote routes from the occupants' use area.

2

Fire Safety Evaluation Worksheet for a Large Residential Facility

Jan. 14, 1983

Facility Identification _____

Evaluator_____ Date_____

(Complete one worksheet for each large residential facility. This normally means a capacity for 17 or more residents.)

First complete Table 1 on page 2. Continue with Table 2 on page 3 and Tables 3 and 4 on page 4. Then return to this page to obtain the Equivalency Conclusions.

TURN TO NEXT PAGE

PART 2 E. EQUIVALENCY CONCLUSIONS

Complete Tables 1-4 before doing this part.

1. [ ] All of the checks on Table 4 are in the "YES" column. The level of fire safety is at least equivalent to that prescribed by the Life Safety Code.*

2. [ ] One or more of the checks in Table 4 are in the "NO" column. The level of fire safety is not shown by this system to be equivalent to that prescribed by the Life Safety Code for large residential facilities.

* The equivalency covered by this worksheet includes the majority of considerations covered by the Life Safety Code. There are a few considerations that are not evaluated by this method. These must be separately considered. These additional considerations are covered in the "Facility Fire Safety Requirements Worksheet." One copy of this separate worksheet is to be completed for each facility.

Facility Fire Safety Requirements Worksheet

Considerations	Met	Not Met	Not Applic.
A. Utilities comply with the provisions of Section 7-1			X
B. Heating, ventilating, and air conditioning equipment complies with provision of Section 7-2			X
C. Elevators, dumbwaiters, and vertical conveyors comply with the provisions of Section 7-4			
D. Rubbish chutes, incinerators, and laundry chutes comply with the provisions of Section 7-5			
E. Complies with the applicable requirements of Chapter 31 (Operating Features).			X

PART 2A DETERMINE SAFETY PARAMETER VALUES — USE TABLE 1

Select and circle the safety value for each safety parameter in Table 1 that best describes the conditions in the facility. Choose only one value for each of the 11 parameters. If two or more values appear to apply, choose the one with the lowest point value.

Table 1. Safety Parameter Values — Large Residential Facility

Safety Parameter	Parameter Values							
1. CONSTRUCTION	Combustible					Noncombustible		
BUILDING HEIGHT	Type V (000)	Type V (111)	Type III (200)	Type III (211)	Type IV (2HH)	Type II (000)	Type II (111)	Type II (222) & Type I
1 STORY	−2( )A	0	−2( )A	0	0	0	2	2
2 STORY	−6( )A	0	−6( )A	0	0	−5( )A	2	2
3-6 STORY	−8( )A	−2	−8( )A	0	−2	−6( )A	2	2
OVER 6 STORY	−10	−4	−10	−2	−4	−8	0	2

2. HAZARDOUS AREAS	Within Bdrms/Suite or On Exit Routes		Elsewhere In Building		None, or No Deficiency
	Double Deficiency	Single Deficiency	Double Deficiency	Single Deficiency	
	NP	−4	−4(−7)B	0(−4)B	0

3. MANUAL FIRE ALARM	No Alarm	Manual Alarm	
		w/o F.D. Notif.	w/F.D. Notif.
	0(2)F	2	3

4. SMOKE DETECTION & ALARM	None or Incomplete	Single Station Units in Each Bedroom	Interconnected System - I			Total Building
			w/o Bdrm Suite Detectors	Single Station Bdrm Suite Detectors	Interconnected Bdrm Suite Detectors	
	−10(0)J	0(2)J	2(0)E	3(0)E	5	6

5. AUTOMATIC SPRINKLERS	None	Bdrms Suites Only	Corrs., Common Spaces	Bdrms Suites, Corrs., Common Spaces	Total Building
	0	2(0)C	4(0)C	6	8

6. SEPARATION OF SLEEPING ROOMS FROM EXIT ACCESS	None or Incomplete	Fire Resistance/Walls and Doors—Expectation of Door Closing				
		Expectation—Not High		Expectation—High		
		Smoke Resisting (G)	20 Min. (G)	Smoke Resisting (G)	20 Min. (G)	1 Hr. Walls 20 Min. Doors (G)
	−6	−1(0)K	0(1)K	1	2(3)L	3(4)L

7. EXIT SYSTEM	Single or Exposed Route	Multiple Routes				
		Deficient	w/o Horiz.	Horiz. Exit	Smoke Proof Tower	Direct Exit
	−6	−2	0	2	2	4

8. EXIT ACCESS	Max. Dead End		No Dead End 35′ & Travel Is:			
	> 100′	> 35′ ≤ 100′	> 150′	100′–150′	50′–100′	< 50′
	−6(0)D	−4(0)D	−2	−1	0	2

9. INTERIOR FINISH	Flame Spread Ratings					
EXIT ROUTES	> 75 ≤ 200		> 25 ≤ 75		≤ 25	
ROOMS/SUITES	> 75 ≤ 200	≤ 75	> 75 ≤ 200	≤ 75	> 25 ≤ 200	≤ 25
	−3	−1	0	1	1	2

10. VERTICAL OPENINGS	Open (or Incomplete Enclosure)			Enclosed (H)		
	Involving 5 or More Floors	3-4 Flrs.	2 Flrs.	< 30 Min	≥ 30 Min < 1 Hr.	≥ 1 Hr.
	−10	−7	−2	−1	0	1(0)B

11. SMOKE CONTROL	None	Smoke Barriers	Mechanically Assisted Systems			
			By Floor		By Zone	By Rm/Suite
			w/o Part.	w/Part.		
	0	2	2	3	3	4

NOTES:
A-Use (−1 × height in stories) if building is fully sheathed with plaster, gypsum board or similar materials.
B-Use ( ) if parameter 1 is based on Type V(000), Type III(200), or Type II(000), if Note A does not apply, and if parameter 5 is ≤ 4.
C-Use ( ) if parameter 1 is based on Type V(000), Type III(200), or Type II(000).
D-Use ( ) if parameter 7 is −6.
E-Use ( ) if parameter 6 is based on "None or Incomplete", or "Walls or Doors" are < 20 min. and parameter 5 is ≤ 4.
F-Use ( ) for levels A, B, and C if parameter 7 = 4 and building height is ≤3 stories.
G-Rate separation as:
- 20 Minutes (or actual rating if greater) if parameter 5 ≥ 6.
- Smoke resisting if parameter 1 is based on Type V (000), Type III (200), or Type II (000), if building is not fully sheathed per Note A, and if parameter 5 ≥ 4.

H-Use 0 in 1 story buildings.
I - Interconnected system covers corridors & common spaces plus indicated bedroom or suite detectors.
J-Use ( ) if parameter 5 is ≥ 6.
K-Use ( ) in facilities where each bedroom/suite has occupant controlled personal security access locks.
L-Use ( ) if separations between bedrooms/suites also meet criteria.

NP-not permitted—system not usable while this condition exists.

PART 2 B. COMPUTE INDIVIDUAL SAFETY EVALUATIONS — USE TABLE 2. Jan. 15, 1983

1. Transfer each of the 11 circled safety parameter values on Table 1 to every unshaded block in the line with the corresponding safety parameter in Table 2. Where the block is indicated (÷2) enter only one-half the value shown in Table 1.

2. Add the four columns, keeping in mind that any negative numbers deduct.

3. Transfer the resulting values for S_1, S_2, S_3, and S_4 on page 4 of this worksheet.

Table 2. Individual Safety Evaluations

SAFETY PARAMETER	FIRE CONTROL (S_1)	EGRESS PROVIDED (S_2)	REFUGE PROVIDED (S_3)	GENERAL FIRE SAFETY PROVIDED (S_4)
1. CONSTRUCTION				
2. HAZARDOUS AREAS		÷2		
3. MANUAL FIRE ALARM	÷2			
4. SMOKE DETECTION & ALARM	÷2		÷2	
5. AUTOMATIC SPRINKLERS		÷2	(÷2)A	
6. SEPARATION OF SLEEPING ROOMS		÷2		
7. EXIT SYSTEM			÷2	
8. EXIT ACCESS				
9. INTERIOR FINISH	÷2			
10. VERTICAL OPENINGS	÷2			
11. SMOKE CONTROL				
TOTAL	S_1=	S_2=	S_3=	S_4=

NOTE: A - Use full value if Safety Parameter 1 is based on Type V (000), Type III (200) or Type II (000) construction. Divide by 2 (÷2) in all other cases.

PART 2 C. DETERMINE MANDATORY REQUIREMENTS — USE TABLE 3. Jan. 4, 1983

1. Use the Level of Requirements Based on Evacuation Capability (see Worksheet 2D in Appendix B) to select the proper row of Table 3. Circle the appropriate values.
2. Transfer the circled values from Table 3 to the blanks marked S_a, S_b, S_c, and S_d in Table 4.

Table 3. Mandatory Requirements

Level of Requirements	Building Height & Number of Residents	Control Requirement (S_a)	Egress Requirement (S_b)	Refuge Requirement (S_c)	General Fire Safety Requirement (S_d)
A	1-2 Story $\leq$ 30	0.5	5.0	−1.0	3.0
B	1 Story $\leq$ 30 2 Story $\leq$ 30	3.5 2.5	6.0 6.0	2.0 1.0	6.0 5.0
C	1 Story * 2 Story * 3-6 Story * >6 Story *	3.5 2.5 4.5 6.5	8.0 8.0 8.0 8.0	4.0 3.0 5.0 7.0	8.0 7.0 9.0 11.0
D	$\geq$1 Story *	8.0	9.5	8.0	13.0

*Unlimited number of residents.

Part 2 D. EQUIVALENCY EVALUATION

1. Perform the indicated subtractions in Table 4. Enter the differences in the appropriate answer blocks.
2. For each row check "YES" if the value in the answer block is zero or greater. Check "NO" if the value in the answer block is a negative number.

Table 4. Equivalency Evaluation

							YES	NO
Control Provided	(S_1)	minus	Required Control	(S_a)	≥ 0	S_1 □ − S_a □ = □		
Egress Provided	(S_2)	minus	Required Egress	(S_b)	≥ 0	S_2 □ − S_b □ = □		
Refuge Provided	(S_3)	minus	Required Refuge	(S_c)	≥ 0	S_3 □ − S_c □ = □		
General Fire Safety	(S_4)	minus	Required Gen. Fire Safety	(S_d)	≥ 0	S_4 □ − S_d □ = □		

Return to page (1) of this form.

GLOSSARY FOR WORKSHEET FOR EVALUATING A LARGE RESIDENTIAL FACILITY

This glossary is provided to assist in completing the Fire Safety Evaluation Worksheets for determining the suitability of large residences to house board and care homes. The instructions for the mechanisms of completing the worksheet are included in the worksheet itself. They are not repeated in this glossary. This glossary provides expanded discussion and definitions for the various items in the worksheet to assist the user when questions of definition or interpretation arise. To the maximum extent possible, the glossary does not repeat the definitions already existing in the Life Safety Code but rather references the appropriate paragraph in Chapters 1-31 of the 1981 Life Safety Code.

Areas of Application

The entire residence is evaluated on a single worksheet to the degree indicated on each item on the worksheet. However, spaces that are not used for living units, in direct utility or maintenance support of the living units, provided for resident use, or in any way involved in resident emergency egress may be omitted from the calculation when such space is separated from all of the resident and resident support spaces by two hour fire resistive construction (including any building members that support the resident areas and emergency egress routes and with fire doors in any communicating opening). In such case, however, any appropriate charges under Parameter 2, Hazardous Areas in Table 1 shall be charged. Also the assignment of values for Parameters 3, Manual Alarms; 7, Exit System; and 8, Exit Access; shall not consider conditions in unoccupied spaces that do not involve any egress paths.

NOTE: Zoning of buildings is permitted and individual zones may have different combinations of safety features and different Levels of Requirements. Such zoning shall, however, be limited to considerations of differences in parameters 6, 7, and 8 covering exits and separation of sleeping areas. Zoning shall be by separate fire/smoke zones. A fire/smoke zone is a portion of the building separated from all other portions of the building by building construction having at least one hour fire resistance and/or smoke partitions, with 20 minute fire resistance, conforming to the requirements of section 6-3 of the Life Safety Code for Smoke Barriers. Zoning of the facility is also permitted in non-fire resistive sprinklered buildings provided the construction separating one zone from another is sound and smoke resisting.

Maintenance

All protection systems, requirements, arrangements and procedures shall be maintained in a dependable operating condition, and a sufficient state of readiness, and shall be used in such a manner that the intended safety function or hazard constraint is not impaired. Otherwise, they shall receive no credit in the evaluation.

Safety Parameter Table (General Discussion)

The safety parameters are a measure of those building factors that bear upon or contribute to the safety of those persons who may be in the building at the time of a fire.

Each of the safety parameters is to be analyzed, and the safety value for each parameter that best describes the condition in the building is to be identified. Only one value for each of the parameters is to be chosen. If two or more appear to apply, the one with the lowest point value shall be used.

1. Construction

Construction types are defined by the fire resistance and combustibility of load bearing framing members, floor construction, and roof construction in accordance with Figure C-2 which is taken from NFPA 220-1979, Standard Types of Building Construction.

Table 3 Fire Resistance Requirements for Type I through Type V Construction

	Type I		Type II			Type III		Type IV	Type V	
	443	332	222	111	000	211	200	2HH	111	000
EXTERIOR BEARING WALLS —										
Supporting more than one floor, columns or other bearing walls	4	3	2	1	0[1]	2	2	2	1	0[1]
Supporting one floor only	4	3	2	1	0[1]	2	2	2	1	0[1]
Supporting a roof only	4	3	1	1	0[1]	2	2	2	1	0[1]
INTERIOR BEARING WALLS —										
Supporting more than one floor, columns or other bearing walls	4	3	2	1	0	1	0	2	1	0
Supporting one floor only	3	2	2	1	0	1	0	1	1	0
Supporting a roof only	3	2	1	1	0	1	0	1	1	0
COLUMNS —										
Supporting more than one floor, bearing walls or other columns	4	3	2	1	0	1	0	H[2]	1	0
Supporting one floor only	3	2	2	1	0	1	0	H[2]	1	0
Supporting a roof only	3	2	1	1	0	1	0	H[2]	1	0
BEAMS, GIRDERS, TRUSSES & ARCHES —										
Supporting more than one floor, bearing walls or columns	4	3	2	1	0	1	0	H[2]	1	0
Supporting one floor only	3	2	2	1	0	1	0	H[2]	1	0
Supporting a roof only	3	2	1	1	0	1	0	H[2]	1	0
FLOOR CONSTRUCTION	3	2	2	1	0	1	0	H[2]	1	0
ROOF CONSTRUCTION	2	1½	1	1	0	1	0	H[2]	1	0
EXTERIOR NONBEARING WALLS	0[1]	0[1]	0[1]	0[1]	0[1]	0[1]	0[1]	0[1]	0[1]	0[1]

▨ Those members listed that are permitted to be of approved combustible material.

[1] Requirements for fire resistance of exterior walls, the provision of spandrel wall sections, and the limitation or protection of wall openings are not related to construction type. These items are covered in other parameters as appropriate.

[2] "H" indicates heavy timber members. see NFPA 220 for requirements.

Figure C-2. Fire Resistance Requirements for Type I through Type V Construction

Where the facility includes additions or connected structures of different construction, the rating and classification of the structure shall be based on (a) separate buildings if a two hour or greater fire resistive separation exists between the portions of the building, or (b) the lower safety parameter point score involved if such a separation does not exist.

The story used to determine the parameter value is the highest story used for sleeping purposes. Story height is based on stories starting with the grade floor or the lowest floor used for sleeping purposes, whichever indicates the greater number of stories.

The exception to Life Safety Code Section 13-1.6.3, stating conditions under which Type I and Type II construction may have combustible roofing systems, applies.

The safety parameter values for Type V(000), Type III(200) and Type II(000) receive a higher parameter credit if the building is fully sheathed. This credit is to be given if all portions of the bearing walls, bearing partitions, floor construction, and roofs (or a roof/loft system if the space above the highest ceiling is inaccessible and either is provided with draft stops or other barriers on 30 foot spacing or is provided with heat or smoke actuated fire detectors that will sound the building fire alarm), and all columns, beams, girders, trusses, or similar bearing members either have an inherent fire resistance or are sheathed, encased, or otherwise treated, to provide approximately 20-minutes or greater fire resistance. Buildings fully sheathed with sound lath and plaster, gypsum board, or equivalent sheathing, are considered to meet the criteria for this note.

2. Hazardous Areas

The assignment of charges for hazardous areas is a four-step process.

Step 1. Identify Hazardous Areas. A hazardous area is any space or compartment that contains a storage or other activity that is not a part of normal living space arrangements and possesses the potential of producing a fully involved fire. A list of typical hazardous areas is listed under the heading, Exposure, in Figure C-3.

Step 2. Determine the Level of Hazard. There are two levels of hazard as follows:

a. Structurally Endangering. A hazardous area with sufficient fire or explosion potential to defeat the basic integrity of the building framing as defined in Parameter 1.

(LARGE)

INHERENT STRUCTURAL DANGER FROM TYPICAL HAZARDOUS AREAS IN

LARGE RESIDENTIAL FACILITIES

Exposure (Area, Space, Activity, Condition)**	MINIMUM FIRE RESISTANCE OF BEARING WALLS, BEARING PARTITIONS, COLUMNS, BEAMS, GIRDERS, TRUSSES, AND FLOOR/CEILING ASSEMBLIES EXPOSED TO HAZARDOUS AREA		
	≥ 2-hour	<2-hour; ≥1-hour	<1-hour
	Not structurally endangering (N/SE)		Structurally endangering (SE)
Occupational therapy spaces		Varies*	
Craft shop		Varies*	
General storage area		Varies*	
Garage		N/SE	
Boiler, heater, or incinerator rooms		Varies*	
Fuel storage		SE	
Trash chutes		SE	
Trash rooms		SE	
Small trash collection room		N/SE	
Laundries (institutional type)		N/SE	
Repair shops		Varies*	

*Must be judged on the individual situation of combustibles involved.

**No area, regardless of title designation is classified as a hazardous area if the total fire hazard is less than that specified for a hazardous area in Step 1 of Parameter 2.

Figure C-3. Hazardous Area - Level of Hazard

b. Not Structurally Endangering. A hazardous area with sufficient fire potential to build to full involvement and present a danger of propagating through openings or wall partitions but not possessing sufficient total potential to endanger the structural framing or floor decking as defined in Parameter 1.

Figure C-3 provides an analysis of typical types of hazardous areas relative to inherent potential structural danger to different classes of structural systems.

Step 3. Determine the Fire Protection Provided

The parameter value for hazardous areas is based on the presence or absence of the fire protection necessary to control or confine the hazard. Two different types of fire protection are considered. The first consists of automatic sprinklers or other appropriate extinguishing system covering the entire hazard.* The second is a complete fire resistive enclosure sufficient to exceed the potential of the fire load involved. The enclosure includes the separation of the hazardous area from any bearing members; partitions separating the hazardous area from all other spaces; and doors to the space.

Any hazardous space that has either of these protection systems is classified as having single protection. Any hazardous space that is both fully enclosed, as described above, and sprinklered is classified as having both, i.e., double level protection. On this basis, any hazardous area with a fuel load that has the potential of overwhelming the available structural capability would, as a minimum, have a single deficiency as determined in Step 4 below.

Step 4. Determine Degree of Deficiency and Assign Parameter Values

The parameter value is finally determined on the basis of the degree of deficiency that the hazardous area has in terms of the level of protection needed.

Figure C-4 provides a matrix type table to assist in determining degree of deficiency to be assessed.

In some situations, the building will contain more than one hazardous area with the same or with differing levels of deficiency. The charge is based on the single most serious charge for hazardous area found.

*The credit for sprinklers is not to be given unless the hazardous area is separated from any living unit or the egress route by reasonably smoke resisting partitions and doors.

	NO PROTECTION	SPRINKLER PROTECTION	FIRE RESISTIVE ENCLOSURE	SPRINKLERED & FIRE RESISTIVE ENCLOSURE
NOT STRUCTURALLY ENDANGERING	SINGLE DEFICIENCY	NO DEFICIENCIES		
STRUCTURALLY ENDANGERING	DOUBLE DEFICIENCY	SINGLE DEFICIENCY	NO DEFICIENCIES[A] DOUBLE DEFICIENCY[B]	NO DEFICIENCIES[A] SINGLE DEFICIENCY[B]

A. If fire resistance and structural strength exceed maximum potential of hazard.

B. If fire resistance or structural strength is not sufficient to withstand potential of hazard.

Figure C-4. Hazardous Areas - Degree of Deficiency

3. Manual Fire Alarm

a. None. There is no manual fire alarm system, or the system is incomplete and does not meet the requirements necessary for a higher scored category.

b. W/O F.D. Notif. There is a manual fire alarm system which meets the requirements of Section 7-6 and has the following features:

(1) Sounding devices are of such character and so located as to alert all occupants of the building or section thereof endangered by fire.

(2) A manual fire alarm station is provided at the main desk or other convenient central control point under continuous supervision of responsible staff.

Exception 1. Level A, B, or C facilities where each occupant room has a direct exit to the outside of the building and the building is three or less stories in height.

Exception 2. In Level A, B, or C facilities additional manual alarms (as specified in Section 7-6) may be omitted where there are other effective means (such as complete automatic sprinkler or automatic fire detection systems) for notification of fire.

c. W/ F.D. Notif. There is a manual fire alarm system which complies with the requirements of b, above, and, in addition, automatically transmits a signal to the fire department which is legally committed to serve the area in which the building is located, through a direct connection, an approved central station, or through other means acceptable to the authority having jurisdiction. Credit can be given for fire department connection in buildings seven stories or more in height only if an annunciator panel, which indicates the location of the fire by floor, is provided.

4. Smoke Detection and Alarm

All references to detectors herein refer to smoke detectors. No credit is given for thermal detectors in habitable spaces except as specifically noted below. Heat detectors can be credited in uninhabitable spaces where ambient temperatures can be expected to exceed 120° Fahrenheit (49°C) or

fall below 0° Fahrenheit (-18°C) (such as unfinished attics or cocklofts) as long as separation from inhabited spaces is at least 20 minutes. The categories under this parameter are as follows:

a. None. There are no detectors or those that are present do not meet the requirements for a higher scored category.

b. Single Station, Bedrooms. There is one single station detector (sounds the alarm only at the responding detector) in each bedroom or sleeping room.

c. Interconnected Systems. Interconnected systems are those systems where the operation of any detector sounds alarm devices that alert all of the occupants. The alarm sounding device may be on other interconnected detectors or may be other separate alarm devices. Where the systems are of the total building variety, the credit can be given only if the system includes manual fire alarm features or the building has a manual fire alarm system and the operation of the detection system sounds the manual fire alarm as though a fire alarm box on that floor had been operated.

(1) Corridors and Common Spaces Without BR/Suite Detectors. To meet the requirements for smoke detector coverage of corridors and common spaces, such spaces shall be provided with smoke detector installations in accordance with NFPA 72E-1982, Automatic Fire Detectors.

Exception 1: Common spaces provided with automatic sprinkler systems.

Exception 2: Corridors and other spaces open to corridors when all of the following conditions exist: (a) the corridors are under continual direct observation by staff during all times residents are in the building; (b) the level of observation equals or exceeds that normally provided by staff at nursing stations in hospitals; and (c) the corridor is not separated from the point of observation by doors which may be closed.

Exception 3: Unenclosed corridors; a corridor, balcony, colonnade, or other arrangement where one side along the long dimension of the passageway is fully or extensively open to the exterior at all times.

(2) Corridors and Common Spaces with Single Station BR/Suite Detectors. There is one single station detector in each bedroom plus interconnected detectors in corridors and common spaces spaced as described in (1) above.

(3) Corridors and Common Spaces with Interconnected BR/Suite Detectors. Same as (2) above except bedroom/suite detectors are interconnected with corridor/common space detectors. In buildings in which Parameter 1 is based on a construction where all the members have a fire resistance rating of at least 20 minutes or more, a system as described in (2) above which has in addition a thermal detector in each bedroom/suite connected to the building fire alarm system may be credited in this category.

(4) Total Building Systems. This system includes detector locations in every bedroom throughout and also provides detector coverage throughout all corridors, common spaces, and hazardous areas.

5. Automatic Sprinklers

Where an automatic sprinkler system is installed, either for total or partial building coverage, the system is in accordance with the requirements of NFPA Booklet No. 13-1980, Installation of Sprinkler Systems.

a. None. No credit is given if there are no sprinklers or if sprinklers, though present, are not sufficient to qualify for one of the other categories listed herein.

Note: Any space that is to be credited as being protected by automatic sprinklers that abuts a hazardous area which is judged deficient in accordance with Parameter 2 (Hazardous Area), will not be considered as sprinkler protected unless that hazardous area is also sprinkler protected.

b. Bedrooms/Suites Only. All bedrooms/suites have sprinkler protection.

c. Corridors and Common Spaces. Sprinkler protection covers all of the corridors and public spaces that separate, directly expose, or are in the egress path from the bedrooms/suites (except fire resistive enclosed non-combustible stairwells). Sprinklers are

installed in corridors along the ceiling, and, in addition, one sprinkler head is installed opposite the center of and inside any bedroom door opening onto the corridor.

d. Bedrooms/Suites, Corridor and Common Space. Meets the combined requirements for b and c above, and is equipped with an automatic alarm initiating device that will activate the building manual fire alarm system or an alternate evacuation alarm.

e. Total. The building is totally sprinkler protected in accordance with Section 7-7 of the Life Safety Code and is equipped with an automatic alarm initiating device that will activate the building manual fire alarm system or an alternate evacuation alarm.

6. Separation of Sleeping Rooms from Exit Access

Separation of sleeping rooms from exit access is based on the wall partitions making the separation and the protection of the openings in those partitions.

The charge for none or incomplete is assessed in any case where the separation of sleeping rooms from exit access is insufficient to meet any of the other classifications in this parameter.

a. Expectation-High. High expectation of door closing (or being closed at time of fire) is considered as met under any of the following conditions:

(1) Such doors are provided with automatic closing release mechanisms actuated by smoke detectors.

(2) Doors are provided with traditional self-closing mechanisms and have occupant controlled locks such that access is normally (other than emergency) restricted to the occupants or staff personnel.

(3) Doors do not have any automatic closing mechanisms but one of the following conditions exists.

(a) The corridors involved are under continual direct observation by staff during all times residents are in the facility. The level of observation equals or exceeds that provided by staff at nursing stations in hospitals.

(b) The corridors involved are not under continual direct observation by staff but the building (or zone) involved is provided with a smoke detection and alarm system that covers the corridors, common spaces, and bedrooms. The alarm system is so arranged as to give immediate alarm to all the occupants and to staff available to respond.

(c) The building is provided with a complete automatic sprinkler system.

b. Smoke-Resisting. Sleeping rooms are separated from corridors or other common spaces by walls, partitions, or other construction that resist the passage of smoke. There are no louvers, transfer grills, operable transoms, or other air passages penetrating the wall except properly installed heating and utility installations. Vision panels may be installed without respect to glass type or size.

Doors, in walls or partitions that separate sleeping rooms from corridors or other common spaces, resist the passage of smoke and are provided with latches or other mechanisms suitable for keeping the doors tightly closed. Vision panels may be installed without respect to glass type or size.

c. 20 Minutes. Sleeping rooms are separated from corridors or other common spaces by walls or partitions, meeting the requirements of b, above, which have at least a 20-minute fire resistance rating. This rating will be considered achieved if the fire resistance rating is demonstrated by acceptable tests or if the walls or partitions are sheathed on both sides with lath and plaster, gypsum board, or equivalent sheathing. Any vision panels are of wired glass, not exceeding 1,296 square inches (0.84 sq. m.) of area each, installed in approved frames.

The doors meet the requirements of b, above, and have at least a 20-minute fire protection rating. Doors will be considered as having such a fire protection rating if they are 1-3/4 inch (4.45 cm) solid core wood construction or any other arrangement of equal or greater stability and fire integrity. The thermal insulation capability of the door is not considered. Hollow sheet steel doors are considered to meet the 20-minute fire protection rating requirement. Any vision panels are of wired glass, not exceeding 1,296 sq. in. (0.84 sq. m.) of area each, installed in approved frames.

Exception: The separation meets the requirements of b, above, and automatic sprinklers are provided on both sides of the partition.

d. 1-Hour Walls, 20-Minute Doors. Sleeping rooms are separated from corridors or other common spaces by walls or partitions and doors meeting the requirements of c, above, and the walls and partitions have at least a 1-hour fire resistance rating.

Exception 1: Doors meeting the requirements of b, above, and automatic sprinklers are provided on both sides of the door.

Exception 2: In existing Level D facilities only, existing walls that are of sound construction meeting or exceeding the requirements of c, above.

7. Exit System

Exit systems are the paths of travel from the facility to the outside. For the purposes of this parameter, however, only those exit routes used in fire drills shall be credited.

a. Single Route. A single route exists when the occupants of any sleeping room do not have either a direct exit as defined in h, below, or multiple routes as defined in c, below.

b. Exposed Route. A route is classified as exposed if a segment of that route is the only available route from one or more sleeping rooms and that segment is not separated from all other spaces by walls and doors that equal the separation credited in Parameter 6, Separation of Sleeping Rooms from Exit Access.

Exception 1: Rooms or spaces provided with an automatic sprinkler system.

Exception 2: Rooms or spaces where both:

(1) the room or space is provided with a smoke detection and alarm system connected to activate the building fire alarm system, and

(2) the furnishings, finishes, and furniture, in combination with all other combustibles within the room or space, are of such minimum quantity and are so arranged that a fully developed fire is unlikely to occur.

c. Multiple Routes. Multiple routes exist when the occupants of any sleeping room have either from the sleeping room or through access in a corridor adjacent to the sleeping room, a choice of two separate exit routes to the outside.

Note: In order to qualify for multiple routes, at least one route must qualify as unexposed.

d. Deficient. The system of multiple routes is deficient if any required portion of that system fails to meet any of the applicable criteria in Chapter 5 of the Life Safety Code.

e. Without Horizontal Exits (W/O Horiz.). An egress system is based on this charge if there are multiple routes that are not deficient but the arrangement does not include a horizontal exit as defined below or have acceptable direct exit from each sleeping room as defined below.

f. Horizontal Exit. The presence of a single horizontal exit (meeting the criteria in Section 5-2.4) on each floor containing sleeping rooms is sufficient to meet this requirement provided that the space created is of sufficient size to provide at least 6 sq. ft. of accessible space for all of the potential occupants already present in such space or evacuating to it.

g. Smoke Proof Towers. Credit for a smoke proof tower may be given if either the stairway so designated meets the requirements of Section 5-2.3 for a smoke proof tower, or has an acceptable designed smoke pressurization system maintaining a positive pressure in the stairwell sufficient to prevent intolerable contamination of the stairwell by smoke or other fire effects. To receive the credit for smoke proof towers, all exit stairs credited in Parameters 7 (Exit System) and 8 (Exit Access) must meet the smoke proof tower requirements.

h. Direct Exits. To be credited with direct exits, each sleeping room shall have within that unit a door that opens to the exterior at grade, or onto an unenclosed exterior balcony with direct access to an exterior exit or smoke proof tower. The credit for direct exits is applicable even if there are no other exit routes from the involved living unit and if the following apply: (1) the opening is directly onto a grade; and (2) the exit is located so that any person egressing can move directly away from the building without further exposure.

Note: This parameter does not cover the charges for the dead end conditions, travel distance, interior finish in the exits or exit access routes, or enclosure of stairways or other exit routes that pass from floor to floor. These elements are separately covered in Parameters 8, Exit Access; 9, Interior Finish; and 10, Vertical Openings.

8. Exit Access

a. Dead End(s). Charges are assessed if dead end travel from any bedroom exceeds 35 feet (10.67m). The dead end travel distance is the measured distance from the centerline of the doorway exiting the bedroom to the nearest point where a person has a choice of two directions or routes of egress. The maximum dead end is the maximum such distance.

b. No Dead End > 35' & Travel is;. To be credited for this classification, the exit access must have no dead end (as defined under a) greater than 35 feet (10.67m). The level of credit is based on the shortest travel distance from each bedroom to an enclosed interior stairway, the outside of the building, a horizontal exit, or a smoke barrier. The length of travel from the bedroom with the longest route is used.

9. Interior Finish

Interior finish on walls, ceilings, and floors is as defined in Section 6-5.

Only floor coverings in the exit and exit access system are considered. For purposes of assigning numerical values in Table 1 of the Worksheet, these floor coverings are considered as having a flame spead <25 if they meet the requirements for Class II and as >75 otherwise.

Exception 1: Previously installed floor coverings, subject to the approval of the authority having jurisdiction.

Exception 2: Exposed portions of structural members complying with the requirements of Type IV (2HH) construction may be permitted.

No consideration is included in the Safety Parameter Value for any finish with a flame spread rating greater than 200 or for any material not rationally measured by the ASTM E84 Test. Materials not rationally measured include: foam plastics, asphalt impregnated paper, and/or

materials capable of inducing extreme rates of fire growth and rapid flashover. In any case where these materials are involved, the resultant risk is considered beyond the capacity of this evaluation system and will require individual appraisal.

Note: 1/4 inch or thicker plywood can be considered as having a flame spread of 200 or less.

10. Vertical Openings.

These values apply to vertical openings and penetrations including exit stairways, ramps, and any other vertical exits, pipeshafts, ventilation shafts, duct penetrations and laundry and incinerator chutes. The charge for vertical openings shall be based on the presence or lack of enclosure and the fire resistance of the enclosure if present.

a. Open (Or Incomplete) Enclosure. A vertical opening or penetration is classified as open if it does not meet the criteria for "Enclosed" in b, below. This includes only openings that are:
(a) unenclosed; (b) partially enclosed but do not have doors;
(c) partially enclosed but have openings other than doorways;
(d) otherwise unable to resist the passage of smoke; and
(e) enclosed with cloth, paper, or similar materials without any sustained fire stopping capabilities.

b. Enclosed. A vertical opening or penetration is classified as enclosed if it is enclosed in accordance with 6-2.2.3.1 or otherwise satisfies the requirements of Section 2-9.

Exception 1: Unprotected vertical openings connecting not more than three floors, used only for board and care home purposes, in accordance with the conditions of 6-2.2.3.1.

Exception 2: An atrium in accordance with 6-2.2.3.1.

Exception 3: A building with a complete approved automatic sprinkler system in accordance with Section 7-7, where every resident use area has direct access to an exterior exit without passing through any public corridor.

Exception 4: One-story stairs that connect two levels within a single dwelling unit, resident room or suite located above the level of exit discharge.

The subclassifications under the classification "Open" refer to the number of floors that are exposed.

The subclassifications under the classification "Enclosed" refer to the level of fire resistance of the enclosure.

If a shaft other than a credited exit route (i.e., credited as one of the multiple routes required in Parameter 7 or in determining travel distance in Parameter 8) is enclosed on all floors but one and this results in an unprotected opening between that shaft, and one and only one floor, the parameter value assigned to that shaft shall be 0. If a credited egress route is contained in that shaft, the parameter value shall be -2.

11. Smoke Control

Smoke control definitions are as follows:

a. No Control. There are no smoke barriers (or horizontal exits) on the floor, the floor is not served by a smoke proof stair tower, and there are no mechanically assisted smoke control systems serving the floor.

b. Smoke Partitions. Smoke partitions consist of installations conforming to the requirements of Section 6-3 and are provided to divide all sleeping room floors into at least two sections. Smoke dampers are not required. Each section has sufficient corridor or other accessible space to provide a minimum of 6 sq. ft. (.557 sq. m.) per resident for each resident on the floor. Occupants on each side of the smoke barrier have access to an exit without passing through the smoke barrier.

c. Mechanically Assisted Systems - By Floors. Mechanically assisted smoke control on a corridor basis is a system initiated by a method of smoke detection that will assure operation of the smoke control system before significant smoke has entered into the corridor involved. The mechanism must be capable of pressurizing the corridor sufficiently to prevent smoke from the room/suite or space of origin from entering the corridor through the entire course of the fire. Such a system must be able to hold back the smoke through the expected maximum severity of the fire. It must also be capable of evacuating smoke from the corridor on the presumption that the emergency evacuation procedures and other activities involving the opening and closing of doors will cause occasional brief periods of overpowering the smoke control

system. This will result in the movement of the smoke from the fire area into the corridor. The evacuation of the smoke would normally be accomplished by having an exhaust fan from the corridor of lower capacity than the fan supplying air for pressurization. The net pressurization force would occur from the effect of the pressurizing fan minus the effect of the removal or purging fans. The corridor's pressurizing system may involve early warning smoke detection, automatic closing of all room/suite doors, and/or sprinklered protection. Where these additional protection devices are provided in order to effect such a smoke control system, the individual credits for each of the involved protection devices are in addition to the credits for the smoke control system.

d. Mechanically Assisted Systems - By Zone. Mechanically assisted smoke control on a zone basis must include a smoke partition (or a horizontal exit) supported by a mechanism of automatic control fans, smoke vent shafts, or a combination thereof to provide a pressure differential that will assist in confining smoke to the compartment of origin. Fans used may be special smoke control fans or special adjustments of the normal building air movement fans.

e. Mechanically Assisted Systems - By Room/Suite. Mechanically assisted smoke control on a room/suite basis is a system so designed as to provide a mechanism of automatically controlled fans, smoke vent shafts, or combination thereof to insure a positive pressure differential that will prevent intrusion of smoke into any room/suite not involved in fire. On this basis, the rooms will have a pressure differential higher than the corridor and higher than any room where fire has been detected. Such systems must be so arranged that there is detection in each room/suite that will prevent a room that is involved in fire from becoming positively pressurized.

3

Fire Safety Evaluation Worksheet for an Apartment Building used to House a Board and Care Home

Jan. 14, 1983

Building Identification _____

Evaluator_____ Date_____

(Complete one worksheet for each apartment house containing one or more apartment units housing a board and care home.)

First complete Table 1 on page 2. Continue with Table 2 on page 3 and Tables 3 and 4 on page 4. Then return to this page to obtain the Equivalency Conclusions.

TURN TO NEXT PAGE

PART 3E. EQUIVALENCY CONCLUSIONS

Complete Tables 1-4 before doing this part.

1. ( ) All of the checks in Table 4 are in the "YES" column. The level of fire safety is at least equivalent to that prescribed by the Life Safety Code.*

2. ( ) One or more of the checks in Table 4 are in the "NO" column. The level of fire safety is not shown by this system to be equivalent to that prescribed by the Life Safety Code for apartments.

* The equivalency covered by this worksheet includes the majority of considerations covered by the Life Safety Code. There are a few considerations that are not evaluated by this method. These must be separately considered. These additional considerations are covered in the "Facility Fire Safety Requirements Worksheet." One copy of this worksheet is to be completed for each facility.

Facility Fire Safety Requirements Worksheet

Considerations	Met	Not Met	Not Applic.
A. Utilities comply with the provisions of Section 7-1			X
B. Heating, ventilating, and air conditioning equipment comply with provisions of Section 7-2			X
C. Elevators, dumbwaiters, and vertical conveyors comply with the provisions of Section 7-4			
D. Rubbish chutes, incinerators, and laundry chutes comply with the provisions of Section 7-5			

Select and circle the safety value for each safety parameter in Table 1 that best describes the conditions in the facility. Choose only one value for each of the parameters. If two or more values appear to apply, choose the one with the lowest point value.

Table 1. Safety Parameter Values — Apartment Building

SAFETY PARAMETER	PARAMETER VALUES							
1. CONSTRUCTION BUILDING HEIGHT	Combustible					Noncombustible		
	Type V (000)	Type V (111)	Type III (200)	Type III (211)	Type IV (2HH)	Type II (000)	Type II (111)	Type II (222) & Type I
1 STORY	−2( )A	0	−2( )A	0	0	0	2	2
2 STORY	−8( )A	0	−6( )A	0	0	−5( )A	2	2
3-6 STORY	−8( )A	−2	−8( )A	0	−2	−6( )A	2	2
OVER 6 STORY	−10	−4	−10	−2	−4	−8	0	2

2. HAZARDOUS AREAS (outside B&C home units)	DOUBLE DEFICIENCY	SINGLE DEFICIENCY	NONE OR NO DEFICIENCY
	−4(−7)B,G	0(−4)G	0

3. MANUAL FIRE ALARM	NO ALARM	MANUAL ALARM	
		w/o F.D. NOTIF.	w/ F.D. NOTIF.
	D(2)I	2	3

4. SMOKE DETECTION & ALARM (outside B&C home units)	NONE	SINGLE STATION LIVING UNITS ONLY		INTERCONNECTED SYSTEM		TOTAL BUILDING
		SINGLE LEVEL	EVERY LEVEL	CORRS. & COMMON SPACES	CORRS., COMMON SPACES & LIVING UNITS	
	−4(0)J	0	2(0)E	3(0)E	4	6

5. AUTOMATIC SPRINKLERS (outside B&C home units)	NONE	CORRS., PUBLIC SPACES, ETC.	LIVING UNITS ONLY	CORRS., HAB. & PUBLIC SPACES	TOTAL BUILDING
	0	2(0)C	4(0)C	6	8

6. SEPARATION OF B&C HOME UNIT AND ITS EXIT ROUTE FROM OTHER SPACES	NONE OR INCOMPLETE	WALLS <20 MIN.		WALLS ≥20 MIN.<1 HR. DOORS ≥20 MIN.	WALLS ≥1 HR. DOORS ≥20 MIN. w/ AC
		DOORS <20 MIN.	DOORS ≥20 MIN.		
	−6	−2	0(−2)B	2(−2)B	4(−2)B

7. EXIT SYSTEM (serving B&C home units)	< 2 STANDARD ROUTES	MULTIPLE ROUTES				
		DEFICIENT	w/o HORIZ.	HORIZ. EXIT	SMOKE PROOF TOWER	DIRECT EXIT
	−6	−2	0	2	2	4

8. EXIT ACCESS (serving B&C home units)	MAX. DEAD END IS:		NO DEAD END > 35' & TRAVEL IS:			
	>100'	>35' ≤ 100	>150'	100'–150'	50'–100'	< 50'
	−6(0)D	−4(0)D	−2	−1	0	2

9. INTERIOR FINISH (egress routes serving B&C home units)	FLAME SPREAD RATINGS		
	>75 ≤ 200	>25 ≤ 75	≤ 25
	−3	−1	0

10. VERTICAL OPENINGS	OPEN OR INCOMPLETE ENCLOSURE			ENCLOSED H	
	THRU 5 OR MORE FLOORS	3-4 FLRS.	2 FLRS.	< 1 HR.	≥1 HR. F
	−10	−7	−2	0	10)A

11. SMOKE CONTROL (serving floors having B&C home units)	NO CONTROL	SMOKE BARRIER	MECHANICALLY ASSISTED AUTOMATIC		
			BY ZONE	BY UNIT	CORRIDORS
	0	2	2	3	4

NOTES:

A — Use (−1 × height in stories) if building is fully sheathed with plaster, gypsum board or similar materials.

B — Use ( ) if parameter 1 is based on Type V(000), Type III(200), or Type II(000), if Note A does not apply, and if parameter 5 is ≤4.

C — Use ( ) if parameter 1 is based on Type V(000), Type III(200), or Type II(000).

D — Use ( ) if parameter 7 is −6.

E — Use ( ) if parameter 6 is based on "None or Incomplete", or "Walls or Doors" are < 20 min. and parameter 5 is ≤4.

F — ≥20 minutes in existing building.

G — Use ( ) if hazardous area is on exit route or in refuge area serving group home unit.

H — Use 0 in 1 story building.

I — Use (2) in 1-3 story buildings with <12 living units.

J — Use ( ) if parameter 6 is ≥ 6.

PART 3B. COMPUTE INDIVIDUAL SAFETY EVALUATIONS — USE TABLE 2

1. Transfer each of the 11 circled safety parameter values on Table 1 to every unshaded block in the line with the corresponding safety parameter in Table 2. Where the block is indicated (÷ 2) enter only one-half the value shown in Table 1.

2. Add the four columns, keeping in mind that any negative numbers deduct.

3. Transfer the resulting values for S_1, S_2, S_3, and S_4 to Table 4 on page 4 of this worksheet.

Table 2. Individual Safety Evaluations

SAFETY PARAMETER	FIRE CONTROL (S_1)	EGRESS PROVIDED (S_2)	REFUGE PROVIDED (S_3)	GENERAL FIRE SAFETY PROVIDED (S_4)
1. CONSTRUCTION				
2. HAZARDOUS AREAS		÷2		
3. MANUAL FIRE ALARM	÷2			
4. SMOKE DETECTION & ALARM	÷2			
5. AUTOMATIC SPRINKLERS		÷2	(÷2)A	
6. SEPARATION OF LIVING UNITS		÷2		
7. EXIT SYSTEM			÷2	
8. EXIT ACCESS				
9. INTERIOR FINISH				
10. VERTICAL OPENINGS	÷2			
11. SMOKE CONTROL				
TOTAL	S_1=	S_2=	S_3=	S_4=

NOTE: A - Use full value if Safety Parameter 1 is based on Type V (000), Type III (200) or Type II (000) construction. Divide by 2 (÷2) in all other cases.

PART 3C. DETERMINE MANDATORY SAFETY REQUIREMENT — USE TABLE 3 Jan. 4, 1983

1. Using the Level of Requirements based on Evacuation Capability (see Scoresheet 2D), the classifications of the building (i.e., New or Existing) and the building height, circle the appropriate value in each of the four columns in Table 3.

2. Transfer the circled values from Table 3 to the blanks marked S_a, S_b, S_c and S_d in Table 4.

Table 3. Mandatory Requirements

BUILDING HEIGHT	LEVEL OF REQUIREMENTS	CONTROL REQUIREMENTS (S_a)		EGRESS REQUIREMENTS (S_b)		REFUGE REQUIREMENTS (S_c)		GENERAL FIRE REQUIREMENTS (S_d)	
		NEW	EXISTING	NEW	EXISTING	NEW	EXISTING	NEW	EXISTING
1-3 STORIES	A,B,C	6.5	4.5	8(6)A	7	7	5	10	8
	D	8.5	6.5	8(6)A	7	9	7	12	10
>3-6 STORIES	A,B,C,D	8.5	8.5	8(6)A	8	9	9	12	12
>6 STORIES	A,B,C,D	8.5	8.5	10(6)B	10	10	10	14	14

NOTES:
A - Use value of 6 for Egress Requirement (S_b) if Control Provided (S_1) is ≥ 12.5
B - Use value of 6 for Egress Requirements (S_b) if Control Provided (S_1) is ≥ 14.5

PART 3D. FIRE SAFETY EQUIVALENCY EVALUATION

1. Perform the indicated subtractions in Table 4. Enter the differences in the appropriate answer blocks.

2. For each row check "YES" if the value in the answer block is zero or greater. Check "NO" if the value in the answer block is a negative number.

Table 4. Equivalency Evaluation

							YES	NO
CONTROL PROVIDED	(S_1)	minus	REQUIRED CONTROL	(S_a)	≥ 0	S_1 ☐ − S_a ☐ = ☐		
EGRESS PROVIDED	(S_2)	minus	REQUIRED EGRESS	(S_b)	≥ 0	S_2 ☐ − S_b ☐ = ☐		
REFUGE PROVIDED	(S_3)	minus	REQUIRED REFUGE	(S_c)	≥ 0	S_3 ☐ − S_c ☐ = ☐		
GENERAL FIRE SAFETY	(S_4)	minus	REQUIRED GEN. FIRE SAFETY	(S_d)	≥ 0	S_4 ☐ − S_d ☐ = ☐		

Return to page (1) of this form.

GLOSSARY FOR WORKSHEET FOR EVALUATING THE SUITABILITY OF AN APARTMENT BUILDING TO HOUSE A SMALL BOARD AND CARE HOME

This glossary is provided to assist in completing the Fire Safety Evaluation Worksheets for determining the suitability of an apartment building to house a small board and care home (16 or fewer residents). This is the second step in a 2-step procedure. The first step is to evaluate the portion of the building used as a board and care home: this step is to evaluate the remainder of the building. The instructions for completing the worksheet are included in the worksheet itself. They are not repeated in this glossary. This glossary provides expanded discussion and definitions for the various items in the worksheet to assist the user when questions of definition or interpretation arise. To the maximum extent possible, the glossary does not repeat the definitions already existing in the Life Safety Code but rather references the appropriate paragraph in Chapters 1-31 of the 1981 Life Safety Code.

Areas of Application

The entire apartment building is evaluated on a single worksheet to the degree indicated on each item on the worksheet. However, spaces that are not used for living units, in direct utility or maintenance support of the living units, provided for tenant use, or in any way involved in resident emergency egress may be omitted from the calculation when such space is separated from all of the tenant and tenant support spaces by two hour fire resistive construction (including any members that bear the load of tenant use space and with fire doors in any communicating opening). In such case, however, any appropriate charges under Parameter 2, Hazardous Areas in Table 1 shall be charged.

The suitability of the apartment unit actually used as the board and care home is evaluated separately and may be evaluated before or after evaluating the suitability of the apartment building.

Maintenance

All protection systems, requirements, arrangements and procedures shall be maintained in a dependable operating condition, and a sufficient state of readiness, and shall be used in such a manner that the intended safety function or hazard constraint is not impaired. Otherwise, they shall receive no credit in the evaluation.

Safety Parameter Table (General Discussion)

The safety parameters are a measure of those building factors that bear upon or contribute to the safety of those persons who may be in the building at the time of a fire.

Each of the safety parameters is to be analyzed and the safety value for each parameter that best describes the condition in the building is to be identified. Only one value for each of the parameters is to be chosen. If two or more appear to apply, the one with the lowest point value shall be used.

1. Construction

(The Construction parameter values are applied to the entire building as defined below.)

Construction types are defined by the fire resistance and combustibility of load bearing framing members, floor construction, and roof construction in accordance with Figure C-5 which is taken from NFPA-220-1979, Standard Types of Building Construction.

Table 3 Fire Resistance Requirements for Type I through Type V Construction

	Type I		Type II			Type III		Type IV	Type V	
	443	332	222	111	000	211	200	2HH	111	000
EXTERIOR BEARING WALLS —										
Supporting more than one floor, columns or other bearing walls	4	3	2	1	0[1]	2	2	2	1	0[1]
Supporting one floor only	4	3	2	1	0[1]	2	2	2	1	0[1]
Supporting a roof only	4	3	1	1	0[1]	2	2	2	1	0[1]
INTERIOR BEARING WALLS —										
Supporting more than one floor, columns or other bearing walls	4	3	2	1	0	1	0	2	1	0
Supporting one floor only	3	2	2	1	0	1	0	1	1	0
Supporting a roof only	3	2	1	1	0	1	0	1	1	0
COLUMNS —										
Supporting more than one floor, bearing walls or other columns	4	3	2	1	0	1	0	H[2]	1	0
Supporting one floor only	3	2	2	1	0	1	0	H[2]	1	0
Supporting a roof only	3	2	1	1	0	1	0	H[2]	1	0
BEAMS, GIRDERS, TRUSSES & ARCHES —										
Supporting more than one floor, bearing walls or columns	4	3	2	1	0	1	0	H[2]	1	0
Supporting one floor only	3	2	2	1	0	1	0	H[2]	1	0
Supporting a roof only	3	2	1	1	0	1	0	H[2]	1	0
FLOOR CONSTRUCTION	3	2	2	1	0	1	0	H[2]	1	0
ROOF CONSTRUCTION	2	1½	1	1	0	1	0	H[2]	1	0
EXTERIOR NONBEARING WALLS	0[1]	0[1]	0[1]	0[1]	0[1]	0[1]	0[1]	0[1]	0[1]	0[1]

Those members listed that are permitted to be of approved combustible material.

[1] Requirements for fire resistance of exterior walls, the provision of spandrel wall sections, and the limitation or protection of wall openings are not related to construction type. These items are covered in other parameters as appropriate.

[2] "H" indicates heavy timber members; see NFPA 220 for requirements.

Figure C-5. Fire Resistance Requirements for Type I through Type V Construction

Where the facility includes additions or connected structures of different construction the rating and classification of the structure shall be based on: (a) separate buildings if a two hour or greater fire resistive separation exists between the portions of the building and, (b) the lower safety parameter point score involved if such a separation does not exist.

The story used to determine the parameter value is the highest story used for sleeping purposes. Story height is based on stories starting with the grade floor or the lowest floor used for sleeping purposes, whichever indicates the greater number of stories.

The exception to Life Safety Code Sect. 13-1.6.3, stating conditions under which Type I & Type II construction may have combustible roofing systems, applies.

2. Hazardous Areas

The Hazardous Area parameter applies to the entire building except the apartment(s) actually used for the residential board and care facility.

The assignment of charges for hazardous areas is a four-step process.

Step 1. IDENTIFY HAZARDOUS AREAS. A hazardous area is any space or compartment that contains a storage or other activity that is not a part of normal living space arrangements and possesses the potential of producing a fully involved fire. A list of typical hazardous areas is listed under the heading, Exposure, in Figure C-6.

Step 2. DETERMINE THE LEVEL OF HAZARD. There are two levels of hazard as follows:

a. Structurally Endangering. A hazardous occupancy with sufficient fire or explosion potential to defeat the basic integrity of the building framing as defined in Parameter No. 1.

b. Not Structurally Endangering. A hazardous occupancy with sufficient fire potential to build to full involvement and present a danger of propagating through openings or wall partitions but not possessing sufficient total potential to endanger the structural framing or floor decking as defined in Parameter No. 1.

INHERENT STRUCTURAL DANGER FROM TYPICAL HAZARDOUS AREAS IN APARTMENT HOUSES

EXPOSURE (Area, Space, Activity, Condition)**	MINIMUM FIRE RESISTANCE OF BEARING WALLS, BEARING PARTITIONS, COLUMNS, BEAMS, GIRDERS, TRUSSES, AND FLOOR/CEILING ASSEMBLIES EXPOSED TO HAZARDOUS AREA		
	≥2-Hour	<2-Hour;≥1-Hour	<1-Hour
	Not Structurally Endangering (N/SE)		Structurally Endangering (SE)
Commercial Space		SE	
Service Spaces		SE	
General Storage Area		N/SE	
Garage		N/SE	
Boiler, Heater, or Incinerator Rooms		SE (VARIES)*	
Fuel Storage		SE	
Trash Chutes		SE	
Trash Rooms		SE	
Small Trash Collection Room		N/SE	
Laundries		N/SE	
Repair Shops		VARIES*	

Figure C-6. Hazardous Area - Level of Hazard

* Must be judged on the individual situation of combustibles involved.
** No area regardless of title designation is classified as a hazardous area if the total fire hazard is less than that specified for a hazardous area in Step 1 of Parameter 2.

Step 3. DETERMINE THE FIRE PROTECTION PROVIDED. The parameter value for hazardous areas is based on the presence or absence of the fire protection necessary to control or confine the hazard. Two different types of fire protection are considered. The first consists of automatic sprinklers or other appropriate extinguishing systems covering the entire hazard*. The second is a complete fire resistive enclosure sufficient to exceed the potential of the fire load involved. The enclosure includes the separation of the hazardous area from any bearing members, partitions separating the hazardous area from all other spaces, and doors to the space. Any hazardous space that has either of these protection systems is classified as having single protection. Any hazardous space that is both fully enclosed - as described above - and sprinklered is classified as having both (i.e., double level protection). On this basis, any hazardous area with a fuel load that has the potential of overwhelming the available structural capability could as a minimum have a single deficiency as determined in step 4 below.

Step 4. DETERMINE DEGREE OF DEFICIENCY AND ASSIGN PARAMETER VALUES. The parameter value is finally determined on the basis of the degree of deficiencies that the hazardous area has in terms of the level of protection needed.

Figure C-7 provides a matrix type table to assist in determining degree of deficiency to be assessed.

In some situations, more than one hazardous area with the same or differing levels of deficiency will exist. The charge is based on the single most serious charge for hazardous area found.

3. Manual Fire Alarm

a. None. There is no manual fire system, or the system is incomplete and does not meet the requirements necessary for a higher scored category.

b. W/O F.D. Notif. There is a manual fire alarm system meeting the requirements of Section 7-6.

*The credit for sprinklers is not to be given unless the hazardous area is separated from any living unit or the egress route by reasonably smoke resisting partitions and doors.

	NO PROTECTION	SPRINKLER PROTECTION	FIRE RESISTIVE ENCLOSURE	SPRINKLERED & FIRE RESISTIVE ENCLOSURE
NOT STRUCTURALLY ENDANGERING	SINGLE DEFICIENCY	NO DEFICIENCIES		
STRUCTURALLY ENDANGERING	DOUBLE DEFICIENCY	SINGLE DEFICIENCY	NO DEFICIENCIES[A] DOUBLE DEFICIENCY[B]	NO DEFICIENCIES[A] SINGLE DEFICIENCY[B]

[A] If fire resistance and structural strength exceed maximum potential of hazard.

[B] If fire resistance or structural strength is not sufficient to withstand potential of hazard.

Figure C-7. Hazardous Areas - Degree of Deficiency

c. W/F.D. Notif. There is a manual fire alarm system which complies with the requirements of b. above and, in addition, automatically transmits a signal to the fire department which is legally committed to serve the area in which the building is located, through a direct connection, an approved central station, or through other means acceptable to the authority having jurisdiction. Credit can be given for fire department connection in buildings seven stories or more in height only if an annunciator panel, which indicates the location of the fire by floor, is provided.

4. Smoke Detection and Alarm

(These parameter values apply only to apartments other than the group residence and to the areas used for apartment corridors, and other common spaces.)

All references to detectors herein refer to smoke detectors. No credit is given for thermal detectors in habitable spaces except as specifically noted below. Heat detectors can be credited in uninhabitable spaces where ambient temperatures can be expected to exceed 120 degrees Fahrenheit (49°C) or fall below 0 degrees Fahrenheit (-18°C) (such as unfinished attics or cocklofts) as long as separation from inhabited spaces is at least 20 minutes. The categories under this parameter are as follows:

a. None. There are no smoke detectors in the building or if any are present they do not meet the requirements for a higher scored category.

b. Single Station Living Units Only. Single Station detectors are those detectors that sound the alarm only at the detector itself.

(1) Single Level. This value applies if each apartment covered by this parameter has at least one smoke detector and a higher value does not apply.

(2) Every Level. This value applies to those situations where there is one detector in each single level living unit or one detector on each level of any multi-level living unit. To receive this credit at least one detector on each level must be loud enough to be heard in each sleeping room of the apartment involved.

The operation of a single station unit does not involve the transmission of the alarm beyond the sounding of the alarm device in the unit itself.

c. Interconnected Systems. Interconnected systems are those systems where the operation of any detector sounds alarm devices that alert all of the occupants. The alarm sounding device may be on other interconnected detectors or may be other separate alarm devices. Where the systems are of the total building variety, the credit can be given only if the system includes manual fire alarm features or the building has a manual fire alarm system and the operation of the detection system sounds the manual fire alarm as though a fire alarm box on that floor had been operated.

(1) Corridors and Common Spaces. This parameter applies to those situations where there is at least one detector spaced every 30 ft. in corridors, and an additional detector in all common use spaces for each 900 sq. ft. or less of floor space. Detectors may be omitted from common use spaces that are either: 1, both sprinklered, and protected from any egress routes or area of refuge or staging that may serve the board and care home, by automatic closing doors operated by smoke detection or activation of the sprinkler system; or 2, are separated from the egress route, or area of refuge or staging, mentioned above, by fire resistant construction and by automatic closing doors of sufficient resistance to withstand the maximum fire potential in the common space.

(2) Corridors and Common Spaces Plus Single Station Living Units. To be credited in this category, detectors are provided which comply with the requirements for Every Level detectors in the living units of, b (2) above, and for corridor and common space system of c (1) above.

(3) Total Building System. An apartment building has a Total Building System if: 1, the detector systems of all living units meet the requirements of "Every Level" above; and 2, it provides detector coverage throughout all corridors, common spaces, and hazaradous areas.

5. Automatic Sprinklers

(The parameter values for automatic sprinklers are based on the protection of spaces outside the apartment used for group residences.) Where an automatic sprinkler system is installed, either for total or partial

building coverage, the system is in accordance with the requirements of NFPA 13-1980, Installation of Sprinkler Systems.

a. None. No credit is given if there are no sprinklers or if sprinklers, though present, are not sufficient to qualify for one of the other categories listed herein.

Note: Any space that abuts a hazardous area which is deficient in accordance with Parameter 2, (Hazardous Areas) will not be considered as sprinkler protected unless that hazardous area is also sprinkler protected.

b. Corridors and Public Spaces. Sprinkler protection covers all of the corridors and public spaces that separate, directly expose, or are in the egress path from the living units (except fire resistive enclosed non-combustible stairwells). Sprinklers are installed in corridors along the ceiling and, in addition, one sprinkler head is installed opposite the center of and inside any living unit door opening onto the corridor.

c. Living Units Only. All living units have sprinkler protection complying with the requirements for light hazard protection in NFPA 13-1980, Installation of Sprinkler Systems.

d. Corridor and Habitable Space. Meets the combined requirements for b and c, above.

e. Total. The building is totally sprinkler protected in accordance with Section 7-7 of the Life Safety Code and is equipped with an automatic alarm initiating device that will activate the building manual fire alarm system. Credit for total sprinkler protection shall not be given unless the living unit used for board and care purposes is also provided with total sprinkler protection.

6. Separation of Board and Care Home Unit and Its Exit Route From Other Spaces

(This parameter applies to all living units abutting corridors that may be used or involved in the exit system, or any areas of refuge or staging servicing the board and care unit. The separation requirements also apply to any common wall partitions between the board and care unit and any other living unit in the building.)

Separation of living units from each other and from common spaces is based on the wall partition making the separation and the protection of the openings in those partitions.

Duct penetrations where the duct is open on one side only of the partition and is of sheet steel construction shall be considered as equivalent to doors having a fire resistance of at least 20 minutes. Where there are duct openings on both sides of the partition the separation shall be considered incomplete unless there is a fire damper in the duct opening or the duct otherwise meets the requirements for omission of fire dampers as specified in NFPA 90A-1981, Installation of Air Conditioning and Ventilating Systems.

a. None or Incomplete. The partition shall be considered as none or incomplete if it has unprotected openings (louvers, gaps, transfer grills, plain glass windows, or plain glass transoms) between the floor and the ceiling. If openings exist above the ceiling level (or even if the partition stops at the ceiling level), the walls shall be considered as complete if the ceiling itself is a complete membrane (such as plasterboard or lath and plaster). In which case, the fire resistance rating shall be based on that of the wall or ceiling system, whichever is less.

   Doors shall be considered as none or incomplete if any living unit does not have a door; has a door but there is some mechanism or obstruction which prevents closing of the door or otherwise leaves a significant opening between the door and the corridor; has a door with open louvers, ordinary glass lights or transoms*. Doors that have been blocked open by doorstops, chalks, tiebacks, or other devices that require manual unlatching or releasing action to close the door shall be classified as none or incomplete. Also doors that are not provided with a latch or other device suitable for keeping the door tightly closed shall be classified as none or incomplete.

b. Walls.

   (1) < 20 Min. Walls shall be considered to have less than 20 minute fire resistance ratings if: 1) they are not equivalent to 1/2 inch gypsum wallboard on both sides of studs well nailed or fastened to the studs with appropriate taping and finishing of joints and

*Ordinary glass lights shall not be considered as requiring the "No Door" classification in locations where both sides of the glass light are protected by automatic sprinklers.

fasteners, or 2) they do not have a standard fire test rating of 20 minutes or greater.

(2) >=20 Min. < 1 Hr. Walls shall be considered to have fire resistance ratings greater than or equal to 20 minutes but less than 1 hour if: 1) the walls have a 20 minute or greater fire test rating, or 2) the walls are sheathed on both sides with lath and plaster, 1/2 inch gypsum wallboard, or equivalent sheathing.

(3) >= 1 Hr. Walls shall be considered as equal to or greater than 1 hour if they are of any of the established systems recognized as having 1 hour or greater fire resistance in accordance with recognized tests or approved listings.

c. Doors.

(1) < 20 Min. Doors shall be considered as less than 20 minutes if they resist the passage of smoke, and do not qualify as 20 minute doors.

(2) >=20 Min. Doors shall be considered as capable of resisting fire for at least 20 minutes if they are of 1 and 3/4 inch (4.45 cm) thick solid core wood construction or an arrangement of equal or greater stability and fire integrity. The thermal insulation capability of the door is not considered. Hollow sheet steel doors are considered to meet the 20 minute fire protection rating requirement.

(3) >=20 Min. W/AC. Doors shall be considered automatic closing if they are provided with devices that either provide the traditional self-closing mechanisms or with release mechanisms actuated by smoke detectors. In the case of doors separating living units from each other or from common spaces, self-closing doors shall be accepted whether or not they are equipped with devices that can be used to hold them in the open position so long as the normal operating mode of the living unit is to keep the door closed, particularly after the occupants have retired for the night.

A separation is considered standard (i.e., rated as equivalent to walls greater than 1 hour, door greater than 20 minutes) if the fire resistance of the doors and walls equals that specified by Chapters 18 and 19 for the protection level involved. The following table, an abstract of these requirements, is provided to assist in this determination.

BUILDING PROTECTION			STANDARD FIRE RESISTANCE OF:	
LSC Option Number	Minimum Score from Table 1, Safety Parameter Values, Apartment Buildings		DOORS	WALL
	Parameter			
	4 is:	5 is:		
1	-4	0	1/3 Hr.	1 Hr.*
2	3	0	1/3 Hr.	3/4 Hr.*
3	-4	2	1/3 Hr.	3/4 Hr.
4	-4	8	1/3 Hr.	1/2 Hr.

* 1/2 Hr. for existing sound partitions.

7. Exit System

This parameter applies to the entirety of the exit routes serving the small dwelling unit used as a Board and Care Home.

Exit routes are the paths of travel from the living unit to the outside of any of the types and arrangements described in Chapter 5.

a. < 2 Standard Routes. An exit system is classified as less than 2 standard routes if it does not have multiple routes as defined below.

b. Multiple Routes. Multiple routes exist when the occupants of the living unit used as a board and care facility have a choice of two separate exit routes to the outside of the types permitted by 18-2 or 19-2 as appropriate. They have this choice from the living unit or through access in a corridor adjacent to the living unit.

c. Deficient. The system of multiple routes is deficient if any required portion of that system fails to meet any of the applicable criteria covered by Chapter 5. The exit system is also classed as deficient if "Smoke Barrier Required for Stair Spacing" as set forth in Tables 18-1 or 19-1, as appropriate, is not provided.

NOTE: Typical deficient routes include usable exit routes that have narrower than minimum requirements, have wrong door swings, have stairs with deficient doors or door hardware, do not have handrails, or have insufficient exit marking or lighting.

d. Without Horizontal Exits (W/O Horiz.). Egress systems are considered without horizontal exits if there are multiple routes that are not deficient but the arrangement does not include a horizontal exit as defined below or does not have an acceptable direct exit from each living unit as defined below.

e. Horizontal Exit. A single horizontal exit on the floor containing the living unit used as a board and care facility is considered as a "Horizontal Exit" if: 1, the space created is of sufficient size to provide at least 6 square feet of accessible space for all of the potential occupants including those already present in such space and those evacuating to it; and 2, the "Maximum Gross Area per Story Between Horizontal Exits" requirement as set forth in Table 18-1 or 19-1 as appropriate is met. The details of horizontal exits must also meet Section 5-2.4. A horizontal exit will act as a smoke partition, and when it exists it is credited as both a smoke partition in Parameter 11 and a horizontal exit in Parameter 7.

f. Smoke Proof Towers. Credit for smoke proof towers may be given if either the stairway so designated meets the requirements of Section 5-2.3 for a smoke proof tower, or has an acceptably designed smoke pressurization system maintaining a positive pressure in the stairwell sufficient to prevent intolerable contamination of the stairwell by smoke or other fire effects. To receive the credit for smoke proof towers, all exit stairs credited in Parameters 7 (Exit System) and 8 (Exit Access) must meet the smoke proof tower requirement.

g. Direct Exits. To be credited with direct exits, the living unit used as a board and care facility has within that unit a door that opens to the exterior at grade or onto an unenclosed exterior balcony with direct access to an exterior exit or smoke

proof tower. The credit for direct exits is applicable even if there are no other exit routes from the involved living unit and if the following apply: (1) the opening is directly onto a grade; and (2) the exit is located so that any person egressing can move directly away from the building without further exposure.

8. Exit Access

(This parameter applies only to the exit access route from the small dwelling unit used as a Board and Care Home.)

a. Dead End(s). Charges are assessed if dead end travel from the small dwelling unit used as a board and care facility exceeds 35 feet (10.67m). The dead end travel distance is the measured distance from the centerline of the doorway exiting the living unit to the nearest point where a person has a choice of two directions or routes of egress.

b. No Dead End > 35' & Travel is:. To be credited for this classification, the exit access must have no dead end (as defined under a) greater than 35 feet (10.67m). The level of credit is based on the shortest travel distance from the dwelling unit to an enclosed interior stairway, the outside of the building, a horizontal exit, or a smoke barrier.

9. Interior Finish (Egress Routes)

This parameter applies to all egress routes and areas serving or open to the egress path from the small dwelling unit used as a board and care home.

Interior finish on walls, ceilings, and floors is as defined in Section 6-5.

Only floor coverings in the exit and exit access system are considered. For purposes of assigning numerical values in Table 1 of the Worksheet, these floor coverings are considered as having a flame spread < 25 if they meet the requirements for Class II and as > 75 otherwise.

Exception 1: Previously installed floor coverings, subject to the approval of the authority having jurisdiction.

Exception 2: Exposed portions of structural members complying with the requirements of Type IV (2HH) construction may be permitted.

No consideration is included in the Safety Parameter Value for any finish with a flame spread rating greater than 200 or for any material not rationally measured by the ASTM E84 Test. Materials not rationally measured include: foam plastics, asphalt impregnated paper and/or materials capable of inducing extreme rates of fire growth and rapid flashover. In any case where these materials are involved, the resultant risk is considered beyond the capacity of this evaluation system and will require individual appraisal.

NOTE: 1/4 inch or thicker plywood can be considered as having a flame spread of 200 or less.

10. Vertical Openings

This parameter applies to those portions of vertical openings exposing the floor containing the small dwelling unit used as a board and care home or the exit routes from that apartment.

These values apply to vertical openings and penetrations including exit stairways, ramps and any other vertical exits, pipeshafts, ventilation shafts, duct penetrations and laundry and incinerator chutes. The charge for vertical openings shall be based on the presence or lack of enclosure and the fire resistance of the enclosure if present.

a. Open or Incomplete Enclosure. A vertical opening or penetration is classified as open or incomplete if it does not meet the criteria for "Enclosed" in b, below. This includes only openings that are: (a) unenclosed; (b) partially enclosed but do not have doors; (c) enclosed but have openings other than doorways; (d) otherwise unable to resist the passage of smoke; (e) enclosed with cloth, paper or similar materials without any sustained fire stopping capabilities.

b. Enclosed. A vertical opening shall be classified as enclosed if it is enclosed in accordance with 6-2.2.3.1 or otherwise satisfies the requirements of Section 2-9.

Exception No. 1: Unprotected vertical openings connecting not more than three floors, used only for board and care home purposes, in accordance with the conditions of 6-2.2.3.1.

Exception No. 2: An atrium in accordance with 6-2.2.3.1.

Exception No. 3: A building with a complete approved automatic sprinkler system in accordance with Section 7-7, where every resident use area has direct access to an exterior exit without passing through any public corridor.

Exception No. 4: One-story stairs that connect two levels within a single dwelling unit, resident room or suite located above the level of exit discharge.

The subclassifications underthe classification, "Open," refer to the number of floors that are exposed.

The subclassifications under the classification, "Enclosed," refer to the level of fire resistance of the enclosure.

If a shaft other than a credited exit route (i.e., credited as one of the multiple routes required in Parameter 7 or in determining travel distance in Parameter 8) is enclosed on all floors but one and this results in an unprotected opening between that shaft, and one and only one floor, the parameter value assigned to that shaft shall be 0. If a required egress route is contained in that shaft the parameter value shall be -2.

11. Smoke Control

This parameter applies to the floor containing the unit used as a Board and Care Home.

Smoke control definitions are as follows:

a. No Control. There are no smoke barriers (or horizontal exits) on the floor, the floor is not served by a smoke proof stairtower, and there are no mechanically assisted smoke control systems serving the floor.

b. Smoke Partitions. Smoke partitions consist of the partitions extending across the entire width of the building or so arranged as to combine a partition in the corridor with existing building elements and subdividing partitions and walls to effectively completely partition the building into two separate units. The smoke partition must be equipped with doors in the corridor that are either self-closing or closed upon detection by smoke detectors located at the door arches, or by smoke detector systems that have been credited the 6 point value in Parameter 4, Smoke

Detection and Alarm. Smoke partitions shall also conform to the requirements of Section 6-3. A horizontal exit will act as a smoke partition and is credited as both a smoke partition in Parameter 11 and a horizontal exit in Parameter 7.

c. Mechanically Assisted Systems - By Zone. Mechanically assisted smoke control on a zone basis must include a smoke partition (or a horizontal exit) supported by a mechanism of automatic control fans, smoke vent shafts, or a combination thereof to provide a pressure differential that will assist in confining smoke to the compartment of origin. Fans involved may be special smoke control fans or special adjustments of the normal building air movement fans.

d. Mechanically Assisted Systems - By Unit. Mechanically assisted smoke control on a living unit basis are systems so designed as to provide a mechanism of automatically controlled fans, smoke vent shafts, or combination thereof to insure a positive pressure differential that will prevent intrusion of smoke into any living unit not involved in fire. On this basis, the living unit will have a pressure differential higher than the corridor and higher than any living unit where fire has been detected. Such systems must be so arranged that there is detection in each unit in the apartment house that will prevent a unit that is involved in fire from becoming positively pressurized.

e. Mechanically Assisted Systems - Corridors. Mechanically assisted smoke control on a corridor basis is a system initiated by a method of smoke detection that will assure operation of the smoke control system before significant smoke has entered into the corridor involved. The mechanism must be capable of pressurizing the corridor sufficiently to prevent smoke from the living unit or space of origin from entering the corridor through the entire course of the fire. Such a system must be able to hold back the smoke through the expected maximum severity of the fire. It must also be capable of evacuating smoke from the corridor on the presumption that the emergency evacuation procedures and other activities involving the opening and closing of doors will cause occasional brief periods of overpowering the smoke control system. This will result in movement of the smoke from the fire area into the corridor. (The evacuation of the smoke would normally be accomplished by having an exhaust fan from the corridor of lower capacity than the fan supplying air for pressurization. The net pressurization force would occur from the effect of the pressurizing fan minus the effect of the removal or

purging fans.) The corridor's pressurizer system may involve early warning smoke detection, automatic closing of all living unit doors, and/or sprinklered protection. Where these additional protection devices are provided in order to effect such a smoke control system, the individual credits for each of the involved protection devices are in addition to the credits for the smoke control system.

Appendix D

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APPENDIX E. NBS DELPHI GROUP

Delphi Method*

The Delphi technique was developed in the 1950's for the purpose of estimating the probable effects of atomic bombing attacks on the United States. Since then it has been applied to technological forecasting as well as in areas where judgmental information is required. The Delphi technique is basically concerned with the utilization of the combined knowledge of experts to arrive at a consensus opinion where factual information is incomplete.

The NBS exercise followed a process called Policy Delphi. The basic premise of the Policy Delphi is that it acts as a precursor to a committee activity. The Policy Delphi is not a substitute for research studies, analyses, or staff work. It is, however, an organized method for correlating views and information pertaining to a specific problem area and for allowing the respondents representing such views and information the opportunity to react to and assess differing viewpoints. Because the respondents are anonymous, fear of potential repercussions or embarrassment is removed and no single individual need commit himself publicly to a particular view until after the alternatives have been put on the table.

Turoff in "The Policy Delphi"** analyzed committee and Delphi processes. The study points out that a Delphi followed by a committee session provides good results in formulating policies.

The study identifies two major areas of problems with large size committees (i.e., communication and psychological). The communication difficulties are attributed to the diverse membership. The major lack of understanding tends to be between the following groups: individuals who are not familiar with many of the new decision aids coming out of operation research and system analyses but who have an intuitive feel for the complexities of the organization, and individuals who have been trained in many of modern management techniques and who are sometimes a little too confident that these approaches can be applied to every problem. The problems associated with the operation of committees that tend to reflect psychological characteristics are:

- The domineering personality or outspoken individual that takes over the committee process.
- The unwillingness of individuals to take a position on an issue before all facts are in or before it is known which way the majority is headed.
- The difficulty of publicly contradicting individuals in higher positions.
- The unwillingness to abandon a position once it is publicly taken.
- The fear of bringing up uncertain ideas that may turn out to be idiotic and result in a loss of face.

*This section was previously printed in Appendix A of "A System for Fire Safety Evaluation for Multifamily Housing, H. E. Nelson and A. J. Shibe, NBSIR 82-2562, September 1982.

**Murray Turoff, "The Design of a Policy Delphi," Technological Forecasting and Social Changes 2, No. 2 (1970).

The above problems may also apply to small size committees, except when the members of the small committee are given sufficient time to consider and explore the issue, and have assurance that the privacy of their respective remarks will be respected outside the committee. Under those conditions a small committee may not have the difficulties which have been identified for the large size committee.

Usually Delphi, whether it is to be conventional or computerized, undergoes four distinct phases. The first phase is characterized by exploration of the subject under discussion, wherein each individual contributes additional information he feels is pertinent to the issue. The second phase involves the process of reaching an understanding of how the group views the issue. If there is significant disagreement among members, the disagreement is explored in the third phase to bring out the underlying reasons for differences and possibly to evaluate them. The last phase, a final evaluation, occurs when all previously gathered information has been initially analyzed and the evaluations have been fed back for consideration.

There are two methods of gaining consensus: conventional and computerized. In the conventional form, a monitor team designs a questionnaire which is sent to a respondent group. After the questionnaire is returned, the monitor team summarizes the results, and based upon the results, develops a revised questionnaire for the respondent group to answer. The respondent group is usually given at least one opportunity to revise its original answers after examining the group response.

The computerized method replaces the monitor group to a large degree with a computer which has been programmed to carry out the compilation of the respondent group results. This process has the advantage of eliminating delays in summarizing each round of Delphi, thereby turning the process into a real-time communication system. However, it does require that the information received from the respondents is in a form that can be fed into a computer and that an algorithm can be provided to analyze the data. The NBS Delphi Group used the conventional four-phase approach in its evaluation process.

Approach Used in Developing Fire Safety Parameters and Their Values

The Delphi Group

Fourteen individuals from the Fire Safety Engineering Division of the Center for Fire Research were chosen to act as a "Delphi" group. The experience of the group members in areas of fire/life safety ranged from six to thirty-five years. Each individual was briefed about the general nature of the life safety risk analysis system and was given a detailed description of the safety model. The individuals were encouraged to seek more information about the system or any individual parameter, if the information given to them was insufficient. No guidance was provided as to the importance of any redundancy system or individual parameter.

NBS Delphi Group

Benjamin, Irwin	Division Chief, Structural Engineer
Bright, Richard	Senior Fire Protection Engineer
Budnick, Edward	Program Head, Fire Protection Engineer
Bukowski, Richard	Program Head, Electrical Engineer
Cooper, Leonard	Fire Prevention Engineer
Custer, Richard	Division Chief, Fire Protection Engineer
Gomberg, Al	Program Head, Fire Protection Engineer
Gross, Daniel	Senior Mechanical Engineer
Lee, Bill	Fire Protection Engineer
Nelson, Harold	Program Head, Fire Protection Engineer
O'Neill, John	Fire Protection Engineer
Parker, William	Physicist
Peacock, Richard	Chemical Engineer
Vogel, Bertram	Structural Engineer

Instructions for Completing of Forms

Each member of the Delphi Group was given five separate but identical forms, one for each of five fire safety functions: (1) General Fire Safety; (2) Fire Development; (3) Fire Containment; (4) Emergency Egress; and (5) Emergency Refuge. Delphi members were told the safety requirements should be considered as they apply to multifamily housing. They were also given a form for Detached Single Family Type Residential Structures and a form for Hotel/Dormitory Type Residential Structures to be rated for General Fire Safety. They were instructed to rate each category of each safety parameter on its effect in providing a safe (or unsafe) facility through the mechanism of the specific safety function. Each form had a clear statement of the specific safety function to be evaluated.

General instructions for completing the questionnaire were:

1. Evaluate the relative worth of the safety requirement (i.e., parameter category) on the five fire safety functions and three types of buildings, one pair at a time, and record conclusions on the appropriate questionnaires.

2. Use numerical values to express the level of safety or hazard for each subdivision of each parameter.

3. The range of numerical values should not exceed (+10) for the highest level of safety of (-10) for the condition presenting the most severely hazardous condition. It is not necessary to use both (+10) and (-10). Such should occur only if the safety value of the most important safeguard exactly compensates the risk imposed by the most detrimental element. If this is not true, the maximum safety value and maximum risk number should not be identical. Where the parameter's status neither improves safety nor creates a hazardous condition, a "zero" value should be assigned.

4. Add additional safety parameters to any of the questionnaires if required to provide a more complete safety evaluation.

5. Increase the number of parameter subdivisions or categories if the number shown on the forms is insufficient.

6. Remarks may be made on each of the seven forms.

Analysis of the Questionnaires

1. Forms. The completed forms were checked for completeness, illegible numbers, and remarks. Where required, individuals were asked to provide additional information to complete the questionnaire. Figures 4 and 5 show the format used.

2. Preparation of Parameter Values. Each individual was requested to submit approximately 700 values, which made the process of judging quite laborious. The values for each safety level were clustered to identify where major deviations occurred. An individual who supplied values significantly different from the cluster was asked for the reasoning behind his choice. Mostly the differences were generated by misinterpretations of the safety parameter functions. The values were then adjusted by the individuals and the process of preparing a consensus safety parameter table began.

3. Safety Parameter Table. Fifteen safety parameters were chosen to represent the most important areas of fire safety in multifamily and hotel/dormitory buildings. Nine safety parameters were chosen for single family buildings. The individual safety parameter values were adjusted using arithmetic means. All the values were expressed as whole numbers rounded off toward the "conservative" side.

4. Safety Parameter Selection for the Redundancy Systems. It is generally recognized that not all safety parameters are of equal importance in providing safety for a particular redundancy fire safety system. To identify those parameters which provide significant safety levels for each of the proposed redundancy systems, the following method was used. For each redundancy system a set of three tables was sequentially generated. The first table had all the values of each parameter as assigned by the individual Delphi member. The second table was similar to the first, except numerical values were clustered in six ranks. The ranks are: High (10-8); Medium (7-4); Low (3-0); Negative Low (-1 to -3); Negative Medium (-4 to -7); and Negative High (-8 to -10). The third table ranked the safety parameters according to whether they provided high safety values or small safety values. Parameters with high safety values were included in the particular redundancy equation. The low value parameters were excluded from the equations because their ability to affect the total safety of a particular redundancy system was marginal.

   A number of safety parameters could not be evaluated by this system. The Delphi members could not agree on a general value for those safety parameters. About one-half of the members assigned high safety values to those parameters, where the other half assigned low safety values for the same parameters. Additional Delphi group query did not change their initial

parameter values. To reflect the Delphi group split, the safety values of those parameters were divided by one-half.

5. Delphi Group Status. The Delphi group finished its prime assignment to provide the basic system to be analyzed by the outside Peer Consulting Panels. The Delphi group also met several times after finishing this initial assignment to consider adjustments or changes to the system suggested by the outside consultants or identified through NBS research. At each meeting the group analyzed the problem and suggested possible improvements to the system.

APPENDIX F. FIELD TEST PARTICIPANTS

American Health Care Association
California Office of the State Fire Marshal
Iowa State Fire Marshal's Office
Maryland State Fire Marshal's Office
Massachusetts Department of Mental Health
Montana State Fire Marshal Bureau
Oklahoma Office of the State Fire Marshal

APPENDIX G. ESCAPE AND RESCUE MODEL

The Escape and Rescue Model is a discrete-event simulation program written in Simscript II.5 for the NBS-1108 computer. It was developed to simulate the emergency movement involved in escape and/or rescue of people from a Board and Care Home housing a group of persons with varying degrees of physical or mental disabilities, along with a small live-in staff. It may be used in a much more general setting. It can reasonably handle a building with up to 100 residents and 100 rooms. The accuracy of the results is dependent on the correctness of the rates of movement and preparation times inputted into the system.

To simulate a building, the first step is to translate the floor plan into a prescribed format. In the model, the building layout is represented by a network consisting of discrete nodes and connections between them. People move in straight lines from node to node along the connections, and, therefore, the nodes and their linkages must be chosen in such a fashion that realistic movement is achieved throughout the simulated building. Next, the staff and residents are given initial node locations, the nature of the residents' disabilities is specified as well as the length of their initial "preparation" times, and a rescue priority is assigned to each resident initially requiring staff aid.

With the aforementioned input and the rules for movement in the computer program, the program computes the movement of each occupant as time progresses until everyone has evacuated. The computer prints the time to safety for each resident as well as his egress route, the total time to clear the building, and a record of various significant events that occur in the course of evacuation.

One major feature of the model is its flexibility. Once a facility layout has been converted into network form, many factors may be easily altered to determine the sensitivity of the evacuation times to the changes. The entire building may be expanded or contracted with the use of a scale factor. The number of staff and/or residents may be changed, as well as their initial locations and preparation times. The movement speeds and nature of the disabilities of the residents are also easily adjustable. An exit route may be "blocked" with a simple change to the network, forcing an alteration in people movement.

The model was used extensively in the later stages of system development, especially during the calibration stage. It was used to develop estimated evacuation times for fictional facilities. These data, together with similar data from fire drills were used in calibrating the time requirements for the four levels of evacuation difficulty (Prompt, Moderate, Slow and Impractical) with Evacuation Difficulty Score (see Section 21-1.3 of the proposed Chapter 21 in Appendix A).

Input Data

The following description of some of the input data should help provide the reader with an understanding of the flexibility and nature of the simulation.

Staff Information:

1. Initial location of each staff member.

2. Initial Delay - The time (in seconds) before each staff member can begin rendering assistance. Current runs use 0-5 seconds as an input value for day simulations, and 15 seconds for simulations of nighttime conditions.

3. Alert Delay - The time (in seconds) spent by a staff member in alerting a resident of the necessity to evacuate where such alerting is the only aid the resident needs. Five seconds was used to represent this delay.

4. Inter-Rescue Time - The delay (in seconds) that is mandatory for a staff member after he has taken a resident to a safe area. This time must expire before the staff member proceeds to the aid of the next resident requiring assistance. In most program runs, 5 seconds was inputted for the inter-rescue time.

Resident Information:

1. Initial location.

2. Resident Type (1A, 1B, 20, 30A, etc. See section on resident types).

3. Rescue Priority - The order in which the resident will be aided if assistance is required.

4. Delay Factor - The resident's preparation time (in seconds). This is the time spent by the resident between time 0 and actual movement when the resident is self-evacuating, or the time spent between arrival of staff member(s) necessary for movement and the beginning of movement.

5. Wanderer Status - Whether or not the resident can be relied upon to remain at a designated location and not reenter the building after emergency escape. This factor is used by the model to determine if one staff member must be diverted from rescue activities to supervise those residents already evacuated.

The Building:

1. Node Number.

2. Node Description - A node with description "SAFE" is a safe area to which residents can go or are taken; it may be an area of safe refuge inside the building or an area outside the building.

The model presumes that time 0 corresponds to a fire alarm that is initiated by an automatic detector, manual fire alarm, or some other means. Initially, each staff member is scheduled to become available for assistance at a time determined by his initial delay. He does not begin assistance and does not even select a resident to aid until the delay has run its course. This scheduling is performed for each staff member, until all staff have been processed.

Those residents who are self-starting move to an exit on their own after a preparation time. Some of these self-starters may require staff aid if they must traverse stairs.

As a staff member becomes available for assistance, perhaps for the first time, he is assigned to the resident with the lowest number priority of all those still needing initial

assistance. Thus, the resident with a priority of 1 would be assigned assistance first, assuming that no resident has a priority numerically less than 1. Two staff members may be required by some residents.

There are four special situations that should be mentioned. The first two cause some residents to be aided before their priority necessitates it, while the second two preempt a newly freed staff member before he is assigned through the priority scheme.

1. Along his route of travel, a staff member will alert residents of the need to evacuate.

2. When he is gathering a resident of type 3C (see next section), a staff member can gather other type 3C residents to be led out when they lie along his route of travel.

3. A resident able to move on his own except up/down stairs has reached stairs and, therefore, requires staff aid.

4. A wanderer has just left the building. The next staff member outside must remain there to guard wanderers unless his removal would make further assistance to some residents impossible.

If a staff member becomes free after all residents have been initially assisted, he still remains in the building until all residents have left, and only then does he leave permanently.

Whenever movement is necessary, the shortest route between the initial node location and the desired node location is computed and travel along it begins. Egress is a special case, with the computed route being the shortest one between the initial node location and the nearest safe area, and the latter is computed automatically. For those residents of types necessitating a wait for staff aid on stairs, the program attempts to find the shortest route without stairs if such a route exists.

In general, travel is at staff walking speed or at resident travel speed, the latter depending on resident type. Movement up/down stairs is at 1/2 the rate on the rest of the route, and if the stairs are blocked by a staff member/resident pair a delay factor is added. When all residents and staff are at an area of safety, the simulation stops.

Resident Types and How They are Treated

The built-in resident speeds given after the description of each resident type are not to be considered inflexible; the values may change and they may be overriden by additional input. The speeds and response times shown are those most frequently used in testing the model. Special runs have been made, however, using different rates and times when actual movement rates and response times of individuals have been measured.

1. Type 0 - Residents capable of self-initiated evacuation at the same speed as the staff, 300 ft/minute (1.5 m/s). In the program, these residents start moving on their own after a preparation time (at time 0 + prep. time). The preparation times usually inputted are 5 seconds during daytime conditions and 15 seconds from the moment of awakening when the resident is asleep.

2. Type 1A - Residents similar to Type 0, but slightly slower. A Type 1A resident is usually the least handicapped type to be found in a group home. The built in movement speed is 210 ft/minute (1 m/s). Daytime and nighttime preparation times are 5 and 15 seconds, respectively.

3. Type 1B - Residents similar to Type 0, but much slower movement speed. The movement speed is 105 ft/minute (.5 m/s). Daytime and nighttime preparation times are 5 and 15 seconds, respectively.

4. Type 3A - Residents similar to Type 0, but still slower movement speed. The built in movement speed is 60 ft/minute (.3 m/s). Preparation times are 5 and 20 seconds.

5. Type 3B - Residents similar to Type 0, but barely mobile. The movement speed is 30 ft/minute (.15 m/s). Preparation times are 10 and 25 seconds.

6. Type 3C - Residents who must be led from their initial location to the nearest exit. One staff member can gather more than one resident of this type. In the program, when a staff member reaches a resident of this type in the context of the priority scheme, he checks to see if the next resident on the priority list is of the same type. If so, he leads the first resident to the location of the next one, gathers the new one, and performs the same check. Otherwise, he takes the resident(s) already gathered to the nearest exit. Also, a staff member can gather residents of Type 3C along his route of travel when he is already assisting, or about to assist, another Type 3C. Movement speed of the group is 147 ft/minute (.75 m/s). Preparation times are 5 and 20 seconds.

7. Type 6A - Residents who need to be alerted of the need to evacuate but are capable of proceeding unassisted afterward. In the program, these residents are alerted by a staff member either when their priority determines it or when a staff member traverses the resident's node. The movement speed after alerting is 210 ft/minute (1 m/s). Preparation times are 5 and 15 seconds.

8. Type 6B -Residents requiring help initially and on stairs but otherwise capable of unassisted movement. Residents of this type are aided initially by a staff member in the context of the priority scheme. Also, if and when their evacuation requires stair traversal, they must wait for other assistance. The movement speed is 147 ft/minute (.75 m/s). Preparation times are 5 and 20 seconds.

9. Type 6C - Residents who can start evacuating initially, but require the assistance of a staff member when stairs must be traversed. The movement speed is 147 ft/minute (.75 m/s). Preparation times are 5 and 20 seconds.

10. Type 10 - Residents who require assistance from a staff member throughout their evacuation. More aid is required than in the case of a Type 3C. A staff member is assigned using the priority scheme, proceeds to the aid of the resident, and takes him outside. The movement speed of the pair is 135 ft/minute (.66 m/s). The preparation times are 10 and 20 seconds.

11. Type 20 - Residents who must be heavily assisted by a staff member throughout their evacuation. More aid is required than for a type 10, and, therefore, the staff-resident combination moves at only 105 ft/minute (.5 m/s). Otherwise, program treatment is the same as for a Type 10. The preparation times are 10 and 30 seconds.

12. Type 30A - Residents who require assistance from 2 staff members initially and whenever they encounter an obstacle, but otherwise move unassisted. When his priority triggers assistance, 2 staff members are sent to his aid, one at a time, as they become free. After both staff members reach the resident they assist him, and he initiates unaided movement. If and when he must traverse stairs, 2 staff members are provided. They carry him up/down stairs and his unassisted movement continues. The movement speed is 147 ft/minute (.75 m/s) while moving alone. Preparation times are 15 and 30 seconds.

13. Type 30b - Residents who must be assisted by 2 staff members initially, and one continually thereafter unless stairs cannot be avoided. If stairs must be traversed the 2 staff members remain with the resident to carry him down the stairs. The movement speed of the resident and those assisting him is approximately 147 ft/minute (.75 m/s). Preparation times are 15 and 30 seconds.

14. Type 30c - Residents who start evacuating without aid, but must be assisted by 2 staff members if and when stairs are traversed. The movement speed when moving alone is 147 ft/minute (.75 m/s). Preparation times are 15 and 30 seconds.

15. Type 40 - Residents who require assistance from 2 staff members throughout the course of their evacuation. The program provides 2 staff members who only become free for other tasks after the type 40 resident has been led/carried outside. The movement speed of the group is 105 ft/minute (.5 m/s). Preparation times are 15 and 30 seconds.

    Any mobile resident may be a wanderer. He requires the normal staff support for his type as well as supervision outside the building.

Figure G-1 shows the actual fire drill time and the simulated evacuation time for six facilities from the field test. The agreement was considerably better than expected. This agreement supports the use of the model to provide estimates of evacuation times for fictional combinations of building and resident characteristics.

A more detailed report of this model is in preparation.

FACILITY	# OF RESIDENTS	# OF STAFF (IN SIMULATION)	FIRE DRILL TIME (IN MINUTES) REAL TIME DAY	SIMULATED DAY
HELENA#1(MT)	4	2 OR 1	.5	.5
MARYLAND#1	7	3	5.0	4.7
HELENA#2MT	8	2	.6	.6
MARYLAND#3	8	3	.5	.6
MARYLAND#4	6	2	2.0	1.8
MONTANA#5	5	1	1.3	1.5
MARYLAND#2	60	9	2.5	2.0

Figure G-1. Comparison of Survey Data with Escape and Rescue Model

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4. TITLE AND SUBTITLE

A Fire Safety Evaluation System for Board and Care Homes

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6. PERFORMING ORGANIZATION (If joint or other than NBS, see instructions)

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10. SUPPLEMENTARY NOTES

☐ Document describes a computer program; SF-185, FIPS Software Summary, is attached.

11. ABSTRACT (A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here)

Board and Care Homes for residents with mental retardation, the infirmities of age, or mental illness are a new type of occupancy, and model fire safety codes do not have requirements specifically for this type of occupancy. In support of efforts to write model codes for this type of occupancy, a Fire Safety Evaluation System has been developed. It can be used for determining if a home has fire safety equivalent to that obtained by meeting the requirements of a given code. The system was calibrated for use with a proposed chapter of the Life Safety Code. There are three sets of requiements: one for small dwelling units, one for large facilities, and one for apartment houses. Within each set, there are four levels of evacuation capability of the residents and staff -- prompt, moderate, slow, and impractical, each with a different requirement for fire safety features, so that homes with more capable residents will not be required to have as many fire safety features to meet the desired level of safety. A novel rating system is described for determining the evacuation capabilities of the residents with available staff assistance. A field test is described.

12. KEY WORDS (Six to twelve entries; alphabetical order; capitalize only proper names; and separate key words by semicolons)

Apartments; board and care homes; developmental disabilities; egress, elderly persons; evacuation; fire safety; Fire Safety Evaluation System; handicapped; mental retardation; residential buildings.

13. AVAILABILITY

☒ Unlimited

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