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Fire Safety Evaluation System for National Park Service Overnight Accommodations

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U.S. DEPARTMENT OF COMMERCE
National Bureau of Standards
National Engineering Laboratory
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U.S. DEPARTMENT OF COMMERCE, Malcolm Baldrige, *Secretary*
NATIONAL BUREAU OF STANDARDS, Ernest Ambler, *Director*

Preface

This report describes a new Fire Safety Evaluation System for Overnight Accommodations. It was developed specifically to identify alternative combinations of widely accepted fire protection systems and building design features that provide a level of fire safety equivalent to that required by the Life Safety Code for related occupancies. This work is an extension of research conducted by the Center for Fire Research with support from the Department of Health and Human Services towards development of a Fire Safety Evaluation System for Board and Care Homes.

The Facility Fire Safety Performance Group, Center for Fire Research, National Engineering Laboratory, National Bureau of Standards, performed the research described in this report under the sponsorship of the National Park Service.

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Abstract

A fire safety evaluation system for overnight accommodations has been developed and is ready for use in evaluating the fire safety of National Park Service residential accomodations. The system can be used to determine combinations of widely accepted fire safety equipment and building construction features that provide a level of safety equivalent to that required by the widely accepted Life Safety Code of the National Fire Protection Association. The system will provide flexibility in meeting fire safety requirements for both the renovations of existing facilities and the design of new facilities.

An approach for controlling smoke from fires in atrium-like arrangements is presented and documented in an appendix. It can be used to determine smoke (exhaust) fan capacity and placement. It is based on the physics of the buoyant hot gas plume produced by the fire.

1. Introduction

Providing an acceptable level of fire safety in overnight guest and staff facilities has been a major concern of the National Park Service. Many of the structures (some of which are considered historic) were built before the present day fire codes and have inherent fire code deficiencies such as unprotected combustible construction, highly flammable interior finish, unprotected vertical openings, and deficient exit systems. Consequently, upgrading these facilities to meet all the requirements of any recognized code would be costly and would require major renovation work. In the case of historic structures, the problem is magnified since any alteration or addition must respect the historical integrity of the facility.

At the request of the National Park Service, the Center for Fire Research at the National Bureau of Standards, has developed a Fire Safety Evaluation System for National Park Service Overnight Accommodations. The Fire Safety Evaluation System (FSES) is designed to assure the same level of fire safety as is obtained by meeting relevant portions of the Life Safety Code published by the National Fire Protection Association.[1][1] The relevant portions are Chapter 20, Lodging or Rooming Houses for small dormitories(16 or less residents), and Chapters 16 and 17, New and Existing Hotels for large facilities. The FSES offers more flexibility than strict conformance with the specifications in the Life Safety Code. Use of the FSES permits some code deficiences to exist provided: these deficiencies are compensated for in other areas of fire safety which exceed requirements specified by the Life Safety Code. In this way, the FSES identifies combinations of widely accepted fire safety designs and systems which provide a level of safety equivalent to or greater than that achieved by meeting all the specifications in the Life Safety Code for New or Existing Hotels (or for Lodging and Rooming Houses in the case of small dormitories).

The Fire Safety Evaluation System for the National Park Service Overnight Accommodations (FSES) is presented as Appendix A of this report. It is in a format that permits its adoption as fire safety requirements. Any decision made by the National Park Service regarding its adoption should largely consider whether

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

the level of safety provided by the occupancy Chapters 16 (New Hotels), 17 (Existing Hotels) and 20 (Lodging and Rooming Houses) of the Life Safety Code (used as the base standard of the FSES) is acceptable. If it is decided that a higher level of safety or that a lower level of safety is preferable, the FSES can be adjusted accordingly.

2. Background

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) [2]. The original FSES was designed as an equivalent alternative to Chapter 10 of the 1973 Life Safety Code for Health Care Facilities. Appendix C of the 1981 Life Safety Code contains a slightly modified version of the FSES/HC for use with the 1981 Code [1]. Similarly, CFR has developed a Fire Safety Evaluation System for Multifamily Housing [3], Board and Care Homes [4], and now, Overnight Accommodations.

At the time of the National Park Service request for a Fire Safety Evaluation System for Overnight Accommodations, the development of the FSES for Board and Care Homes (FSES/B&C) was nearly complete. The National Park Service request prompted the NBS staff to initiate preliminary field inspections of overnight facilities in national parks to determine their degree of similarity to Board and Care Homes. Based on visits to four national parks (Yosemite, Glacier, Shenandoah and Yellowstone) and a consideration of the characteristics of the facilities in those parks, it was decided to pattern the FSES/Overnight Accommodations after the FSES/B&C. Data acquired from these inspections resulted in modification and refinement of the FSES/B&C to insure a high degree of similarity between the two systems. It should be noted that sections 4.1 to 4.4 of this report, on System Development, refer to activities originally conducted for the FSES/B&C.

3. Equivalency Concept

Equivalency, for the purpose of this evaluation system, refers to fire safety equal to or greater than that prescribed by the Life Safety Code. Specifically, occupancy Chapters 16, 17 and 20 were used as the basis for equivalency. In order to create the most up-to-date version of the FSES

as possible, projected requirements for the 1984-85 edition of the Life Safety Code were incorporated into the system. Consequently, few changes or adjustments should be required to update the FSES to meet equivalency to the 1984-85 edition of the Life Safety Code when it is published.

The development of this equivalency system consisted of:

(1) Identifying all the factors, (i.e., building characteristics and fire safety features) which significantly contribute to life safety with respect to fire.

(2) Quantifying or assigning a numerical weight to each of these factors.

(3) Creating redundant safety subsystems within the system to assure that failure of any one fire safety feature or method will not create an unacceptable decrease in fire safety.

(4) Seeking professional judgment review and critique.

(5) Calibrating to the requirements in the Life Safety Code.

(6) Providing sufficient field testing of the system.

Once these tasks were accomplished, and the Fire Safety Evaluation System was completed, it could be used to:

(1) Evaluate the level of life safety in an existing facility.

(2) Compare the existing level of life safety in a facility to the level of safety specified by the Life Safety Code.

(3) Determine alternative solutions which upgrade an existing facility to the level of safety prescribed by the Life Safety Code.

(4) Design fire safety feature combinations for new facilities to provide the level of safety prescribed by the Life Safety Code.

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. To allay apprehensions, the technical report by Nelson and Shibe [2] gave a detailed justification for the structure of the system. Although the approach is no longer novel and unfamiliar to fire experts, the background descriptions in the Nelson and Shibe report apply equally in explaining the methodological basis for the new FSES/Overnight Accommodations.

4. System Development

As stated earlier, development of the fire safety evaluation system consisted of six operations: fire safety parameter identification, fire safety factor quantification, redundant safety subsystem creation, professional judgment review and critique, calibration, and system testing. The tasks involved in system development were heavily dependent on professional judgment. The professional judgment of the project staff was supplemented and supported in a formal manner. Two consulting panels were formed to provide this support: the Delphi Panel and the Peer Consulting Panel. In addition, an outside consultant applied the system to a variety of residential buildings in the National Parks to judge the system's effectiveness.

Delphi Panel. A group of 13 experts from the Center for Fire Research, served as the Delphi panel with Harold Nelson of the project staff as Chairman. They provided 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 panel is contained in Appendix C.

Peer Consulting Panel. NBS staff worked in close cooperation with a group of experts in the areas of fire protection engineering and architecture to provide advice to the staff and in-depth review of their work. See Section 4.5.

4.1 Fire Safety Parameter Identification

The fire safety parameters are measures of the building characteristics and fire protection features that bear upon the safety of the people who

may be in the facility at the time of a fire. The safety parameters, selected by the project staff, were determined by examining the specific code requirements for existing hotels, and lodging or rooming houses, (Chapters 17 and 20 of the 1981 Life Safety Code), and by evaluating the impact of various elements of the code. The selected safety parameters were modified first by the NBS Delphi Panel and later by the Peer Consulting Panel. The preliminary safety parameters are shown in Figure 1.

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 lodges and dormitories, and each category differed from all other categories in a significant way. For example, one parameter was defined as "Manual Fire Alarm" and the three categories are: No Alarm; Manual Fire Alarm without Fire Department Notification; and Manual Fire Alarm with Fire Department Notification.

Figures 2 and 3 show the preliminary "matrix" form of the breakdown of the safety parameters for the facility classifications. The safety parameters are designed to constitute a complete assembly of all of the basic building factors determining the level of safety in an overnight accommodations facility for which equivalency could be expressed.

Note: the "cabin" classification applies to a type of facility that is not specifically addressed by the 1981 Life Safety Code, and therefore, for which no equivalency exists. However, it has been included in this evaluation system due to the presence of a large number of this type of occupancy in National Park Service jurisdictions. For a more detailed discussion see section 5.0.

In addition to the safety parameters and their subcategories illustrated in Figures 2 & 3, there is an additional series of items required by the Life Safety Code for which no equivalency could be expressed. These items, illustrated in Figure 4, relate primarily to building utilities or building services and are covered in the Facility Fire Safety Requirements Worksheet

section of the Fire Safety Evaluation System for Large Facilities. Only two subcategories are defined for these items: "Met" and "Not met".

4.2 Fire Safety Parameter Quantification

The goal of the NBS research effort 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 subcategory of each parameter had to be assigned a point value. In order to provide the best available consensus judgment and experience in determining the preliminary values, the Delphi panel was established.

Each member of the panel was provided with copies of an initial matrix similar to the ones shown in Figures 2 and 3. Each person then evaluated the relative importance (i.e., assigned a point value) with respect to fire safety of each item in the entire matrix of parameter categories without consultation with other members of the panel. The members of the Delphi Panel were advised that the goal of the project was to develop a system that was similar to the Fire Safety Evaluation System for Health Care Facilities. See Appendix D for a more detailed discussion of this operation and its methodological base.

4.3 Redundant Safety Subsystem Creation

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 decision trees, especially the National Fire Protection Association's Fire Safety Concepts Tree [5] [6].

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, other mechanisms of containing fire and its impacts, and extinguishment 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.

Each member of the Delphi panel 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 panel. 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 panel, Sprinklers, Separation of Living Units, Vertical Openings, and Protection of Hazardous Areas impact on all four. Figures 5 and 6 (Table 2 of the evaluation worksheets found in Appendix A) show the breakdown in terms of which parameters apply to which methodologies, where Fire Development and Fire Containment are combined as Fire Control.

4.4 Calibration

Once the basic framework for the system was established, it was necessary to determine the level at which code equivalency is achieved for each of the facility classifications (base code). This was accomplished by "scoring" the Life Safety Code requirements of Chapter 16 for New Hotels, Chapter 17 for Existing Hotels and Chapter 20 for Lodging and Rooming Houses using the evaluation system. (Figures 7 and 8 illustrate this process for small dormitories and Figures 9-12 for large facilities). Since requirements for new and existing hotels vary with the number of stories, the evaluation score varied accordingly. The results of this "scoring", illustrated in Figures 13, 14 and 15, were incorporated into the evaluation system as the equivalency requirement values for achieving safety equivalent to the Life Safety Code.

4.5 Professional Judgment and Review

In order to provide an independent in-depth review of the work of the staff, and to provide to the project the insight of experts, the Peer Consulting Panel was formed. The members of the group were carefully selected so that competence in a wide variety of areas relative to fire protection were represented. The panel 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.

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.

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.

The panel met 5 times for 2 or 3 days each during 1980 and 1981.

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

In addition to the formation of the Peer Consulting Panel, the staff made use of a computer program to aid them in evaluating the proposed system and analyzing 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.)

Since the evaluation system is theoretically capable of evaluating each of over 600 million combinations of the 11 safety parameters for large facilities, it is important that the only combinations passing the system are those that provide a satisfactory level of fire protection. 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 combinations 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.

5.0 Development of the Cabin Classification

The "cabin" classification applies to a type of facility that is not specifically addressed in the Life Safety Code. Cabins could be required

to meet the provisions of Chapter 20, Lodging or Rooming Homes. However, some of the requirements do not apply: for example, those related to unprotected vertical openings and those related to sleeping rooms above the level of exit discharge. The requirement for a manual alarm system does not appear to be appropriate. A special system was developed based on those parts of Chapter 20 that are relevant and appropriate.

The cabin evaluation form (Figure 11) is similar in format and scope to those developed for Large Facilities and Small Dormitories. The terms and definitions used for the cabin parameters are essentially the same as those found in the other occupancy classes. Therefore, no glossary has been included with the form.

The cabin accommodations evaluation system has been purposely devised so that any single room cabin will pass the equivalency test if an acceptable smoke detector is present. Conversely, a cabin accommodation of any configuration (that is, with one or more rooms) will fail if it contains no smoke detection. The cabin accommodation system should be applied to each unit of any one story facility where each unit has a direct exit at grade to the outside (e.g., 1-story motels).

6.0 System Field Testing

In order to substantiate the appropriateness of using the FSES for evaluating the fire safety of a facility and to uncover difficulties in the use of the system, extensive field testing of the system was undertaken. Specifically, the field test had the following objectives:

(1) Identify areas where the FSES/Overnight Accommodations could be improved.

(2) Determine if there are problems in applying the FSES/Overnight Accommodations to the wide variety of residential buildings found in the National Parks.

(3) Identify any points which were not clear or possibly conflicting in the explanatory material accompanying the FSES Overnight Accommodations worksheets.

Two extensive field test projects were conducted; one for Board and Care Homes, the other for National Park Service Overnight Accommodations. The Board and Care Home field tests included 151 facilities in eight geographically dispersed states. 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 two states. The National Park Service Overnight Accommodations field tests included over 80 large facilities, motels, and dormitories and 20 cabins (identically designed and constructed cabins were not counted twice) from 5 different National Parks (Yosemite, Crater Lake, Mt. Rainier, Glacier, and Yellowstone). The actual field testing was conducted by Ron Melott through a grant from the National Bureau of Standards to the University of Washington, and was carried out with the cooperation of the National Park Service and its concessioners.

The results of the field tests 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 group. Furthermore, the comments, suggestions and information provided by the field investigation led to refinements in the definitions, and the development of the FSES/User's Guide (see Section 7.0, Training Aids). The information also led to the inclusion of a category under the smoke detection parameter for Small Dormitories--a system of hallway detection augmented by single station detection in bedrooms. All of these additions and changes were approved by a consensus of the Peer Consulting Panel and the NBS staff.

A wide range and variety of National Park Service guest and staff accommodations were studied by Melott to determine the applicability of the FSES to these facilities. Appendix E contains the list of facilities. Based on the data furnished by Melott and upon Melott's recommendations, the NBS staff concluded that the FSES can be used to measure fire safety for the entire range of buildings providing overnight accommodations to guests and staff in the National Parks. (This applies only to the residential portions of buildings whose main function is providing overnight accommodations).

7.0 Training Aids

Once the development of the FSES/Overnight Accommodations was complete, it was anticipated that a majority of potential users would undoubtedly need training, more readable documentation, and possibly other assistance to fully appreciate and understand the fire safety procedures and alternatives expressed in the FSES documentation. Therefore, several tasks were undertaken to minimize these learning difficulties. These tasks included: development of the User's Guide; a three-day technology transfer seminar for NPS staff; and development of a video tape self-instructional guide.

The User's Guide was published as National Bureau of Standards Report No. NBS-GCR-83-427, "User's Guide for the Application of Table 1 - Safety Parameter Values for the Fire Safety Evaluation System for National Park Service Facilities," by K.E. Bush, H.L. Bradley and H.D. Hicks. It was developed to provide definitions, explanations, and background information for the application of the FSES for Overnight Accommodations. It clarifies and describes fire safety-related terminology which may be unfamiliar to some users. It also provides, through expanded text and illustrations, suggestions for the reasonable and uniform application and interpretation of the evaluation system. So that the reader may easily differentiate between the text of the FSES and the text of the expanded explanations and background information, two different type faces were used in the document. The text of the FSES is printed in the elite (small) type and the expanded explanations and background information are printed in orator (large) type.

In order to familiarize park service personnel and Park Service Concessioners in the application of the FSES, a technology transfer seminar was conducted for NPS on October 26-28, 1982 at the National Bureau of Standards. The seminar, attended by over 40 people from various parks across the nation, focused on case studies.

The need for additional training tools in the area of fire safety led to the development of a video tape self-instructional guide on the application of the FSES. The self-instructional guide explains to the viewer how to

use the forms and User's Guide, and gives the viewer an opportunity to evaluate 3 sample overnight facilities at his or her own pace. The guide was the result of an NPS/NBS joint effort.

8.0 Atriums

A portion of the overnight accommodations buildings in National Parks contain multistory lobbies (atria) or other floor openings that are impractical to enclose. Such a configuration may have inherent problems related to fire safety not covered by the Fire Safety Evaluation System. A fire developing in this space, if left unchecked, will eventually fill the space with smoke, heat and toxic gases making it hazardous to any occupants. Also, occupants whose sleeping rooms open directly into such a space would be unable to exit the building safely. The Fire Safety Evaluation System in Appendix A permits three approaches. The choice of approach should be made on the basis of that approach which best suits the operational requirements and which is least costly. The first approach is to accept the charge for vertical openings in parameter 10. The second method is to meet the Life Safety Code requirements for protection of atriums in exception two of Section 6-2.2.3.1. (See Multi-Story lobby section in Appendix A for instruction.) A third way is to prevent development of hazardous conditions in such a space through buoyant smoke control. Appendix B contains a methodology developed by Dr. Leonard Cooper for designing smoke control/exhaust systems for atrium-like arrangements.

9.0 Summary

A method has been developed and described for generating equivalency to a specified set of occupancy safety requirements. This method is based on the articulation of levels of building safety and on the redundancy of safeguards. This method can provide the necessary flexibility enabling a designer to achieve minimum cost solutions for a specified level of safety.

The described method "Fire Safety Evaluation System for Overnight Accommodations" is a specific example of an equivalency approach. The system provides equivalency

to the minimum life safety requirements for the 1981 Life Safety Code and can be revised to reflect later editions of the Life Safety Code.

A method is presented for evaluating the safety of atrium-like arrangements where safety is provided through buoyant smoke control.

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

- Large Facilities (Hotels, Motels and large dormitories)
- Small Dormitories
- Cabin Accommodations

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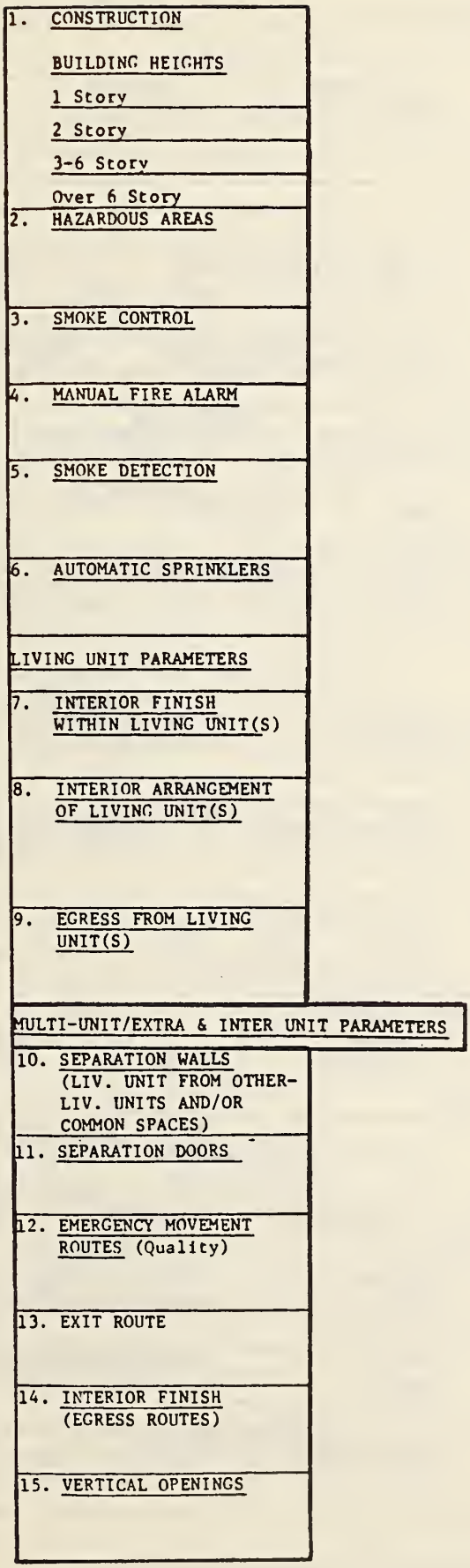

Figure 1. Preliminary Safety Parameters

"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 / ≥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)		MULTIPLE ROUTES			
	<2 STANDARD 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 2. Sample Delphi Form-Large Facilities

"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 3. Sample Delphi Form-Small Facilities

Considerations	Met	Not Met	Not Applic.
A. Building utilities conform to the requirements of of Paragraph 7-1 of the Life Safety Code.			
B. The air conditioning, heating, and ventilating systems conform with Paragraph 7-2 of the Life Safety Code.			
C. Elevator installations are made in accordance with the requirements of Paragraph 7-4 of the Life Safety Code.			
D. Rubbish chutes, incinerators, and laundry chutes are installed in accordance with Paragraph 7-5 of the Life Safety Code.			
E. An emergency organization meeting the requirements of Section 31-6 of the Life Safety Code exists and is functional.			

Figure 4. Facility Fire Safety Requirements Worksheet

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 BEDROOMS/SUITES		÷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.

Figure 5. Individual Safety Evaluations-Large Facilities

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.

Figure 6. Individual Safety Evaluations-Small Facilities

Table 1. Safety Parameter Values — Small Facilities

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		
8. EGRESS — 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 7. Base Case Safety Parameter Values- Small Dormitories

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 = 0.0	S_2 = 3.0	S_3 = 1.0	S_4 = 0.0

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

Figure 8. Base Case Individual Safety Evaluations- Small Dormitories

Table 1. SAFETY PARAMETER VALUES—LARGE FACILITIES

SAFETY PARAMETER	PARAMETER VALUES							
1. CONSTRUCTION	COMBUSTIBLE					NONCOMBUSTIBLE		
BUILDING HEIGHT	TYPE V (000)	TYPE V (111) p	TYPE III (200)	TYPE III (211) p	TYPE IV (2HH)	TYPE II (000)	TYPE II (111) p	TYPE I & II (222)
1 STORY	-1[ ]a	0	-2[ ]a	0	0	-2[ ]a	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	-8[ ]a	(2)	2

2. HAZARDOUS AREAS	WITHIN BDRMS. SUITES OR ON EXIT ROUTES		ELSEWHERE IN BUILDING		NONE, OR NO DEFICIENCY
	DOUBLE DEFICIENCY	SINGLE DEFICIENCY	DOUBLE DEFICIENCY	SINGLE DEFICIENCY	
	-7	-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[1] l,m	(2)	3

4. SMOKE DETECTION & ALARM	NONE OR INCOMPLETE m	SINGLE STATION UNITS IN EACH BEDROOM j,l,m	INTERCONNECTED SYSTEM COVERING CORRIDORS & COMMON SPACES			TOTAL BUILDING
			w/o BDRM/SUITE DETECTORS	SINGLE STATION BDRM/SUITE DETECTORS	INTERCONNECTED BDRM/SUITE DETECTORS	
	-4[0]	0[2]	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	
					STANDARD	SPECIAL
	(0)	2[0] c	4[0] c	6	8	10

6. SEPARATION OF BEDROOMS/SUITES	NONE OR INCOMPLETE	COMPLETE SEPARATION OF BR SUITES FROM CORRIDOR -LEVEL OF PROTECTION IS				
		ITEM 5 IS < 6 & DOORS w/o AUTO. CLOSERS		ITEM 5 IS ≥ 6 OR DOORS ARE ALL w/ DOOR CLOSERS		
		SMOKE RESISTING	20 MIN	SMOKE RESISTING	20 MIN	1-HR WALLS, 20 MIN DOORS
	-6	-1 g	0 g	1 g	(2[3] f,g)	3[4] f,g

7. EXIT SYSTEM	SINGLE OR EXPOSED ROUTE	MULTIPLE ROUTES				DIRECT EXIT
		DEFICIENT	w/o HORIZ.	HORIZ. EXIT	SMOKE PROOF STAIRS	
	-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[0] m	-1[0] m	(0[1] m)	1	1	2

10. VERTICAL OPENINGS	OPEN (OR INCOMPLETE ENCLOSURE)			ENCLOSED (h)		
	CONNECTS 5 OR MORE FLRS	3-4 FLRS.	2 FLRS.	<30 M	≥30 M <1 Hr	≥1 Hr
	-10	-7	-2	-1	(0)	1[0] b

11. SMOKE CONTROL	NONE	SMOKE PARTITIONS	
		PASSIVE	MECHANICALLY ASSISTED
	0	(2)	3

NOTES:

a- Use (-1 x height in stories) if building is sheathed with plaster, gypsum board or similar materials.

b- Use [ ] in multi-story buildings if item 1 is based on Type V (000), Type III (200) or Type II (000) without Note "a" and item 5 ≤ 4.

c- Use [ ] if item 1 is based on Type V (000), Type III (200) and Type II (000).

d- Use [ ] if item 7 is -6.

e- Use [ ] if item g is based on "None or Incomplete", or "Walls or Doors" are < 20 min. and item 5 is ≤ 4.

f- Use [ ] if separations between bedroom/suites also meet criteria.

g- Rate separation different than actual construction as follows:
- "Smoke Resisting," if parameter 5 is < 6; parameter 1 is V(000), III(200) or II(000); and Note a does not apply.
- "20 min," if Note a applies and separation is 20 min or more.
- "20 min," if parameter 5 is ≥ 6 and separation is < 20 min.

h- Use 0 in 1 story buildings that have no vertical openings.

j- Use [ ] where less than 15 guests are accommodated and item 1 is not based on V(000); III(200) or II(000)

k- 30 min. in existing bldgs.

l- Use [ ] where item 7 is 4 in buildings not over 3 stories.

m- Use [ ] where item 5 is ≥ 6.

p- Use this column for indicated type regardless of sheathing if item 5 is 10.

Figure 9. Base Case Safety Parameter Values-New Large Facilities

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	-1		-1	-1
2. HAZARDOUS AREAS	0	÷2 0	0	0
3. MANUAL FIRE ALARM	÷2 1	2		2
4. SMOKE DETECTION & ALARM	÷2 1.5	3	÷2 1.5	3
5. AUTOMATIC SPRINKLERS	0	÷2 0	(÷2)A 0	0
6. SEPARATION OF BEDROOMS/SUITES	2	÷2 1	2	2
7. EXIT SYSTEM		0	÷2 0	0
8. EXIT ACCESS		0		0
9. INTERIOR FINISH	÷2 0	0		0
10. VERTICAL OPENINGS	÷2 0	0	0	0
11. SMOKE CONTROL		2	2	2
TOTAL	S_1= 3.5	S_2= 8.0	S_3= 4.5	S_4= 8.0

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.

Figure 10a. Base Case Individual Safety Evaluations-New 1 Story Large Facilities

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	0		0	0
2. HAZARDOUS AREAS	0	÷2 0	0	0
3. MANUAL FIRE ALARM	÷2 1	2		2
4. SMOKE DETECTION & ALARM	÷2 1.5	3	÷2 1.5	3
5. AUTOMATIC SPRINKLERS	0	÷2 0	(÷2)A 0	0
6. SEPARATION OF BEDROOMS/SUITES	2	÷2 1	2	2
7. EXIT SYSTEM		0	÷2 0	0
8. EXIT ACCESS		0		0
9. INTERIOR FINISH	÷2 0	0		0
10. VERTICAL OPENINGS	÷2 0	0	0	0
11. SMOKE CONTROL		2	2	2
TOTAL	S_1= 4.5	S_2= 8.0	S_3= 5.5	S_4= 9.0

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.

Figure 10b. Base Case Individual Safety Evaluations-New 2 Story Large Facilities

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		2	2
2. HAZARDOUS AREAS	0	÷2 0	0	0
3. MANUAL FIRE ALARM	÷2 1	2		2
4. SMOKE DETECTION & ALARM	÷2 1.5	3	÷2 1.5	3
5. AUTOMATIC SPRINKLERS	0	÷2 0	(÷2)A 0	0
6. SEPARATION OF BEDROOMS/SUITES	2	÷2 1	2	2
7. EXIT SYSTEM		0	÷2 0	0
8. EXIT ACCESS		0		0
9. INTERIOR FINISH	÷2 0	0		0
10. VERTICAL OPENINGS	÷2 0	0	0	0
11. SMOKE CONTROL		2	2	2
TOTAL	S_1= 6.5	S_2= 8.0	S_3= 7.5	S_4= 11.0

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.

Figure 10c. Base Case Individual Safety Evaluations-New 3 Story Large Facilities

Table 1. SAFETY PARAMETER VALUES—LARGE FACILITIES

SAFETY PARAMETER	PARAMETER VALUES							
1. CONSTRUCTION	COMBUSTIBLE					NONCOMBUSTIBLE		
BUILDING HEIGHT	TYPE V (000)	TYPE V (111) p	TYPE III (200)	TYPE III (211) p	TYPE IV (2HH)	TYPE II (000)	TYPE II (111) p	TYPE I & II (222)
1 STORY	-1[ ] a	0	-2[ ] a	0	0	-2[ ] a	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	-8[ ] a	2	2

2. HAZARDOUS AREAS	WITHIN BORMS. SUITES OR ON EXIT ROUTES		ELSEWHERE IN BUILDING		NONE, OR NO DEFICIENCY
	DOUBLE DEFICIENCY	SINGLE DEFICIENCY	DOUBLE DEFICIENCY	SINGLE DEFICIENCY	
	-7	-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[1] l,m	(2)	3

4. SMOKE DETECTION & ALARM	NONE OR INCOMPLETE m	SINGLE STATION UNITS IN EACH BEDROOM j,l,m	INTERCONNECTED SYSTEM COVERING CORRIDORS & COMMON SPACES			TOTAL BUILDING
			w/o BORM/SUITE DETECTORS	SINGLE STATION BORM/SUITE DETECTORS	INTERCONNECTED BORM/SUITE DETECTORS	
	-4[0]	0[2]	(2[0] e	3[0] e	5	8

5. AUTOMATIC SPRINKLERS	NONE	BORMS/SUITES ONLY	CORRS., COMMON SPACES	BORMS/SUITES, CORRS., COMMON SPACES	TOTAL BUILDING	
					STANDARD	SPECIAL
	(0)	2[0] c	4[0] c	6	8	10

6. SEPARATION OF BEDROOMS SUITES	NONE OR INCOMPLETE	COMPLETE SEPARATION OF BR SUITES FROM CORRIDOR -LEVEL OF PROTECTION IS:				
		ITEM 5 IS < 6 & DOORS w/o AUTO. CLOSERS		ITEM 5 IS ≥ 6 OR DOORS ARE ALL w/ DOOR CLOSERS		
		SMOKE RESISTING	20 MIN	SMOKE RESISTING	20 MIN	1-HR WALLS, 20 MIN DOORS
	-6	-1 g	0 g	1 g	(2)[3] f,g	3[4] f,g

7. EXIT SYSTEM	SINGLE OR EXPOSED ROUTE	MULTIPLE ROUTES				DIRECT EXIT
		DEFICIENT	w/o HORIZ.	HORIZ. EXIT	SMOKE PROOF STAIRS	
	-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[0] m	-1[0] m	(0)[1] m	1	1	2

10. VERTICAL OPENINGS	OPEN (OR INCOMPLETE ENCLOSURE)			ENCLOSED (h)		
	CONNECTS 5 OR MORE FLRS	3-4 FLRS.	2 FLRS.	<30 M	≥30 M <1 Hr	≥1 Hr
	-10	-7	-2	-1	(0)	1(0) b

11. SMOKE CONTROL	NONE	SMOKE PARTITIONS	
		PASSIVE	MECHANICALLY ASSISTED
	(0)	2	3

NOTES:

a- Use (-1 x height in stories) if building is sheathed with plaster, gypsum board or similar materials.

b- Use [ ] in multi-story buildings if item 1 is based on Type V (000), Type III (200) or Type II (000) without Note "a" and item 5 ≤ 4.

c- Use [ ] if item 1 is based on Type V (000), Type III (200) and Type II (000).

d- Use [ ] if item 7 is -6.

e- Use [ ] if item g is based on "None or Incomplete", or "Walls or Doors" are < 20 min. and item 5 is ≤ 4.

f- Use [ ] if separations between bedrooms/suites also meet criteria.

g- Rate separation different than actual construction as follows:
- "Smoke Resisting," if parameter 5 is < 6; parameter 1 is V(000), III(200) or II(000); and Note a does not apply.
- "20 min," if Note a applies and separation is 20 min or more.
- "20 min," if parameter 5 is ≥ 6 and separation is < 20 min.

h- Use 0 in 1 story buildings that have no vertical openings.

j- Use [ ] where less than 15 guests are accommodated and item 1 is not based on V(000); III(200) or II(000)

k- 30 min in existing bldgs

l- Use [ ] where item 7 is 4 in buildings not over 3 stories.

m- Use [ ] where item 5 is ≥ 6

p- Use this column for indicated type regardless of sheathing if item 5 is 10

Figure 11. Base Case Safety Parameter Values-Existing Large Facilities

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	-1		-1	-1
2. HAZARDOUS AREAS	0	÷2 0	0	0
3. MANUAL FIRE ALARM	÷2 1	2		2
4. SMOKE DETECTION & ALARM	÷2 1	2	÷2 1	2
5. AUTOMATIC SPRINKLERS	0	÷2 0	(÷2)A 0	0
6. SEPARATION OF BEDROOMS/SUITES	2	÷2 1	2	2
7. EXIT SYSTEM		0	÷2 0	0
8. EXIT ACCESS		0		0
9. INTERIOR FINISH	÷2 0	0		0
10. VERTICAL OPENINGS	÷2 0	0	0	0
11. SMOKE CONTROL		0	0	0
TOTAL	S_1= 3	S_2= 5	S_3= 2	S_4= 5

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.

Figure 12a. Base Case Individual Safety Evaluations-Existing 1 Story Large Facilities

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		-2	-2
2. HAZARDOUS AREAS	0	÷2 0	0	0
3. MANUAL FIRE ALARM	÷2 1	2		2
4. SMOKE DETECTION & ALARM	÷2 1	2	÷2 1	2
5. AUTOMATIC SPRINKLERS	0	÷2 0	(÷2)A 0	0
6. SEPARATION OF BEDROOMS/SUITES	2	÷2 1	2	2
7. EXIT SYSTEM		0	÷2 0	0
8. EXIT ACCESS		0		0
9. INTERIOR FINISH	÷2 0	0		0
10. VERTICAL OPENINGS	÷2 0	0	0	0
11. SMOKE CONTROL		0	0	0
TOTAL	S_1= 2	S_2= 5	S_3= 1	S_4= 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.

Figure 12b. Base Case Individual Safety Evaluations- Existing 2 Story Large Facilities

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	0		0	0
2. HAZARDOUS AREAS	0	÷2 0	0	0
3. MANUAL FIRE ALARM	÷2 1	2		2
4. SMOKE DETECTION & ALARM	÷2 1	2	÷2 1	2
5. AUTOMATIC SPRINKLERS	0	÷2 0	(÷2)A 0	0
6. SEPARATION OF BEDROOMS/SUITES	2	÷2 1	2	2
7. EXIT SYSTEM		0	÷2 0	0
8. EXIT ACCESS		0		0
9. INTERIOR FINISH	÷2 0	0		0
10. VERTICAL OPENINGS	÷2 0	0	0	0
11. SMOKE CONTROL		0	0	0
TOTAL	S_1= 4.0	S_2= 5.0	S_3= 3.0	S_4= 6.0

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.

Figure 12c. Base Case Individual Safety Evaluations-Existing 3-6 Story Large Facilities

Control Requirement (S_a)	Egress Requirement (S_b)	Refuge Requirement (S_c)	General Fire Safety Requirement (S_d)
0.0	3.0	1.0	0.0

Figure 13. Equivalency Requirements Small-Facilities

Building Height	Control Requirement (S_a)	Egress Requirement (S_b)	Refuge Requirement (S_c)	General Fire Safety Requirement (S_d)
1 Story	3.5	8	4.5	8
2 Story	4.5 (4.5)	8(6)	5.5 (3.5)	9(7)
3-6 Story	6.5 (6.5)	8(6)	7.5 (5.5)	11(9)

Use values in ( ) for 2 or 3 story motel type facilities.

Figure 14. Equivalency Requirements-New Large Facilities

Building Height	Control Requirement (S_a)	Egress Requirement (S_b)	Refuge Requirement (S_c)	General Fire Safety Requirement (S_d)
1 Story	3	5	2	5
2 Story	2	5	1	4
3-6 Story	4	5	3	6

Figure 15. Equivalency Requirements-Existing Large Facilities

APPENDIX A

Fire Safety Evaluation System for National Park Service Overnight Accommodations

Table of Contents

CLASSIFICATION OF FACILITIES

This document contains the worksheets, instructions, and glossary material necessary to apply the Fire Safety Evaluation System to guest and dormitory accommodations in National Parks. The evaluation system presented here divides these overnight accommodations into three separate classifications as follows:

1. Large Facilities (Hotels and Dormitories).

Large facilities include all overnight accommodation buildings for guests or concession staff except for the special cases covered under Small Dormitories or Cabin Accommodations. The conceptual model for the large facility is a hotel type arrangement with individual guest rooms normally opening onto an interior corridor.

The large facilities documents include special procedures for handling:

a. Portions of large buildings that are not involved with sleeping accommodations.

b. Multi-story lobbies (and other atria).

c. Two or three story motel type facilities when such do not involve any interior or other enclosed corridors. (Single story motel type facilities without interior corridors are covered under Cabin Accommodations.)

2. Small Dormitories.

The evaluation system for small dormitories is intended to be used only for staff accommodations (not for guests). The conceptual model is a structure similar to a single family dwelling with common living or recreational space and bedrooms similar to a lodging house. Normally, the maximum number of persons housed in a facility classified as a small dormitory should be 16 or less. The restriction limiting the application to staff dormitory results from the inherent fire safety assumption that the occupants will be a communal type of group, reasonably familiar with the geography of the building, and probably will have had some fire evacuation drill training relating to the dormitory.

3. Cabin Accommodations (Including Qualifying One-Story Motel Arrangements).

The cabin accommodation worksheet is suitable for use on buildings that are provided either for guest or staff accommodations. The cabin accommodation for the purposes of the evaluation system is defined as a one-story living unit with a private door direct to the exterior and having no access to any corridors or vestibules that are enclosed and shared by another accommodation. A living unit is an accommodation that is rented or assigned as a single unit. Several staff members may share a single living unit. Cabin accommodations may have private vestibules or open porches provided the exit path from the private door is essentially directly away from the building.

Cabins may have common walls with other cabins. These common walls may have doors or shared bathrooms.

Cabins may be more than one room but may not have more than one intervening room, such as a living room, between any sleeping room and a door leading directly to the exterior.

Single story motel type structures that conform with the above requirements may be evaluated as a series of cabin accommodations that have common walls with other cabin units using the cabin accommodation form.

Note: The cabin accommodations evaluation system has been purposely devised so that any single room cabin will pass the equivalency test if a smoke detector is present. The system will also fail any cabin accommodation without smoke detection. The cabin accommodation system is most useful for facilities that involve a series of living units or multi-room living units.

Fire Safety Evaluation Worksheet for Large Facilities

Facility Identification _____

Evaluator _____ Date _____

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 E. 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 for large facilities*.

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 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 below.

Facility Fire Safety Requirements Worksheet

Considerations	Met	Not Met	Not Applic.
A. Building utilities conform to the requirements of of Paragraph 7-1 of the Life Safety Code.			
B. The air conditioning, heating, and ventilating systems conform with Paragraph 7-2 of the Life Safety Code.			
C. Elevator installations are made in accordance with the requirements of Paragraph 7-4 of the Life Safety Code.			
D. Rubbish chutes, incinerators, and laundry chutes are installed in accordance with Paragraph 7-5 of the Life Safety Code.			
E. An emergency organization meeting the requirements of Section 31-6 of the Life Safety Code exists and is functional.			

Table 1. SAFETY PARAMETER VALUES—LARGE FACILITIES

SAFETY PARAMETER	PARAMETER VALUES							
1. CONSTRUCTION	COMBUSTIBLE					NONCOMBUSTIBLE		
BUILDING HEIGHT	TYPE V (000)	TYPE V (111) p	TYPE III (200)	TYPE III (211) p	TYPE IV (2HH)	TYPE II (000)	TYPE II (111) p	TYPE I & II (222)
1 STORY	−2( )a	0	−2( )a	0	0	−2( )a	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	−8( )a	2	2

2. HAZARDOUS AREAS	WITHIN BDRMS/SUITES OR ON EXIT ROUTES		ELSEWHERE IN BUILDING		NONE, OR NO DEFICIENCY
	DOUBLE DEFICIENCY	SINGLE DEFICIENCY	DOUBLE DEFICIENCY	SINGLE DEFICIENCY	
	−7	−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(1) l,m	2	3

4. SMOKE DETECTION & ALARM	NONE OR INCOMPLETE m	SINGLE STATION UNITS IN EACH BEDROOM j,l,m	INTERCONNECTED SYSTEM COVERING CORRIDORS & COMMON SPACES			TOTAL BUILDING
			w/o BDRM/SUITE DETECTORS	SINGLE STATION BDRM/SUITE DETECTORS	INTERCONNECTED BDRM/SUITE DETECTORS	
	−4(0)	0(2)	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	
					STANDARD	SPECIAL
	0	2(0) c	4(0) c	6	8	10

6. SEPARATION OF BEDROOMS/SUITES	NONE OR INCOMPLETE	COMPLETE SEPARATION OF BR/SUITES FROM CORRIDOR -LEVEL OF PROTECTION IS:				
		ITEM 5 IS < 6 & DOORS w/o AUTO. CLOSERS		ITEM 5 IS ≥ 6 OR DOORS ARE ALL w/DOOR CLOSERS		
		SMOKE RESISTING	20 MIN	SMOKE RESISTING	20 MIN	1-HR WALLS, 20 MIN DOORS
	−6	−1 g	0 g	1 g	2(3) f,g	3(4) f,g

7. EXIT SYSTEM	SINGLE OR EXPOSED ROUTE	MULTIPLE ROUTES				DIRECT EXIT
		DEFICIENT	w/o HORIZ.	HORIZ. EXIT	SMOKE PROOF STAIRS	
	−6	−2	0	8	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(0) m	−1(0) m	0(1) m	1	4	2

10. VERTICAL OPENINGS	OPEN (OR INCOMPLETE ENCLOSURE)			ENCLOSED (h)		
	CONNECTS 5 OR MORE FLRS	3-4 FLRS.	2 FLRS.	<30 M	≥30 M <1 Hr	≥1 Hr
	−10	−7	−2	−1	0	1(0) b

11. SMOKE CONTROL	NONE	SMOKE PARTITIONS	
		PASSIVE	MECHANICALLY ASSISTED
	0	2	3

NOTES:

a- Use (−1 x height in stories) if building is sheathed with plaster, gypsum board or similar materials.

b- Use ( ) in multi-story buildings if item 1 is based on Type V (000), Type III (200) or Type II (000) without Note "a" and item 5 ≤ 4.

c- Use ( ) if item 1 is based on Type V (000), Type III (200) and Type II (000).

d- Use ( ) if item 7 is −6.

e- Use ( ) if item g is based on "None or Incomplete", or "Walls or Doors" are < 20 min. and item 5 is ≤ 4.

f- Use ( ) if separations between bedroom/suites also meet criteria.

g- Rate separation different than actual construction as follows:
- "Smoke Resisting," if parameter 5 is < 6; parameter 1 is V(000), III(200) or II(000); and Note a does not apply.
- "20 min," if Note a applies and separation is 20 min or more.
- "20 min," if parameter 5 is ≥ 6 and separation is < 20 min.

h- Use 0 in 1 story buildings that have no vertical openings.

j- Use ( ) where less than 15 guests are accommodated and item 1 is not based on V(000); III(200) or II(000)

k- 30 min. in existing bldgs.

l- Use ( ) where item 7 is 4 in buildings not over 3 stories.

m- Use ( ) where item 5 is ≥ 6.

p- Use this column for indicated type regardless of sheathing if item 5 is 10.

PART B. 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 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 BEDROOMS/SUITES		÷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 C. DETERMINE EQUIVALENCY REQUIREMENTS—USE TABLE 3.

Transfer the circled values from Table 3 to the blanks marked S_a, S_b, S_c, and S_d in Table 4.

Table 3a. Equivalency Requirements-Existing Facilities

Building Height	Control Requirement (S_a)	Egress Requirement (S_b)	Refuge Requirement (S_c)	General Fire Safety Requirement (S_d)
1 Story	3	5	2	5
2 Story	2	5	1	4
3-6 Story	4	5	3	6

PART D. EQUIVALENCY EVALUATION

1. Peform 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.

PART C. DETERMINE EQUIVALENCY REQUIREMENTS—USE TABLE 3.

Transfer the circled values from Table 3 to the blanks marked S_a, S_b, S_c, and S_d in Table 4.

Table 3b. Equivalency Requirements—New Facilities

Building Height	Control Requirement (S_a)	Egress Requirement (S_b)	Refuge Requirement (S_c)	General Fire Safety Requirement (S_d)
1 Story	3.5	8	4.5	8
2 Story	4.5 (4.5)	8(6)	5.5 (3.5)	9(7)
3-6 Story	6.5 (6.5)	8(6)	7.5 (5.5)	11(9)

Use values in ( ) for 2 or 3 story motel type facilities.

PART D. EQUIVALENCY EVALUATION

1. Peform 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 EVALUATING A LARGE OVERNITE ACCOMMODATION (HOTEL OR DORMITORY)

This glossary is provided to assist in completing the Fire Safety Evaluation Worksheets for determining the suitability of large accommodations. 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 the 1981 edition of that Code.

Areas of Application

The entire building can be evaluated on a single worksheet. The building may, however, be zoned with each zone considered separately or in any convenient grouping of zones. The choice of zoning is normally based on the approach that produces the most functional or economical results. The criteria for zoning facilities is as follows:

a. Zoning must be such as to divide the building evaluation by units that consist of one or more complete fire/smoke zones. A fire/smoke zone is a portion of a building that is separated from all other portions of the building by building construction having at least 1-hour fire resistance and/or smoke partitions conforming to the requirements of section 6-3 of the Life Safety Code for smoke barriers of at least 20-minute fire resistance. Any vertical openings (shafts, stairs, etc.) involved must also provide 1-hour separation (except that stair doors may be 45-minute, Class C doors). In facilities completely protected by automatic sprinkler protection, the above fire resistance requirements do not apply. The elements separating one zone from another must, however, be of sound, smoke resisting construction. Doors in zone separations must be either self-closing or equipped with automatic closers operated by smoke detectors.

b. Zones may be either adjacent to each other (e.g., separate wings or building sections) or above each other (e.g., floors or groups of floors).

c. Each zone containing sleeping accommodations for guests, staff, or others must be evaluated using this system with the following adjustments:

   (1) Charges for Parameter 2, Hazardous Areas, apply to any hazardous area in the zone being evaluated and to any hazardous areas in zones adjacent to or below the zone being evaluated.

(2) Where zones are located above each other, the value assigned to Parameter 1, Construction, is based on the highest story used for sleeping purposes in that "stack of zones," and the type of construction of that "stack of zones."

(3) The assignment of values for Parameters 3, Manual Alarms; 7, Exit Systems; and 8, Exit Access, does not consider conditions in unoccupied spaces in other zones when such are not involved in any egress paths.

(4) The evaluation of Parameter 7, Exit Systems, includes those portions of any exit route that transverse another zone. Any exposures or deficiencies pertaining to any part of the exit route must be taken into account in the evaluation of the zone.

d. Zones that do not involve sleeping accommodations are evaluated the same as those with sleeping accommodations with the following variations:

(1) Any zone not involving sleeping accommodations may be omitted from the numerical evaluation if all of the following conditions are met:

a. The zone is not involved in the exit route from any sleeping accommodation.

b. The zone conforms to the Life Safety Code requirements applicable to its use.

c. In any case when the zone is located below another zone that involves sleeping accommodations, the non-sleeping zone is protected by sprinklers, smoke detectors, or a combination of these (so distributed and arranged that any fire in the zone will promptly cause the operation of the fire alarm in that zone and all zones above that zone).

(2) Alternatively, zones not involving sleeping accommodations may be evaluated using this system provided any additional egress capabilities and arrangements appropriate to the specific use of the space are provided. In such case, the separation measured in Parameter 6 is based on separation of use spaces from corridors. Where the zone has no corridor arrangement (e.g., lobbies, dining rooms, kitchens), a value of "0" is assigned to this parameter. In evaluating Parameter 4, Smoke Detection, only those detectors that are part of an interconnected system are to be credited in this evaluation. Any usable rooms or spaces other than corridors should be substituted for "bedrooms" or "bedrooms/suites."

Maintenance

All protection systems, requirements, arrangements, and procedures must be maintained in a dependable operating condition and a sufficient state of readiness, and 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 the following table.

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.

Where the facility includes horizontally separate zones, additions, or connected structures of different construction, the rating and classification of the structure shall be based on (a) separate buildings if the portions qualify as separate zones or (b) the lower safety parameter point score involved if not.

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 level of primary exit discharge or the lowest floor used for sleeping purposes, whichever indicates the greater number of stories.

In Table 1 of the worksheet for large overnight accommodations, some building constructions are given a special parameter value if the construction is "sheathed." Buildings where the interior is fully sheathed with lath and plaster, gypsum board, or sheathing have equivalent ability to maintain structural integrity and are considered to meet this requirement.

The safety parameter values for type V(000), type III(200), and type II(000) buildings 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.

Any type II, III, or V building is given the same point value for the fire resistive version of the type involved regardless of the actual situation if the building is fully protected by a "special" automatic sprinkler system as described under Parameter 5, Automatic Sprinklers.

2. Hazardous Areas

The assignment of charges for hazardous areas is a five-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 2.

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 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 1.

Figure 2 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 including the separation of the hazardous area from any bearing members, partitions separating the hazardous area from all other spaces, and doors to the space sufficient to exceed the potential of the fire load involved. 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 protecton). 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 the Hazardous Area Location. The parameter value also considers location at hazardous areas in terms of proximity of such areas to sleeping areas (bedroom/suites) or to exit routes from such areas, as follows:

a. Within Bedrooms Or Suites. The hazardous areas are physically within a bedroom or suite, staff sleeping room, or other room or space assigned for sleeping use without separating walls or with such separation but having a door or other opening directly from the hazardous area into the sleeping area.

b. On Exit Route. The hazardous area is physically within an exit route from a sleeping area without separating walls (or floors) or is so separated but has a door or other opening that opens directly from the hazardous area into the exit route.

Step 5. 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 3 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.

---

*When the hazardous area is within or abuts an egress route (exit access or exit system) addressed in Parameters 7 and 8, the credit for sprinklers is not to be given unless the hazardous area is separated from the rest of the living unit or the egress route by reasonably smoke resisting partitions and doors.

INHERENT STRUCTURAL DANGER FROM TYPICAL HAZARDOUS AREAS

	MINIMUM FIRE RESISTANCE OF BEARING WALLS, BEARING PARTITIONS, COLUMNS, BEAMS GIRDERS, TRUSSES, AND FLOOR/CEILING ASSEMBLIES EXPOSED TO HAZARDOUS AREA			
	2 HOURS OR MORE	LESS THAN 2 HOURS BUT 1 HOUR OR MORE	LESS THAN 1 HOUR	
			Sheathed	Unsheathed
	Not structurally endangering for all cases (N/SE)			Structurally endangering for all cases (SE)
Commercial Space (Gift Shop)		N/SE	Usually N/SE	
Service Spaces		N/SE	Usually N/SE	
Storage Area		N/SE	Usually SE	
Garage		N/SE	N/SE	
Boiler, Heater, or Incinerator* Rooms		Varies	Varies	
Fuel Storage (Solid fuels)		SE	SE	
Linen Rooms		N/SE	Usually N/SE	
Trash Rooms		SE	SE	
Small Trash Collection Room		N/SE	Often SE	
Laundries		N/SE	Often SE	
Repair Shops**		Varies	Varies	

Figure 2 - HAZARDOUS AREA - LEVEL OF HAZARD

* Individual or domestic size heating units that are properly installed and provided with UL or similarly approved combustion safeguards are not in themselves classed as hazardous areas.

** Type of Shop (paint, carpentry, etc.) and amount of combustible content determines classification.

	NO PROTECTION	SPRINKLER PROTECTION	FIRE RESISTIVE ENCLOSURE	SPRINKLERED AND 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 DEFICIENCIES[B]

A - If fire resistance exceeds maximum potential of hazard.
B - If fire resistance is not sufficient to withstand potential of hazard.

Figure 3 Hazardous Areas - Degree of Deficiency

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, except that credit for a manual fire alarm is credited even if no such alarm is present in buildings three stories or less in height where every sleeping room has a direct exit to the outside.

b. W/O F.D. Notif. There is a manual fire alarm system which meets the requirements of LSC Section 7-6, including the following features:

(1) Sounding devices (bells, etc.) are of such character and so located as to alert all occupants of the building or fire/smoke zone thereof endangered by fire.

(2) In addition to the normal requirements, a manual fire alarm station is provided at the main desk or other convenient central point, the location being that most continuously staffed. In buildings where such a location is continuously staffed at all times, the building is occupied and the building is completely protected by an automatic sprinkler or smoke detection system, the operation of which causes the sounding devices (i.e., fire evacuation alarm) to sound, all other manual fire alarm stations may be omitted.

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 brigade or fire department which is legally committed to serve the area in which the building is located, through a direct connection, an approved central station, a constantly manned NPS control center, or through other means acceptable to the Park Service.

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 degrees F or fall below 0 degrees F (such as unfinished attics or cocklofts) as long as separation to 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. Inter-connected Systems. Inter-connected systems are those systems so arranged that the operation of any detector sounds alarm devices on other inter-connected detectors or other separate alarm devices spread sufficiently to alert all of the occupants. Where the systems are of the total building variety, the credit can be given only if 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 Bedroom/Suite Detectors. There is at least one detector spaced every 30 feet in enclosed corridors and an additional detector in all common spaces for each 900 square feet or less of floor space. Detectors may be omitted from common spaces that are both sprinkler protected and separated from the corridors by automatic closing doors (as defined in Parameter 6).

(2) Corridors and Common Spaces with Single Station Bedroom/Suite Detectors. There is one single station detector in each bedroom or sleeping room plus inter-connected detectors in enclosed corridors and common spaces spaced as described in (1) above. Detectors may be omitted from common use areas that are both sprinkler protected and separated from the corridors by automatic closing doors (as defined in Parameter 6).

(3) Corridors and Common Spaces with Inter-connected Bedroom/Suite Detectors. Same as (2) above except bedroom/suite detectors are inter-connected 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. Detectors may be omitted from common use areas that are both sprinkler protected and separated from the corridors by automatic closing doors (as defined in Parameter 6).

(4) Total Building Systems. This system includes detector locations in every bedroom throughout and also provides detector coverage throughout all corridors, common spaces, hazardous areas, and other spaces meeting the requirements for an automatic fire alarm system in accordance with NFPA Standard 72. Heat detectors are permitted in specific locations by NFPA 72.

5. Automatic Sprinklers

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 the hazardous area is also sprinkler protected.

b. Bedrooms/Suites Only. All bedrooms/suites have sprinkler protection complying with the requirements for light hazard protection in NFPA Standard No. 13 or other appropriate standard for sprinkler installations.

c. 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 bedrooms/suites (except fire resistive enclosed non-combustible stairwells). Sprinklers are installed in corridors along the ceilings plus one sprinkler head opposite the center of and inside any bedroom/suite door openings to the corridor.

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. The system is classified as "Special" if it is so arranged that the building cannot be used for overnight accommodations at any time the sprinkler system is not in full operating condition.

NOTE: To receive credit for protection of "Corridor and Habitable Space" or "Total," the sprinkler system must be equipped with an automatic alarm initating 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. Separation of Bedrooms/Suites from Corridors and Common Spaces

The values assigned in Parameter 6, Separation of Bedrooms/Suites from Corridors and Common Spaces, are based on the quality of separation between the bedrooms/suites and the corridor or common space. In the instance where the separation is credited as 20 minutes or greater fire resistance, a higher value is assigned if the separation between adjacent bedrooms/suites is also fire resistant.

a. Incomplete. The separation is judged as incomplete if the wall or partition adjacent to the corridor or common space has unprotected openings (no door, louvers, gaps, or transfer grills) between the floor and the ceiling. If openings exist above the ceiling level, the separation is not considered incomplete if the ceiling in the bedroom/suite is a complete membrane. In this case, the separation rating is based on the minimum level of smoke or fire resistance involved in the wall/ceiling system.

Doors adjoining the bedroom/suite to the common space or corridor may cause the separation to be incomplete if there is some mechanism or obstruction which prevents closing of the door (doors that have been blocked open by doorstops, chocks, tiebacks, or

other devices that require manual unlatching or releasing action to close the door); there is a significant gap between the door and the jamb; there is no latch or suitable device for keeping the door closed; or the door contains open louvers.

b. Complete Separation. If the separation is not found to be incomplete based on the above criteria, the separation is considered to be complete.

Automatic Closers. A door is considered to have an automatic door closer if it is equipped with a traditional self-closing mechanism, or a release mechanism actuated by a smoke detector.

(1) Smoke Resisting. A separation is classified as smoke resisting if the walls, partitions, and doors separating the bedrooms/suites from the corridor or common space resist the passage of smoke. Vision panels may be present without limit to glass type or size. Conversely, louvers, transfer grilles, operable transoms, or other air passages that exchange air between sleeping rooms and corridors cause the separation to be considered incomplete. Properly installed heating and utility installations meeting NFPA 90A or other applicable standards are acceptable under this criteria.

(2) Twenty Minute. The separation between the bedroom/suite and the corridor or common space is considered to be 20 minutes if it meets the criteria for smoke resisting and has at least 20-minute fire resistance capability. This capability is based on standard fire test ratings for doors, walls, and partitions. This capability is assumed if walls or partitions are sheathed on both sides with lath and plaster, gypsum board, or equivalent sheathing and the doors have a fire resistance rating of 20 minutes or more.* Vision panels of wired glass in an approved frame are allowed under this classification provided the frames do not exceed 1,296 square inches and both sides of the separation are protected by automatic sprinklers. The separation is assumed to be 20 minutes if both sides of the separation are protected by automatic sprinklers.

NOTE: In non-sprinklered buildings, the credit for 20 minute separation is given only in buildings that have fire resistive construction (Parameter 1) or are fully sheathed with plaster, gypsum board or similar materials.

*Doors made of 1 3/4-inch thick solid core wood construction, hollow steel, or an arrangement of comparable construction shall be considered to have 20 minute or greater fire resistance (the thermal insulation capability of the door is not considered).

(3) One-Hour Walls, 20-Minute Doors. The separation of the bedrooms/suites from the corridor or common space is classified as 1-hour walls, 20-minute doors if it meets the requirement for the 20-minute separation classification and has wall construction that equals or exceeds one hour if tested in standard fire tests.

NOTE: The credit for 1-hour separation is given only in buildings that have at least 1-hour fire resistive construction (Parameter 1).

7. Exit System.

Exit systems are the paths of travel from the bedroom/suite to the outside of any of the types and arrangements described in Chapter 5 of the Life Safety Code.

a. Single Route. A single route exists when the occupants of any sleeping room/suite do not have either a direct exit as defined in (5), below, or multiple routes as defined in c, below.

b. Exposed Route. An exit route is exposed if a segment of that route is the only available route from one or more sleeping rooms/suites and that segment is not separated from all other rooms or spaces by walls and doors that equal the separation credited in Parameter 6, Separation of Bedrooms/Suites. In determining which rooms or spaces expose an exit route, any sprinkler protected room or space that is not a hazardous area (Parameter 2) is not considered as an exposure.

c. Multiple Routes. Multiple routes exist when the occupants of any bedroom/suite have, either from the bedroom/suite or through access in a corridor adjacent to the bedroom/suite, a choice of two separate exit routes to the outside of the types listed in paragraph 17-2 of the Life Safety Code.

NOTE: In order to qualify for multiple routes, at least one route must qualify as unexposed. The unexposed route must be well marked to guide occupants to it and the facility emergency plan must have regularly tested procedures for training staff and guiding guests through the protected routes.

(1) Deficient. An exit route is deficient if it fails to meet any of the applicable criteria in Chapter 5 of the Life Safety Code.

NOTE: Typical deficient routes include usable exit routes that may be narrower than minimum requirements, have wrong door swings, have stairs with no enclosures or deficient enclosures, involve stairs with deficient doors or door hardware, or lacking handrails, or having insufficient exit marking or lighting, etc.

(2) Without Horizontal Exits (W/O Horiz.). An egress system is based on this charge if there are multiple routes that are not deficient but it does not include a horizontal exit as defined below or have acceptable direct exits from each bedroom/suite as defined below.

(3) Horizontal Exit. In order to qualify as a horizontal exit, the exit system must be in conformance with section 5-2.4 of the Life Safety Code. The presence of a single horizontal exit on each floor containing bedrooms/suites shall be considered as sufficient criteria to meet this criteria provided that the space created is of sufficient size to provide at least 3 square feet of accessible space for all of the potential occupants already present in the space or evacuating to it and has the required other exit from that space.

(4) Smoke Proof Stairs. Credit for a smoke proof stair may be given if either the stairway meets the requirements for a smoke proof stair specified in section 5-2.3 of the Life Safety Code, 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 this credit, all exit stairs being evaluated under this parameter and Parameter 8, Exit Access, must meet the smoke proof stair requirements.

(5) 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 exterior balcony with direct access to an exterior exit or smoke proof stair. Where such openings are directly onto grade in a location where any person egressing can move directly away from the building without further exposure, the credit for direct exit is applicable even if there are not other exit routes from the sleeping unit.

8. Exit Access

Exit access is a measurement of the travel distance from the bedroom/suite to the outside or to an enclosed interior stairway or other exit (i.e., horizontal exit), or through a smoke barrier, whichever is shorter.

The charge for deadend (DE) access shall be made when any corridor affords access in only one direction to a required exit. The calculation of the distance to determine the level of charge is the measurement from the centerline of the doorway exiting the bedroom/suite to the nearest point where a person has a choice of two directions or routes of egress.

9. Interior Finish

Classification of interior finish is based on the flame spread rating of the interior finish in accordance with ASTM Standard E84, Tunnel Test. The requirements apply to wall and ceiling finish materials as described in section 6-5 of the Life Safety Code.

No consideration is included in the safety parameter value for any finish with a flame spread rating >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 is based on the presence or lack of enclosure and the fire resistance of the enclosure if present.

A vertical opening or penetration is classified as open if it is (a) unenclosed; (b) enclosed but does not have doors; (c) enclosed but has openings other than doorways; and (d) enclosed with cloth, paper or similar materials without any sustained fire stopping capabilities.

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 but one floor and this results in an unprotected opening between the shaft, and one and only one floor, the parameter value assigned to the shaft shall be 0. If a required egress route is contained in the shaft, the maximum value assigned to Parameter 7, Exit System, shall be -2.

Enclosed vertical openings are considered to meet the requirements for 30 minute enclosure if:

a. The enclosure is of a type of construction that has been proven by standard test to have 30 minute or greater fire resistance.

b. The enclosure is of any type of substantial masonry construction.

c. The enclosure is of wood or metal stud construction sheathed on each side with sound, well installed 1/2-inch or thicker gypsum board, lath and plaster, or equivalent.

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 stairtower; and no mechanically assisted smoke control systems serve the floor.

b. Smoke Partitions. Smoke partitions consist of installations conforming to the requirements of section 6-3 of the Life Safety Code 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 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 by the operation of smoke detectors located at the door arches or by smoke detector systems that have been credited as the six-point value in Parameter 4, Smoke Detection and Alarm. A horizontal exit will act as a smoke partition and when it exists is credited as both a smoke partition in Parameter 11 and a horizontal exit in Parameter 7.

(1) Passive. The smoke control system is passive if there is not a specifically designed engineered smoke control system that will obstruct the leakage of smoke through the barrier.

(2) Mechanically Assisted. The smoke control system is mechanically assisted if it has a tested engineered smoke control system that will obstruct the leakage of smoke through the barrier.

EVALUATION OF TWO- OR THREE-STORY MOTEL TYPE FACILITIES THAT DO NOT CONTAIN INTERIOR OR ENCLOSED CORRIDORS

A special adaptation of Table 1 for large facilities has been developed to cover two- and three-story facilities where each sleeping room has a direct exit to the outside or onto a balcony which in turn exits to grade.

Essentially, the special Table 2 is identical to Table 1 for large facilities except that those types of measurements and conditions that will not occur in such a building have been eliminated and the form has been adjusted to recognize the absence of an enclosed corridor arrangement that can become smoke filled or be a channel for propagation of fire. The following parameters involve terms not covered in the large facility glossary. The parameters and new terms are as follows:

Parameter 7. Exit Systems

a. Exit Systems Involve Balconies. This applies to any exit system where persons making emergency evacuation from a sleeping room must traverse a balcony or other restricted path that prevents them from immediately moving away from the building upon leaving their room.

b. With Single Exit. A balcony system is considered to have a single exit if there is one normal stairway ramp or direct to grade exit from the balcony.

c. With Multiple Exits. Multiple exits are considered to exist in any case where there are at least two reasonably remote stairs, ramps, or direct exits from the balcony. To be credited as multiple exits, at least one of these must be to grade without re-entering the building proper.

d. Deficient. The exits from a balcony are considered as deficient if there are not at least two exits by way of substantial stairways with hand rails, ramps, or exit directly to grade that allow passage to the outside without re-entering the building. Exits are also considered deficient if there is not some form of continuous night or emergency lighting. Exit marking is considered necessary only if the location of at least two exit routes is not obvious from any sleeping room.

e. Standard. Exits are considered standard if they have substantial well built stairs, ramps, or direct exits having emergency or continuous night lighting and in good order with a reasonable pitch. Stairs may be of combustible construction in building of Type III, Type IV, or Type V construction.

Parameter 9. Interior Finish

a. Balcony Ceiling. That portion of the balcony construction that extends over the walkway. This may consist of weather protection over a balcony or the underside of a balcony (in relationship to a lower floor). The balcony ceiling is considered to have flame spread ratings of greater than 75 if it is of wooden construction.

Parameter 10. Vertical Openings (Inside Building).

The assignment of charges for vertical openings applies only to those openings contained within the weather envelope of the building.

If there are no vertical openings within the weather envelope of the building, assume that the enclosure is at least 1 hour.

In buildings where the interior of the roof is exposed to the top floor, (i.e., there is no attic, loft, or similar space), the sheathing or lack of sheathing for the roof, walls, and partitions for the top floor only is ignored in applying Note a.

MOTELS: 2 or 3 story motel type facilities without interior or enclosed corridors

DETERMINE SAFETY PARAMETER VALUES—USE TABLE 1

Select and circle the safety value for each 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. Use Tables 2, 3 & 4 for large facilities to complete evaluation.

Table 1. SAFETY PARAMETER VALUES

SAFETY PARAMETER	PARAMETER VALUES							
1. CONSTRUCTION		Combustible				Noncombustible		
BUILDING HEIGHT	Type V (000)	Type V (111) p	Type III (200)	Type III (211) p	Type IV (2HH)	Type II (000)	Type II (111) p	Type I&II (222)
2 STORY	−6( )a	0	−6( )a	0	0	−5( )a	2	2
3 STORY	−8( )a	−2	−8( )a	0	−2	−8( )a	2	2
2. HAZARDOUS AREAS	Within Bdrms/Suites or on Exit Routes			Elsewhere in Building		None, or No No Def.		
	Double Deficiency		Single Deficiency	Double Deficiency		Single Deficiency		
	−7		−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(1) l,m	2		3				
4. SMOKE DETECTION & ALARM	None or Incomplete m	Single Station Units in Each Bedroom		Interconnected System Covering All Bedrooms		Total Building		
	−4(0)	2		5		6		
5. AUTOMATIC SPRINKLERS	None	Bdrms/Suites Only	Total Building					
			Standard	Special				
	0	6	8	10				
6. SEPARATION OF BEDROOMS/SUITES	None or Incomplete	Separation Between Rooms (Incl: Doors) Is:						
		Smoke Resisting	20 Min	1-Hr Walls, 20 Min Doors				
	−6	2g	3g	4g				
7. EXIT SYSTEM	Exit System Involves Balconies			All Sleeping Rooms Exit to Grade				
	w/Single Exit	w/Multiple Exits						
		Deficient	Standard					
	0	2	4	4				
8. EXIT ACCESS	Max. Dead End		No Dead End 35′ & Travel Is:					
	>100′	>35′≤100′	>150′	100′-150′	50′-100′	<50′		
	−6	−4	−2	−1	0	2		
9. INTERIOR FINISH	Flame Spread Ratings							
BALCONY CEILING q	>75≤200		>25≤75		≤25			
ROOMS/SUITES	>75≤200	≤75	>75≤200	≤75	>25≤200	≤25		
	−3(0) m	−1(0) m	0(1) m	1	1	2		
10. VERTICAL OPENINGS	Open (Or Incomplete Encl.)		Enclosed					
	3 Flrs.	2 Flrs.	<30 M	≥30 M <1 Hr	≥1 Hr			
	−7	−2	−1	0	1(0) b			
11. SMOKE CONTROL	All Cases							
	0							

NOTES:

a- Use (−1 × height in stories) if building is sheathed with plaster, gypsum board or similar materials.

b- Use ( ) if item 1 is based on Type V (000), Type III (200) or Type II (000) without Note "a" and item 5≤4.

g- Rate separation different than actual construction as follows:
- "Smoke Resisting," if parameter 1 is V (000), III (200) or II (000) and Note a does not apply.
- "20 min," if Note a applies and separation is 20 min.
- "20 min," if parameter 5 is ≥6 and separation is <20 min.

m- Use ( ) where item 5 is ≥6.

p- Use this column for indicated type regardless of sheathing if item 5 is 10.

q- If no balcony ceiling exists, use ≤25 for balcony ceiling flame spread rating.

l- Use ( ) when Item 7 is 4.

Evaluation of Fire/Smoke Zones Containing a Multistoried Lobby, Atrium, or Other Floor Opening.

A portion of the overnight accommodations buildings in National Parks contain multistoried lobbies or other floor openings that are impractical to enclose. These provide special conditions, and special approaches are available when evaluating fuel smoke zones that include such arrangements. Any of the following three approaches are acceptable. The choice of approach should normally be made on the basis of that approach which best suits the operational requirements or is least costly. All are considered as satisfactorily providing equivalency.

1. Charge for Vertical Openings

   Apply the fire safety evaluation system to the zone assessing the appropriate negative charges under Parameter 10 for vertical openings and Parameter 8 for exposure of the egress route. In all other manners, apply the evaluation approach charging each level as a separate floor but grading the entire inner connected collection of fire/smoke zones as a single zone.

2. Life Safety Code Requirements for Protection of Atrium.

   Exception number two of Section 6-2.2.3.1 of the Life Safety Code prescribes a protection mechanism for atriums. A multistoried lobby is classed as an atrium. If this approach is followed, the value for Parameter 10, Vertical Openings, is to be based on that assigned to vertical openings having protection of less than one hour. The charges in Parameter 8 for exposed exits apply only to any exposures not related to the atrium. Where complying with the requirements of the Life Safety Code provides additional fire protection within the zone, such protection is to be credited in the evaluation of that zone. The Life Safety Code requirements for the protection of an atrium or multistoried lobby in an NPS hotel or lodge are interpreted as follows:

   a. These criteria are usable only where the minimum width of the atrium floor opening is at least 20 feet.

   b. All exit stairways are separately enclosed from the lobby or atrium and egress from the stairs does not involve crossing of or exposure to the base floor of the atrium.

      NOTE: Architectural stairways completely open to the atrium may be left unenclosed provided that each level of the atrium has at least two other wall marked and remotely located exit routes that are either into enclosed stairways or through smoke barriers into a separate fire/smoke zone.

   c. The occupancy is low hazard. For NPS accommodation facilities this is interpreted to mean that there are no hazardous areas within the open atrium system and that any abutting the system are protected in such a manner as to be graded as no deficiencies under Parameter 2, Hazardous Areas.

d. Any fire in the atrium or within any room directly exposing the atrium (unless such room is fully sprinklered and has at least a 20-minute or equivalent separation with self-closing doors) will be immediately obvious to any occupants of the atrium or any persons who may have to use the atrium as an exit route. This is interpreted as meaning coverage by automatic smoke detection throughout all such areas except in the special cases where all of the floors opening on to the atrium have no hidden spaces or rooms that could contain persons who would not be instantly aware by their own sight, smell, and hearing of any fire incident.

e. The building is entirely protected by a sprinkler system meeting the requirements for total protection in Parameter 5, Automatic Sprinklers.

3. Buoyant Smoke Control Approach.

If a smoke control/exhaust system is provided and so designed as to maintain the bottom of any potential smoke layer higher than the head height of any person who may have to evacuate through the atrium, the entire atrium arrangement may be considered as a single zone with vertical opening protection equivalent to enclosure of less than one hour and no charges made for exposed exit routes. (See Appendix B)

Fire Safety Evaluation Worksheet for Small Facilities

Facility Identification _____

Evaluator _____ Date _____

(Complete one worksheet for each individual residence type structure used as a dormitory for 16 or less persons.)

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 E. 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 for small dormitories.

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 dormitories.

PART A. 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 Facilities

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		
8. EGRESS — 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 B 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 C. DETERMINE EQUIVALENCY REQUIREMENTS—USE TABLE 3.

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. Equivalency Safety Requirements

Control Requirement (S_a)	Egress Requirement (S_b)	Refuge Requirement (S_c)	General Fire Safety Requirement (S_d)
0.0	3.0	1.0	0.0

PART D. FIRE SAFETY EQUIVALENCY EVALUATION

1. Peform 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. Fire Safety 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 EVALUATING SMALL FACILITIES

This glossary is provided to assist in completing the Fire Safety Evaluation Worksheets for determining the suitability of small staff accommodations. 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 the 1981 edition of that Code.

Area of Application

The evaluation shall be completed covering the entire unit including spaces that are not used for sleeping rooms.

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/Fire Resistance

Small facilities are of construction types defined in NFPA 220-1979, Standard Types of Building Construction, except as modified herein.

Sprinklered Construction. If a building housing a small dormitory is partially covered by automatic sprinklers, the construction classification is based on the fire resistance of the unsprinklered portion(s) of the building.

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

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

b. Protected (20 Minutes). 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, rooms, 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 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 (III) construction.

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. Exit Route. Hazardous area is on the same floor as; and is in or abuts the exit route.

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 sleeping areas and exit routes by a reasonably tight smoke resisting partition or other smoke resisting barrier including doors.

	NO SPRINKLERS			SPRINKLERED PROTECTION	
	FIRE RESISTIVE		UNENCLOSED	SMOKE RESISTIVE	UNENCLOSED
	LIGHT	MODERATE		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 1. HAZARDOUS AREAS - DEGREE OF DEFICIENCY

c. Light Fire Resisting Enclosure. The hazardous area is cut off from all other areas by construction, including doors that have approximately 20-minute fire resisting construction (e.g., 1/2-inch gypsum board on stud partitions and solid-core, 1 3/4-inch (4.45 cm) wood doors). Doors are either automatic or self-closing, or the nature of the space is such that the door is kept closed at all times.

d. Moderate Fire Resistive Enclosure. The hazardous area is cut off from all other areas (including any floors or attic space over such areas) by at least 1-hour fire resistive construction and 3/4-hour fire doors. Doors are either automatic or self-closing.

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 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. Notif. There is a manual fire alarm system meeting the requirement of section 7-6 of the Life Safety Code, or credit can be given if all of the following conditions are met: (1) there is a smoke detection system which qualifies for at least two points under Parameter 4, (2) the smoke detectors are capable of connection to an approved manual fire alarm box for alarm initiation, (3) at least one manual fire alarm box is provided on each floor, and (4) there is at least one or more sounding devices that assure that the alarm is audible in all sleeping areas.

c. W/F.D. Notif. There is a manual fire alarm system which complies with the requirements of section 7-6 of the Life Safety Code, and, in addition, automatically transmits a signal to the fire brigade or the fire department which serves the area in which the building is located, through a direct connection, an approved central station, park communications center, or through other reliable means.

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 is 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 also meets the following requirements:

(1) At least one detector on each level is located in the corridor or similar common space.

(2) All detectors necessary in order to meet the requirements of (1), above, produce or initiate an alarm 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 Standard No. 13 for light hazard occupancy or NFPA 13D, 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

Classification of interior finish is based on the flame spread rating of the interior finish in accordance with ASTM Standard E 84, Tunnel Test. The requirements apply to wall and ceiling finish materials as described in section 6-5 of the Life Safety Code.

No consideration is included in the Safety Parameter Value for any finish with a flame spread rating > 200 or for any material not rationally measured by the ASTM E 84 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 (.64 cm) 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 Item 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 Opening" and "Protected Vertical Opening." A facility is classed as having protected vertical openings if there are no vertical openings (as in a single level building) or if the vertical openings are so protected that no primary exit route (as defined in Parameter 8, Egress) 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 a smoke tight separation having fire resisting capabilities of approximately 20 minutes. Any doors in the cut-off or enclosure need to have equivalent fire and smoke resisting capabilities and be either automatic closing on detection of smoke or self closing. Otherwise, this parameter is assessed on the basis of "unprotected vertical openings."

a. None Or Incomplete. A 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. Twenty-Minute Fire Resistance. Sleeping rooms are separated from corridors or other common spaces of the building by separations meeting the requirements of b, 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 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 1,296 square inches (0.836 square 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. Twenty-Minute 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 are self closing or 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 integrated 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 1,296 square inches (0.836 square m) of area each, installed in approved frames.

8. Egress

a. 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.

b. <Two Remote Routes Without Alternate Means. A case where the egress system fails to meet any of the other classifications in this parameter.

c. <Two Remote Routes With Alternate Means. A case where the facility has at least one primary route and one alternative means of egress, but fails to meet a higher valued classification in this parameter.

(1) 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 residential building. 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.

Note: Windows, ladders, and other arrangements not considered normal means of movement do not qualify as primary routes but may be classed as alternative means as described below.

(2) 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 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.

d. Two Remote Routes. Each bedroom has access to two routes leading to two separate building exit doorways.

e. 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, hazardous areas classed as having deficiencies in Parameter 2, or common living spaces (e.g., living rooms, kitchens, etc.).

f. Two Remote Routes Unseparated. A case where two or more remote routes are present (see d, above), but there are one or more sleeping rooms where all available exit routes fail to meet the criteria for separated route (see e, above).

g. Two Remote Routes, Separated. A case where two or more remote routes are present (see d, above) and each sleeping room has access to at least one route qualifying as separated in accordance with e, above.

h. 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.

CABIN ACCOMMODATIONS

CABIN NAME: _____

PARAMETER	PARAMETER VALUES					
1. CONSTRUCTION	COMBUSTIBLE			NON-COMBUSTIBLE		
	UNSHEATHED/COMB. SHEATHED		GYPSUM BOARD OR OTHER NON-COMB. SHEATHED			
	−1(0)[a]		0	0		
2. SMOKE DET. & ALARM	NONE	LESS THAN EVERY ROOM		EVERY HABITABLE ROOM (EXCEPT BATHROOMS)-b		
		BATTERY POWERED	LINE POWERED	BATTERY POWERED	LINE POWERED	
	−4	2	3	4	5	
3. SEPARATION FROM OTHER UNITS	COMMON WALL			SEPARATE BUILDINGS		
	WITH CONNECTING DOORS OR OTHER OPENINGS-c	WITHOUT OPENINGS				
	0(2)[a]	2		2		
4. EXIT SYSTEM	MULTI-ROOM UNITS				SINGLE ROOM UNIT	
	SINGLE EXIT, BEDROOM WINDOWS			EXTERIOR EXIT DOOR ON EACH SLEEPING ROOM		
	NOT USABLE FOR EMERGENCY EGRESS	USABLE FOR EMERGENCY EGRESS				
	−1	0		2	2	
5. INTERIOR FINISH	MORE THAN 10% UNTREATED WOOD OR OTHER COMBUSTIBLES	90% OR MORE IS GYPSUM BD, OTHER NON-COMBUSTIBLE OR FIRE RETARDANT TREATED WOOD				
	0(2)[a]	2				

a-If cabin (including all units with common walls) is sprinkler protected, credit Item 1 as "0," Item 3 as "2," and Item 5 as "2."
b-For single room units:
One smoke detector = Detectors in all habitable rooms.
c-If Item 3 is "0," detectors in each unit must: Sound a general alarm; activate at least one detector in every other unit with connecting doors or other openings; OR be loud enough to be clearly heard in all sleeping rooms involved.

PARAMETER	FIRE CONTROL	ESCAPE
1. CONSTRUCTION		X
2. SMOKE DET. & ALARM		
3. SEPARATION OF UNITS		
4. EXIT SYSTEM	X	
5. INTERIOR FINISH		
TOTAL		
REQUIRED	4	6

REQUIREMENTS MET? YES ☐ NO ☐

*APPENDIX B: AN INTERIM BUOYANT SMOKE CONTROL APPROACH (FOR ATRIUM-LIKE ARRANGEMENTS)

B1 Introduction

The methodology presented herein can be used to determine smoke (exhaust) fan capacity, temperature rating, and placement in atriums and atrium-like arrangements. It is based on the physics of the buoyant hot gas plume produced by fire. The rate of accumulation of smoke above a fire is determined by both the rate of burning (rate of energy production) and the amount of air entrained in the rising plume.

The details of the rate of energy production driving the plume is the least predictable factor involved. Current research is directed at improving the ability to predict the actual course and duration of energy released during a fire. To bridge the resulting uncertainty, this method assumes that the fire will continue to burn indefinitely at a given energy level to be determined from full-scale burn experiments.

The intent is to prescribe exhaust capacity based on the maximum energy release rate likely to occur. This approach results in a conservative overdesign which is necessary until more detailed prediction of fire development is available.

The Buoyant Smoke Control Approach is applicable only in buildings that have automatic sprinkler protection receiving credit for total protection in Parameter 5, Automatic Sprinklers, or are of Type I or Type II (222) construction and are so credited in Parameter 1, Construction.

Data obtained experimentally in full-scale burnout tests of hotel room mockups and in burn tests of typical furniture will be used to identify the appropriate design rate of convected energy, Q_c, used in the calculation to be described.

*This Appendix was prepared by Leonard Y. Cooper

The lowest acceptable level of smoke accumulation, Z_{clear}, is defined as the characteristic elevation, above the atrium floor, of the heads of occupants of the highest floor where evacuation through the atrium is required, unless this is the lowest floor. In the latter case, Z_{clear} is equal to 10 feet.* Application of the method requires that:

1. the smoke reservoir above the Z_{clear} elevation have a depth of at least $0.2Z_{clear}$;

2. the length and width of the atrium must not be less than Z_{clear}; and

3. the exhaust fan outlet must be at least 10 feet higher than the elevation of the floor of the highest occupied room requiring egress through the atrium.

The determination of smoke removal requirements is based on the rate of energy production developed in full scale tests. From the results of these tests, the largest potential fire on both the lowest floor level and the highest floor level in the atrium is to be estimated. The fire at the lowest level will determine the total amount of fan air movement required, and the fire at the highest level will determine the highest temperatures to be handled by the fans.

B2 Procedure for Fan Selection

The fans' size, temperature rating, and means of operation is determined from Figure B-1 by the following procedure:

a. Acceptable Smoke Level. Determine the lowest acceptable level of smoke accumulation. This is the highest level in which sleeping accommodations are to be permitted. The vertical distance between head level (approximately 5 feet above the floor) and the floor

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*English units will be used throughout this Appendix in order to make it more readily useable by people who are likely to implement this Fire Safety Evaluation System.

level of the lowest floor in the atrium is the value Z_{clear} to be used in Figure B-1 for determining the required rate of volume of smoke removal. If sleeping accommodations are only permitted on the lowest floor then Z_{clear} = 10 feet.

b. Characteristic Fuel. Determine the steady rate of convected energy, Q_c passing into the smoke layer. In Figure B-1, curves are plotted that relate to the steady rate of convected energy, in units of BTU/s, of the fire which could threaten the atrium space. The upper sketch in the figure is meant to indicate that the curves are useful for describing conditions related to combustibles burning on the atrium floor or on any balcony open to the atrium space. The lower sketch indicates that the curves are also relevant in cases of combustibles burning in rooms which enter onto the atrium space.

c. Exhaust Fan Rate. From Figure B-1 determine the exhaust fan capacity needed to extract smoke at the rate that will maintain the smoke level at Z_{clear}. This rate is found in the base line of the figure and corresponds to the level of Z_{clear} on the vertical axis as determined by the solid line characterizing the maximum anticipated steady rate of convected energy (i.e. the largest anticipated fire) in the atrium. This is the minimum exhaust capacity of the fan.

d. Intake Air. Provide intake air openings that will be either present or automatically activated at the time of emergency smoke removal. These are to be located at or near the lowest floor involved to allow for air intake at the rate vented by the fan. The openings provided need to be large enough so that losses at the intake do not significantly reduce the fan exhaust capacity. Standard air handling design criteria are used in making this calculation.

e. Fan Temperature Rate. Determine the potential temperature of gases that the fan may be required to handle. To do this, identify the highest floor of the atrium where balcony combustibles or

potentially hazardous room fires are to be found. Determine the distance from the elevation of this floor to the center line of the fan (or fan ports if the fan is in a dock or similar arrangement). Determine the intersection of the new Z_{clear} value with the appropriate ventilation rate curve (solid line) for the maximum rate of convected energy at that higher level. Estimate the temperature rise by interpolating between the (dashed) constant temperature rise curves on Figure, B-1. Provide all elements of the exhaust system that are to be above the applicable smoke level with the capacity to effectively operate at the indicated increase of temperature.

f. Operation of Exhaust System. Design the emergency exhaust system for direct manual operation and to initiate automatically under detection of smoke, operation of a manual fire alarm system, or operation of sprinkler protection for any of the spaces exposing the atrium. The capability to manually start the automatic exhaust system should be provided both at the main desk or control location, and at another remote location.

B3 Technical Basis for Figure B-1

B3.1 Background

$\dot{Q}$ is the rate of energy released by the fire in the lobby or atrium space portrayed in Figure B-1. If the fire is in the space itself (the upper sketch in the Figure), then $\dot{Q}$ is the total rate of energy released by the fire. If the fire is in an adjacent space (the lower sketch), then $\dot{Q}$ is the flow of enthalpy actually entering the lobby or atrium from the adjacent space.

Of the total energy release rate, $\dot{Q}$, a fraction λ_r is assumed to be radiated away to the bounding surfaces of the lobby or atrium space. The rest of $\dot{Q}$, i.e., $(1-\lambda_r)\dot{Q} \equiv \dot{Q}_c$, is convected upward in the fire-generated plume depicted in the Figure. For fires in the lobby or atrium, λ_r is typically of the order of 0.35, while for fires in adjacent spaces, λ_r can be taken as zero provided most flaming combustion is taking place within the adjacent space and not in the lobby or atrium space itself.

The fraction of $\dot{Q}$ which is transferred to the bounding surfaces of the space by combined radiation and convection is designated by λ. Limited information is available for values of λ, but for the types of lobby or atrium configurations of interest, λ would typically range from 0.75 for the λ_r=0.35 radiating fire of the upper sketch of the Figure to 0.6 for the λ_r=0, adjacent room, threat of the lower sketch (when significant flaming out of the doorway and into the atrium or lobby space has not yet been initiated). The basis for these latter estimates are in References 1 and 2.

The phenomena portrayed in the Figure are assumed to have reached a quasi-steady state in that $\dot{Q}_c$, the interface elevation of the upper smoke layer, Z_{clear}, and the basic heat transfer characteristics to enclosure surfaces are all relatively constant. At the Z_{clear} elevation, the mass flux of the fire products of combustion in the fire plume is assumed to be small compared to the mass flux of entrained air. The upper smoke layer is assumed to be well-mixed, and of uniform average temperature, $\bar{T}$. $\bar{T}$ is, therefore, the temperature of gases exhausted by the fan, provided that the exhaust outlet is not directly above the fire. In the latter case the temperature of the exhaust gases would be somewhat greater than $\bar{T}$.

B3.2 The Equations

Conservation of mass requires

$$\dot{m}_{plume}(Z_{clear}) = \dot{m}_{FAN} = \dot{m} \qquad (1)$$

where the $\dot{m}$'s are mass flows.

Conservation of energy requires

$$(1-\lambda_c)\dot{Q} = \dot{m}_{FAN} C_p \Delta\bar{T} \qquad (2)$$

where C_p is the specific heat of air at constant pressure, T_{amb} is the ambient temperature of lobby or atrium and

$$\Delta\bar{T} \equiv \bar{T}-T_{amb} \tag{3}$$

Making us of Eq.(1) and the relation $\dot{Q}_c = (1-\lambda_r)\dot{Q}$, $\Delta\bar{T}$ can be written as

$$\Delta\bar{T} = (\frac{1-\lambda}{1-\lambda_r})\dot{Q}_c/[C_p\dot{m}_{plume}(Z_{clear})] \tag{4}$$

Assuming T_{amb} to be 530°R, Reference 3 provides the following result for $\dot{m}_{plume}(Z_{clear})$

$$\dot{m}_{plume}(Z_{clear}) = 0.022\dot{Q}_c^{1/3}Z^{5/3}[1+0.19\dot{Q}_c^{2/3}Z_{clear}^{-5/3}] \tag{5}$$

provided

$$Z_{clear} > 0.39\dot{Q}_c^{2/5} \tag{6}$$

where $\dot{m}$ is in lb_m/s, $\dot{Q}_c$ is in BTU/s and Z_{clear} is in ft. The proviso of Eq.(6) is essentially equivalent to the restriction that, for Eq.(5) to be valid, all flaming combustion is below the smoke interface. Plots provided in Figure B-1 are all consistent with this restriction.

Using Eq.(5) for $\dot{m}_{plume}(Z_{clear})$, and taking C_p to be $0.24BTU/(lb_m\,°F)$ leads to

$$\Delta\bar{T} = 1000(1 + 5.3\dot{Q}_c^{-2/3}Z_{clear}^{5/3})^{-1}(1-\lambda)/(1-\lambda_r) \tag{7}$$

provided Eq.(6) is satisfied. $\Delta\bar{T}$ in the above is in °R.

The volume flow rate exhausted by the fan, V_{FAN}, can be obtained from

$$\dot{V}_{FAN} = \frac{\dot{m}_{FAN}}{\bar{\rho}} \tag{8}$$

where $\bar{\rho}$ is the average upper layer gas density corresponding to the smoke temperature, $\bar{T}$. Assuming that the absolute pressure throughout all spaces is essentially constant, and using the perfect gas law, leads to

$$\bar{\rho}\,\bar{T} = \rho_{amb} T_{amb} \tag{9}$$

where ρ_{amb} is the density of the ambient air, and where $\bar{T}$ and T_{amb} are absolute temperatures. Using Eq.(9) in Eq.(8) results in

$$\dot{V}_{FAN} = \frac{\dot{m}_{FAN}}{\rho_{amb}}\left(\frac{\Delta\bar{T}}{T_{amb}} + 1\right) \tag{10}$$

and using Eqs.(1), (4), (5), and (10) finally leads to

$$\dot{V}_{FAN} = [0.057 + 0.10(1-\lambda)/(1-\lambda_r)]\,\dot{Q}_c + 0.30\dot{Q}_c^{1/3}Z^{5/3} \tag{11}$$

where $\dot{V}_{FAN}$ is in ft^3/s, and provided Eq.(6) is satisfied.

"Standard volume" exhaust rate of the fan, $\dot{V}_{FAN}^{(SV)}$, is also of interest. This is the volume flow of the exhausted smoke gases at $\bar{T}$ after they have been cooled to the outside ambient temperature (also assumed here to be $T_{amb} = 530°R$).

Thus

$$\dot{V}_{FAN}^{(SV)} = \frac{\dot{m}_{FAN}}{\rho_{amb}} = \frac{\dot{m}_{FAN}}{\bar{\rho}} \frac{\bar{\rho}}{\rho_{amb}} = \dot{V}_{FAN} \frac{1}{(\frac{\Delta\bar{T}}{T_{amb}} + 1)} \tag{12}$$

or

$$\dot{V}_{FAN}^{(SV)} = \dot{V}_{FAN} \frac{1}{(\frac{\Delta\bar{T}}{530} + 1)} \tag{13}$$

where $\dot{V}_{FAN}$ is found in Eq.(10) and $\Delta\bar{T}$ is found in Eq.(7).

Generating the Plots of Figure B-1

The plots of the Figure B-1 were obtained with the use of Eqs.(7) and (11).

For all calculations the value of $(1-\lambda)/(1-\lambda_r)$ was fixed at 0.4. Note that this is exactly the value of this parameter for $\lambda = 0.6$, $\lambda_r = 0$ fire scenarios and within a few percent of $\lambda = 0.75$ $\lambda_r = 0.35$ scenarios, both of which were discussed above.

It is noted that the plots for $\dot{V}_{FAN}$ are in $10^3 ft^3/min$ while Eq.(11) is for $\dot{V}_{FAN}$ in ft^3/s. Note that $\dot{V}_{FAN}^{(SV)}$ can be estimated from the plots of Figure B-1 with the use of Eq.(13).

B4 References

1. Cooper, L.Y., A Mathematical Model for Estimating Available Safe Egress Time in Fires, Fire and Materials, Vol. 6, p. 135, 1982.

2. Zukoski, E.E., and Kubota, T., An Experimental Investigation of the Heat Transfer from a Buoyant Gas Plume to a Horizontal Ceiling--Part 2. Effects of Ceiling Layer, Cal. Inst. Tech., U.S. Nat. Bur. Stand. NBS-GCR-77-98, 1975.

3. Guide for Smoke and Heat Venting (Appendix A), NFPA 204M National Fire Protection Assoc., 1982.

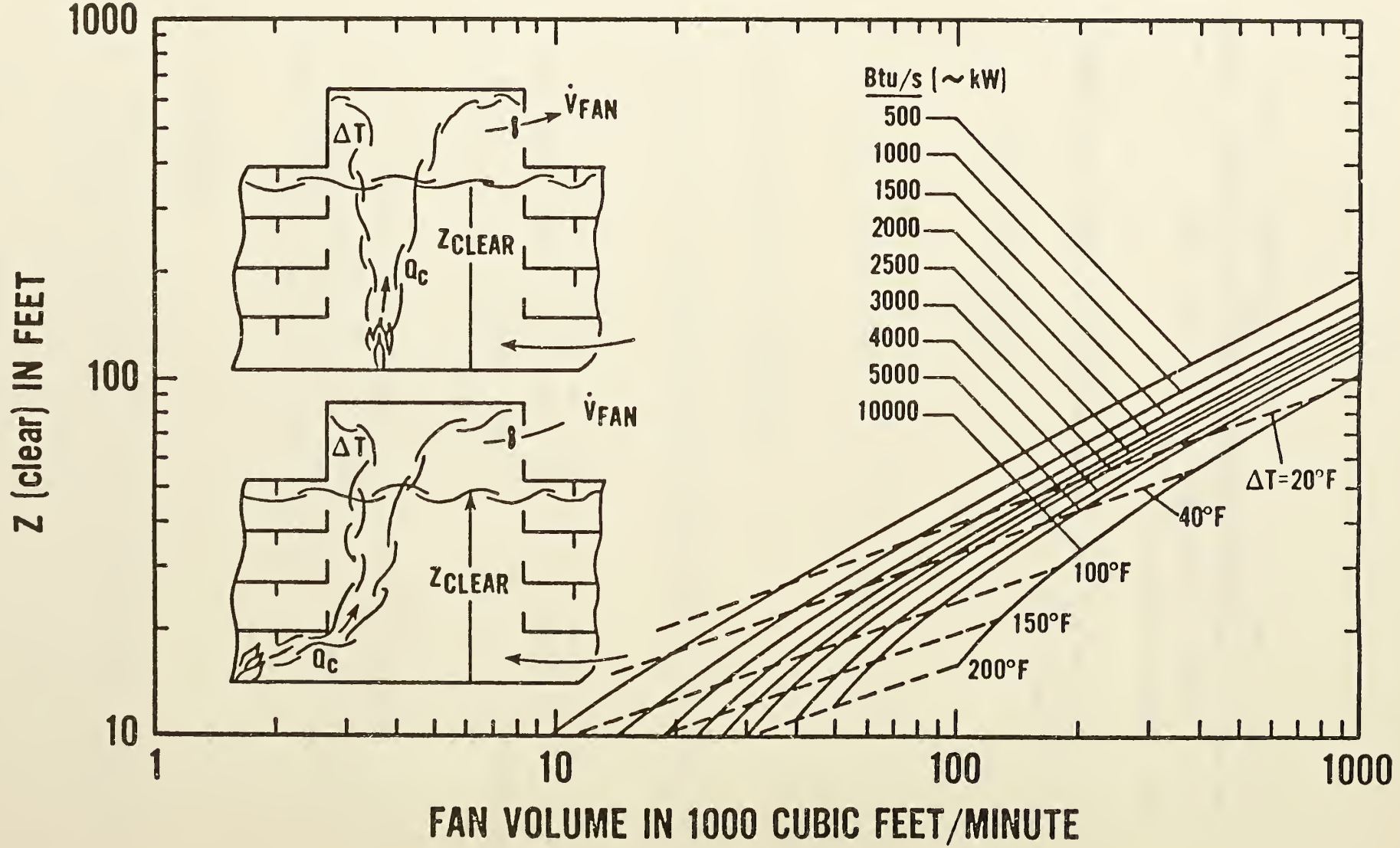
1000
100
10
1
10
100
1000
Z (clear) IN FEET
FAN VOLUME IN 1000 CUBIC FEET/MINUTE
Btu/s (~kW)
500
1000
1500
2000
2500
3000
4000
5000
10000
ΔT=20°F
40°F
100°F
150°F
200°F
ΔT
V̇FAN
ZCLEAR
QC

Figure B-1

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 embassassment 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

*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).

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.

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 or (-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 2 and 3, of the main body of this report, 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 sytem. 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 D

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Appendix E

National Park Service
Buildings Surveyed by Melott

Yosemite National Park
- Ahwahnee Hotel
- Ahwahnee Bungalows
- Yosemite Lodge
  - Cedar
  - Maple
  - Elderberry
  - Pine
  - Tamarack
  - Oak
- Curry Village
  - Stoneman Lodge
  - 819 House
  - Tent Cabins
- Cabins Nos. 1, 24, 36C, 187
- Wawona
  - Wawona Annex
  - Clark Cottage
  - Washburn Cottage
  - Moore's Cottage
  - Wawona Hotel
- Employee Housing
  - H Dorm
  - J Dorm
  - K Dorm
  - Ozone Dorms
  - Two unnamed employee dorms
  - Cabin Dorms
  - E Dorm
  - A Dorm
  - Lost Arrow Dorm
  - Ahwahnee Dorm

Crater Lake National Park
- Crater Lake Lodge
- Crater Lake Cabins
- Ponderosa Cabins
- Sleeping Cabins
- Crater Lake Dormitory

Mt. Rainier National Park
- Paradise Inn
- Ohanapecosh Employee quarters
- Guide Service Building (Employee quarters upstairs)
- Visitors Center (Employee quarters in basement)
- Longmire Employee Housing modular units
- YCC Dorm
- Building 110
- Building 135
- Girls Dorm
- Longmire National Park Inn

Sunrise Lodge
North Block House
South Block House
Ski Dorm

Glacier National Park
Village Inn
Lake McDonald Lodge
Cobb Cottage
Snyder Dorm
Boys Dorms 1 and 2
Johnson Dorm
Garden Court
Lake McDonald Cabins Nos. 7, 8, 9, 12, 13
Lake McDonald Motels (ten unit, twenty unit)
Many Glacier Hotel
Lower (No Place) Dorm
McKinley Dorm
Swiftcurrent (two types of motel units)
Swiftcurrent Cabins

Yellowstone National Park
Windflower Dorm
Snow Lodge
Snow Lodge Cabins
Obsidian Dorm
Hamilton Dorm
Old Faithful Inn
Hamilton General Store Dorms
Columbine Dorm
Old Faithful Lodge
Old Faithful Lodge Cabins
Mammoth Hot Springs Hotel
Hamilton Stores Dorms at Mammoth
Laundry Dorm
Juniper Dorm
Aspen Dorm
Spruce Dorm
Hamilton Photo Shop
Lake Hotel
Sandpiper Dorm
Lake Cabins
Larkspur Dorm

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Department of Interior
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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)

A fire safety evaluation system for overnight accommodations has been developed and is ready for use in evaluating the fire safety of National Park Service residential accommodations. The system can be used to determine combinations of widely accepted fire safety equipment and building construction features that provide a level of safety equivalent to that required by the widely accepted Life Safety Code of the National Fire Protection Association. The system will provide flexibility in meeting fire safety requirements for both the renovations of existing facilities and the design of new facilities.

An approach for controlling smoke from fires in atrium-like arrangements is presented and documented in an appendix. It can be used to determine smoke (exhaust) fan capacity and placement. It is based on the physics of the buoyant hot gas plume produced by the fire.

12. KEY WORDS (Six to twelve entries; alphabetical order; capitalize only proper names; and separate key words by semicolons)

atriums; building construction; fire safety; fire safety evaluation system; hotels; NFPA 101; residential buildings; smoke

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