Healthcare Evaluation System for Australia

(HESA)

In Cooperation with Ove Arup & Partners
And Worcester Polytechnic Institute

IQP ID: 00-JRB9902 FPE

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Dear Mr. Johnson,

Enclosed is our report entitled "Healthcare Evaluation System for Australia – HESA". It was written at Worcester Polytechnic Institute's Melbourne Project Center for IQPs during the period of March 10 through April 28, 1999. Preliminary work was completed in Worcester, Massachusetts, prior to our arrival in Melbourne, Australia. Copies of this report are being submitted to Professors Ward and Barnett for their evaluation. Upon review, the original of this report will be catalogued in the Gordon Library at Worcester Polytechnic Institute. We hope this report will be helpful in your work, and we appreciate the time that you have devoted to this project.

Sincerely,

Jared F. Beres David R. Llibre Ian E. MacGregor

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HESA – Healthcare Evaluation System of Australia

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This project report is submitted in partial fulfillment of the degree requirements of Worcester Polytechnic Institute. The views and opinions expressed herein are those of the authors and do not necessarily reflect the positions of Ove Arup & Partners or Worcester Polytechnic Institute (WPI). The reader should not construe the report as a working document. Worcester Polytechnic Institute and Ove Arup & Partners take no responsibilities for any damages or loss of life that results from the use of this report.

Abstract:

This project was commissioned by Ove Arup & Partners. The main goal was to develop an evaluation system similar to NFPA 101A for Australian healthcare facilities. This goal was accomplished by adapting NFPA 101A to the Australian situation, adding new parameters, using meetings to solidify values, testing values, creating a computer tool, and writing training documents. Arup will continue to develop and trial the evaluation through its work with healthcare facilities both local to Melbourne and nationally, throughout Australia.

Authorship Page:

The authorship page does not accurately reflect the amount of work and effort contributed by each member of the team. The project required that a lot of work be done besides the writing of the report. The project team feels that each member of the team was a valuable addition and pulled his weight.

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Finally, we would like to thank our two advisors, Prof. Matthew Ward and Prof. Jonathan Barnett, who spent hours reading our drafts. We're sure we gave you plenty of time to practice your editing skills.

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Executive Summary

Australia had no way to quickly survey a healthcare facility for its level of life safety in the event of a fire. An evaluation system for the healthcare facilities was needed. In the United States, the National Fire Protection Association (NFPA) has published an evaluation procedure for healthcare facilities as part of NFPA 101A. This project was the result of Ove Arup & Partners sponsoring a project that called for part of the National Fire Protection Association's standard 101A to be adapted to the Australian environment. The primary goal of the project was adapting the evaluation into a system usable in Australia. Secondly, a computer tool and two training documents were created for the use by Arup's fire engineering employees.

NFPA 101A is a process in which a facility is evaluated for the safety provided to its occupants. The process is undertaken in four different worksheets. The first one is the "Occupancy Risk Parameters" which evaluates the level of risk the occupants are at. The second worksheet is called the "Safety Risk Parameters". This worksheet is used to determine the safety elements of a facility. Through charts and equations, the result is calculated on the last two worksheets. The result is four numbers in different categories of safety.

The project was undertaken in three main steps. First, the healthcare facility section of NFPA 101A was adapted by correlating it to the Building Codes of Australia. Secondly, new parameters and values were added to the evaluation process to provide a more comprehensive evaluation. This was completed through meetings with Arup fire engineers. Thirdly, a testing of the new evaluation process was completed by comparing the results of the new evaluation with already finished NFPA 101A evaluations. The

healthcare facilities used in the testing phase were located in Victoria, Australia and reflect a variety of typical situations. Finally, a computer tool and training documents were created to make the evaluation easier to perform. During these steps the input of Arup fire engineers from the Melbourne office was invaluable and helped form the evaluation through their opinions.

The Healthcare Evaluation System for Australia (HESA) is included, along with the training documents, in this report. HESA is the evaluation system that was developed through the project. Recommendations for the use and further development of the evaluation system and the accomplishments of the project are as follows.

Recommendation 1: Consider New Risk Parameters

Although new parameters were added to the evaluation, there is still room to make the evaluation process more comprehensive. Areas such as patient medication levels, mental awareness levels, and reaction levels are prime candidates to be added into the evaluation. Part of many healthcare facilities are psychiatric wards, these areas would especially benefit from the new parameters.

Recommendation 2: Conduct Further Value Analysis

NFPA 101A had its values determined by computer programs and a panel of experienced fire engineers. The computer program allowed for a very thorough analysis of the evaluation to be done, and problems with unsafe buildings passing the evaluation were virtually eliminated. An analysis similar to the type completed on NFPA 101A has not yet been done on the new evaluation system. The changing and adding of parameters has made an analysis of the new evaluation system necessary. The type of analysis similar to the one used on NFPA 101A will assure that the new evaluation systems is accurate.

Recommendation 3: Restrict Use to Supplement Comprehensive Analysis

The new evaluation is in no way a polished document. The members of the project group were not fire protection engineers, and the opinions represented by the evaluation are those of the fire engineers from Arup's Melbourne office. The evaluation is only designed to give a rough estimate of the level of life safety of a building. The evaluation should be used in conjunction with more comprehensive and technical methods of fire engineering.

Accomplishments

The project accomplished all that was expected and more. Primarily an evaluation system was created that can be used for determining the life safety of a building in Australia. This project provided Australia with an evaluation system that can be used to quickly and easily determine which buildings pose a great risk to safety of the occupants. The addition of four priority levels to the evaluation system results in a better understanding of risk associated with a particular facility or zone.

The new evaluation system is a more comprehensive evaluation than NFPA 101A. The addition of parameters allows the evaluation system to accurately reflect the status of the building. A more comprehensive will better identify the buildings which do not meet standards for life safety. This better level of identification has been shown true for facilities that are referenced in the report.

A computer tool, and training documents have been created to provide the users with the tools necessary to use the evaluation quickly and effectively. The computer tool will reduce the amount of time that it takes to complete and display the results of the evaluation system. The training documents will assist the users of the evaluation system from becoming confused about the process.

Final Comments

The project group believes that with further development the new evaluation can be of use to Ove Arup & Partners and to Australia. However, until the further development has been completed, the project group strongly recommends caution be used in applying the evaluation, and use it only after reading the training documents included. The use of this evaluation should also be restricted to Arup staff until such a decision is made by Arup to allow the new evaluation system to be made public.

1.0 Introduction

In the United States, every 15 seconds firemen respond to a fire related call. In our modern society we have developed fire codes, standards and regulations that help protect the populace against the effects of fire. These codes are designed to provide a minimum acceptable level of safety for the occupants of buildings and structures. A non-profit organization called the National Fire Protection Association (NFPA) is one of the developers of such codes, standards and regulations. The codes and standards that this project addresses are NFPA standards 101, 101A and the Building Code of Australia.

The NFPA standard number 101 is also known as the Life Safety Code. This standard focuses on life safety in buildings. It divides buildings into functional categories and then provides a reference as to how a building must be constructed. It provides standards for many types of buildings. Each of these types has a different set of rules with which it must comply (LSC, 1997). NFPA 101 treats healthcare facilities very differently from other buildings. Healthcare facilities have a large number of people who are immobile due to an injury or the treatment they are currently undergoing. The immobility of patients forces special considerations. As a result, standards for healthcare facilities deal less with the means of exit than with the means of containing and extinguishing the fire (LSC, 1997).

NFPA 101A, known as the Alternative to Life Safety Code, presents a process for an evaluation of buildings to determine if a building meets the criteria outlined in the NFPA 101. It was developed to provide a quick way of finding out if a building is designed properly in accordance with NFPA 101. By equations, numbers, and charts of the building's level of fire safety can be analyzed. Because NFPA 101A uses numerical methods, the engineer responsible for the work on the building can easily find the parts of the building which are deficient. This method can be a time saving device because of the way it can easily pinpoint breaches in the code (ALSC, 1998).

Arup, the project sponsor, has proposed that the project group create an evaluation system similar to the NFPA 101A which can be used for building design in Australia. There is a need for it since an equivalent evaluation does not yet exist for Australia. If the project can be successfully completed, it will allow Arup and others to do more efficient fire safety engineering design for healthcare facilities. Ideally, such an evaluation process should be simple enough that technicians, instead of professional engineers, could complete the worksheet. This would allow a more efficient use of company resources, as well as provide a mechanism for quickly finding specific deficiencies in a building.

After the evaluation of a building is completed, an engineer should be able to measure the equivalency of the building to the Building Code of Australia (BCA). Upon seeing this result, the engineer should be able to create a feasible solution to the problem with the use of minimal resources. This will streamline the construction and renovations of buildings.

The first part of this report details the most pertinent background information on the topic. Included in the background information are topics such as: NFPA 101, NFPA 101A, the Building Code of Australia (BCA), the Capital Development Guidelines by the DHS, risk assessment, other evaluation techniques, and some information gathered through interviewing experts in the field. Next, the methodology shows the process by which this project was completed. This involves researching pertinent material, interviewing appropriate people, referencing evaluations created for other countries, holding meetings, developing the new evaluation, developing training documents and evaluating the results of the new evaluation. The data and analysis section, chapter 4, follows the methodology and focuses on the results from the various stages of the project. An in depth look at the data collected and discussions of the reasons certain decisions were made is presented. Finally, recommendations and conclusions of the project are discussed in detail in chapter 5. The new evaluation, which has been developed during this project, was named Healthcare Evaluation System for Australia (HESA) and is included as Appendix D along with the training documents.

This project is being undertaken for partial completion of the graduation requirements for Worcester Polytechnic Institute. This report is the Interactive Qualifying Project. This project is intended to allow the project group to apply studies in technology to a social setting in a different society.

2.0 Background Information

The purpose of the background information chapter is to provide information to develop a better understanding of the concepts relating to the project. This section will describe the basic codes and standards, evaluations systems and opinions on how to create an evaluation system.

The main codes and standards that the project focused on are those written by the National Fire Protection Association (NFPA) and the Australian Building Codes Board (ABCB). The National Fire Protection Association (NFPA) is a nonprofit organization that is in charge of developing codes, standards, and evaluation techniques; it also researches areas related to fire protection and prevention. The Building Codes of Australia (BCA) is a government set of codes that are required for the design all buildings in Australia.

These sources contain most of the information needed to understand the concepts for evaluating healthcare facilities. Interviews were also conducted to determine the purpose behind the creation of the evaluation. The interviews offered ideas on the initial steps of analyzing the quality of the existing evaluations.

2.1 Delphi Process

It is important to know the manner in which NFPA 101A was developed in order to have better understanding of the concepts involved in the creation of an evaluation. The fire safety evaluation, NFPA 101A was established and revised by a system called the Delphi Process (Nelson, April 99).

The Delphi Process is a method that involves large numbers of people to generate policies and find answers to topics. The larger a group the process involves, the more complete the answer or policy will be. However, problems with the collection and processing of the data increase as the group size increases. Issues such as transportation, communication, background, and strong opinions are amplified. The Delphi Process addresses these problems by keep opinions anonymous and making travel optional. The concepts of the process are simple, but have to be implemented carefully to insure that the method is done correctly.

At the basis of the process is a control group. This group is responsible for creating questions, compiling responses, and creating a sample group, and insuring the sample groups continue participation in the project. They look for people who are experts in the field, or deal daily with the subject and areas related to it. The control group then writes a survey, or a type of document that allows these experts to respond. The control group receives these responses. The responses are compiled and analyzed. More documentation is created with the previous responses taken into consideration. This new documentation is sent out and the responses are compiled and analyzed. The process continues until the control group feels that they have completed the study or that a general consensus is achieved within the sample group. (Linstone, 1975)

The process can be greatly enhanced with the aid of computers. The response times and the automatic processing of information can greatly increase the speed of the study that is being conducted. The process also becomes more impersonal which can reduce the conflict inherently imbedded in highly controversial subjects. The strength of the process is its ability to involve a large study group, a reduction of emotional answers, and the flow of a great amount of information. (Linstone, 1975)

2.1.2 NFPA'S use of the Delphi

There are now hundreds of fire standards published by the NFPA. The standards are referenced all over the world. They are recognized because of the credibility that the method of their creation provides. Committees and modified Delphi processes are used in the development of their codes and standards. Because of this, many prominent names and leaders in the fire industry are involved in this work.

Technical committees provide an initial report of a code or standard for purpose of being reviewed by the NFPA and other interested parties including fire protection engineers. The technical committee will also publish a report to get feedback and more information. Anyone is allowed to submit information, corrections, or additions in relation to the report, but must do so within 24 months. The submitted information and proposals are brought forth in the Report of Proposals (ROP). This report must be approved by two thirds of the NFPA committee or it goes back to technical committee. The ROP is then published again for comments and proposals. After the technical committee revises the ROP and gets a two-thirds vote, it submits the Report of Comments (ROC). The ROC is a published report of the opinions and comments made by outside sources on the standards. These two reports are discussed and then voted on by the members of NFPA. Then complaints are then again submitted (Grant: pg. 2).

After the NFPA recognizes the new standard, code, or revision, local governments often use the document for reference and inclusion in local standards and ordinances.

2.2 NFPA 101 – Life Safety Code

The purpose of the Life Safety Code (LSC) is to provide minimum requirements for an occupant's safety in case of a fire. It addresses necessary features like construction type, means of egress and occupancy risk to insure overall safety. This code is the basic reference for many types of facilities and concerns almost every aspect of a building.

As previously stated, the objective of this code is to provide occupants a certain level of safety that is appropriate for a particular type of building. This level of safety should be accomplished by taking the following criteria into consideration:

- Prevention of ignition of fire.
- Detection of fire.
- Control of fire development.
- Confinement of the effects of fire.
- Extinguishing of fire.
- Provision of refuge and/or evacuation facilities.
- Staff reaction.
- Provision of fire safety information to occupants (LSC, 1997)

This code may be applied to both new and existing buildings. Some physical limitations in existing buildings require tremendous effort and expense with little affect on life safety. According to NFPA 101, during a renovation, the level of life safety in existing buildings should not be less than what is required for the original design of the building. All changes and alterations have to be made without compromising the Life Safety Code.

2.2.1 Requirements of NFPA 101 for all Buildings

According to NFPA 101 any building that follows their guidelines has to comply with the following requirements:

- Every building must have exits and other safety requirements, such as sprinkler systems and smoke barriers, provided in case of fire or other emergencies. Sometimes, it may not be practical to exit the building. In this case, buildings must be equipped with a refuge area that provides occupants with safety from the smoke and fire.
- Every building must be constructed, equipped and maintained to ensure life safety to occupants at all times.
- Buildings must also have exits and other safety measurements in proportion to the number of people in the facility.
- Exits in buildings must be located and maintained with paths free for egress from all parts of building while it is occupied. Exits cannot have any lock or fastening device that would prevent egress from the building. They should also be accessible for disabled for occupants. In the case that the occupants must be restrained, the doors must have an automatic unlocking system, or the staff must be able to effect the release.
- Exits must be clearly marked and visible for occupants. Occupants must be able to recognize the exits and use them in case of an emergency. Doorways or pathways that can be confused with exits must be clearly marked to avoid confusion.
- The lighting design must include exit signs where applicable.

- Buildings of certain size that cannot warn occupants visually of fire must be equipped with audible fire alarms to warn occupants of fire.
- Buildings should have at least two means of egress, in case one of them is not accessible due to the fire.
- Vertical exits and openings must be protected with a certain level of safety to prevent the spread of flames and smoke to other parts of the building.
- This code will not necessarily provide a building suitable for handicapped people; other methods have to be taken into account. (LSC, 1997)

2.2.2 Mean of Egress Requirements

Means of egress are defined for all buildings in chapter 5 of the LSC. Engineers use chapter 5 of the LSC as a base and supplement the chapter with standards that pertain to the type of building being designed. For example, a fire engineer would make the building comply with everything in chapter 5 and compliment it with chapter 12 if he/she is working on a new healthcare facility. Following are the basic requirements of egress as defined by chapter 5 of NFPA 101.

- All aisles, exits corridors and passageways must meet requirements specified by Chapter 5 in the Life Safety Code.
- In planning exits, an allowance must be made for occupants to be transferred to another section or floor that is separated by a smoke or fire barrier. In case the occupants are bound to their beds, they need to be transferred in their beds.

- Locks cannot be put on patients' sleeping rooms. In the case that patients need to be locked up for security reasons, staff must always carry keys. The locks on the doors may also be equipped with automatic releasing devices.
- Doors that are not a means of egress can be locked
- Doors that can be locked can only have one lock and staff must be able to open them in case they are needed in an emergency.
- Doors in exit passageways, stairs, horizontal exits, smoke and fire barriers must be closed to block the travel of smoke and gases. Doors that act as a means of egress (like horizontal exits and smoke barriers) can be held open by hold open devices provided they release upon the activation of a fire alarm.
- Automatic devices used to close stairway doors must close all stairway doors upon an alarm. (LSC, 1997)

2.2.2.1 Horizontal Exits Must Meet the Following Requirements

Part of every egress system includes horizontal exits. This section details the requirements of horizontal exits. Horizontal motion is a key point in life safety in healthcare facilities and needs to be address when designed. This is because there are many patients with limited mobility and it is difficult to egress by way of stairs.

- The area on each side of horizontal exits associated with patient rooms, treatment rooms, lounge, or corridors must be 2.79 m^2(30 net sq. ft) per occupant of a hospital or nursing home, or 1.39 m^2 per occupant of limited care facility.
- For horizontal exits, it is allowable to have a single door that will serve as a one way exit only. It can be either a swinging or a horizontal sliding door. If a sliding door, it

should be an automatic one. If not automatic then it should be one leaf only and should have a mechanism that will keep door to open. The minimum width for doors is 1.12 m.

- A horizontal exit with a corridor of 2.23 m or more must be equipped with two swinging doors opposite to each other. These doors must also meet requirements set above.
- In case that horizontal exit has a corridor of 1.83 m or more it should also have an exit with a pair of swinging doors. These doors must have a width of at least 86 cm.
- Capacity of all other exits must not be less than 1/3 the amount required for building.
- The width of a means of egress must be proportional to the occupancy load.
- Means of egress equipped with stairs should provide a space of .76 cm per person. For those means of egress without stairs, equipped with doors, ramps or horizontal exits provide a space of .508 cm per person.
- All ramps, aisles and corridors that comply with a mean of egress have to be at least 2.44 m in width. Those that are located in areas that are used by the inpatients like treatment rooms and administrative offices should have a minimum width of 1.12 m. Those that are located in a limited care facility or a psychiatric care hospital must have a width of at least 183-cm.
- Each floor or section must be equipped with at least one of the following exits:
    - ♦ A door that leads directly out of building.
    - ♦ A flight of stairs.
    - ♦ A smoke proof enclosure.
    - ♦ A ramp.

- An exit passageway.

- Any rooms of more than 92.90 m^2 in area that has patient sleeping in them must be equipped with at least two exit access doors separately located from each other. Any room or any suite of rooms of more than 232.26 m^2 must also have at least two accessible exit doors.
- Suite of sleeping patient rooms cannot be greater than 464.51 m^2. Other suite rooms cannot be greater than 929.03 m^2.
- Means of egress has to be illuminated according to Chapter 5 section 8 of the Life Safety Code.
- Allowable travel distance:
    - Cannot exceed 45.72 m between any room door and an exit.
    - Cannot exceed 60.96 m between any point in a room and an exit.
    - Cannot exceed 15.24 m between any point in a sleeping room and an exit access door.
    - Cannot exceed 30.48 m between any point in a suite of sleeping rooms and an exit access door. (LSC, 1997)

2.3 Specific Requirements for Healthcare Facilities

Healthcare occupancies are institutes used for medical purposes, occupied by four or more individuals with either physical or mental illness. The following fit under the Healthcare definition: 24-hour facilities: hospitals, nursing homes, and limited care facilities. The only non 24-hour facility under the healthcare definition is ambulatory centers (ALSC, 1998).

Chapter 12 and 13 in the LSC are specific to either new or existing healthcare facilities. These are the basic concepts in those chapters:

- All new and existing healthcare facilities should adapt themselves to the chapters (12& 13) of the Life Safety Code.
- Healthcare facilities that have a security section where doors have to be locked can't conform to LSC because it says that all doors must remain unlocked. This requires special modifications. These modifications include the automatic release of locks upon activation of a fire alarm, or instructing the staff to release the restraining devices.
- All buildings that are attached to healthcare facilities must conform to the standards for healthcare facilities.
- All facilities that do not provide 24-hour occupancy are not categorized as healthcare facilities. They should adapt themselves to the requirements that they are classified under. The exception is in the case of ambulatory healthcare centers.
- The Life Safety Code takes into account that certain requirements are needed for occupants including a staff to help the immobile patients. However, it is not the purpose of the code to specify the ratio of staff needed for this activity.
- All new healthcare facilities must be equipped with a certified automatic sprinkler system. Existing health care facilities however are not required to follow this regulation.
- Doctor's offices, treatment areas, and diagnostic facilities that are separated from a healthcare facility are considered business occupancies and have to adapt themselves to requirements established by chapter 26 and 27 of the Life Safety Code.

- The number of occupants that the means of egress is designed for should not be exceeded. However, it can't be less than one person for each 120 sq. ft (11.1 sq. m) in a gross floor area designated for sleeping. It can't be less than 240 sq. ft (22.3 sq. m) for gross floor area in inpatient healthcare treatment partitions. Gross floor area can be measured by the size of a floor plus its exterior walls. (LSC: pg. 413-424)

2.4 Alternative to Life Safety (NFPA 101A)

The NFPA has published a guide called Alternative Approaches to Life Safety (ALSC, 1998) The Alternative to Life Safety does two things. Primarily, it is a tool to evaluate the life safety provided by facilities. Secondly it adds to the basic concepts of the 101. NFPA standard 101A consists of evaluations for five different classifications of buildings. The large risk and number of occupants of these types of facilities necessitates the need for this evaluation. (ALSC, 1998)

The evaluation system is both a quantitative and qualitative one. Numbers are put into the evaluation to ultimately give a result of "yes the facility is safe" or "no it is not safe". Some members of the NFPA in a Delphi process chose certain parameters to evaluate facilities based on what they felt were the most important. Some people feel that the evaluation could have been more comprehensive. (Paul Sullivan)

The second part of NFPA 101A, an addition to the concepts of the life safety, is only a compliment of the LSC. These are mostly calculations of egress. For example the NFPA101A provides the width of corridors and average flow or evacuators.

2.4.1 Parameters

The aspects of the facilities addressed and evaluated by the 101A are referred to as parameters. The way these parameters are evaluated is discussed in NFPA 101A. Each value is determined by the analysis of the control group of the Delphi Process and is weight on their importance to fire safety. A technical committee of the NFPA determines the thirteen parameters that the evaluation uses.

The evaluation is completed by finishing a point scoring system for specific fire zones. Fire zones are areas in a facility that are separated by floors, firewalls, or smoke barriers. Figuring out the specific zone is an extremely important role in the evaluation. The evaluation's validity can be sacrificed if the zones are determined incorrectly. Zones should be evaluated by the following parameters: patient mobility, density, attendant ratio, different types of construction, finish, protection system special medical equipment, areas not involving housing or customary access. There is a certain exception to whether a zone is put into the evaluation, if it is separated by a 2-hour fire resistant construction (ALSC, 1998).

The parameters are explained in detail in the 101A, outlined in Appendix B. Table 2.1 shows a list of criteria for the evaluation.

Evaluation Parameters	
Patient Mobility	Dimensions
Patient Density and Patient Factor	Openings
Zone Location	Hazardous Areas
Floor Factor	Smoke Control
Ratio of Patients to Attendants	Smoke Barriers
Patient-Attendant Factor	Emergency Routes
Patient Average Age	Horizontal Exits
Safety Parameters	Direct Exists
Construction	Manual Fire Alarm
Interior Finish	Smoke Alarm
Corridor Partition	Sprinklers
Doors	

Table 2.1 Parameters Evaluated in the NFPA 101A (ALSC, 1998)

2.4.2 Evaluation Worksheets

The evaluation of healthcare facilities consists of five worksheets, which are broken into ten steps.

The first step is to figure out Risk Factor values. This consists of five parameters: patient mobility, patient density, zone location, ratio of patients to attendants, and average patient age. Patient mobility is calculated and represented by the letter M. The different levels of mobility have a different numerical values associated with them. The other factors that are evaluated in the same way are patient density (D), zone location (L), ratio of patients to attendants (T), and patient age (A). These are then put into the equation: occupation risk (F)= M*D*L*T*F. The layout can be seen in the table 2.2.

Patient Mobility (M)	Mobility Status	Limited Mobility	Not Mobile	Not Movable
	Risk Factor	1.0	1.6	4.5

Patient Density (D)	# of Patients	1-5	6-10	11-30	>30
	Risk Factor	1.0	1.2	1.5	2.0

Zone location (L)	Floor	1^{st}	2^{nd} or 3^{rd}	4^{th} to 6^{th}	> 6^{th}	Basement
	Risk Factor	1.1	1.2	1.4	1.6	1.6

Ration of Patients to Attendants (T)	Patients/ Attendants	(1-2)/1	(3-5)/1	6-10/1	>10/1	None
	Risk Factor	1.0	1.1	1.2	1.5	4.0

Patient Average Age (A)	Age	>65>1	<65 , >1
	Risk Factor	1.0	1.2

Table 2.2 Occupancy Risk Parameter Factors

Next, the safety parameter values are determined. The scores determined for each one of the 13 parameters are put into the appropriate qualification in the Individual Safety Evaluation and summed. The qualifications are confinement safety, extinguishment safety, people movement safety, and general safety. Each summation also has a mandatory minimum value. The values of the mandatory safety requirements are subtracted from the individual safety evaluations. If the resulting values are greater then zero, the safety standards have been met and a yes box can be checked next to that parameter. If all are yes, the minimum requirements are met and if not then there are violations (ALSC, 1998). After completing this the Facility Fire Safety Requirements Worksheet, series of yes or no questions are asked. If the facility complies with the LSC then the evaluation is complete. (ALSC, 1998).

An evaluation is completed for every representative zone in the healthcare facility. Depending on the size or functionality of the facility, dozens of zone could be present. The process could be somewhat tedious if you have many zones, but proves to be an effective way to obtain an overall picture of the safety of a building.

2.5 Australian Codes

There are currently two building codes used in Australia today, the Building Codes of Australia (BCA) and the Department of Human Services' Fire Risk Management Strategy. Both of the codes are required by law and are written by government agencies. The following sections explain what the codes are and what they entail.

2.5.1 Building Codes of Australia

" The BCA is a uniform set of technical provisions for the design of and construction of buildings and other structures" (BCA, 1996). It is written and amended by the Australian Buildings Codes Board, which is advised by the Building Codes Committee (BCC), and the building industry. The purpose of the code is to provide an adequate set of standards that serve the public.

The Australian government requires that all buildings meet the requirements of the BCA. In some cases, alternative solutions are accepted as opposed to proscriptively following the requirements of the BCA. Architects and contractors in Australia must conform to the BCA, which says that its users must comply with the Performance Requirements. The performance requirements are referred to as "Deemed-to-Satisfy Provisions", in which the codes are followed exactly, or "Alternative Solutions" where the architect or builder provides a solution that is acceptable to the council that reviews buildings. This gives the architects options; they can use the BCA for specific requirements or reference it and make alternative provisions for safety (BCA 1996).

The BCA is broken into nine sections of design parameters and eight sections regarding the specific differences in the different areas of Australia. The different states have concessions due to their different laws and adoption of the BCA.

The nine sections are displayed in table 2.3.

A) General Provisions	F) Heath and Amenity
B) Structure	G) Ancillary Provisions
C) Fire Resistance	H) Special Use Buildings
D) Access and Egress	I) Maintenance
E) Service and Equipment	

Table 2.3 The nine sections of the BCA.

The sections that pertain to the project are those of general provision, structure, fire resistance, and access and egress. (BCA, 1996)

2.5.1.1 General Provisions

The section entitled "General Provisions", Section A, deals with the definitions used in the BCA, classifications of different buildings, materials referenced by the BCA, and the fire-resistance of building elements. . The sub-section, "Classifications", is how the BCA references different types of buildings such as car parks and laboratories. The "Reference Materials" section provides the technical document number of published work by Standards Australia, which are referenced by the BCA. Section A is used to clarify questions instead of being a proscriptive code like the rest of the BCA. The last subsection in section A is fire-resistance of building materials. This section outlines the process to get the Fire Resistance Level (FRL) of different building materials and charts the actual value. The FRL is the rating the BCA assigns to building elements and is covered extensively in chapter 4 of this report. Section A of the BCA is included in Appendix B.

2.5.1.2 Structure

This is a very small section of the BCA but is very important. The objective of this section is to protect people from structural failure (BCA, 1996). Structural failure is said to occur when a loaded supporting structure element can no longer sustain the loading forces. This section contains references to what types of loads structures must be able to sustain. The section also includes the material properties of building elements. References are made to the Standards Australia's proscriptive documents.

The material properties also referred to the in Standards Australia's requirements. Standards Australia is a private company that works on research and development to create a safer environment by providing rules, regulations, standards, and specifications.

2.5.1.3 Fire Resistance

One of the sections of the BCA discusses fire resistance. The objectives of this section are to protect people from injury in case of a fire in a building, to prevent the fire from spreading and protect other property from any physical damage (BCA, 1996).

According to the BCA there are three types of construction. There is type A, type B, and type C buildings. Type A has the most resistance to fires and C has the least.

These different types of construction are explained in the methodology as well as in appendix B.

Under the section of fire resistance there is a sub-section called Compartmentation and Separation. Compartmentation and separation is the division of floors into areas which will not allow smoke or fire to spread for a specified amount of time. The BCA assumes that a zone will be separated by a two-hour rating. A zone is an area that has been compartmentalized. The section also expands on where smoke proof doors or firewalls should go and what their specific requirements are. For the purpose of this project, only those requirements specified for class 9a buildings (healthcare facilities) are taken into consideration. These requirements are explained in greater detail in our methodology.

Protection of Openings is another sub-section of fire resistance. According to this section "openings in building elements required to be fire-resisting include doorways, windows, infill panels, and fixed or open-able glazed areas that do not have the required FRL. Also, openings between building elements such as columns, beams, and the like are deemed to be openings in an external wall." (BCA, 1996) These openings need to be protected by one of the solutions given by the BCA in this section. The methods are specified in the BCA as well as the measurement requirements for each.

The BCA continues into Fire Hazards Properties. In here, the BCA provides the ratings allowed for the flame-spread index and the smoke-development index of materials. These ratings vary for different types of buildings; they are given to identify a certain level of safety depending on the building. It also covers materials used in the ceiling of fire-isolated exits and fire retardant materials that comply with the code. Fire retardant materials are special materials that are used to delay the spread of fire or smoke in the event of a fire.

The section then covers in greater detail things that had already being touched by different sub-sections. For example, there is a section just for the requirements for fire doors, smoke doors, fire windows and shutters that had already being covered by Protection of Openings. There is also a sub-section that expands more on the different construction types.

Fire Resistance is an important section of the BCA because it addresses some factors for the delay of the spread of fire or smoke and the protection of the people in the building. As has been seen, the FRL specifies the requirements for openings, construction of building, and other methods for delaying the spread of fire and smoke.

2.5.1.4 Access and Egress

In this section, the main objective is to protect people from injury while evacuating a building, provide safety to people while accessing a building, and the services and facilities while in the building (BCA, 1996). This section is divided into three sub-sections: Provision for Escape, Construction of Exits, Access for People with Disabilities.

Provision of Escape covers all the necessary requirements that a building needs to comply with providing the means to evacuate a building. In this part the BCA specifies the number of exits required, if fire-isolated exits are needed, the distance between exits, dimension of exits and path travel, the external stairways or ramps, and horizontal exits.

(BCA, 1996) The last one is very important in this project because horizontal exits are required in class 9a buildings. This is explained in greater detail in the methodology.

Another part of Access and Egress is dealing with the construction of exits. This section determines the requirements needed by an exit to comply with the BCA. It touches topics like the materials used in fire-isolated stairways, installation of equipment in exits and path of travel, the required width of stairways, handrails, requirements of doorways and swinging doors, and signs on doors (BCA, 1996). A building needs to comply with all of these requirements in order to meet their objective, that is protection of people while evacuating building.

The last part of this section relates to access for people with disabilities. This section is important in this project because of the amount of people with disabilities that occupy healthcare facilities. In this section, the BCA sets the requirements for accessing a building and hearing augmentation among others (BCA, 1996). Hearing augmentation is very important for people who have hearing problems might not be able to listen clearly to an alarm in case of a fire. This is why the alarm has to comply with the sound requirements of this section of the BCA.

The access and egress means and procedures are significantly important for any building, especially for healthcare facilities. It is the role of the healthcare facility to provide its patients and staff with the necessary number of exits and insure they meet the requirements specified by the BCA.

2.5.2 Capital Development Guidelines

The Department of Human Service (DHS) has created a Fire Risk Management Strategy (FRMS). The objective of this strategy is to weigh the risk of fire in a building and take the necessary precautions. In order to do this, the DHS has developed the Capital Development Guidelines, which help consultants and engineers through necessary steps to complete their evaluation.

The whole purpose of FRMS is to provide a level of safety complying with the DHS regulations to all occupants including residents, patients, visitors and staff. In addition, the FRMS develops guidelines to protect assets of a building from being affected by fire. The FRMS tries to keep the services available to the community and minimize business interruptions. In order for FRMS fulfill its purpose, a fire audit together with both a qualitative risk assessment and a quantitative one needs to be done by an engineer or a consultant.

According to the Capital Development Guidelines, "the purpose of a fire audit is to characterize the building, contents, fire safety provisions, people and the environment to the degree necessary, to undertake a fire risk assessment or to satisfy other supplementary tasks such as compliance audits and the like." (CDG, 1997) This audit should be accompanied by a formal report that explains all the details about the audit that was completed.

When an existing building has been audited the consultant doing the audit should have copies of all previous fire audits that have been completed. They should also be supplied with all architectural and building service drawings. In the case that the facility being audited is new, the consultants doing the audit must base themselves on drawings rather than from previous fire audits.

A fire audit must address all of the following parameters, this does not mean that more parameters cannot be added to it if they increase the level of safety.

- General architectural/structural/services design and site layout
- Fire protection equipment
- Occupant characteristics
- Fire brigade intervention
- Enclosure audit
- Fire prevention methods
- Fire safety management
- Emergency exit signs and emergency lightning
- External hazards identification
- Other

(CDG, 1997)

These parameters are divided into sub-parameters. For a complete list of all the parameters needed to complete a fire audit, please refer to appendix B of this report.

After the audit has been completed a qualitative risk assessment has to be done. The Capital Development Guidelines state that a qualitative risk assessment must meet two objectives. First, consultants have to identify all fire hazards and suggest recommendations on how to address the fire hazards. Second, consultants have to propose methods of analysis and evaluation for a quantitative risk assessment. (CDG, 1997)

Having completed the qualitative risk assessment, the next step is to do a quantitative risk assessment. A quantitative risk assessment must evaluate, using numbers, the effectiveness of fire protection methods, as well as fire protection systems and fire management procedures. (CDG, 1997)

Both quantitative and qualitative risk assessments are needed in order to justify each other. The quantitative risk assessment is based on theory and knowledge of the consultant. The qualitative risk assessment is supported by numbers rather than facts, as previously stated. Consultants can use the quantitative and qualitative risk assessment to support the suggestions that they have made for the facility that has been evaluated.

After the consultant has done a fire audit, a qualitative risk assessment, and a quantitative risk assessment, the facility can take the necessary measurements suggested by the consultant.

2.6 Other Evaluation Systems

The NFPA is not the only organization that has an evaluation system for healthcare facilities. There is one in the United Kingdom and Australia as well.

2.6.1 Quantified Assessment of Hospitals Fire Risks in the U.K.

David Charters, an Arup fire engineer at London, states that a quantified risk assessment can be used to implement a safety policy in the most cost-effective way. Quantified risk assessment is an approach to assist in the policy decisions, planning, implementation and monitoring of safety (Charters, 1996). In order to evaluate or assess the uncertainty of any activity, a parameter has to be chosen that can be related to the particular activity.

This quantified risk assessment process can be divided into four parts:

a. Hazard identification- This identifies hazards that can provoke a fire or an incident.
b. Frequency analysis- This is done to get an estimate on how often these events might happen, using previous data, or doing a fault and event tree
c. Consequence analysis- In order to get a feel of what might be the consequences of such an event an analysis is necessary. These can be predicted by using fire models for growth, smoke movement, evacuation, etc.
d. Risk assessment- This is undertaken to decide if anything should be done to address the predicted level of risk. This part depends on many political, economical, and cultural factors. A healthcare facility in a remote area maybe required to take different steps to bring the level of fire safety to an "acceptable" level than a more suburban healthcare facility.

(Charters, 1996)

For the frequency analysis part, historical data was collected to better understand how often these events happen. Looking at the history of fire in health care facilities, there has not been a substantial amount of fires to predict the likelihood of an event like this happening. So to fill in the missing information they had to construct event trees and fault trees. Event and fault trees are used to determine the most probable outcomes of a fire. The tree allusion is used because of the branching nature of the analysis.

Figure 2 and 3 of the Charters evaluation (placed in Appendix B) show us event trees done which predict the possible outcome of an event since its initial phase. Outcomes of the event trees were defined in the number of patients that were at risk from a fire in a health care facility or that were at risk from the evacuation procedure.

The probability that was chosen for each of the other parts of the process (hazard identification, consequence analysis and risk assessment) was gathered from historical data and judgement from professionals in the fire engineering field. The frequency of the outcome was estimated by evaluating the frequency of an initial event together with probabilities of the factors that were mentioned earlier.

To determined the level of risk, calculations had to be done on the frequency and then combined with the consequence analyses for the outcomes of the events. Charters says that in this case "a factor is used to adjust the total level of risk so that it equals that for the data used to quantify the event tree." (Charters, 1996) This factor is labeled as the "probability of injury," assuming that it will be proportional to the number of people exposed to the hazard and that for all outcomes the probability does not change.

After the level of risk has been calculated, a decision must be made to denote if area being assessed is acceptable or not. Finally, it has to be considered what can it be done to reduce risk of an event.

Quantified risk assessment has several uncertainties that need to be taken into consideration. These uncertainties are completeness, quality of data, physical modeling, accuracy, management competency, and human factors. In order to address the uncertainties they had to use assumptions and models. Management and human factors also must be into account to reduce the number of uncertainties (Charters, 1996).

It should be known that a normal risk assessment does not take human factors in to consideration. This should be addressed using other methods, such as assumptions. Their importance to the conclusion of this project is necessary for getting correct results.

2.6.2 Australia Aged Care Facility Evaluation

The purpose of this evaluation is to identify the quality of aged care facilities in Australia. The Commonwealth Department of Health and Family services set up this quantitative evaluation. It provides a range of parameters for fire safety. This is a fairly comprehensive tool to evaluate these facilities. The evaluation rates the facilities by assigning a score to the parameters that have been chosen. These parameters include areas ranging from safety to happiness of the residents.

The evaluation has eight different sections. The sections are broken into parameters, which are also broken into subsections. These parameters are explained in detail in Appendix B. The sections are weighted based on the author's opinion of which ones are more important. The scores given in the sub-parameters are also weighed against each other and summed to form the score for the individual section. For example, the scores in the Safety section are multiples of each other. The sub-parameters 1.b (i), 1.b (ii), and 1.b (iii) have weighting of 3 times the other scores in their subsection. This means the values given to them are three times the amount of the other sub-parameters in 1.b. Some scores are evaluated in other manners according to their importance. If a subsection gets a score of less than 4 out of a possible 5 it gets a zero because of its level of consequence. (CHFS, 1998)

The parameters that are pertinent are in sections 1, 2, and 4. These deal with fire prevention, detection, and emergency procedures. These parameters could possibly be included in the evaluation of the Australia healthcare facilities. The other sections in the evaluation are irrelevant to the project, only dealing with concerns of comfort for the facility and residents.

The sections scored and weighted are reflected against the maximum score of 100. The numerical value is an overall determination of the quality of the facility. This does not appear to be widely used in the fire-engineering field possibly due to its dealings with many other issues that do not concern the fire engineers. It will provide an idea of the pertinent variables to put in an evaluation.

2.7 How to Create an Evaluation System

This section explains the principle ideas and concepts behind the method of creating an evaluation system from the beginning.

"Fire safety decisions often have to be made under conditions where the data is sparse and uncertain." (SFPE HBK, 1995) When creating an evaluation, having this uncertainty makes it difficult to determine what values or parameters should be discussed in an evaluation of fire safety. Dr Jack Watts suggest that in the creation of an evaluation system for fire safety, a systematic and documentable approach is taken. This approach is detailed in <u>The Society of Fire Protection Engineers Handbook of Fire Protection Engineering</u>.

At the very base of the evaluation, a method of making the decisions that will affect the ranking must be created. A hierarchical approach to fire risk ranking was initially developed at the University of Edinburgh and later further developed at the University of Ulster (SFPE HBK, 1995). The hierarchical approach is designed to differentiate the levels of decision making.

Through the differentiation of the levels, an evaluation that is more clearly designed can be created. The more clear the reason the evaluation exists is, the easier it is to keep develop the evaluation to meet that goal. A decision-making hierarchy with multiple levels is shown in Table 2.4.

Level	Name	Description
1	Policy	Course or general plan of action adopted by an organization to achieve security against fire and its effects
2	Objectives	Specific fire safety goals to be achieved
3	Strategies	Independent fire safety alternatives, each of which contributes wholly or partly to the fulfillment of fire safety objectives
4	Parameters	Components of fire risk that are determined by direct or indirect measure or estimate
5	Survey Items	Measurable feature that serves as a constituent part of a fire safety parameter

Table 2.4 Hierarchy of Fire Safety Decision-Making Levels (SFPE HBK, 1995)

In adapting the 101A directly to Australia, the top four levels do not affect the project progress. They have already been defined, and the evaluation has been written. The fifth level, the survey items, is of concern. The change in culture and the adjustment for the codes will make the evaluations different. The code can be totally adapted without changing the parameters or the numbers associated with them.

If the levels were more pertinent to our project, each of the levels would become a matrix. The matrices would then be multiplied in such a way that the most important strategies and parameters in relation to the policies would be displayed (SFPE HBK, 1995)

2.7.1 Criteria for Development and Evaluation of Fire Risk Ranking

Dr. Jack Watts also suggest that ten criteria be used to evaluate and develop a fire risk ranking system. These criteria are:

1. “Development and implementation of the method should be thoroughly documented according to standard procedures.” This criteria defines the need for the explanation of what, why and how of a the evaluation. NFPA 101A is lacking these ideas very much and its exact structure may be somewhat vague.

2.“Partition the universe rather than select from it.” Dr. Watts is referring to how parameters of an evaluation are chosen. The parameters need to be broken up into to logical collection and used so that they incorporate all areas.

3. “Parameters should represent the most frequent fire scenarios.”

4. “Provide operational definitions of parameters.” The terms used for parameters can be difficult to decipher at times and a need for their exact meaning is necessary.

5. “Elicit subjective values systematically.” The decisions made have to be justified as to why they were chosen.

6. “Parameter values should be maintainable. The procedure that is used to make the decision concerning the parameters and values in the evaluation need to be documented.” This will make it easier to amend the evaluation.

7. “Treat parameter interaction consistently.”

8. “State the linearity assumption. Fire risk variables don’t necessarily behave linearly and this needs to be understood.”

9. “Describe fire risk by a single indicator. Risk assessments are made easier by sacrificing details. The results need to be easily understood.”

10. “Evaluate predictive capability.” The relative level of importance of the fire risks needs to be specified.

(SFPE HBK, 1995)

The purpose of Dr. Watts' ten criteria is to show how understanding the process by which NFPA 101A was set up is very difficult. Its use in the U.S. is relatively easy but its creation and justification are unclear. In some areas it lacks many pertinent parameters that need to be evaluated. To add these to the evaluation would be very difficult because there is no documentation on how the evaluation was developed.

3.0 Methodology

This chapter documents the methods used to complete the project. The methods are written mainly in chronological order. However, some of the sections of the project overlapped, as would be expected. The project naturally divided itself into four sections: background information, adapting NFPA 101A, creating a computer implementation, and creating a training document for the new evaluation.

3.1 Background Information

The background information was collected from a variety of sources in both the United States and Australia. The sources that were used can be broken into four categories: library resources, interviews, site visits, and the Internet.

3.1.1 Library Resources

Library research was completed with the intent to understand the Australian fire codes, NFPA standards and the reasoning behind them. The codes and standards were studied in depth. The tenets of both the Australian codes and the NFPA standards were studied. The codes and standards are similar in certain aspects. For example, all of the documents which this project references place a heavy emphasis on egress. The sections of the codes and standards that detailed regulations for healthcare facilities were given special attention. The sections were chapter 12 and 13 of NFPA 101, chapter 3 of NFPA 101A, and chapters 1-9 of the BCA.

The second area studied was the reasoning behind codes and the standards. The codes and standards were designed to assure that buildings provide the occupants an adequate level of life safety. An "adequate level of life safety" means that a building must be constructed in such a way that all the occupants can reach a safe area in case of a fire (LSC, 1997). Two options are available for engineers to meet the purpose behind codes and standards.

The first and more traditional option is to follow the building codes or standards exactly and meet all the requirements. However, in both the United States and Australia, provisions are allowed for a building not to conform strictly to the specified details in the building code or standard (LCS, 1997)(BCA, 1996). However, engineers designing a building must be able to prove to the satisfaction of the authority of jurisdiction that the building will provide an adequate level of life safety for the occupants.

Most of the information gathered on the reasoning behind the codes and standards was compiled using the codes or standards themselves, as well as books such as The Society of Fire Protection Engineers Handbook of Fire Protection Engineering and other fire safety evaluations.

3.1.2 Interviewing

Interviews were conducted with experts in the field of fire engineering. The experts were selected for either their extensive experience in the field or direct experience with NFPA 101A. The questions posed to the experts were designed to gain a better understanding of the development of NFPA 101A, and to determine good and bad aspects of it. Through the interviews, the group gained an understanding of the process the NFPA 101A committee went through. The knowledge was applied to the project in the adaptation of NFPA 101A to Australia.

3.1.3 Site Visits

During the phase of the project that was completed in Melbourne, several site visits were undertaken. The site visits were to the Monash Medical Center in Clayton and The Museum of Victoria.

The Monash Medical Center is a major hospital located in Clayton, Victoria. During the site visit, two objectives were completed. Primarily the site visit was to establish the qualities of a well-protected healthcare facility. A few areas were improperly designed. Comments were made on these areas. Secondly, an evacuation drill was conducted by the staff. The evacuation drill was designed to test emergency systems and provide training for the people involved.

The site visit to the Museum of Victoria was intended to give the group a better understanding of the construction of a building. During this visit, special attention was given to the installation of fire systems and methods of performance-based fire engineering.

3.1.4 Internet

The Internet was useful for collecting general information on many different subjects. These subjects included the NFPA, Fire Protection Association of Australia (FPAA), Arup, and possible contacts for interviews. Initially, the NFPA's web-site was accessed. From the NFPA site, information was collected on NFPA standards. In addition, a list of people that were involved with the standards was created for possible interviews. The FPAA's site was a link from the NFPA's. From the FPAA's site, an attempt was made to determine major differences in the building codes and standards.

3.2 Adapting NFPA 101A

The process of adapting an evaluation procedure such as NFPA 101A to a different country is a complex process and must be taken in steps. The steps that were taken by the project group were 1) direct adaptation, 2) addition of parameters, 3) testing of evaluation, 4) reworking the evaluation, and 5) final form.

3.2.1 Direct Adaptation

The direct adaptation of NFPA 101A was the logical place to start. Ove Arup and Partners have used the existing NFPA 101A standard in their projects as a way to attain a quick understanding of a building's level of life safety. However, NFPA 101A is based on the U.S. standard NFPA 101. The differences between the BCA and NFPA 101 caused confusion in the application of the evaluation. The first step was to take NFPA 101A and make the changes within the evaluation to base it on the BCA. This required a careful comparison of the Australian codes and NFPA standards. The second step was to make cultural changes. In the two cultures, some terminologies are different. The terminology was changed to be appropriate to the Australian culture. For example, in Australia, a pitcher is referred to as a jug, and a manual fire alarm is referred to as a manual call point.

3.2.2 Addition of Parameters

The fire engineers of Arup find NFPA 101A incomplete. Arup works extensively with healthcare facilities that are often in remote areas. Parameters in the existing NFPA 101A standard do not reflect the true risk associated with remote facilities. Arup asked that more parameters be included to correct this problem. The project group created a list of parameters based on information from Arup reports, other evaluations, the DHS fire audit, and discussions with Arup employees. This list was then refined, and some of the suggested parameters eliminated.

The elimination of parameters either was due to the parameter not affecting life safety enough, or based on a review of statistics showing a low correlation with healthcare facility fires. For example, in the original Delphi group, fire extinguishers were eliminated as a parameter because of the low value the extinguisher provided to increase life safety (Nelson, April 99).

The remaining parameters were presented to the Arup fire engineers in a meeting designed to clarify and evaluate the additions. Each member of the discussion was presented with a packet of materials. Contained in the packet were sheets of parameter weightings for NFPA 101A and other evaluations similar in purpose. Also included in the packet were initial values for the new parameters. Relying upon the materials and the engineers' previous experiences, the participants discussed and made recommendations. After the discussion of the parameters, a new evaluation was completed with the new parameters added to the worksheets.

3.2.3 Testing the Evaluation

The new evaluation was then tested against buildings using projects Arup had previously completed. Three trials of the new evaluation were completed. Upon the completion of each of the trials, changes were made to reflect the problems found. The project group took a sampling of 14 different zones to use in each trial. The zones were selected by choosing areas that would be representative of a variety of zones, or improvements in previously evaluated zones to test the value weighting.

3.2.4 Reworking the Evaluation

The problems discovered during testing required a partial reworking of the evaluation. Using the values that were found from each round of testing, the project group compared their results with the original scores from NFPA 101A. The project group presented the comparisons to the sponsor. A discussion was held on the results of the trial and changes were made to the evaluation to reflect the outcomes of the discussions. The changes made on the evaluation after testing were minor adjustments to values of parameters.

3.2.5 Final Form

The corrections were made on the evaluation, and then it was tested again. Upon completion of the testing, the newly revised evaluation procedure was found acceptable. The testing used the same method as before. Buildings that Arup had worked on were used as the test subjects of the evaluation. The final form of the evaluation is included in Appendix D.

3.3 Computer Tool

A computer tool was also created to ease the use of the modified NFPA 101A. The project group decided to use an Excel spreadsheet. Excel is not only a very common spreadsheet program, it is easy to use and modify. A simple worksheet was created with fields defined and the equations entered.

The next step in creating the computer tool was to expand upon the basic Excel sheet. After the initial set up was completed, the text of the new healthcare evaluation was placed in the spreadsheet to improve the ease of use of the tool. The evaluation was then formatted for easy readability. After a brief testing period, the computer tool was considered finished.

3.4 Training Material

The final step of the project was to complete training documents for the eventual users of the evaluation procedure. Two different training tools were made available, step-by-step instructions and a PowerPoint presentation.

3.4.1 Step-by-Step Instructions

The training document was designed so that any person, not just an expert in the field, could understand and complete the evaluation. The evaluation was broken into individual steps, each of which were explained carefully. The parameters were defined for the steps that referenced them, as well as the possible values for each of the parameters. The training document is located in Appendix D.

3.4.2 PowerPoint Presentation

A PowerPoint presentation was created for Arup to assist users with the Excel worksheet that the project group created. The presentation covers step-by-step instructions as well as the use of the computer tool. The presentation is included in Appendix D.

4.0 Data Collection and Analysis

This chapter details the collection and analysis of the data. The nature of the project forced the data to be collected and analyzed sequentially, or in stages. The project was broken in to steps that correlate to the stages. The steps are direct adaptation, new parameters, values, and testing.

4.1 Direct Adaptation

The first step in the process was to create a direct adaptation of NFPA 101A to the Australian situation. Two problems arose from the adaptation. The first problem was cultural differences such as language and terminology. The second problem was building code differences.

4.1.1 Terminology Adaptations

The parameters were examined for different terminology in a meeting with the sponsor. Two problems were found with one of the parameters in the current evaluation. The first problem was with the parameter 11 element, Manual Fire Alarm. In Australia, manual fire alarms are referred to as either manual call points or break glass alarms. After a brief discussion with the sponsor, the decision was made to change the parameter to read Manual Call Points. The reasoning behind the change was simply that a few buildings still have older alarms that do not use the glass breaking method. The second problem was with the use of the term Fire Department. In Australia, the fire department is referred to as the ”fire brigade”. Parameter 11 was changed to use the Australian term of fire brigade.

4.1.2 Building Code Adaptations

The building code adaptations were necessary for only three parameters. The parameters were Construction, Interior Finish, and Zone Dimensions.

4.1.2.1 Construction Type

The first parameter in NFPA 101A, construction type, uses a different classification scheme than that of the BCA. The NFPA standard divides the different types into combustible and non-combustible. The types are further subdivided into five construction types as opposed to three types in the BCA. These three BCA types are labeled A, B, and C (BCA: pg. 8,013). The fire-resisting construction of type A, B or C must comply with the guidelines in Chapter 3 of the BCA. Type A is the classification for a building constructed with masonry, or heavy construction with very fire resistant materials. Type B is for a building constructed using lighter, possibly thinner walls, and with elements that are lacking fire resistance. Type C is for buildings with the lightest construction and with the highest structural fire load (highest level of combustible construction).

The basic materials and fire-resistance level (FRL) of the building elements separate the different types and structures. The fire resistance level (FRL) of an element is determined by testing a prototype element in accordance with the appropriated Australian Standard (BCA: pg. 3202). The variables calculated are strength, modulus of elasticity of a component, the shape, the fire protection, and performance in the Standard Fire Test (BCA: pg. 3,201). There are three parts to it: structural adequacy, integrity, and insulation. The time given for the structural adequacy is the time that the structure can maintain its load in a test environment. The integrity of a structure is the amount of time it resists the passage of flames, smoke and hot gases in a test environment. Insulation refers to the time required for a part of a building or structure unexposed to a fire to reach a defined temperature above its ambient temperature. Since the FRL rating is given in three times it is essential to use the lowest value. The standard test protocol referenced by NFPA standard 101A, the ASTM standard E119, ends the test as soon as one criteria fails. Finally, according to NFPA 101 the construction type descriptions refer only to load bearing walls.

In the BCA, the FRL ratings of the different construction types are divided into four columns as seen in Appendix B. The five NFPA 101A types were decided similarly to the way the BCA divides the construction types. NFPA 101A uses Fire Protection Ratings (FPR). The FPR is similar to the FPL, however the testing standards are different. This causes the times to not correlate. A load-bearing wall with an FRL of 60/60/30 is not the same as a wall with a 60-minute FPR. In order to correlate the two construction types the project group used a process of elimination to find which types most closely correlate with the other. There was a good correlation between construction type A of the BCA and Type 222, noncombustible in NFPA 101. Type B appears at first inspection to correlate with type 222 but in fact does not. Type B was more like the Type 111 of NFPA 101. This is because the FRL ratings that appear to be similar are for buildings that are in close proximity to a fire-source feature. A fire-source feature is defined as the external wall of an adjacent building (BCA).

The BCA has three FRL ratings for buildings separated by different distances. In correlating the types, we used a distance of 1.5 meters (BCA: pg. 8,014). NFPA 101 assumes that buildings are at least a distance of 1.5 meters from each other.

Type C construction is most closely related to type 000 of NFPA 101A. Type C construction does not address the specifications on roofs, internal walls, or floors.

The BCA does not deal with combustible construction as NFPA 101 does because combustible structures are outdated and no new buildings should be constructed using combustible materials in Australia. For the outdated combustible construction types, type 200 is used as a template. Type 200 uses the most negative scores in NFPA 101A evaluation, which is associated with a highly combustible construction type. In order to make the correlation of construction types, some conservative judgement was used.

Table 4.1 lists the ratings in NFPA 101A as a function of construction type and number of stories. Table 4.2 lists the corresponding ratings for use in Australia based on the adaptation to BCA construction types.

	Combustible Types III, IV, and V				Noncombustible Types I and II		
Floor and Zone	000	111	200	211+2HH	000	111	222,322,433
First	-2	0	-2	0	0	2	2
Second	-7	-2	-4	-2	-2	2	4
Third	-9	-7	-9	-7	-7	2	4
Fourth and Above	-13	-7	-13	-7	-9	-7	4

Table 4.1 NFPA 101A Construction Types Parameter.

Floor and Zone	Class A	Class B	Class C	Combustible
First	2	2	0	-2
Second	4	2	-2	-4
Third	4	2	-7	-9
Fourth and Above	4	-7	-9	-13

Table 4.2 BCA Based Construction Types Parameter.

4.1.2.2 Interior Finishes

The interior finish in a building was defined by two parameters. These parameters were the Flame Spread Index (FSI) and the Smoke Development Index (SDI). Although the NFPA standard and the Australian one uses both the FSI and the SDI, the methods of testing were different and the numbers do not correlate.

The NFPA standard splits the interior finishes into five categories. These categories are Class A, Class B, Class C, Type I, and Type II (LSC: pg. 213). Types I and II were not referenced in NFPA 101A and are ignored in the project. The types were defined in the table below according to the two indices mentioned above.

	Flame Spread Index	Smoke Development Index
Class A	0-25	0-450
Class B	26-75	0-450
Class C	76-200	0-450

Table 4.3 NFPA 101 Class Specifications for Interior Finish

The BCA doesn't divide interior finishes into any classes or categories apart from the FSI and SDI. However, the different levels of safety for different types of buildings are specified.

The correlation of the levels of allowable interior trim for the Australian adaptation of NFPA 101A was as follows. The most stringent requirements for any building became the equivalent of class A. The second moderately restrictive requirement became class B, and the least restrictive requirement became class C. The conversions are shown in table 1.4.

Class A was taken from the requirement for exits and stairways in a class 9a building. For the class 9a situation, the FSI has to be 0, and the SDI no greater than 2. Class B was taken from the requirements for a 9a-class building's interior finishing on a floor. The FSI is 3, the SDI is 5. Class C was defined to correspond to the minimum requirements for the internal finish of a building in the classes between 2 and 9. The FSI is 9, with an SDI of 8 (BCA: pg. 8,601-8,603).

	Flame Spread Index	Smoke Development Index
Class A	0	0-2
Class B	1-3	0-5
Class C	>4	>6

Table 4.4 BCA Based Class Specifications for Interior Finish.

As compared to NFPA 101, the BCA is stricter when it came to interior finishes. Only Australian class A materials are allowed in exit areas according to the BCA, but in NFPA 101 classes A and B are allowed (BCA, 1996). In both the NFPA standards and Australian codes, the equivalents of class C interior finishes are not allowed in any public area of healthcare facilities. In addition, with both the code and standard, class C internal finishes are allowed only in patients' rooms, and only in small amounts.

4.1.2.3 Zone Dimensions

Another parameter of NFPA 101A that needed to be adapted to the Australian situation was zone dimensions. If the zone dimensions met the standards, the evaluation was given a value of 0. If the dimensions were better than suggested in NFPA 101, the evaluation assessed a value of one. On the other hand, if the zone dimensions do not comply with NFPA 101 then negative values were assessed to the parameter according to the severity of the infraction. Positive values indicate a "good" level of safety. Negative values indicate a "bad" level of safety.

Table 4.5 is the Zone Dimensions parameter taken from the evaluation with no changes except for a conversion to SI units. The values are displayed below the length. The values in the parentheses are values that would be used for special situations. For a description of the situations, refer to the section of NFPA 101A in appendix B.

Dead Ends			No Dead Ends >9.14m and Zone Length is		
>30	>15m to 30m	9m to 15m	>46	30m to 46	<30m
-6(0)	-4(0)	-2(0)	-2(0)	0	1

Table 4.5 NFPA 101A Zone Dimensions Parameter.

After looking at the requirements of the BCA, ranges of values were established for the dimensions of the zones. Requirements were also found for dead-end and non dead-end zones.

For the dead-end zones, an allowable range was established between 12 meters and 30 meters. If the value was below this range, then the zone dimensions were better the requirements but if it was greater then the range then it did not comply with the requirements. It can be noted that for all of the values in the dead-end zone, negative values are assessed. This was because dead-end zones, as they are defined, cause a danger to the life safety of people attempting to exit a building.

For zones without dead-ends the same method was used. Ranges of values were found, but in the Australian evaluation, the dimensions have been denoted as area rather as length. The dimensions were changed because BCA defines zone dimensions in area. NFPA 101 uses diagonal length; however, because most zones are not square, and the BCA uses area, area was a better choice of measures for the adaptation. A better way to define space, would be the to define distance a person must travel to reach an exit. However, this approach is impractical for a general evaluation.

A completed adaptation of the zone dimension parameter is displayed in table 1.6 below.

Dead Ends			No Dead Ends >30m and Zone Area is		
>30 m	>12m to 30m	<12 m	>2000m^2	500m^2 to 2000m^2	<500m^2
-6(0)[b]	-4(0)[b]	-2(0)[b]	-2(0)[c]	0	1

Table 4.6 BCA Based Zone Dimension Parameter.

4.2 New Parameters

Acting on advice from the sponsor, the project group compiled a list of possible parameters to be added to the evaluation. The list of new parameters was a collection of requirements taken from other evaluations, Arup project reports, the DHS Audit, and discussions with Arup employees. There were no initial values associated with the new parameters. The list was only intended for discussion to decide if they should be included in the new evaluation procedure. The first attempt at developing such a list is displayed in table 4.7.

New Safety Parameters	**New Occupancy Parameters**
	1) Staff Training
1) Brigade Response	2) Wardens/Security
2) Emergency Procedures	3) House Keeping
3) Posted fire Plans	
4) Maintenance of Building	
5) Flame Retardant Materials	
6) Portable Extinguishers	
7) Hose Reels	
8) Fire Blankets	
9) Heat Detectors	
10) Illuminated Signs	
11) Emergency Lighting	
12) Estimated Evacuation Time	

Table 4.7 Initial List of New Parameters.

The first draft of new parameters was shown to the sponsor. After some discussion and reasoning, the list was shortened. The parameters that were eliminated were found not to provide a great enough increase in the level of life safety or had no provisions in the BCA. The second draft of the list is displayed in table 4.8.

New Safety Parameters	New Occupancy Parameters
1) Brigade Response Time	1) Emergency Procedure & Posted Fire Plans
2) Level of Maintenance	2) Staff Training
3) Fire Retardant Materials	
4) Emergency Lighting & Illuminated Exits	

Table 4.8 Revised List of New Parameters

The second draft of the new parameter list was presented to the employees of Arup. The employees discussed each of the parameters and decided a few of the proposed parameters needed altering. The final list of new parameters is displayed in table 4.9.

New Safety Parameters	New Occupancy Parameters
1) Brigade Response Time	None
2) Level of Maintenance	
3) Fire Retardant Materials	
4) Emergency Lighting & Illuminated Exits	
5) Emergency Procedure and Staff Training	

Table 4.9 Final List of New Parameters

4.3 Value Changes

The values for NFPA 101A parameters were originally created by a Delphi process by members of NIST (National Institute of Science and Technology) in the 1970s (Nelson, April 1999). The project group found through meetings with the sponsor that the values in existence were under question. Experience of the employees of Arup suggested that the values might be inappropriate for certain situations under a performance based design concept.

The value change section of this report is split into four sections. The first section deals briefly with the rationale. The second section discussed mandatory building requirements and changes in the appropriate parameter values (constants). The third and fourth sections are dedicated to the changes of the values for individual parameters.

4.3.1 Causes of Change

Since the time of the original Delphi team, fire technology has changed significantly. The addition of newer and better technology has caused some equipment to become more effective while others still retain their relative value to life safety (Nelson, April 99). Smoke detectors are an example of this advance. Most modern smoke detectors are connected to a control board. Control boards often have an automatic connection to the fire department. The automatic connection quickens the response time and reduces the risk to life safety.

4.3.2 Mandatory Values

The addition of new parameters to the evaluation also raised problems with the overall weighting of the values. At the end of the evaluation, values were specified that buildings must meet. The mandatory minimum values were decided by completing the evaluation using the requirements of the codes (Nelson, April 99). The new values caused changes in the minimum mandatory scores that the building must meet. Every time the parameter's weighting changed within the evaluation, the mandatory minimum values also changed.

4.3.3 Initial Meeting

In the same meeting in which new parameters were discussed with a group of employees of Arup, values were chosen for the new parameters. The project group had created a set of values for each of the parameters. The values picked for the new parameters are displayed in figure 4.11.

New Occupancy Parameters Table

Emergency Procedure and Posted Fire Plan	No Plan	Posted Plan	Fully Engineered Plan	
	2.0	1.6	1.0	
Staff Training	No Emergency Training	Low Frequency of Training	Average Frequency of Training	Trained Frequently
	3.0	1.8	1.4	1.0

New Safety Parameters Table

Brigade Response time	<5 Min	>5 to < 15 Min	> 15 Min	No response
	5	0	-2	-7
Level of Maintenance	No Plan	Serviced when needed	Scheduled Maintenance/ Contracted	
	-4	1	2	
Fire Retardant Materials	No Checks	Partial Fire Retardation	All Materials Retardant	
	-2	1	3	
Emergency Lighting and Illumination	No lighting or illuminated exits	Emergency Exits	Illuminated Exits	Emergency lighting and Illuminated Exits
	0	2	3	4

Figure 4.11 Initial Values for New Parameter

The values were presented to the employees for feedback. The employees went through each parameter. New values for most of the parameters were selected by the employees by the end of the meeting. The new values that were selected are displayed in figure 4.12.

New Safety Parameters

Emergency Procedures and Staff Training	No procedures or training	Procedures but no training	Training but no procedures	Comprehensive plan and training
	-3	0	3	5
Brigade Response Time	No Response	> 15 Min	>5 to < 15 Min	<5 Min
	0	1	2	6
Fire Retardant Materials	No Checks	Partial Fire Retardation	All Materials Retardant	
	0	1	2	
Emergency Lighting and Illumination	No lighting or illuminated exits	Emergency Exits	Illuminated Exits	Emergency lighting and Illuminated Exits
	-2	1	2	3

Figure 4.12 Revised Values of New Parameters

During the meeting, the parameter for Brigade Response Time was questioned by the fire engineers for inclusion into the new evaluation. Two opposing opinions were predominate in the discussion. The first opinion was that a building with a quick fire brigade response time should be safer than a building with a longer response time. The second and opposing opinion was that a building should be engineered to be safe on its own without the introduction of the brigade. If the safety of a building is based on the brigade but the brigade cannot response because of lack of preparation or poor road conditions the occupants of the building are put at high risk. The final agreement was that a fire brigade could alter the life safety of a building enough that it should be included in the new evaluation.

4.3.4 Mini-Delphi Process

During the course of the first meeting with Arup employees, discrepancies were detected in the values of some existing parameters compared with the experience of the employees. They felt that the values of the sprinkler and smoke detection parameters were inaccurate.

To solve the problem, the group handed out a sheet with selected parameters on it but listed no values. The selected parameters were Sprinklers, Smoke Detectors, Manual Call Points, and Emergency Procedures and Training. The employees were asked to rate the values of each parameter with a value between +10 and –10. A +10 value would represent the most important factor in life safety. A value of –10 would represent the worst possible detriment to life safety. The method used was the same as the original Delphi group (Nelson, April 1999). The handout is included in figure 4.13.

<table>
<tr><td rowspan="3">Manual Call Points</td><td colspan="2" rowspan="2">No Manual Call Points</td><td colspan="10">Manual Call Points</td></tr>
<tr><td colspan="6">W/O F.B. Conn.</td><td colspan="4">W/F.B. Conn.</td></tr>
<tr><td colspan="2"></td><td colspan="6"></td><td colspan="4"></td></tr>
<tr><td rowspan="2">Smoke Detection and Alarm</td><td>None</td><td colspan="4">Corridor Only</td><td colspan="2">Rooms Only</td><td colspan="4">Corridor & Habit Spaces</td><td>Total Zone Space</td></tr>
<tr><td></td><td colspan="4"></td><td colspan="2"></td><td colspan="4"></td><td></td></tr>
<tr><td rowspan="2">Automatic Sprinklers</td><td colspan="4">None</td><td colspan="5">Corridor and Habit Space</td><td colspan="3">Entire Building</td></tr>
<tr><td colspan="4"></td><td colspan="5"></td><td colspan="3"></td></tr>
<tr><td rowspan="2">Emergency Procedure and Staff Training</td><td colspan="3">No Procedures or Training</td><td colspan="3">Procedures and no training</td><td colspan="4">Training and no procedures</td><td colspan="2">Comprehensive Plan and Training</td></tr>
<tr><td colspan="3"></td><td colspan="3"></td><td colspan="4"></td><td colspan="2"></td></tr>
</table>

Figure 4.13 First Handout for the Mini-Delphi

The results of the handouts were recorded and averaged. The averages are displayed in table 4.14. These ranges and averages were then shown to the employees on a personal basis. The opinions of the employees were taken into account and the values were decided upon as shown in table 4.14.

	Average
Manual Call Points	
None	-0.33
W/O F.B. Conn.	1.00
W/F.B. Conn.	2.67
Smoke Detection and Alarm	
None	-3.00
Corridor Only	1.33
Rooms Only	2.33
Corridor and Habit Space	6.00
Total Zone Space	8.00
Automatic Sprinklers	
None	-1.67
Corridor and Habit Space	6.00
Entire Building	9.33
Emergency Procedure and Staff Training	
None	-4.67
Procedures and no training	0.33
Training and no procedure	2.67
Comprehensive Plan and Training	6.67

Table 4.14 Average Survey Response

4.4 Evaluation Testing

The evaluation was tested using data from Arup projects. Buildings or sections of buildings that were found unsafe, safe and marginally safe were evaluated using the new evaluation. If the scores reflected the safety of the building as determined by Arup engineers, then the evaluation was considered to have valid values. If the evaluation did not reflect the safety of the building, then the evaluation was considered to have incorrect values.

Since no member of the project group was a fire protection engineer, the decision as to whether a building was accurately assessed was based on an understanding of the evaluation.

4.4.1 Trial One

Fourteen evaluations were used in the first round of testing. Although only five buildings were used, different zones and different permutations of those zones allowed fourteen different evaluations to be generated. The evaluations completed are included in Appendix C.

The first round of testing revealed to the project group a problem with the values used for the Fire Brigade Response Time parameter. In each of the evaluations, the results appeared to be too high to the project group in the General Safety column of the evaluation. A good response from the fire brigade could replace a smoke detection system or another system that was equally important to the safety of the occupants. The project group decided to reduce the highest value of the Fire Brigade Response Time

Parameter by two points. The change left the value for the quickest brigade response time as a four.

4.4.2 Trial Two

The same buildings were used in the second trial run of the evaluation. Although the evaluation results were better with the reduction of the Fire Brigade Response Parameter value, some problems were again found in the results of the evaluations. The problem, as before, was in the values for General Safety. On average, the values that appeared in the new evaluation for General Safety were 10 points higher than the original NFPA 101A scores. To re-center the scores, the project group added 10 points to the occupancy risk factor. This reduced the final General Safety values to a level that the group found was an acceptable reflection of the actual safety of the building. A graph showing the General Safety Parameter is shown in figure 4.14.

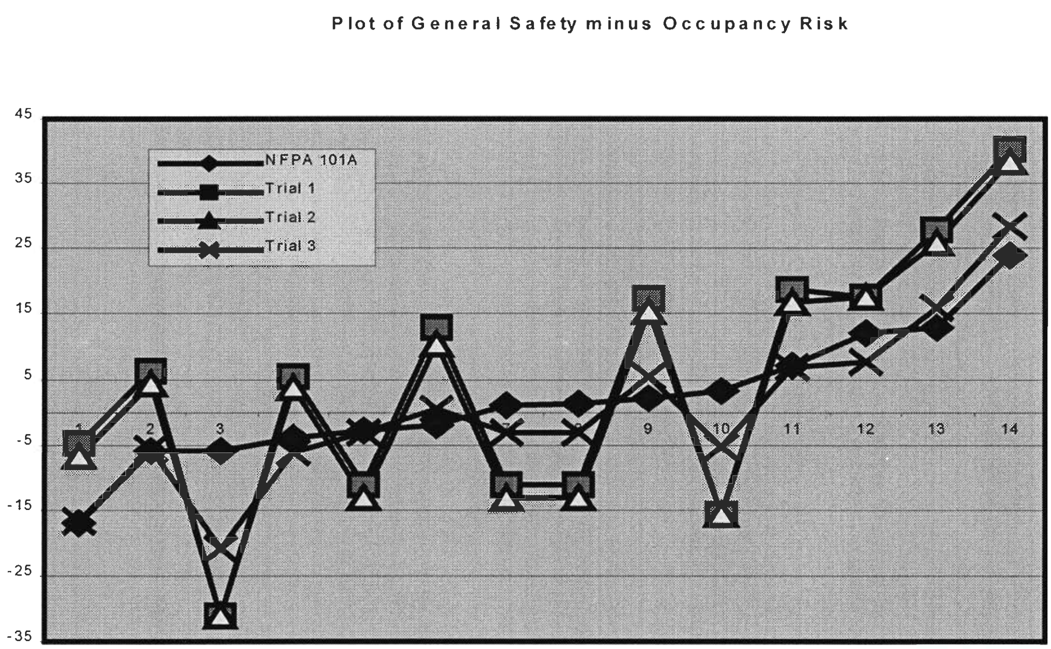

Figure 4.14 A Graph of the General Safety Over Three Trials.

During the second test run, the values for the lack of maintenance were considered to provide too much value by the sponsor and the project group. To correct this, the value for having no maintenance plans was moved closer to zero from a negative four to a negative two, and the value for having some maintenance was changed from a negative two to a negative one.

4.4.3 Trial Three

The results from trial three were evaluated against the previous two runs and the NFPA 101A results. In general, the results of the NFPA 101A analysis were equivalent to the results of trial three with two exceptions. The Lorne Hospital and Lorne Nursing Home both showed results that were significantly different. As the buildings were discussed, it was acknowledged that the buildings were far below the standards, and the new evaluation reflected the lack of safety better then the analysis done with NFPA 101A. The results of the third trial run were deemed acceptable, at least on a qualitative basis, and the values for the parameters were considered established for the project.

During the third run, a suggestion was made to make the evaluation closer to the method of Arup by providing safety ranges for the resulting values. Arup, in their reports, specify building renovations as four different priority types: interim, priority 1, priority 2, priority 3. Interim means that the building must be worked upon immediately to improve the life safety. Priority 1 means that the building must be renovated in the next 12 months. Priority 2 means that the correction to the building must be undertaken in the next 2 to 5 years. Priority 3 requires further analysis and review before any actions are taken. The ranges of the output values from the assessment for the four categories are displayed in table 4.15. A complete breakdown of all the values for all the trials is included in Appendix C.

Range	Category
< -15	Interim
-15 to –5	Priority 1
-5 to 5	Priority 2
> 5	Priority 3

Table 4.15 Established Ranges for Categories.

5.0 Conclusions

The goal of this project was to create an adaptation of NFPA 101A for Australian healthcare facilities. The project group adapted the evaluation procedure. Then the group added new parameters, established new values, and created a computer tool to aid in implementation of the new evaluation approach.

5.1 Comments about the New Evaluation

With the addition of new parameters to the evaluation procedure, it became more comprehensive. Many of the remote facilities with which Arup works are often missing basic life safety devices such as lighted exits signs and emergency lighting. By adding these to the evaluation the project group has created an evaluation that will allow catch these problems.

However, the addition of parameters also created problems in addition to already existing ones. The largest existing problem is that people who used the evaluations in Australia have had problems choosing which values are correct for each particular zone. The two areas in which the project group found further problems were the new values for use in the evaluation and the method of using the evaluation.

5.1.2 New Values of the Evaluation

The addition of new parameters changed the results of the evaluation, as did changes to the mandatory values. The amount of time allotted for the project did not allow for comprehensive testing of all the possible scenarios. A possibility exists that a building may pass an evaluation yet might not be considered safe by a professional fire protection engineer. The procedure that created NFPA 101A limited this possibility by thorough testing of the results.

The values of the original evaluation were created in a way similar to the values that are in the new evaluation for Australia. However, the values used were based on opinion rather than physical sciences. Many of the values could be debated and changed. The values currently being used are the opinions of the project group and agreed upon by the employees of the Arup office in Melbourne. The evaluation should be used in conjunction with other methods of evaluating a building for life safety.

5.1.3 Using the New Evaluation

When a building is being evaluated by the new procedure, the evaluator should take a conservative approach. The evaluation was intended to be used from a practical worse case scenario perspective. For example, if a zone being evaluated has a maximum occupancy of 40 people, even if only 12 people are currently in occupancy, the evaluation should be filled out according to a 40-person scenario.

The selection of the values for each of the parameters should also be based on an understanding of the background material surrounding fire safety and the evaluation approach. The parameter "Hazardous Areas" requires the evaluator to know what constitutes a hazardous area. An area with medical or office files being stored could be considered a high-risk area, but if the evaluator didn't know, they might make a mistake in the selection of the correct value. The step by step instructions address some of these issues; however, a prudent approach still should be taken.

5.1.4 Training Documents

Two training tools were provided as a result of this project. A PowerPoint presentation was developed for training purposes. This can be used for both the evaluation worksheet and the computer tool. A step by step manual was created for the worksheets alone. One or both of the training documents should be studied before using the evaluation. An understanding of the evaluation is needed for it to be completed correctly. Both of the training documents are included in Appendix D.

5.1.5 Evaluation Worksheets

The new evaluation worksheets are included in Appendix D. The new evaluation represents the opinion of the project group and Arup. The evaluation should only be used after reading the training documentation provided in Appendix D.

5.1.6 Ove Arup & Partners Involvement

The project was completed under the supervision of Ove Arup & Partners fire engineering group in Melbourne and Worcester Polytechnic Institute's Professors Matthew Ward and Jonathan Barnett. Many of the decisions made for the project were based on the needs and requirements of Arup. The four categories of building safety reflect the concept that Arup uses for determining the necessity of building renovation. The computer tool was also created to allow Arup to use the new evaluation with less time demand. The project group would like to caution any users of the evaluation to bear in mind that the evaluation was adapted for Arup's use. The results have been specialized for Arup's needs and they do not reflect the opinions of the entire fire industry.

5.2 Further Development

The project group recommends that more development be done on the evaluation. Primarily more work needs to be completed on the values of the parameters. Secondly, the group feels that more parameters could be considered for a more comprehensive version of the Australian healthcare evaluation.

5.2.1 Value Refinement

The project group feels that more work needs to be completed on the values in the new evaluation. The original NFPA 101A used a computer program to systematically proceed through all possible permutations of the evaluation. The results that were close to 0 were analyzed and a decision was made to determine if the building being evaluated was safe. If the building was not safe, yet passed the evaluation, changes were made to the values until most of the unsafe buildings were not allowed to pass.

The level of analysis the project group feels is appropriate for a thorough review of the project would extend past the time allotted for the completion of the project. However, the project group feels a similar level of analysis should be completed on the new evaluation as NFPA 101A was applied to. The group would like to see more time spent on ascertaining the best values for the parameters.

5.2.2 Parameter Development

With the addition of parameters to the evaluation, the revised evaluation procedure can become more comprehensive and supply a more accurate portrayal of a building's level of fire safety. For the purpose of staying within time constraints and keeping the evaluation simple, the project grouped decided to add only a few parameters. However, room for more parameters is available. The occupancy risk section of the evaluation has potential for the addition of parameters. Areas such as mental ability of the occupants, their level of medication, and type of treatment they are undergoing have not been addressed at all. In a future version of the evaluation, perhaps more parameters dealing with patients could be added. A Delphi process to ascertain which parameters could be added should be considered and how they should be scored.

5.3 Final Caution

The new evaluation should not to be taken as a completed and polished document. The members of the project group, who were the authors of the new evaluation, were not fire protection engineers. More time should be spent on determining appropriate values for the parameters used in the evaluation procedure. This should involve input from an experienced group of fire protection engineers. Although the evaluation can provide an overview of the safety of a building, the results should not be considered authoritative.

5.4 Summary

The completion of the project leaves Australia with an evaluation of life safety for the healthcare facilities. The fire engineers at Arup's Melbourne office provided the project group with ideas and help whenever it was needed. The project group appreciates Arup's participation and hopes the evaluation is useful. Although more work needs to be completed to call the evaluation finished, the project group feels that the work done during the eight weeks of the project has been a large step forward in the process.

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Appendix A – Sponsor Background Information.

Appendix A offers a better idea of the what type of firm Arup is and what sort of business their office conducts.

Appendix A:

A man named Ove Arup founded Ove Arup & Partners. Ove had been working for his cousin's construction company, but in 1946, Ove decided to quit his job and form an engineering firm. Two offices were established in the United Kingdom, one in London and another in Dublin. By 1950, Ove Arup & Partners had over 30 people in their employ. They have grown as a company since then and now employ over 5000 people in over 50 different countries. The company prides themselves in this as it provides distinct advantages to them. Their global market allows them to conduct a variety of projects that extend over country borders. This gives them experience in meeting requirements for many different countries and dealing with the officials in them. The large size of the company also provides a large library of previous work for current engineers to reference.

During a speech in 1970, Ove Arup stated the company's objective. Provide client with excellent service and quality of work. Be known for their commitment to deliver and for their concern about the environment without ever regarding their multi-disciplinary approach. Since then this speech has been known as The Key Speech from which members of Ove Arup & Partners guide themselves.

Arup's large staff also allows for the company to complete projects in its entirely. This sets them apart from other firms who do not have the personnel to tackle all the aspects of a project. A basic four-step approach for a project is used which involves planning, investigating, designing, and managing. Arup believes that a comprehensive approach produces a better final product. The Arup project team consults extensively

Appendix B

Appendix B is designed as a resource of information on the different codes and evaluation systems. It is necessary to fully understand the components of each code that were adapted and added. This Appendix is broken up into sub-appendices.

B.1 NFPA 101, Construction Requirements

The following Appendix consists of the construction requirements defined in NFPA 101. It is necessary to know the requirements in order to understand the way in which the parameters in NFPA 101A were correlated to BCA. (LSC, pg. 149-150 1997)

Appendix C - Testing the Evaluation

This Appendix is design to offer the way in which the HESA was refined to its final form.

C.1 Trial 1

Trial one consists of the evaluation system with the initial parameters and values for those.

Monash Hospital - Students Residence

Australia Evaluation System

Trial 1

Risk Factor Values

1.) Patient Mobility (M)

Mobility Status	Mobile	Limited Mobility	Not Mobile	Not Movable
Risk Factor	1.0	1.6	3.2	4.5

2.) Patient Density (D)

Floor	1-5	6-10	11-30	>30
Risk Factor	1.0	1.2	1.5	2.0

3.) Zone Location (L)

Floor	1st	2nd or 3rd	4th to 6th	7th and Above	Basements
Risk Factor	1.1	1.2	1.4	1.6	1.6

4.) Ratio of Patients to Attendants (T)

Patients/ Attendants	1-2 / 1	3-5 / 1	6-10 / 1	>10	One or More/None
Risk Factor	1.0	1.1	1.2	1.5	4.0

5.) Patient Average Age (A)

Age	Under 65 Years and Over 1 Year	65 Years and Over, 1 Year and Younger
Risk Factor	1.0	1.2

	M		D		L		T		A		F
Occupancy Risk	1.0	X	1.0	X	1.1	X	1.0	X	1.0	=	1.1

1. Construction	Floor and Zone	Class A	Class B	Class C	Combustible	
	First	2	2	0	-2	
	Second	4	2	-2	-4	
	Third	4	2	-7	-9	
	Fourth and Above	4	-7	-9	-13	
2. Interior Finish (Corridors and Exits)	Class C	Class B	Class A			
	$-5(0)^h$	$0(3)^h$	3			
3. Interior Finish (Rooms)	Class C	Class B	Class A			
	$-3(1)^h$	$1(3)^h$	3			
4. Corridors Partitions/Walls	None or Incomplete	< ½ hr	≥ ½ to < 1 hr	≥ 1 hr		
	$-10(0)^a$	0	$1(0)^a$	$2(0)^a$		
5. Doors to Corridor	No Door	< 20 Min FLR	≥ 20 Min FLR	≥ 20 Min FLR and Auto Closing		
	-10	0	$1(0)^d$	$2(0)^d$		
6. Zone Dimensions	Dead End			No Dead Ends >30m and Zone Area Is		
	>30 m	>12m to 30m	<12 m	>2000m²	500m² to 2000m²	<500m²
	$-6(0)^b$	$-4(0)^b$	$-2(0)^b$	$-2(0)^c$	0	1
7. Vertical Openings	Open 4 or More Floors	Open 2 or 3 Floors	Enclosed with Indicated Fire Resist			
	-14	-10	< 1hr	≥1hr to <2hr	≥ 2 hr	
			0	$2(0)^g$	$3(0)^g$	
8. Hazardous Areas	Double Deficiency		Single Deficiency		No Deficiency	
	In Zone	Outside Zone	In Zone	In Adjacent Zone		
	-11	-5	-6	-2	0	
9. Smoke Control[e]	No Control	Smoke Barrier Serves Zone	Mech. Assisted Systems by Zone			
	$-5(0)^c$	0	3			
10. Emergency Movement Routes	< 2	Multiple Exits				
		Deficient	W/O Horizontal Exits	Horizontal Exits	Direct Exits	
	-8	-2	0	1	5	
11. Manual Call Points[e]	No Manual Call Points	Manual Call Points				
		W/O F.B. Conn.	W/F.B. Conn.			
	-4	1	2			
12. Smoke Detection and Alarm[e]	None	Corridor Only	Rooms Only	Corridor & Habit Spaces	Total Zone Space	
	$0(3)^j$	$2(3)^j$	$4(3)^j$	6	8	
13. Automatic Sprinklers[e]	None	Corridor and Habit Space	Entire Building			
	0	8	10			
14. Fire Retardant Materials	No Materials	Some Materials	All Materials			
	0	1	2			
15. Brigade Response	No Response	> 15 Min	>5 Min and <15 Min	≤ 5 Min		
	0	1	2	6		
16. Emergency Lighting and Illumination	No Emerg. Lighting or Illum. Exits	Illuminated Exits	Emergency Lighting	Emergency Lighting and Illum. Exits		
	-2	1	2	3		
17. Emergency Procedure and Staff Training	No Procedures or Training	Procedures and no training	Training and no procedures	Comprehensive Plan and Training		
	-3	0	3	5		

NOTES:
- a Use (0) where Parameter 5 is –10.
- b Use (0) where Parameter 10 is –8.
- c Use (0) on floor with fewer than 31 patients (existing buildings only).
- d Use (0) where Parameter 4 is –10.
- e If no maintenance plan add a –4 to the value. If repairs and maintenance are done when needed, add a – 2 to the value. The value can never be less than 0.
- g Use (0) where Parameter 1 is based on first floor zone or on an unprotected type of construction (columns marked "U").
- h Use ( ) if the area is class B or C interior finish in the corridor and exit or room is protected by automatic sprinklers and Parameter 13 is 0.
- j Use this value in addition to Parameter 13 if the entire zone is protected with quick-response automatic sprinklers.

Safety Parameters	Containment Safety (S_1)	Extinguishment Safety (S_2)	People Movement Safety (S_3)	General Safety (S_4)
1. Construction	2	2	X	2
2. Interior Finish (Corr. And Exit)	3	X	3	3
3. Interior Finish (Rooms)	3	X	X	3
4. Corridors Partitions/Walls	2	X	X	2
5. Doors to Corridors	0	X	0	0
6. Zone Dimensions	X	X	0	0
7. Vertical Openings	2	X	2	2
8. Hazardous Areas	-6	-6	X	-6
9. Smoke Control	X	X	0	0
10. Emergency Movement Routes	X	X	5	5
11. Manual Call Points	X	2	X	2
12. Smoke Detection and Alarms	X	0	0	0
13. Automatic Sprinklers	0	0	÷2= 0	0
14. Fire Retardant Materials	1	X	X	1
15. Fire Brigade Response Time	X	6	6	6
16. Emergency Lighting and Illumination	X	X	3	3
17. Emergency Procedure and Staff Training	X	X	5	5
Total Value	S_1= 8	S_2= 4	S_3= 25	S_4= 29

Zone Location	Containment (S_a)	Extinguishment (S_b)	People Movement (S_c)
1st Story	9	9	13
2nd Story	13	11	15
3rd Story or Above	15	13	15

				Yes	No
Containment Safety (S_1)	minus	Mandatory Containment (S_a)	≥ 0	S_1 $\boxed{8}$ - S_a $\boxed{13}$ = C $\boxed{-5}$		✓
Extinguishment Safety (S_2)	minus	Mandatory Extinguishment (S_b)	≥ 0	S_2 $\boxed{4}$ - S_b $\boxed{11}$ = C $\boxed{-7}$		✓
People Movement Safety (S_3)	minus	Mandatory People Movement (S_c)	≥ 0	S_3 $\boxed{25}$ - S_c $\boxed{15}$ = C $\boxed{10}$	✓	
General Safety (S_4)	minus	Occupancy Risk (R)	≥ 0	S_4 $\boxed{29}$ - R $\boxed{1.1}$ = C $\boxed{27.9}$	✓	

Adult Psychiatry - Level 1 (Ground Patients)

Australia Evaluation System Trial 1 Monash Hospit

Risk Factor Values

1.) Patient Mobility (M)

Mobility Status	Mobile	Limited Mobility	Not Mobile	Not Movable
Risk Factor	1.0	1.6	3.2	4.5

2.) Patient Density (D)

Floor	1-5	6-10	11-30	>30
Risk Factor	1.0	1.2	1.5	2.0

3.) Zone Location (L)

Floor	1st	2nd or 3rd	4th to 6th	7th and Above	Basements
Risk Factor	1.1	1.2	1.4	1.6	1.6

4.) Ratio of Patients to Attendants (T)

Patients/ Attendants	1-2 / 1	3-5 / 1	6-10 / 1	>10	One or More/None
Risk Factor	1.0	1.1	1.2	1.5	4.0

5.) Patient Average Age (A)

Age	Under 65 Years and Over 1 Year	65 Years and Over, 1 Year and Younger
Risk Factor	1.0	1.2

	M		D		L		T		A		F
Occupancy Risk	1.0	X	1.2	X	1.1	X	1.2	X	1.0	=	1.6

Parameter						
1. Construction	Floor and Zone	Class A	Class B	Class C	Combustible	
	First	2	2	0	-2	
	Second	4	2	-2	-4	
	Third	4	2	-7	-9	
	Fourth and Above	4	-7	-9	-13	
2. Interior Finish (Corridors and Exits)	Class C	Class B	Class A			
	-5(0)[h]	0(3)[h]	3			
3. Interior Finish (Rooms)	Class C	Class B	Class A			
	-3(1)[h]	1(3)[h]	3			
4. Corridors Partitions/Walls	None or Incomplete	< ½ hr	≥ ½ to < 1 hr	≥ 1 hr		
	-10(0)[a]	0	1(0)[a]	2(0)[a]		
5. Doors to Corridor	No Door	< 20 Min FLR	≥ 20 Min FLR	≥ 20 Min FLR and Auto Closing		
	-10	0	1(0)[d]	2(0)[d]		
6. Zone Dimensions	Dead End			No Dead Ends >30m and Zone Area Is		
	>30 m	>12m to 30m	<12 m	>2000m²	500m² to 2000m²	<500m²
	-6(0)[b]	-4(0)[b]	-2(0)[b]	-2(0)[c]	0	1
7. Vertical Openings	Open 4 or More Floors	Open 2 or 3 Floors	Enclosed with Indicated Fire Resist			
			≤ 1hr	≥1hr to <2hr	≥ 2 hr	
	-14	-10	0	2(0)[g]	3(0)[g]	
8. Hazardous Areas	Double Deficiency		Single Deficiency		No Deficiency	
	In Zone	Outside Zone	In Zone	In Adjacent Zone		
	-11	-5	-6	-2	0	
9. Smoke Control[c]	No Control	Smoke Barrier Serves Zone	Mech. Assisted Systems by Zone			
	-5(0)[c]	0	3			
10. Emergency Movement Routes	< 2	Multiple Exits				
		Deficient	W/O Horizontal Exits	Horizontal Exits	Direct Exits	
	-8	-2	0	1	5	
11. Manual Call Points[c]	No Manual Call Points	Manual Call Points				
		W/O F.B. Conn.	W/F.B. Conn.			
	-4	1	2			
12. Smoke Detection and Alarm[c]	None	Corridor Only	Rooms Only	Corridor & Habit Spaces	Total Zone Space	
	0(3)[j]	2(3)[j]	4(3)[j]	6	8	
13. Automatic Sprinklers[c]	None	Corridor and Habit Space	Entire Building			
	0	8	10			
14. Fire Retardant Materials	No Materials	Some Materials	All Materials			
	0	1	2			
15. Brigade Response	No Response	> 15 Min	>5 Min and <15 Min	≤ 5 Min		
	0	1	2	6		
16. Emergency Lighting and Illumination	No Emerg. Lighting or Illum. Exits	Illuminated Exits	Emergency Lighting	Emergency Lighting and Illum. Exits		
	-2	1	2	3		
17. Emergency Procedure and Staff Training	No Procedures or Training	Procedures and no training	Training and no procedures	Comprehensive Plan and Training		
	-3	0	3	5		

NOTES:
- a Use (0) where Parameter 5 is –10.
- b Use (0) where Parameter 10 is –8.
- c Use (0) on floor with fewer than 31 patients (existing buildings only).
- d Use (0) where Parameter 4 is –10.
- e If no maintenance plan add a –4 to the value. If repairs and maintenance are done when needed, add a – 2 to the value. The value can never be less than 0.
- g Use (0) where Parameter 1 is based on first floor zone or on an unprotected type of construction (columns marked "U").
- h Use ( ) if the area is class B or C interior finish in the corridor and exit or room is protected by automatic sprinklers and Parameter 13 is 0.
- j Use this value in addition to Parameter 13 if the entire zone is protected with quick-response automatic sprinklers.

Safety Parameters	Containment Safety (S_1)	Extinguishment Safety (S_2)	People Movement Safety (S_3)	General Safety (S_4)
1. Construction	2	2	X	2
2. Interior Finish (Corr. And Exit)	3	X	3	3
3. Interior Finish (Rooms)	3	X	X	3
4. Corridors Partitions/Walls	2	X	X	2
5. Doors to Corridors	0	X	0	0
6. Zone Dimensions	X	X	0	0
7. Vertical Openings	0	X	0	0
8. Hazardous Areas	-2	-2	X	-2
9. Smoke Control	X	X	0	0
10. Emergency Movement Routes	X	X	1	1
11. Manual Call Points	X	2	X	2
12. Smoke Detection and Alarms	X	6	6	6
13. Automatic Sprinklers	10	10	10 ÷2= 5	10
14. Fire Retardant Materials	1	X	X	1
15. Fire Brigade Response Time	X	6	6	6
16. Emergency Lighting and Illumination	X	X	3	3
17. Emergency Procedure and Staff Training	X	X	5	5
Total Value	S_1= 19	S_2= 24	S_3= 29	S_4= 42

Zone Location	Containment (S_a)	Extinguishment (S_b)	People Movement (S_c)
1st Story	9	9	13
2nd Story	13	11	15
3rd Story or Above	15	13	15

						Yes	No
Containment Safety (S_1)	minus	Mandatory Containment (S_a)	$\geq$ 0	S_1 19 - S_a 9 = C 10		✓	
Extinguishment Safety (S_2)	minus	Mandatory Extinguishment (S_b)	$\geq$ 0	S_2 24 - S_b 9 = C 15		✓	
People Movement Safety (S_3)	minus	Mandatory People Movement (S_c)	$\geq$ 0	S_3 29 - S_c 13 = C 16		✓	
General Safety (S_4)	minus	Occupancy Risk (R)	$\geq$ 0	S_4 42 - R 1.6 = C 40.4		✓	

Trial 1 - Child Psychiatry Level 1
In-Patient bedroom areas
MONASH HOSPITAL

Australia Evaluation System

Risk Factor Values

1.) Patient Mobility (M)

Mobility Status	Mobile	Limited Mobility	Not Mobile	Not Movable
Risk Factor	1.0	1.6	3.2	4.5

2.) Patient Density (D)

Floor	1-5	6-10	11-30	>30
Risk Factor	1.0	1.2	1.5	2.0

3.) Zone Location (L)

Floor	1st	2nd or 3rd	4th to 6th	7th and Above	Basements
Risk Factor	1.1	1.2	1.4	1.6	1.6

4.) Ratio of Patients to Attendants (T)

Patients/ Attendants	1-2 / 1	3-5 / 1	6-10 / 1	>10	One or More/None
Risk Factor	1.0	1.1	1.2	1.5	4.0

5.) Patient Average Age (A)

Age	Under 65 Years and Over 1 Year	65 Years and Over, 1 Year and Younger
Risk Factor	1.0	1.2

	M		D		L		T		A		F
Occupancy Risk	1.0	X	1.2	X	1.1	X	1.2	X	1.0	=	1.6

1. Construction	Floor and Zone	Class A	Class B	Class C	Combustible
	First	2	2	0	-2
	Second	4	2	-2	-4
	Third	4	2	-7	-9
	Fourth and Above	4	-7	-9	-13

2. Interior Finish (Corridors and Exits)	Class C	Class B	Class A
	-5(0)[h]	0(3)[h]	3

3. Interior Finish (Rooms)	Class C	Class B	Class A
	-3(1)[h]	1(3)[h]	3

4. Corridors Partitions/Walls	None or Incomplete	< ½ hr	≥ ½ to < 1 hr	≥ 1 hr
	-10(0)[a]	0	1(0)[d]	2(0)[d]

5. Doors to Corridor	No Door	< 20 Min FLR	≥ 20 Min FLR	≥ 20 Min FLR and Auto Closing
	-10	0	1(0)[d]	2(0)[d]

6. Zone Dimensions	Dead End			No Dead Ends >30m and Zone Area Is		
	>30 m	>12m to 30m	<12 m	>2000m²	500m² to 2000m²	<500m²
	-6(0)[b]	-4(0)[b]	-2(0)[b]	-2(0)[c]	0	1

7. Vertical Openings	Open 4 or More Floors	Open 2 or 3 Floors	Enclosed with Indicated Fire Resist		
	-14	-10	< 1hr	≥1hr to <2hr	≥ 2 hr
			0	2(0)[g]	3(0)[g]

8. Hazardous Areas	Double Deficiency		Single Deficiency		No Deficiency
	In Zone	Outside Zone	In Zone	In Adjacent Zone	
	-11	-5	-6	-2	0

9. Smoke Control[c]	No Control	Smoke Barrier Serves Zone	Mech. Assisted Systems by Zone
	-5(0)[c]	0	3

10. Emergency Movement Routes	< 2	Multiple Exits			
		Deficient	W/O Horizontal Exits	Horizontal Exits	Direct Exits
	-8	-2	0	1	5

11. Manual Call Points[c]	No Manual Call Points	Manual Call Points	
		W/O F.B. Conn.	W/F.B. Conn.
	-4	1	2

12. Smoke Detection and Alarm[c]	None	Corridor Only	Rooms Only	Corridor & Habit Spaces	Total Zone Space
	0(3)[j]	2(3)[j]	4(3)[j]	6	8

13. Automatic Sprinklers[c]	None	Corridor and Habit Space	Entire Building
	0	8	10

14. Fire Retardant Materials	No Materials	Some Materials	All Materials
	0	1	2

15. Brigade Response	No Response	> 15 Min	>5 Min and <15 Min	≤ 5 Min
	0	1	2	6

16. Emergency Lighting and Illumination	No Emerg. Lighting or Illum. Exits	Illuminated Exits	Emergency Lighting	Emergency Lighting and Illum. Exits
	-2	1	2	3

17. Emergency Procedure and Staff Training	No Procedures or Training	Procedures and no training	Training and no procedures	Comprehensive Plan and Training
	-3	0	3	5

NOTES:
- a Use (0) where Parameter 5 is –10.
- b Use (0) where Parameter 10 is –8.
- c Use (0) on floor with fewer than 31 patients (existing buildings only).
- d Use (0) where Parameter 4 is –10.
- e If no maintenance plan add a –4 to the value. If repairs and maintenance are done when needed, add a – 2 to the value. The value can never be less than 0.
- g Use (0) where Parameter 1 is based on first floor zone or on an unprotected type of construction (columns marked "U").
- h Use ( ) if the area is class B or C interior finish in the corridor and exit or room is protected by automatic sprinklers and Parameter 13 is 0.
- j Use this value in addition to Parameter 13 if the entire zone is protected with quick-response automatic sprinklers.

Safety Parameters	Containment Safety (S_1)	Extinguishment Safety (S_2)	People Movement Safety (S_3)	General Safety (S_4)
1. Construction	2	2	X	2
2. Interior Finish (Corr. And Exit)	3	X	3	3
3. Interior Finish (Rooms)	3	X	X	3
4. Corridors Partitions/Walls	2	X	X	2
5. Doors to Corridors	0	X	0	0
6. Zone Dimensions	X	X	0	0
7. Vertical Openings	0	X	0	0
8. Hazardous Areas	-6	-6	X	-6
9. Smoke Control	X	X	-5	-5
10. Emergency Movement Routes	X	X	-2	-2
11. Manual Call Points	X	2	X	2
12. Smoke Detection and Alarms	X	0	0	0
13. Automatic Sprinklers	0	0	0 ÷2= 0	0
14. Fire Retardant Materials	1	X	X	1
15. Fire Brigade Response Time	X	6	6	6
16. Emergency Lighting and Illumination	X	X	3	3
17. Emergency Procedure and Staff Training	X	X	5	5
Total Value	S_1= 5	S_2= 4	S_3= 10	S_4= 14

Zone Location	Containment (S_a)	Extinguishment (S_b)	People Movement (S_c)
1st Story	9	9	13
2nd Story	13	11	15
3rd Story or Above	15	13	15

					Yes	No
Containment Safety (S_1)	minus	Mandatory Containment (S_a)	≥ 0	S_1 - S_a = C: $\boxed{5}$ - $\boxed{9}$ = $\boxed{-4}$		✓
Extinguishment Safety (S_2)	minus	Mandatory Extinguishment (S_b)	≥ 0	S_2 - S_b = C: $\boxed{4}$ - $\boxed{9}$ = $\boxed{-5}$		✓
People Movement Safety (S_3)	minus	Mandatory People Movement (S_c)	≥ 0	S_3 - S_c = C: $\boxed{10}$ - $\boxed{13}$ = $\boxed{-3}$		✓
General Safety (S_4)	minus	Occupancy Risk (R)	≥ 0	S_4 - R = C: $\boxed{14}$ - $\boxed{1.6}$ = $\boxed{12.4}$	✓	

Monash Hospital

Australia Evaluation System

Third Child Psychiatry
W/ smoke detector added

Risk Factor Values

1.) Patient Mobility (M)

Mobility Status	Mobile	Limited Mobility	Not Mobile	Not Movable
Risk Factor	1.0	1.6	3.2	4.5

2.) Patient Density (D)

Floor	1-5	6-10	11-30	>30
Risk Factor	1.0	1.2	1.5	2.0

3.) Zone Location (L)

Floor	1st	2nd or 3rd	4th to 6th	7th and Above	Basements
Risk Factor	1.1	1.2	1.4	1.6	1.6

4.) Ratio of Patients to Attendants (T)

Patients/ Attendants	1-2 / 1	3-5 / 1	6-10 / 1	>10	One or More/None
Risk Factor	1.0	1.1	1.2	1.5	4.0

5.) Patient Average Age (A)

Age	~~Under~~ 65 Years and Over 1 Year	65 Years and Over, 1 Year and Younger
Risk Factor	1.0	1.2

Occupancy Risk	M		D		L		T		A		F
	1.0	X	1.2	X	1.1	X	1.2	X	1.0	=	1.6

1.3 = $\square$

1. Construction	Floor and Zone	Class A	Class B	Class C	Combustible	
	First	2	2	0	-2	
	Second	4	2	-2	-4	
	Third	4	2	-7	-9	
	Fourth and Above	4	-7	-9	-13	
2. Interior Finish (Corridors and Exits)	Class C	Class B	Class A			
	-5(0)^{h}	0(3)^{h}	3			
3. Interior Finish (Rooms)	Class C	Class B	Class A			
	-3(1)^{h}	1(3)^{h}	3			
4. Corridors Partitions/Walls	None or Incomplete	< ½ hr	≥ ½ to < 1 hr	≥ 1 hr		
	-10(0)^{a}	0	1(0)^{a}	2(0)^{a}		
5. Doors to Corridor	No Door	< 20 Min FLR	≥ 20 Min FLR	≥ 20 Min FLR and Auto Closing		
	-10	0	1(0)^{d}	2(0)^{d}		
6. Zone Dimensions	Dead End			No Dead Ends >30m and Zone Area Is		
	>30 m	>12m to 30m	<12 m	>2000m^2	500m^2 to 2000m^2	<500m^2
	-6(0)^{b}	-4(0)^{b}	-2(0)^{b}	-2(0)^{c}	0	1
7. Vertical Openings	Open 4 or More Floors	Open 2 or 3 Floors	Enclosed with Indicated Fire Resist			
			< 1hr	≥1hr to <2hr	≥ 2 hr	
	-14	-10	0	2(0)^{g}	3(0)^{g}	
8. Hazardous Areas	Double Deficiency		Single Deficiency		No Deficiency	
	In Zone	Outside Zone	In Zone	In Adjacent Zone		
	-11	-5	-6	-2	0	
9. Smoke Control$^{(e)}$	No Control	Smoke Barrier Serves Zone	Mech. Assisted Systems by Zone			
	-5(0)^{c}	0	3			
10. Emergency Movement Routes	< 2	Multiple Exits				
		Deficient	W/O Horizontal Exits	Horizontal Exits	Direct Exits	
	-8	-2	0	1	5	
11. Manual Call Points$^{(e)}$	No Manual Call Points	Manual Call Points				
		W/O F.B. Conn.	W/F.B. Conn.			
	-4	1	2			
12. Smoke Detection and Alarm$^{(e)}$	None	Corridor Only	Rooms Only	Corridor & Habit Spaces	Total Zone Space	
	0(3)^{j}	2(3)^{j}	4(3)^{j}	6	8	
13. Automatic Sprinklers$^{(e)}$	None	Corridor and Habit Space	Entire Building			
	0	8	10			
14. Fire Retardant Materials	No Materials	Some Materials	All Materials			
	0	1	2			
15. Brigade Response	No Response	> 15 Min	>5 Min and <15 Min	≤ 5 Min		
	0	1	2	6 4		
16. Emergency Lighting and Illumination	No Emerg. Lighting or Illum. Exits	Illuminated Exits	Emergency Lighting	Emergency Lighting and Illum. Exits		
	-2	1	2	3		
17. Emergency Procedure and Staff Training	No Procedures or Training	Procedures and no training	Training and no procedures	Comprehensive Plan and Training		
	-3	0	3	5		

NOTES:
- a Use (0) where Parameter 5 is –10.
- b Use (0) where Parameter 10 is –8.
- c Use (0) on floor with fewer than 31 patients (existing buildings only).
- d Use (0) where Parameter 4 is –10.
- e If no maintenance plan add a –4 to the value. If repairs and maintenance are done when needed, add a – 2 to the value. The value can never be less than 0.
- g Use (0) where Parameter 1 is based on first floor zone or on an unprotected type of construction (columns marked "U").
- h Use ( ) if the area is class B or C interior finish in the corridor and exit or room is protected by automatic sprinklers and Parameter 13 is 0.
- j Use this value in addition to Parameter 13 if the entire zone is protected with quick-response automatic sprinklers.

Safety Parameters	Containment Safety (S_1)	Extinguishment Safety (S_2)	People Movement Safety (S_3)	General Safety (S_4)
1. Construction	2	2	X	2
2. Interior Finish (Corr. And Exit)	3	X	3	3
3. Interior Finish (Rooms)	3	X	X	3
4. Corridors Partitions/Walls	2	X	X	2
5. Doors to Corridors	0	X	0	0
6. Zone Dimensions	X	X	0	0
7. Vertical Openings	0	X	0	0
8. Hazardous Areas	-6	-6	X	-6
9. Smoke Control	X	X	-5	-5
10. Emergency Movement Routes	X	X	-2	-2
11. Manual Call Points	X	2	X	2
12. Smoke Detection and Alarms	X	6	6	6
13. Automatic Sprinklers	0	0	÷2= 0	0
14. Fire Retardant Materials	1	X	X	1
15. Fire Brigade Response Time	X	6	6	6
16. Emergency Lighting and Illumination	X	X	3	3
17. Emergency Procedure and Staff Training	X	X	5	5
Total Value	S_1= 5	S_2= 10	S_3= 18	S_4= 19

1 1
2 4
3 9
5 0
6

Zone Location	Containment (S_a)	Extinguishment (S_b)	People Movement (S_c)
1st Story	9	9	13
2nd Story	13	11	15
3rd Story or Above	15	13	15

								Yes	**No**
Containment Safety (S_1)	minus	Mandatory Containment (S_a)	$\geq$ 0	S_1: 5	-	S_a: 9	= C: -4		✓
Extinguishment Safety (S_2)	minus	Mandatory Extinguishment (S_b)	$\geq$ 0	S_2: 10	-	S_b: 9	= C: 1	✓	
People Movement Safety (S_3)	minus	Mandatory People Movement (S_c)	$\geq$ 0	S_3: 18	-	S_c: 13	= C: 5	✓	
General Safety (S_4)	minus	Occupancy Risk (R)	$\geq$ 0	S_4: 19	-	R: 1.6	= C: 17.4	✓	

Australia Evaluation System

Risk Factor Values

1.) Patient Mobility (M)

Mobility Status	Mobile	Limited Mobility	Not Mobile	Not Movable
Risk Factor	1.0	1.6	3.2	4.5

2.) Patient Density (D)

Floor	1-5	6-10	11-30	>30
Risk Factor	1.0	1.2	1.5	2.0

3.) Zone Location (L)

Floor	1st	2nd or 3rd	4th to 6th	7th and Above	Basements
Risk Factor	1.1	1.2	1.4	1.6	1.6

4.) Ratio of Patients to Attendants (T)

Patients/ Attendants	1-2 / 1	3-5 / 1	6-10 / 1	>10	One or More/None
Risk Factor	1.0	1.1	1.2	1.5	4.0

5.) Patient Average Age (A)

Age	Under 65 Years and Over 1 Year	65 Years and Over, 1 Year and Younger
Risk Factor	1.0	1.2

Occupancy Risk	M		D		L		T		A		F
	2.4	X	1.5	X	1.1	X	1.2	X	[illegible]	=	5.7

Parameter						
1. Construction	Floor and Zone	Class A	Class B	Class C	Combustible	
	First	2	2	0	-2	
	Second	4	2	-2	-4	
	Third	4	2	-7	-9	
	Fourth and Above	4	-7	-9	-13	
2. Interior Finish (Corridors and Exits)	Class C	Class B	Class A			
	-5(0)[h]	0(3)[h]	3			
3. Interior Finish (Rooms)	Class C	Class B	Class A			
	-3(1)[h]	1(3)[h]	3			
4. Corridors Partitions/Walls	None or Incomplete	< ½ hr	≥ ½ to < 1 hr	≥ 1 hr		
	-10(0)[a]	0	1(0)[a]	2(0)[a]		
5. Doors to Corridor	No Door	< 20 Min FLR	≥ 20 Min FLR	≥ 20 Min FLR and Auto Closing		
	-10	0	1(0)[d]	2(0)[d]		
6. Zone Dimensions	Dead End			No Dead Ends >30m and Zone Area Is		
	>30 m	>12m to 30m	<12 m	>2000m²	500m² to 2000m²	<500m²
	-6(0)[b]	-4(0)[b]	-2(0)[b]	-2(0)[c]	0	1
7. Vertical Openings	Open 4 or More Floors	Open 2 or 3 Floors	Enclosed with Indicated Fire Resist			
	-14	-10	< 1hr	≥1hr to <2hr	≥ 2 hr	
			0	2(0)[g]	3(0)[g]	
8. Hazardous Areas	Double Deficiency		Single Deficiency		No Deficiency	
	In Zone	Outside Zone	In Zone	In Adjacent Zone		
	-11	-5	-6	-2	0	
9. Smoke Control[e]	No Control	Smoke Barrier Serves Zone	Mech. Assisted Systems by Zone			
	-5(0)[c]	0	3			
10. Emergency Movement Routes	< 2	Multiple Exits				
		Deficient	W/O Horizontal Exits	Horizontal Exits	Direct Exits	
	-8	-2	0	1	5	
11. Manual Call Points[e]	No Manual Call Points	Manual Call Points				
		W/O F.B. Conn.	W/F.B. Conn.			
	-4	1	2			
12. Smoke Detection and Alarm[e]	None	Corridor Only	Rooms Only	Corridor & Habit Spaces	Total Zone Space	
	0(3)[j]	2(3)[j]	4(3)[j]	6	8	
13. Automatic Sprinklers[e]	None	Corridor and Habit Space	Entire Building			
	0	8	10			
14. Fire Retardant Materials	No Materials	Some Materials	All Materials			
	0	1	2			
15. Brigade Response	No Response	> 15 Min	>5 Min and <15 Min	≤ 5 Min		
	0	1	2	6		
16. Emergency Lighting and Illumination	No Emerg. Lighting or Illum. Exits	Illuminated Exits	Emergency Lighting	Emergency Lighting and Illum. Exits		
	-2	1	2	3		
17. Emergency Procedure and Staff Training	No Procedures or Training	Procedures and no training	Training and no procedures	Comprehensive Plan and Training		
	-3	0	3	5		

NOTES:
- a Use (0) where Parameter 5 is –10.
- b Use (0) where Parameter 10 is –8.
- c Use (0) on floor with fewer than 31 patients (existing buildings only).
- d Use (0) where Parameter 4 is –10.
- e If no maintenance plan add a –4 to the value. If repairs and maintenance are done when needed, add a – 2 to the value. The value can never be less than 0.
- g Use (0) where Parameter 1 is based on first floor zone or on an unprotected type of construction (columns marked "U").
- h Use ( ) if the area is class B or C interior finish in the corridor and exit or room is protected by automatic sprinklers and Parameter 13 is 0.
- j Use this value in addition to Parameter 13 if the entire zone is protected with quick-response automatic sprinklers.

Safety Parameters	Containment Safety (S_1)	Extinguishment Safety (S_2)	People Movement Safety (S_3)	General Safety (S_4)
1. Construction	-2	-2	X	-2
2. Interior Finish (Corr. And Exit)	3	X	3	3
3. Interior Finish (Rooms)	3	X	X	3
4. Corridors Partitions/Walls	0	X	X	0
5. Doors to Corridors	0	X	0	0
6. Zone Dimensions	X	X	0	0
7. Vertical Openings	0	X	0	0
8. Hazardous Areas	-11	-11	X	-11
9. Smoke Control	X	X	0	0
10. Emergency Movement Routes	X	X	1	1
11. Manual Call Points	X	2	X	2
12. Smoke Detection and Alarms	X	2	2	2
13. Automatic Sprinklers	0	0	÷2= 0	0
14. Fire Retardant Materials	1	X	X	1
15. Fire Brigade Response Time	X	6	6	6
16. Emergency Lighting and Illumination	X	X	3	3
17. Emergency Procedure and Staff Training	X	X	3	[illegible]
Total Value	S_1= -[illegible]	S_2= -3	S_3= 19	S_4= [illegible]

Zone Location	Containment (S_a)	Extinguishment (S_b)	People Movement (S_c)
1^{st} Story	9	9	13
2^{nd} Story	13	11	15
3^{rd} Story or Above	15	13	15

						Yes	No
Containment Safety (S_1)	minus	Mandatory Containment (S_a)	$\geq$	0	S_1 $\boxed{-9}$ - S_a $\boxed{9}$ = C $\boxed{-18}$		✓
Extinguishment Safety (S_2)	minus	Mandatory Extinguishment (S_b)	$\geq$	0	S_2 $\boxed{-3}$ - S_b $\boxed{9}$ = C $\boxed{-12}$		✓
People Movement Safety (S_3)	minus	Mandatory People Movement (S_c)	$\geq$	0	S_3 $\boxed{18}$ - S_c $\boxed{13}$ = C $\boxed{5}$	✓	
General Safety (S_4)	minus	Occupancy Risk (R)	$\geq$	0	S_4 $\boxed{11}$ - R $\boxed{5.7}$ = C $\boxed{5.3}$	✓	

Bright Hospital ①

Australia Evaluation System Trial ①

Risk Factor Values

1.) Patient Mobility (M)

Mobility Status	Mobile	Limited Mobility	Not Mobile	Not Movable
Risk Factor	1.0	1.6	3.2	4.5

2.) Patient Density (D)

Floor	1-5	6-10	11-30	>30
Risk Factor	1.0	1.2	1.5	2.0

3.) Zone Location (L)

Floor	1st	2nd or 3rd	4th to 6th	7th and Above	Basements
Risk Factor	1.1	1.2	1.4	1.6	1.6

4.) Ratio of Patients to Attendants (T)

Patients/ Attendants	1-2 / 1	3-5 / 1	6-10 / 1	>10	One or More/None
Risk Factor	1.0	1.1	1.2	1.5	4.0

5.) Patient Average Age (A)

Age	Under 65 Years and Over 1 Year	65 Years and Over, 1 Year and Younger
Risk Factor	1.0	1.2

	M		D		L		T		A		F
Occupancy Risk	2.4	X	2.0	X	1.1	X	1.5	X	1.2	=	9.5

Parameter						
1. Construction	Floor and Zone	Class A	Class B	Class C	Combustible	
	First	2	2	0	-2	
	Second	4	2	-2	-4	
	Third	4	2	-7	-9	
	Fourth and Above	4	-7	-9	-13	
2. Interior Finish (Corridors and Exits)	Class C	Class B	Class A			
	-5(0)[h]	0(3)[h]	3			
3. Interior Finish (Rooms)	Class C	Class B	Class A			
	-3(1)[h]	1(3)[h]	3			
4. Corridors Partitions/Walls	None or Incomplete	< ½ hr	≥ ½ to < 1 hr	≥ 1 hr		
	-10(0)[a]	0	1(0)[a]	2(0)[a]		
5. Doors to Corridor	No Door	< 20 Min FLR	≥ 20 Min FLR	≥ 20 Min FLR and Auto Closing		
	-10	0	1(0)[d]	2(0)[d]		
6. Zone Dimensions	Dead End			No Dead Ends >30m and Zone Area Is		
	>30 m	>12m to 30m	<12 m	>2000m²	500m² to 2000m²	<500m²
	-6(0)[b]	-4(0)[b]	-2(0)[b]	-2(0)[c]	0	1
7. Vertical Openings	Open 4 or More Floors	Open 2 or 3 Floors	Enclosed with Indicated Fire Resist			
	-14	-10	< 1hr	≥1hr to <2hr	≥ 2 hr	
			0	2(0)[g]	3(0)[g]	
8. Hazardous Areas	Double Deficiency		Single Deficiency		No Deficiency	
	In Zone	Outside Zone	In Zone	In Adjacent Zone		
	-11	-5	-6	-2	0	
9. Smoke Control[(e)]	No Control	Smoke Barrier Serves Zone	Mech. Assisted Systems by Zone			
	-5(0)[e]	0	3			
10. Emergency Movement Routes	< 2	Multiple Exits				
		Deficient	W/O Horizontal Exits	Horizontal Exits	Direct Exits	
	-8	-2	0	1	5	
11. Manual Call Points[(e)]	No Manual Call Points	Manual Call Points				
		W/O F.B. Conn.	W/F.B. Conn.			
	-4	1	2			
12. Smoke Detection and Alarm[(e)]	None	Corridor Only	Rooms Only	Corridor & Habit Spaces	Total Zone Space	
	0(3)[j]	2(3)[j]	4(3)[j]	6	8	
13. Automatic Sprinklers[(e)]	None	Corridor and Habit Space	Entire Building			
	0	8	10			
14. Fire Retardant Materials	No Materials	Some Materials	All Materials			
	0	1	2			
15. Brigade Response	No Response	> 15 Min	>5 Min and <15 Min	≤ 5 Min		
	0	1	2	6		
16. Emergency Lighting and Illumination	No Emerg. Lighting or Illum. Exits	Illuminated Exits	Emergency Lighting	Emergency Lighting and Illum. Exits		
	-2	1	2	3		
17. Emergency Procedure and Staff Training	No Procedures or Training	Procedures and no training	Training and no procedures	Comprehensive Plan and Training		
	-3	0	3	5		

NOTES:
- a Use (0) where Parameter 5 is –10.
- b Use (0) where Parameter 10 is –8.
- c Use (0) on floor with fewer than 31 patients (existing buildings only).
- d Use (0) where Parameter 4 is –10.
- e If no maintenance plan add a –4 to the value. If repairs and maintenance are done when needed, add a – 2 to the value. The value can never be less than 0.
- g Use (0) where Parameter 1 is based on first floor zone or on an unprotected type of construction (columns marked "U").
- h Use ( ) if the area is class B or C interior finish in the corridor and exit or room is protected by automatic sprinklers and Parameter 13 is 0.
- j Use this value in addition to Parameter 13 if the entire zone is protected with quick-response automatic sprinklers.

Safety Parameters	Containment Safety (S_1)	Extinguishment Safety (S_2)	People Movement Safety (S_3)	General Safety (S_4)
1. Construction	2	2	X	2
2. Interior Finish (Corr. And Exit)	3	X	3	3
3. Interior Finish (Rooms)	3	X	X	3
4. Corridors Partitions/Walls	1	X	X	1
5. Doors to Corridors	1	X	1	1
6. Zone Dimensions	X	X	1	1
7. Vertical Openings	0	X	0	0
8. Hazardous Areas	0	0	X	0
9. Smoke Control	X	X	0	0
10. Emergency Movement Routes	X	X	5	5
11. Manual Call Points	X	2	X	2
12. Smoke Detection and Alarms	X	0	0	0
13. Automatic Sprinklers	0	0	÷2= 0	0
14. Fire Retardant Materials	1	X	X	1
15. Fire Brigade Response Time	X	1	1	1
16. Emergency Lighting and Illumination	X	X	3	3
17. Emergency Procedure and Staff Training	X	X	3	3
Total Value	S_1= 11	S_2= 5	S_3= 17	S_4= 26

Zone Location	Containment (S_a)	Extinguishment (S_b)	People Movement (S_c)
1^{st} Story	9	9	13
2^{nd} Story	13	11	15
3^{rd} Story or Above	15	13	15

									Yes	No
Containment Safety (S_1)	minus	Mandatory Containment (S_a)	≥	0	S_1: 11	-	S_a: 9	= C: 2	✓	
Extinguishment Safety (S_2)	minus	Mandatory Extinguishment (S_b)	≥	0	S_2: 5	-	S_b: 9	= C: -4		✓
People Movement Safety (S_3)	minus	Mandatory People Movement (S_c)	≥	0	S_3: 17	-	S_c: 13	= C: 4	✓	
General Safety (S_4)	minus	Occupancy Risk (R)	≥	0	S_4: 26	-	R: 9.5	= C: 17.5	✓	

Myrtleford Hospital ②
Trial 1

Australia Evaluation System

Risk Factor Values

1.) Patient Mobility (M)

Mobility Status	Mobile	Limited Mobility	Not Mobile	Not Movable
Risk Factor	1.0	1.6	3.2	4.5

2.) Patient Density (D)

Floor	1-5	6-10	11-30	>30
Risk Factor	1.0	1.2	1.5	2.0

3.) Zone Location (L)

Floor	1st	2nd or 3rd	4th to 6th	7th and Above	Basements
Risk Factor	1.1	1.2	1.4	1.6	1.6

4.) Ratio of Patients to Attendants (T)

Patients/ Attendants	1-2 / 1	3-5 / 1	6-10 / 1	>10	One or More/None
Risk Factor	1.0	1.1	1.2	1.5	4.0

5.) Patient Average Age (A)

Age	Under 65 Years and Over 1 Year	65 Years and Over, 1 Year and Younger
Risk Factor	1.0	1.2

	M		D		L		T		A		F
Occupancy Risk	2.4	X	1.2	X	1.1	X	1.1	X	1.2	=	4.2

Parameter						
1. Construction	Floor and Zone	Class A	Class B	Class C	Combustible	
	First	2	2	0	-2	
	Second	4	2	-2	-4	
	Third	4	2	-7	-9	
	Fourth and Above	4	-7	-9	-13	
2. Interior Finish (Corridors and Exits)	Class C	Class B	Class A			
	-5(0)[h]	0(3)[h]	3			
3. Interior Finish (Rooms)	Class C	Class B	Class A			
	-3(1)[h]	1(3)[h]	3			
4. Corridors Partitions/Walls	None or Incomplete	< ½ hr	≥ ½ to < 1 hr	≥ 1 hr		
	-10(0)[a]	0	0(0)[a]	2(0)[a]		
5. Doors to Corridor	No Door	< 20 Min FLR	≥ 20 Min FLR	≥ 20 Min FLR and Auto Closing		
	-10	0	1(0)[d]	2(0)[d]		
6. Zone Dimensions	Dead End			No Dead Ends >30m and Zone Area Is		
	>30 m	>12m to 30m	<12 m	>2000m^2	500m^2 to 2000m^2	<500m^2
	-6(0)[b]	-4(0)[b]	-2(0)[b]	-2(0)[c]	0	1
7. Vertical Openings	Open 4 or More Floors	Open 2 or 3 Floors	Enclosed with Indicated Fire Resist			
			< 1hr	≥1hr to <2hr	≥ 2 hr	
	-14	-10	0	2(0)[g]	3(0)[g]	
8. Hazardous Areas	Double Deficiency		Single Deficiency		No Deficiency	
	In Zone	Outside Zone	In Zone	In Adjacent Zone		
	-11	-5	-6	-2	0	
9. Smoke Control[c]	No Control	Smcke Barrier Serves Zone	Mech. Assisted Systems by Zone			
	-5(0)	0	3			
10. Emergency Movement Routes	< 2	Multiple Exits				
		Deficient	W/O Horizontal Exits	Horizontal Exits	Direct Exits	
	-8	-2	0	1	5	
11. Manual Call Points[c]	No Manual Call Points	Manual Call Points				
		W/O F.B. Conn.	W/F.B. Conn.			
	-4	1	2			
12. Smoke Detection and Alarm[c]	None	Corridor Only	Rooms Only	Corridor & Habit Spaces	Total Zone Space	
	0(3)[j]	2(3)[j]	4(3)[j]	6	8	
13. Automatic Sprinklers[c]	None	Corridor and Habit Space	Entire Building			
	0	8	10			
14. Fire Retardant Materials	No Materials	Some Materials	All Materials			
	0	1	2			
15. Brigade Respcnse	No Response	> 15 Min	>5 Min and <15 Min	≤ 5 Min		
	0	1	2	6		
16. Emergency Lighting and Illumination	No Emerg. Lighting or Illum. Exits	Illuminated Exits	Emergency Lighting	Emergency Lighting and Illum. Exits		
	-2	1	2	3		
17. Emergency Procedure and Staff Training	No Procedures or Training	Procedures and no training	Training and no procedures	Comprehensive Plan and Training		
	-3	0	3	5		

NOTES:
- a Use (0) where Parameter 5 is –10.
- b Use (0) where Parameter 10 is –8.
- c Use (0) on floor with fewer than 31 patients (existing buildings only).
- d Use (0) where Parameter 4 is –10.
- e If no maintenance plan add a –4 to the value. If repairs and maintenance are done when needed, add a – 2 to the value. The value can never be less than 0.
- g Use (0) where Parameter 1 is based on first floor zone or on an unprotected type of construction (columns marked "U").
- h Use ( ) if the area is class B or C interior finish in the corridor and exit or room is protected by automatic sprinklers and Parameter 13 is 0.
- j Use this value in addition to Parameter 13 if the entire zone is protected with quick-response automatic sprinklers.

Safety Parameters	Containment Safety (S_1)	Extinguishment Safety (S_2)	People Movement Safety (S_3)	General Safety (S_4)
1. Construction	2	2	X	2
2. Interior Finish (Corr. And Exit)	3	X	3	3
3. Interior Finish (Rooms)	3	X	X	3
4. Corridors Partitions/Walls	1	X	X	1
5. Doors to Corridors	0	X	0	0
6. Zone Dimensions	X	X	0	0
7. Vertical Openings	0	X	0	0
8. Hazardous Areas	-2	-2	X	-2
9. Smoke Control	X	X	0	0
10. Emergency Movement Routes	X	X	1	1
11. Manual Call Points	X	2	X	2
12. Smoke Detection and Alarms	X	0	0	0
13. Automatic Sprinklers	0	0	÷2= 0	0
14. Fire Retardant Materials	1	X	X	1
15. Fire Brigade Response Time	X	6	6	6
16. Emergency Lighting and Illumination	X	X	3	3
17. Emergency Procedure and Staff Training	X	X	3	3
Total Value	S_1= 8	S_2= 8	S_3= 16	S_4= 23

Zone Location	Containment (S_a)	Extinguishment (S_b)	People Movement (S_c)
1st Story	9	9	13
2nd Story	13	11	15
3rd Story or Above	15	13	15

				Yes	**No**
Containment Safety (S_1)	minus	Mandatory Containment (S_a)	≥ 0	S_1 $\boxed{8}$ - S_a $\boxed{9}$ = C $\boxed{-1}$		✓
Extinguishment Safety (S_2)	minus	Mandatory Extinguishment (S_b)	≥ 0	S_2 $\boxed{8}$ - S_b $\boxed{9}$ = C $\boxed{-1}$		✓
People Movement Safety (S_3)	minus	Mandatory People Movement (S_c)	≥ 0	S_3 $\boxed{16}$ - S_c $\boxed{13}$ = C $\boxed{3}$	✓	
General Safety (S_4)	minus	Occupancy Risk (R)	≥ 0	S_4 $\boxed{23}$ - R $\boxed{4,2}$ = C $\boxed{18,9}$	✓	

Trial 1 - James Grimes Aged Care Centre, Nambour, Queensland

Australia Evaluation System

NO Sprinklers

Risk Factor Values

1.) Patient Mobility (M)

Mobility Status	Mobile	Limited Mobility	Not Mobile	Not Movable
Risk Factor	1.0	1.6	3.2	4.5

2.) Patient Density (D)

Floor	1-5	6-10	11-30	>30
Risk Factor	1.0	1.2	1.5	2.0

3.) Zone Location (L)

Floor	1^{st}	2^{nd} or 3^{rd}	4^{th} to 6^{th}	7^{th} and Above	Basements
Risk Factor	1.1	1.2	1.4	1.6	1.6

4.) Ratio of Patients to Attendants (T)

Patients/ Attendants	$\frac{1-2}{1}$	$\frac{3-5}{1}$	$\frac{6-10}{1}$	>10	One or More/None
Risk Factor	1.0	1.1	1.2	1.5	4.0

5.) Patient Average Age (A)

Age	Under 65 Years and Over 1 Year	65 Years and Over, 1 Year and Younger
Risk Factor	1.0	1.2

	M		D		L		T		A		F
Occupancy Risk	3.2	X	2.0	X	1.1	X	1.5	X	1.2	=	12.7

1. Construction	Floor and Zone	Class A	Class B	Class C	Combustible
	First	2	2	0	-2
	Second	4	2	-2	-4
	Third	4	2	-7	-9
	Fourth and Above	4	-7	-9	-13

2. Interior Finish (Corridors and Exits)	Class C	Class B	Class A
	-5(0)[h]	0(3)[h]	3

3. Interior Finish (Rooms)	Class C	Class B	Class A
	-3(1)[h]	1(3)[h]	3

4. Corridors Partitions/Walls	None or Incomplete	< ½ hr	≥ ½ to < 1 hr	≥ 1 hr
	-10(0)[a]	0	1(0)[a]	2(0)[a]

5. Doors to Corridor	No Door	< 20 Min FLR	≥ 20 Min FLR	≥ 20 Min FLR and Auto Closing
	-10	0	1(0)[d]	2(0)[d]

6. Zone Dimensions	Dead End			No Dead Ends >30m and Zone Area Is		
	>30 m	>12m to 30m	<12 m	>2000m^2	500m^2 to 2000m^2	<500m^2
	-6(0)[b]	-4(0)[b]	-2(0)[b]	-2(0)[c]	0	1

7. Vertical Openings	Open 4 or More Floors	Open 2 or 3 Floors	Enclosed with Indicated Fire Resist		
	-14	-10	< 1hr	≥1hr to <2hr	≥ 2 hr
			0	2(0)[g]	3(0)[g]

8. Hazardous Areas	Double Deficiency		Single Deficiency		No Deficiency
	In Zone	Outside Zone	In Zone	In Adjacent Zone	
	-11	-5	-6	-2	0

9. Smoke Control[e]	No Control	Smoke Barrier Serves Zone	Mech. Assisted Systems by Zone
	-5(0)[c]	0	3

10. Emergency Movement Routes	< 2	Multiple Exits			
		Deficient	W/O Horizontal Exits	Horizontal Exits	Direct Exits
	-8	-2	0	1	5

11. Manual Call Points[e]	No Manual Call Points	Manual Call Points	
		W/O F.B. Conn.	W/F.B. Conn.
	-4	1	2

12. Smoke Detection and Alarm[e]	None	Corridor Only	Rooms Only	Corridor & Habit Spaces	Total Zone Space
	0(3)[j]	2(3)[j]	4(3)[j]	6	8

13. Automatic Sprinklers[e]	None	Corridor and Habit Space	Entire Building
	0	8	10

14. Fire Retardant Materials	No Materials	Some Materials	All Materials
	0	1	2

15. Brigade Response	No Response	> 15 Min	>5 Min and <15 Min	≤ 5 Min
	0	1	2	6

16. Emergency Lighting and Illumination	No Emerg. Lighting or Illum. Exits	Illuminated Exits	Emergency Lighting	Emergency Lighting and Illum. Exits
	-2	1	2	3

17. Emergency Procedure and Staff Training	No Procedures or Training	Procedures and no training	Training and no procedures	Comprehensive Plan and Training
	-3	0	3	5

NOTES:
- a Use (0) where Parameter 5 is –10.
- b Use (0) where Parameter 10 is -8.
- c Use (0) on floor with fewer than 31 patients (existing buildings only).
- d Use (0) where Parameter 4 is –10.
- e If no maintenance plan add a –4 to the value. If repairs and maintenance are done when needed, add a – 2 to the value. The value can never be less than 0.
- g Use (0) where Parameter 1 is based on first floor zone or on an unprotected type of construction (columns marked "U").
- h Use ( ) if the area is class B or C interior finish in the corridor and exit or room is protected by automatic sprinklers and Parameter 13 is 0.
- j Use this value in addition to Parameter 13 if the entire zone is protected with quick-response automatic sprinklers.

Safety Parameters	Containment Safety (S_1)	Extinguishment Safety (S_2)	People Movement Safety (S_3)	General Safety (S_4)
1. Construction	2	2	X	~~0~~ 2
2. Interior Finish (Corr. And Exit)	3	X	3	3
3. Interior Finish (Rooms)	3	X	X	3
4. Corridors Partitions/Walls	-10	X	X	-10
5. Doors to Corridors	0	X	0	0
6. Zone Dimensions	X	X	-2	-2
7. Vertical Openings	0	X	0	0
8. Hazardous Areas	-11	-11	X	-11
9. Smoke Control	X	X	0	0
10. Emergency Movement Routes	X	X	1	1
11. Manual Call Points	X	2	X	2
12. Smoke Detection and Alarms	X	8	8	8
13. Automatic Sprinklers	0	0	0 ÷2=	0
14. Fire Retardant Materials	1	X	X	1
15. Fire Brigade Response Time	X	6	6	6
16. Emergency Lighting and Illumination	X	X	2	2
17. Emergency Procedure and Staff Training	X	X	3	3
Total Value	S_1= -12	S_2= 7	S_3= 21	S_4= 8

Zone Location	Containment (S_a)	Extinguishment (S_b)	People Movement (S_c)
1st Story	9	9	13
2nd Story	13	11	15
3rd Story or Above	15	13	15

					Yes	No
Containment Safety (S_1)	minus	Mandatory Containment (S_a)	≥ 0	S_1 − S_a = C: $\boxed{-12}$ - $\boxed{9}$ = $\boxed{-21}$		
Extinguishment Safety (S_2)	minus	Mandatory Extinguishment (S_b)	≥ 0	S_2 − S_b = C: $\boxed{7}$ - $\boxed{9}$ = $\boxed{-2}$		
People Movement Safety (S_3)	minus	Mandatory People Movement (S_c)	≥ 0	S_3 − S_c = C: $\boxed{21}$ - $\boxed{13}$ = $\boxed{8}$		
General Safety (S_4)	minus	Occupancy Risk (R)	≥ 0	S_4 − R = C: $\boxed{8}$ - $\boxed{12.7}$ = $\boxed{-4.7}$		

Trial 1 - James Grimes Aged Care Centre, Nambour, Queensland

Australia Evaluation System

Smoke Detectors
w/ Seperation

Risk Factor Values

1.) Patient Mobility (M)

Mobility Status	Mobile	Limited Mobility	Not Mobile	Not Movable
Risk Factor	1.0	1.6	3.2	4.5

2.) Patient Density (D)

Floor	1-5	6-10	11-30	>30
Risk Factor	1.0	1.2	1.5	2.0

3.) Zone Location (L)

Floor	1st	2nd or 3rd	4th to 6th	7th and Above	Basements
Risk Factor	1.1	1.2	1.4	1.6	1.6

4.) Ratio of Patients to Attendants (T)

Patients/ Attendants	1-2 / 1	3-5 / 1	6-10 / 1	>10	One or More/None
Risk Factor	1.0	1.1	1.2	1.5	4.0

5.) Patient Average Age (A)

Age	Under 65 Years and Over 1 Year	65 Years and Over, 1 Year and Younger
Risk Factor	1.0	1.2

	M		D		L		T		A		F
Occupancy Risk	3.2	X	2.0	X	1.1	X	1.5	X	1.2	=	12.7

Parameter						
1. Construction	Floor and Zone	Class A	Class B	Class C	Combustible	
	First	2	2	0	-2	
	Second	4	2	-2	-4	
	Third	4	2	-7	-9	
	Fourth and Above	4	-7	-9	-13	
2. Interior Finish (Corridors and Exits)	Class C	Class B	Class A			
	-5(0)[h]	0(3)[h]	3			
3. Interior Finish (Rooms)	Class C	Class B	Class A			
	-3(1)[h]	1(3)[h]	3			
4. Corridors Partitions/Walls	None or Incomplete	< ½ hr	≥ ½ to < 1 hr	≥ 1 hr		
	-10(0)[a]	0	1(0)[a]	2(0)[a]		
5. Doors to Corridor	No Door	< 20 Min FLR	≥ 20 Min FLR	≥ 20 Min FLR and Auto Closing		
	-10	0	1(0)[d]	2(0)[d]		
6. Zone Dimensions	Dead End			No Dead Ends >30m and Zone Area Is		
	>30 m	>12m to 30m	<12 m	>2000m^2	500m^2 to 2000m^2	<500m^2
	-6(0)[b]	-4(0)[b]	-2(0)[b]	-2(0)[c]	0	1
7. Vertical Openings	Open 4 or More Floors	Open 2 or 3 Floors	Enclosed with Indicated Fire Resist			
	-14	-10	< 1hr	≥1hr to <2hr	≥ 2 hr	
			0	2(0)[g]	3(0)[g]	
8. Hazardous Areas	Double Deficiency		Single Deficiency		No Deficiency	
	In Zone	Outside Zone	In Zone	In Adjacent Zone		
	-11	-5	-6	-2	0	
9. Smoke Control[e]	No Control	Smoke Barrier Serves Zone	Mech. Assisted Systems by Zone			
	-5(0)[c]	0	3			
10. Emergency Movement Routes	< 2	Multiple Exits				
		Deficient	W/O Horizontal Exits	Horizontal Exits	Direct Exits	
	-8	-2	0	1	5	
11. Manual Call Points[e]	No Manual Call Points	Manual Call Points				
		W/O F.B. Conn.	W/F.B. Conn.			
	-4	1	2			
12. Smoke Detection and Alarm[e]	None	Corridor Only	Rooms Only	Corridor & Habit Spaces	Total Zone Space	
	0(3)[j]	2(3)[j]	4(3)[j]	6	8	
13. Automatic Sprinklers[e]	None	Corridor and Habit Space	Entire Building			
	0	8	10			
14. Fire Retardant Materials	No Materials	Some Materials	All Materials			
	0	1	2			
15. Brigade Response	No Response	> 15 Min	>5 Min and <15 Min	≤ 5 Min		
	0	1	2	6		
16. Emergency Lighting and Illumination	No Emerg. Lighting or Illum. Exits	Illuminated Exits	Emergency Lighting	Emergency Lighting and Illum. Exits		
	-2	1	2	3		
17. Emergency Procedure and Staff Training	No Procedures or Training	Procedures and no training	Training and no procedures	Comprehensive Plan and Training		
	-3	0	3	5		

NOTES:
- a Use (0) where Parameter 5 is –10.
- b Use (0) where Parameter 10 is –8.
- c Use (0) on floor with fewer than 31 patients (existing buildings only).
- d Use (0) where Parameter 4 is –10.
- e If no maintenance plan add a –4 to the value. If repairs and maintenance are done when needed, add a – 2 to the value. The value can never be less than 0.
- g Use (0) where Parameter 1 is based on first floor zone or on an unprotected type of construction (columns marked "U").
- h Use ( ) if the area is class B or C interior finish in the corridor and exit or room is protected by automatic sprinklers and Parameter 13 is 0.
- j Use this value in addition to Parameter 13 if the entire zone is protected with quick-response automatic sprinklers.

Safety Parameters	Containment Safety (S_1)	Extinguishment Safety (S_2)	People Movement Safety (S_3)	General Safety (S_4)
1. Construction	2	2	X	2
2. Interior Finish (Corr. And Exit)	3	X	3	3
3. Interior Finish (Rooms)	3	X	X	3
4. Corridors Partitions/Walls	-10	X	X	-10
5. Doors to Corridors	0	X	0	0
6. Zone Dimensions	X	X	-2	-2
7. Vertical Openings	0	X	0	0
8. Hazardous Areas	0	0	X	0
9. Smoke Control	X	X	0	0
10. Emergency Movement Routes	X	X	1	1
11. Manual Call Points	X	2	X	2
12. Smoke Detection and Alarms	X	8	8	8
13. Automatic Sprinklers	0	0	0 ÷2=	0
14. Fire Retardant Materials	1	X	X	1
15. Fire Brigade Response Time	X	6	6	6
16. Emergency Lighting and Illumination	X	X	2	2
17. Emergency Procedure and Staff Training	X	X	3	3
Total Value	S_1= -1	S_2= 18	S_3= 21	S_4= 19

Zone Location	Containment (S_a)	Extinguishment (S_b)	People Movement (S_c)
1st Story	9	9	13
2nd Story	13	11	15
3rd Story or Above	15	13	15

			Yes	No
Containment Safety (S_1) minus	Mandatory Containment (S_a) ≥ 0	S_1 $\boxed{-1}$ - S_a $\boxed{9}$ = C $\boxed{-10}$		
Extinguishment Safety (S_2) minus	Mandatory Extinguishment (S_b) ≥ 0	S_2 $\boxed{14}$ - S_b $\boxed{9}$ = C $\boxed{9}$		
People Movement Safety (S_3) minus	Mandatory People Movement (S_c) ≥ 0	S_3 $\boxed{21}$ - S_c $\boxed{13}$ = C $\boxed{8}$		
General Safety (S_4) minus	Occupancy Risk (R) ≥ 0	S_4 $\boxed{19}$ - R $\boxed{12.7}$ = C $\boxed{6.3}$		

C.2 Trial 2

Trial two consist of minor changes to that of trial one. The results are later specified.

STUDENTS Residence Trial 2

Safety Parameters	Containment Safety (S_1)	Extinguishment Safety (S_2)	People Movement Safety (S_3)	General Safety (S_4)
1. Construction	2	2	X	2
2. Interior Finish (Corr. And Exit)	3	X	3	3
3. Interior Finish (Rooms)	3	X	X	3
4. Corridors Partitions/Walls	2	X	X	2
5. Doors to Corridors	0'	X	0'	0'
6. Zone Dimensions	X	X	0	0
7. Vertical Openings	2	X	2	2
8. Hazardous Areas	-6	-6	X	-6
9. Smoke Control	X	X	0	0
10. Emergency Movement Routes	X	X	5	5
11. Manual Call Points	X	2	X	2
12. Smoke Detection and Alarms	X	0	0	0
13. Automatic Sprinklers	0	0	÷2= 0	0
14. Fire Retardant Materials	1	X	X	1
15. Fire Brigade Response Time	X	4	~~6~~ 4	4
16. Emergency Lighting and Illumination	X	X	3	3
17. Emergency Procedure and Staff Training	X	X	5	5
Total Value	S_1= 8	S_2= 2	S_3=23	S_4= 27

Zone Location	Containment (S_a)	Extinguishment (S_b)	People Movement (S_c)
1st Story	9	9	13
2nd Story	13	11	15
3rd Story or Above	15	13	15

					Yes	**No**
Containment Safety (S_1)	minus	Mandatory Containment (S_a)	$\geq$ 0	S_1 $\boxed{8}$ - S_a $\boxed{13}$ = C $\boxed{-5}$		✓
Extinguishment Safety (S_2)	minus	Mandatory Extinguishment (S_b)	$\geq$ 0	S_2 $\boxed{2}$ - S_b $\boxed{11}$ = C $\boxed{-9}$		✓
People Movement Safety (S_3)	minus	Mandatory People Movement (S_c)	$\geq$ 0	S_3 $\boxed{23}$ - S_c $\boxed{15}$ = C $\boxed{8}$	✓	
General Safety (S_4)	minus	Occupancy Risk (R)	$\geq$ 0	S_4 $\boxed{27}$ - R $\boxed{1.1}$ = C $\boxed{25.9}$	✓	

adult Psychiatry Level 1 Trial 2

Safety Parameters	Containment Safety (S_1)	Extinguishment Safety (S_2)	People Movement Safety (S_3)	General Safety (S_4)
1. Construction	2	2	X	2
2. Interior Finish (Corr. And Exit)	3	X	3	3
3. Interior Finish (Rooms)	3	X	X	3
4. Corridors Partitions/Walls	2	X	X	2
5. Doors to Corridors	0	X	0	0
6. Zone Dimensions	X	X	0	0
7. Vertical Openings	0	X	0	0
8. Hazardous Areas	-2	-2	X	-2
9. Smoke Control	X	X	0	0
10. Emergency Movement Routes	X	X	1	1
11. Manual Call Points	X	2	X	2
12. Smoke Detection and Alarms	X	6	6	6
13. Automatic Sprinklers	10	10	÷2= 5	10
14. Fire Retardant Materials	1	X	X	1
15. Fire Brigade Response Time	X	4	4	6
16. Emergency Lighting and Illumination	X	X	3	3
17. Emergency Procedure and Staff Training	X	X	5	5
Total Value	S_1= 19	S_2= 22	S_3= 27	S_4= 40

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Zone Location	Containment (S_a)	Extinguishment (S_b)	People Movement (S_c)
1^{st} Story	9	9	13
2^{nd} Story	13	11	15
3^{rd} Story or Above	15	13	15

			Yes	No
Containment Safety (S_1)	minus Mandatory Containment (S_a) ≥ 0	S_1 19 - S_a 9 = C 10	✓	
Extinguishment Safety (S_2)	minus Mandatory Extinguishment (S_b) ≥ 0	S_2 22 - S_b 9 = C 13	✓	
People Movement Safety (S_3)	minus Mandatory People Movement (S_c) ≥ 0	S_3 27 - S_c 13 = C 14	✓	
General Safety (S_4)	minus Occupancy Risk (R) ≥ 0	S_4 40 - R 1.6 = C 38.4	✓	

Child Psychiatry Level 1

Trial 2

Safety Parameters	Containment Safety (S_1)	Extinguishment Safety (S_2)	People Movement Safety (S_3)	General Safety (S_4)
1. Construction	2	2	X	2
2. Interior Finish (Corr. And Exit)	3	X	3	3
3. Interior Finish (Rooms)	3	X	X	3
4. Corridors Partitions/Walls	2	X	X	2
5. Doors to Corridors	0	X	0	0
6. Zone Dimensions	X	X	0	0
7. Vertical Openings	0	X	0	0
8. Hazardous Areas	-6	-6	X	-6
9. Smoke Control	X	X	-5	-5
10. Emergency Movement Routes	X	X	-2	-2
11. Manual Call Points	X	2	X	2
12. Smoke Detection and Alarms	X	0	0	0
13. Automatic Sprinklers	0	0	÷2= 0	0
14. Fire Retardant Materials	1	X	X	1
15. Fire Brigade Response Time	X	4	4	4
16. Emergency Lighting and Illumination	X	X	3	3
17. Emergency Procedure and Staff Training	X	X	5	5
Total Value	S_1= 5	S_2= 2	S_3= 8	S_4= 12

Zone Location	Containment (S_a)	Extinguishment (S_b)	People Movement (S_c)
1st Story	9	9	13
2nd Story	13	11	15
3rd Story or Above	15	13	15

				Yes	No
Containment Safety (S_1)	minus	Mandatory Containment (S_a)	≥ 0	S_1 $\boxed{5}$ - S_a $\boxed{9}$ = C $\boxed{-4}$		✓
Extinguishment Safety (S_2)	minus	Mandatory Extinguishment (S_b)	≥ 0	S_2 $\boxed{2}$ - S_b $\boxed{9}$ = C $\boxed{-7}$		✓
People Movement Safety (S_3)	minus	Mandatory People Movement (S_c)	≥ 0	S_3 $\boxed{8}$ - S_c $\boxed{13}$ = C $\boxed{-5}$		✓
General Safety (S_4)	minus	Occupancy Risk (R)	≥ 0	S_4 $\boxed{12}$ - R $\boxed{1.6}$ = C $\boxed{10.4}$	✓	

Trial 2: Child Psychiatry w/ smoke detectors

Safety Parameters	Containment Safety (S_1)	Extinguishment Safety (S_2)	People Movement Safety (S_3)	General Safety (S_4)
1. Construction	2	2	X	2
2. Interior Finish (Corr. And Exit)	3	X	3	3
3. Interior Finish (Rooms)	3	X	X	3
4. Corridors Partitions/Walls	2	X	X	2
5. Doors to Corridors	0	X	0	0
6. Zone Dimensions	X	X	6	0
7. Vertical Openings	0	X	0	0
8. Hazardous Areas	-6	-6	X	-6
9. Smoke Control	X	X	-5	-5
10. Emergency Movement Routes	X	X	-2	-2
11. Manual Call Points	X	2	X	2
12. Smoke Detection and Alarms	X	6	6	6
13. Automatic Sprinklers	0	0	÷2= 0	0
14. Fire Retardant Materials	1	X	X	1
15. Fire Brigade Response Time	X	4	4	4
16. Emergency Lighting and Illumination	X	X	3	3
17. Emergency Procedure and Staff Training	X	X	5	5
Total Value	S_1= 5	S_2= 8	S_3= 16	S_4= 17

Zone Location	Containment (S_a)	Extinguishment (S_b)	People Movement (S_c)
1[st] Story	9	9	13
2[nd] Story	13	11	15
3[rd] Story or Above	15	13	15

			Yes	No
Containment Safety (S_1)	minus Mandatory Containment (S_a) ≥ 0	S_1 $\boxed{5}$ - S_a $\boxed{9}$ = C $\boxed{-4}$		✓
Extinguishment Safety (S_2)	minus Mandatory Extinguishment (S_b) ≥ 0	S_2 $\boxed{8}$ - S_b $\boxed{9}$ = C $\boxed{-1}$		✓
People Movement Safety (S_3)	minus Mandatory People Movement (S_c) ≥ 0	S_3 $\boxed{16}$ - S_c $\boxed{13}$ = C $\boxed{3}$	✓	
General Safety (S_4)	minus Occupancy Risk (R) ≥ 0	S_4 $\boxed{17}$ - R $\boxed{1.6}$ = C $\boxed{15.4}$	✓	

Trial 2 - MT. Beauty Hospital

Safety Parameters	Containment Safety (S_1)	Extinguishment Safety (S_2)	People Movement Safety (S_3)	General Safety (S_4)
1. Construction	-2	-2	X	-2
2. Interior Finish (Corr. And Exit)	3	X	3	3
3. Interior Finish (Rooms)	3	X	X	3
4. Corridors Partitions/Walls	0	X	X	0
5. Doors to Corridors	0	X	0	0
6. Zone Dimensions	X	X	0	0
7. Vertical Openings	0	X	0	0
8. Hazardous Areas	-11	-11	X	-11
9. Smoke Control	X	X	0	0
10. Emergency Movement Routes	X	X	1	1
11. Manual Call Points	X	2	X	2
12. Smoke Detection and Alarms	X	2	2	2
13. Automatic Sprinklers	0	0	÷2= 0	0
14. Fire Retardant Materials	1	X	X	1
15. Fire Brigade Response Time	X	4	4	4
16. Emergency Lighting and Illumination	X	X	3	3
17. Emergency Procedure and Staff Training	X	X	3	3
Total Value	S_1= -9	S_2= -5	S_3= 16	S_4= 9

Zone Location	Containment (S_a)	Extinguishment (S_b)	People Movement (S_c)
1[st] Story	9	9	13
2[nd] Story	13	11	15
3[rd] Story or Above	15	13	15

				Yes	No
Containment Safety (S_1)	minus	Mandatory Containment (S_a)	≥ 0	S_1 $\boxed{-9}$ - S_a $\boxed{9}$ = C $\boxed{-18}$		✓
Extinguishment Safety (S_2)	minus	Mandatory Extinguishment (S_b)	≥ 0	S_2 $\boxed{-5}$ - S_b $\boxed{9}$ = C $\boxed{-14}$		✓
People Movement Safety (S_3)	minus	Mandatory People Movement (S_c)	≥ 0	S_3 $\boxed{16}$ - S_c $\boxed{13}$ = C $\boxed{3}$	✓	
General Safety (S_4)	minus	Occupancy Risk (R)	≥ 0	S_4 $\boxed{9}$ - R $\boxed{5.3}$ = C $\boxed{3.7}$	✓	

Trial 2 - Bright Hostel w/ Brigade Response Lowered

Safety Parameters	Containment Safety (S_1)	Extinguishment Safety (S_2)	People Movement Safety (S_3)	General Safety (S_4)
1. Construction	2	2	X	2
2. Interior Finish (Corr. And Exit)	3	X	3	3
3. Interior Finish (Rooms)	3	X	X	3
4. Corridors Partitions/Walls	1	X	X	1
5. Doors to Corridors	1	X	1	1
6. Zone Dimensions	X	X	1	1
7. Vertical Openings	0	X	0	0
8. Hazardous Areas	0	0	X	0
9. Smoke Control	X	X	0	0
10. Emergency Movement Routes	X	X	5	5
11. Manual Call Points	X	2	X	2
12. Smoke Detection and Alarms	X	0	0	0
13. Automatic Sprinklers	0	0	÷2= 0	0
14. Fire Retardant Materials	1	X	X	1
15. Fire Brigade Response Time	X	1	1	1
16. Emergency Lighting and Illumination	X	X	5	3
17. Emergency Procedure and Staff Training	X	X	3	3
Total Value	S_1= 11	S_2= 5	S_3= 17	S_4= 26

Zone Location	Containment (S_a)	Extinguishment (S_b)	People Movement (S_c)
1^{st} Story	9	9	13
2^{nd} Story	13	11	15
3^{rd} Story or Above	15	13	15

			Yes	**No**
Containment Safety (S_1) minus	Mandatory Containment (S_a) ≥ 0	S_1 $\boxed{11}$ - S_a $\boxed{9}$ = C $\boxed{2}$	✓	
Extinguishment Safety (S_2) minus	Mandatory Extinguishment (S_b) ≥ 0	S_2 $\boxed{5}$ - S_b $\boxed{9}$ = C $\boxed{-4}$		✓
People Movement Safety (S_3) minus	Mandatory People Movement (S_c) ≥ 0	S_3 $\boxed{17}$ - S_c $\boxed{13}$ = C $\boxed{4}$	✓	
General Safety (S_4) minus	Occupancy Risk (R) ≥ 0	S_4 $\boxed{26}$ - R $\boxed{9.5}$ = C $\boxed{17}$5	✓	

Brigade 1 to 4 Myrtle Ford hospital - Trial 2

Safety Parameters	Containment Safety (S_1)	Extinguishment Safety (S_2)	People Movement Safety (S_3)	General Safety (S_4)
1. Construction	2	2	X	2
2. Interior Finish (Corr. And Exit)	3	X	3	3
3. Interior Finish (Rooms)	3	X	X	3
4. Corridors Partitions/Walls	1	X	X	1
5. Doors to Corridors	0	X	0	0
6. Zone Dimensions	X	X	0	0
7. Vertical Openings	0	X	0	0
8. Hazardous Areas	-2	-2	X	-2
9. Smoke Control	X	X	0	0
10. Emergency Movement Routes	X	X	1	1
11. Manual Call Points	X	2	X	2
12. Smoke Detection and Alarms	X	0	0	0
13. Automatic Sprinklers	0	0	÷2= 0	0
14. Fire Retardant Materials	1	X	X	1
15. Fire Brigade Response Time	X	4	4	4
16. Emergency Lighting and Illumination	X	X	3	3
17. Emergency Procedure and Staff Training	X	X	3	3
Total Value	S_1= 8	S_2= 6	S_3= 14	S_4= 21

Zone Location	Containment (S_a)	Extinguishment (S_b)	People Movement (S_c)
1^{st} Story	9	9	13
2^{nd} Story	13	11	15
3^{rd} Story or Above	15	13	15

				Yes	No
Containment Safety (S_1)	minus	Mandatory Containment (S_a)	≥ 0	S_1 $\boxed{8}$ - S_a $\boxed{9}$ = C $\boxed{-1}$		✓
Extinguishment Safety (S_2)	minus	Mandatory Extinguishment (S_b)	≥ 0	S_2 $\boxed{6}$ - S_b $\boxed{9}$ = C $\boxed{-3}$		✓
People Movement Safety (S_3)	minus	Mandatory People Movement (S_c)	≥ 0	S_3 $\boxed{14}$ - S_c $\boxed{12}$ = C $\boxed{1}$	✓	
General Safety (S_4)	minus	Occupancy Risk (R)	≥ 0	S_4 $\boxed{21}$ - R $\boxed{4.2}$ = C $\boxed{16.8}$	✓	

Trial 2 - James Grimes Aged Care Centre
NO Sprinklers

Safety Parameters	Containment Safety (S_1)	Extinguishment Safety (S_2)	People Movement Safety (S_3)	General Safety (S_4)
1. Construction	2	2	X	2
2. Interior Finish (Corr. And Exit)	3	X	3	3
3. Interior Finish (Rooms)	3	X	X	3
4. Corridors Partitions/Walls	-10 ~~3~~	X	X	-10
5. Doors to Corridors	0	X	0	0
6. Zone Dimensions	X	X	-2	-2
7. Vertical Openings	0	X	0	0
8. Hazardous Areas	-11	-11	X	-11
9. Smoke Control	X	X	0	0
10. Emergency Movement Routes	X	X	1	1
11. Manual Call Points	X	2	X	2
12. Smoke Detection and Alarms	X	8	8	8
13. Automatic Sprinklers	0	0	0 ÷2=	0
14. Fire Retardant Materials		X	X	1
15. Fire Brigade Response Time	X	4	4	4
16. Emergency Lighting and Illumination	X	X	2	2
17. Emergency Procedure and Staff Training	X	X	3	3
Total Value	S_1= -12	S_2= 5	S_3= 19	S_4= 6

Zone Location	Containment (S_a)	Extinguishment (S_b)	People Movement (S_c)
1st Story	9	9	13
2nd Story	13	11	15
3rd Story or Above	15	13	15

					Yes	No
Containment Safety (S_1)	minus	Mandatory Containment (S_a)	≥ 0	S_1 $\boxed{-12}$ - S_a $\boxed{9}$ = C $\boxed{-21}$		
Extinguishment Safety (S_2)	minus	Mandatory Extinguishment (S_b)	≥ 0	S_2 $\boxed{5}$ - S_b $\boxed{9}$ = C $\boxed{-4}$		
People Movement Safety (S_3)	minus	Mandatory People Movement (S_c)	≥ 0	S_3 $\boxed{19}$ - S_c $\boxed{13}$ = C $\boxed{6}$		
General Safety (S_4)	minus	Occupancy Risk (R)	≥ 0	S_4 $\boxed{8}$ - R $\boxed{12.7}$ = C $\boxed{-6.7}$		

James Grimes Aged Care Centre

Trial 2

Smoke detec w/separation

Safety Parameters	Containment Safety (S_1)	Extinguishment Safety (S_2)	People Movement Safety (S_3)	General Safety (S_4)
1. Construction	2	2	X	2
2. Interior Finish (Corr. And Exit)	3	X	3	3
3. Interior Finish (Rooms)	3	X	X	3
4. Corridors Partitions/Walls	-10	X	X	-10
5. Doors to Corridors	0	X	0	0
6. Zone Dimensions	X	X	-2	-2
7. Vertical Openings	0	X	0	0
8. Hazardous Areas	0	0	X	0
9. Smoke Control	X	X	0	0
10. Emergency Movement Routes	X	X	1	1
11. Manual Call Points	X	2	X	2
12. Smoke Detection and Alarms	X	8	8	8
13. Automatic Sprinklers	0	0	÷2=	0
14. Fire Retardant Materials	1	X	X	1
15. Fire Brigade Response Time	X	4	4	4
16. Emergency Lighting and Illumination	X	X	2	2
17. Emergency Procedure and Staff Training	X	X	3	3
Total Value	S_1= -1	S_2= 16	S_3= 19	S_4= 17

Zone Location	Containment (S_a)	Extinguishment (S_b)	People Movement (S_c)
1st Story	9	9	13
2nd Story	13	11	15
3rd Story or Above	15	13	15

				Yes	No
Containment Safety (S_1)	minus	Mandatory Containment (S_a)	≥ 0	S_1 $\boxed{-1}$ - S_a $\boxed{9}$ = C $\boxed{-10}$		
Extinguishment Safety (S_2)	minus	Mandatory Extinguishment (S_b)	≥ 0	S_2 $\boxed{16}$ - S_b $\boxed{9}$ = C $\boxed{7}$		
People Movement Safety (S_3)	minus	Mandatory People Movement (S_c)	≥ 0	S_3 $\boxed{19}$ - S_c $\boxed{13}$ = C $\boxed{6}$		
General Safety (S_4)	minus	Occupancy Risk (R)	≥ 0	S_4 $\boxed{17}$ - R $\boxed{12.7}$ = C $\boxed{4.3}$		

C.3 Trial 3

Trial three was weighted to give conclusions that are much closer to the NFPA 101A. The justification for the weighting is in chapter five of this report.

LORNE HOSPITAL Hospital Zone TRIAL 3

Australia Evaluation System

Risk Factor Values

1.) Patient Mobility (M)

Mobility Status	Mobile	Limited Mobility	Not Mobile	Not Movable
Risk Factor	1.0	1.6	3.2	4.5

2.) Patient Density (D)

Floor	1-5	6-10	11-30	>30
Risk Factor	1.0	1.2	1.5	2.0

3.) Zone Location (L)

Floor	1st	2nd or 3rd	4th to 6th	7th and Above	Basements
Risk Factor	1.1	1.2	1.4	1.6	1.6

4.) Ratio of Patients to Attendants (T)

Patients/ Attendants	$\frac{1-2}{1}$	$\frac{3-5}{1}$	$\frac{6-10}{1}$	>10	One or More/None
Risk Factor	1.0	1.1	1.2	1.5	4.0

5.) Patient Average Age (A)

Age	Under 65 Years and Over 1 Year	65 Years and Over, 1 Year and Younger
Risk Factor	1.0	1.2

	M		D		L		T		A		F
Occupancy Risk	3.2	X	1.5	X	1.1	X	1.5	X	1.0	=	8.0

		F		R
10	+	8.0	=	18

1. Construction	Floor and Zone	Class A	Class B	Class C	Combustible
	First	2	2	0	-2
	Second	4	2	-2	-4
	Third	4	2	-7	-9
	Fourth and Above	4	-7	-9	-13

2. Interior Finish (Corridors and Exits)	Class C	Class B	Class A
	-5(0)[h]	0(3)[h]	3

3. Interior Finish (Rooms)	Class C	Class B	Class A
	-3(1)[h]	1(3)[h]	3

4. Corridors Partitions/Walls	None or Incomplete	< ½ hr	≥ ½ to < 1 hr	≥ 1 hr
	-10(0)[a]	0	1(0)[a]	2(0)[a]

5. Doors to Corridor	No Door	< 20 Min FLR	≥ 20 Min FLR	≥ 20 Min FLR and Auto Closing
	-10	0	1(0)[d]	2(0)[d]

6. Zone Dimensions	Dead End			No Dead Ends >30m and Zone Area Is		
	>30 m	>12m to 30m	<12 m	>2000m²	500m² to 2000m²	<500m²
	-6(0)[b]	-4(0)[b]	-2(0)[b]	-2(0)[c]	0	1

7. Vertical Openings	Open 4 or More Floors	Open 2 or 3 Floors	Enclosed with Indicated Fire Resist		
	-14	-10	< 1hr	≥1hr to <2hr	≥ 2 hr
			0	2(0)[g]	3(0)[g]

8. Hazardous Areas	Double Deficiency		Single Deficiency		No Deficiency
	In Zone	Outside Zone	In Zone	In Adjacent Zone	
	-11	-5	-6	-2	0

9. Smoke Control[c]	No Control	Smoke Barrier Serves Zone	Mech. Assisted Systems by Zone
	-5(0)[c]	0 -1	3

10. Emergency Movement Routes	< 2	Multiple Exits			
		Deficient	W/O Horizontal Exits	Horizontal Exits	Direct Exits
	-8	-2	0	1	5

11. Manual Call Points[e]	No Manual Call Points	Manual Call Points	
		W/O F.B. Conn.	W/F.B. Conn.
	-4	1	2 -1

12. Smoke Detection and Alarm[e]	None	Corridor Only	Rooms Only	Corridor & Habit Spaces	Total Zone Space
	0(3)[j]	2(3)[j]	4(3)[j]	6	8

13. Automatic Sprinklers[e]	None	Corridor and Habit Space	Entire Building
	0	8	10

14. Fire Retardant Materials	No Materials	Some Materials	All Materials
	0	1	2

15. Brigade Response	No Response	> 15 Min	>5 Min and <15 Min	≤ 5 Min
	0	1	2	4

16. Emergency Lighting and Illumination	No Emerg. Lighting or Illum. Exits	Illuminated Exits	Emergency Lighting	Emergency Lighting and Illum. Exits
	-2	1	2	3

17. Emergency Procedure and Staff Training	No Procedures or Training	Procedures and no training	Training and no procedures	Comprehensive Plan and Training
	-3	0	3	5

NOTES:
- a Use (0) where Parameter 5 is –10.
- b Use (0) where Parameter 10 is –8.
- c Use (0) on floor with fewer than 31 patients (existing buildings only).
- d Use (0) where Parameter 4 is –10.
- e If no maintenance plan add a –2 to the value. If repairs and maintenance are done when needed, add a – 1 to the value. The value can never be less than 0.
- g Use (0) where Parameter 1 is based on first floor zone or on an unprotected type of construction (columns marked "U").
- h Use ( ) if the area is class B or C interior finish in the corridor and exit or room is protected by automatic sprinklers and Parameter 13 is 0.
- j Use this value in addition to Parameter 13 if the entire zone is protected with quick-response automatic sprinklers.

Safety Parameters	Containment Safety (S_1)	Extinguishment Safety (S_2)	People Movement Safety (S_3)	General Safety (S_4)
1. Construction	0	0	X	0
2. Interior Finish (Corr. And Exit)	-5	X	-5	-5
3. Interior Finish (Rooms)	3	X	X	3
4. Corridors Partitions/Walls	0	X	X	0
5. Doors to Corridors	0	X	0	0
6. Zone Dimensions	X	X	0	0
7. Vertical Openings	0	X	0	0
8. Hazardous Areas	-6	-6	X	-6
9. Smoke Control	X	X	-1	-1
10. Emergency Movement Routes	X	X	5	5
11. Manual Call Points	X	1	X	1
12. Smoke Detection and Alarms	X	0	0	0
13. Automatic Sprinklers	0	0	÷2= 0	0
14. Fire Retardant Materials	0	X	X	0
15. Fire Brigade Response Time	X	2	2	2
16. Emergency Lighting and Illumination	X	X	-2	-2
17. Emergency Procedure and Staff Training	X	X	0	0
Total Value	S_1= -8	S_2= -3	S_3= -1	S_4= -3

Zone Location	Containment (S_a)	Extinguishment (S_b)	People Movement (S_c)
1st Story	9	9	13
2nd Story	13	11	15
3rd Story or Above	15	13	15

					Yes	No
Containment Safety (S_1)	minus	Mandatory Containment (S_a)	$\geq$	0	S_1 $\boxed{-8}$ - S_a $\boxed{9}$ = C $\boxed{}$		
Extinguishment Safety (S_2)	minus	Mandatory Extinguishment (S_b)	$\geq$	0	S_2 $\boxed{-3}$ - S_b $\boxed{9}$ = C $\boxed{}$		
People Movement Safety (S_3)	minus	Mandatory People Movement (S_c)	$\geq$	0	S_3 $\boxed{-1}$ - S_c $\boxed{13}$ = C $\boxed{}$		
General Safety (S_4)	minus	Occupancy Risk (R)	$\geq$	0	S_4 $\boxed{-3}$ - R $\boxed{18}$ = C $\boxed{}$		

-5.8

LORNE NURSING HOME TRIAL 3

Australia Evaluation System

Risk Factor Values

1.) Patient Mobility (M)

Mobility Status	Mobile	Limited Mobility	Not Mobile	Not Movable
Risk Factor	1.0	1.6	3.2	4.5

2.) Patient Density (D)

Floor	1-5	6-10	11-30	>30
Risk Factor	1.0	1.2	1.5	2.0

3.) Zone Location (L)

Floor	1st	2nd or 3rd	4th to 6th	7th and Above	Basements
Risk Factor	1.1	1.2	1.4	1.6	1.6

4.) Ratio of Patients to Attendants (T)

Patients/ Attendants	$\frac{1-2}{1}$	$\frac{3-5}{1}$	$\frac{6-10}{1}$	>10	One or More/None
Risk Factor	1.0	1.1	1.2	1.5	4.0

5.) Patient Average Age (A)

Age	Under 65 Years and Over 1 Year	65 Years and Over, 1 Year and Younger
Risk Factor	1.0	1.2

	M		D		L		T		A		F
Occupancy Risk	3.2	X	1.5	X	1.1	X	1.5	X	1.2	=	9.5

		F		R
10	+	9.5	=	19.5

Parameter						
1. Construction	Floor and Zone	Class A	Class B	Class C	Combustible	
	First	2	2	0	-2	
	Second	4	2	-2	-4	
	Third	4	2	-7	-9	
	Fourth and Above	4	-7	-9	-13	
2. Interior Finish (Corridors and Exits)	Class C	Class B	Class A			
	-5(0)^{h}	0(3)^{h}	3			
3. Interior Finish (Rooms)	Class C	Class B	Class A			
	-3(1)^{h}	1(3)^{h}	3			
4. Corridors Partitions/Walls	None or Incomplete	< ½ hr	≥ ½ to < 1 hr	≥ 1 hr		
	-10(0)^{a}	0	1(0)^{a}	2(0)^{a}		
5. Doors to Corridor	No Door	< 20 Min FLR	≥ 20 Min FLR	≥ 20 Min FLR and Auto Closing		
	-10	0	1(0)^{d}	2(0)^{d}		
6. Zone Dimensions	Dead End			No Dead Ends >30m and Zone Area Is		
	>30 m	>12m to 30m	<12 m	>2000m^2	500m^2 to 2000m^2	<500m^2
	-6(0)^{b}	-4(0)^{b}	-2(0)^{b}	-2(0)^{c}	0	1
7. Vertical Openings	Open 4 or More Floors	Open 2 or 3 Floors	Enclosed with Indicated Fire Resist			
			< 1hr	≥1hr to <2hr	≥ 2 hr	
	-14	-10	0	2(0)^{g}	3(0)^{g}	
8. Hazardous Areas	Double Deficiency		Single Deficiency		No Deficiency	
	In Zone	Outside Zone	In Zone	In Adjacent Zone		
	-11	-5	-6	-2	0	
9. Smoke Control$^{(c)}$	No Control	Smoke Barrier Serves Zone	Mech. Assisted Systems by Zone			
	-5(0)^{c}	0	3			
10. Emergency Movement Routes	< 2	Multiple Exits				
		Deficient	W/O Horizontal Exits	Horizontal Exits	Direct Exits	
	-8	-2	0	1	5	
11. Manual Call Points$^{(e)}$	No Manual Call Points	Manual Call Points				
		W/O F.B. Conn.	W/F.B. Conn.			
	-4	1	2			
12. Smoke Detection and Alarm$^{(e)}$	None	Corridor Only	Rooms Only	Corridor & Habit Spaces	Total Zone Space	
	0(3)^{j}	2(3)^{j}	4(3)^{j}	6	8	
13. Automatic Sprinklers$^{(e)}$	None	Corridor and Habit Space	Entire Building			
	0	8	10			
14. Fire Retardant Materials	No Materials	Some Materials	All Materials			
	0	1	2			
15. Brigade Response	No Response	> 15 Min	>5 Min and <15 Min	≤ 5 Min		
	0	1	2	6		
16. Emergency Lighting and Illumination	No Emerg. Lighting or Illum. Exits	Illuminated Exits	Emergency Lighting	Emergency Lighting and Illum. Exits		
	-2	1	2	3		
17. Emergency Procedure and Staff Training	No Procedures or Training	Procedures and no training	Training and no procedures	Comprehensive Plan and Training		
	-3	0	3	5		

NOTES:

a Use (0) where Parameter 5 is –10.
b Use (0) where Parameter 10 is –8.
c Use (0) on floor with fewer than 31 patients (existing buildings only).
d Use (0) where Parameter 4 is –10.
e If no maintenance plan add a –2 to the value. If repairs and maintenance are done when needed, add a – 1 to the value. The value can never be less than 0.
g Use (0) where Parameter 1 is based on first floor zone or on an unprotected type of construction (columns marked "U").
h Use ( ) if the area is class B or C interior finish in the corridor and exit or room is protected by automatic sprinklers and Parameter 13 is 0.
j Use this value in addition to Parameter 13 if the entire zone is protected with quick-response automatic sprinklers.

Safety Parameters	Containment Safety (S_1)	Extinguishment Safety (S_2)	People Movement Safety (S_3)	General Safety (S_4)
1. Construction	2	2	X	2
2. Interior Finish (Corr. And Exit)	3	X	3	3
3. Interior Finish (Rooms)	3	X	X	3
4. Corridors Partitions/Walls	0	X	X	0
5. Doors to Corridors	0	X	0	0
6. Zone Dimensions	X	X	0	0
7. Vertical Openings	0	X	0	0
8. Hazardous Areas	-6	-6	X	-6
9. Smoke Control	X	X	0	0
10. Emergency Movement Routes	X	X	5	5
11. Manual Call Points	X	2	X	2
12. Smoke Detection and Alarms	X	0	0	0
13. Automatic Sprinklers	0	0	÷2= 0	0
14. Fire Retardant Materials	0	X	X	0
15. Fire Brigade Response Time	X	2	2	2
16. Emergency Lighting and Illumination	X	X	3	3
17. Emergency Procedure and Staff Training	X	X	0	0
Total Value	S_1= 2	S_2= 0	S_3= 13	S_4= 14

Zone Location	Containment (S_a)	Extinguishment (S_b)	People Movement (S_c)
1^{st} Story	9	9	13
2^{nd} Story	13	11	15
3^{rd} Story or Above	15	13	15

			Yes	No
Containment Safety (S_1)	minus Mandatory Containment (S_a) ≥ 0	S_1 $\boxed{2}$ - S_a $\boxed{9}$ = C $\boxed{-7}$		✓
Extinguishment Safety (S_2)	minus Mandatory Extinguishment (S_b) ≥ 0	S_2 $\boxed{0}$ - S_b $\boxed{9}$ = C $\boxed{-9}$		✓
People Movement Safety (S_3)	minus Mandatory People Movement (S_c) ≥ 0	S_3 $\boxed{13}$ - S_c $\boxed{13}$ = C $\boxed{0}$	✓	
General Safety (S_4)	minus Occupancy Risk (R) ≥ 0	S_4 $\boxed{14}$ - R $\boxed{19.5}$ = C $\boxed{-5.5}$		✓

3, 3

Dimboola Hospital Trial 3
Hospital & medical Center

Australia Evaluation System

Risk Factor Values

1.) Patient Mobility (M)

Mobility Status	Mobile	Limited Mobility	Not Mobile	Not Movable
Risk Factor	1.0	1.6	3.2	4.5

2.) Patient Density (D)

Floor	1-5	6-10	11-30	>30
Risk Factor	1.0	1.2	1.5	2.0

3.) Zone Location (L)

Floor	1st	2nd or 3rd	4th to 6th	7th and Above	Basements
Risk Factor	1.1	1.2	1.4	1.6	1.6

4.) Ratio of Patients to Attendants (T)

Patients/ Attendants	1-2 / 1	3-5 / 1	6-10 / 1	>10	One or More/None
Risk Factor	1.0	1.1	1.2	1.5	4.0

5.) Patient Average Age (A)

Age	Under 65 Years and Over 1 Year	65 Years and Over, 1 Year and Younger
Risk Factor	1.0	1.2

Occupancy Risk	M		D		L		T		A		F
	1.6	X	1.5	X	1.1	X	1.0	X	1.2	=	3.2

	F		R
10 +	3.2	=	13.2

1. Construction	Floor and Zone	Class A	Class B	Class C	Combustible
	First	2	2	0	-2
	Second	4	2	-2	-4
	Third	4	2	-7	-9
	Fourth and Above	4	-7	-9	-13

2. Interior Finish (Corridors and Exits)	Class C	Class B	Class A
	-5(0)[h]	0(3)[h]	3

3. Interior Finish (Rooms)	Class C	Class B	Class A
	-3(1)[h]	1(3)[h]	3

4. Corridors Partitions/Walls	None or Incomplete	< ½ hr	≥ ½ to < 1 hr	≥ 1 hr
	-10(0)[a]	0	1(0)[a]	2(0)[a]

5. Doors to Corridor	No Door	< 20 Min FLR	≥ 20 Min FLR	≥ 20 Min FLR and Auto Closing
	-10	0	1(0)[d]	2(0)[d]

6. Zone Dimensions	Dead End			No Dead Ends >30m and Zone Area Is		
	>30 m	>12m to 30m	<12 m	>2000m²	500m² to 2000m²	<500m²
	-6(0)[b]	-4(0)[b]	-2(0)[b]	-2(0)[c]	0	1

7. Vertical Openings	Open 4 or More Floors	Open 2 or 3 Floors	Enclosed with Indicated Fire Resist		
	-14	-10	≤ 1hr	≥1hr to <2hr	≥ 2 hr
			0	2(0)[g]	3(0)[g]

8. Hazardous Areas	Double Deficiency		Single Deficiency		No Deficiency
	In Zone	Outside Zone	In Zone	In Adjacent Zone	
	-11	-5	-6	-2	0

9. Smoke Control[(e)]	No Control	Smoke Barrier Serves Zone	Mech. Assisted Systems by Zone
	-5(0)[c]	0	3

10. Emergency Movement Routes	< 2	Multiple Exits			
		Deficient	W/O Horizontal Exits	Horizontal Exits	Direct Exits
	-8	-2	0	1	5

11. Manual Call Points[(e)]	No Manual Call Points	Manual Call Points	
		W/O F.B. Conn.	W/F.B. Conn.
	-4	1	2

12. Smoke Detection and Alarm[(e)]	None	Corridor Only	Rooms Only	Corridor & Habit Spaces	Total Zone Space
	0(3)[j]	2(3)[j]	4(3)[j]	6	8

13. Automatic Sprinklers[(e)]	None	Corridor and Habit Space	Entire Building
	0	8	10

14. Fire Retardant Materials	No Materials	Some Materials	All Materials
	0	1	2

15. Brigade Response	No Response	> 15 Min	>5 Min and <15 Min	≤ 5 Min
	0	1	2	4

16. Emergency Lighting and Illumination	No Emerg. Lighting or Illum. Exits	Illuminated Exits	Emergency Lighting	Emergency Lighting and Illum. Exits
	-2	1	2	3

17. Emergency Procedure and Staff Training	No Procedures or Training	Procedures and no training	Training and no procedures	Comprehensive Plan and Training
	-3	0	3	5

NOTES:
- a Use (0) where Parameter 5 is –10.
- b Use (0) where Parameter 10 is –8.
- c Use (0) on floor with fewer than 31 patients (existing buildings only).
- d Use (0) where Parameter 4 is –10.
- e If no maintenance plan add a –2 to the value. If repairs and maintenance are done when needed, add a – 1 to the value. The value can never be less than 0.
- g Use (0) where Parameter 1 is based on first floor zone or on an unprotected type of construction (columns marked "U").
- h Use ( ) if the area is class B or C interior finish in the corridor and exit or room is protected by automatic sprinklers and Parameter 13 is 0.
- j Use this value in addition to Parameter 13 if the entire zone is protected with quick-response automatic sprinklers.

Safety Parameters	Containment Safety (S_1)	Extinguishment Safety (S_2)	People Movement Safety (S_3)	General Safety (S_4)
1. Construction	2	2	X	2
2. Interior Finish (Corr. And Exit)	3	X	3	3
3. Interior Finish (Rooms)	3	X	X	3
4. Corridors Partitions/Walls	2	X	X	2
5. Doors to Corridors	1	X	1	1
6. Zone Dimensions	X	X	0	0
7. Vertical Openings	0	X	0	0
8. Hazardous Areas	−11	−11	X	−11
9. Smoke Control	X	X	0	0
10. Emergency Movement Routes	X	X	1	1
11. Manual Call Points	X	2	X	2
12. Smoke Detection and Alarms	X	0	0	0
13. Automatic Sprinklers	0	0	÷2= 0	0
14. Fire Retardant Materials	1	X	X	1
15. Fire Brigade Response Time	X	4	4	4
16. Emergency Lighting and Illumination	X	X	2	2
17. Emergency Procedure and Staff Training	X	X	0	0
Total Value	S_1= 1	S_2= −3	S_3= 11	S_4= 10

Zone Location	Containment (S_a)	Extinguishment (S_b)	People Movement (S_c)
1^{st} Story	9	9	13
2^{nd} Story	13	11	15
3^{rd} Story or Above	15	13	15

					Yes	**No**
Containment Safety (S_1)	minus	Mandatory Containment (S_a)	≥ 0	S_1 - S_a = C: $\boxed{1}$ - $\boxed{9}$ = $\boxed{-8}$		✓
Extinguishment Safety (S_2)	minus	Mandatory Extinguishment (S_b)	≥ 0	S_2 - S_b = C: $\boxed{-3}$ - $\boxed{9}$ = $\boxed{-12}$		✓
People Movement Safety (S_3)	minus	Mandatory People Movement (S_c)	≥ 0	S_3 - S_c = C: $\boxed{11}$ - $\boxed{13}$ = $\boxed{-2}$		✓
General Safety (S_4)	minus	Occupancy Risk (R)	≥ 0	S_4 - R = C: $\boxed{10}$ - $\boxed{13.2}$ = $\boxed{-3.2}$		✓

Dimboola Tr. 6/(3)

Nursing Home/Day Center

Australia Evaluation System

Risk Factor Values

1.) Patient Mobility (M)

Mobility Status	Mobile	Limited Mobility	Not Mobile	Not Movable
Risk Factor	1.0	1.6	3.2	4.5

2.) Patient Density (D)

Floor	1-5	6-10	11-30	>30
Risk Factor	1.0	1.2	1.5	2.0

3.) Zone Location (L)

Floor	1st	2nd or 3rd	4th to 6th	7th and Above	Basements
Risk Factor	1.1	1.2	1.4	1.6	1.6

4.) Ratio of Patients to Attendants (T)

Patients/ Attendants	1-2 / 1	3-5 / 1	6-10 / 1	>10	One or More/None
Risk Factor	1.0	1.1	1.2	1.5	4.0

5.) Patient Average Age (A)

Age	Under 65 Years and Over 1 Year	65 Years and Over, 1 Year and Younger
Risk Factor	1.0	1.2

	M		D		L		T		A		F
Occupancy Risk	2.4	X	1.5	X	1.1	X	1.1	X	1.2	=	5.2

		F		R
10	+	5.2	=	15.2

<table>
<tr><td rowspan="5">1. Construction</td><td colspan="2">Floor and Zone</td><td>Class A</td><td>Class B</td><td>Class C</td><td>Combustible</td></tr>
<tr><td colspan="2">First</td><td>2</td><td>2</td><td>0</td><td>-2</td></tr>
<tr><td colspan="2">Second</td><td>4</td><td>2</td><td>-2</td><td>-4</td></tr>
<tr><td colspan="2">Third</td><td>4</td><td>2</td><td>-7</td><td>-9</td></tr>
<tr><td colspan="2">Fourth and Above</td><td>4</td><td>-7</td><td>-9</td><td>-13</td></tr>
<tr><td rowspan="2">2. Interior Finish (Corridors and Exits)</td><td colspan="2">Class C</td><td colspan="2">Class B</td><td colspan="2">Class A</td></tr>
<tr><td colspan="2">-5(0)[h]</td><td colspan="2">0(3)[h]</td><td colspan="2">3</td></tr>
<tr><td rowspan="2">3. Interior Finish (Rooms)</td><td colspan="2">Class C</td><td colspan="2">Class B</td><td colspan="2">Class A</td></tr>
<tr><td colspan="2">-3(1)[h]</td><td colspan="2">1(3)[h]</td><td colspan="2">3</td></tr>
<tr><td rowspan="2">4. Corridors Partitions/Walls</td><td colspan="2">None or Incomplete</td><td>< ½ hr</td><td>≥ ½ to < 1 hr</td><td colspan="2">≥ 1 hr</td></tr>
<tr><td colspan="2">-10(0)[a]</td><td>0</td><td>1(0)[a]</td><td colspan="2">2(0)[a]</td></tr>
<tr><td rowspan="2">5. Doors to Corridor</td><td colspan="2">No Door</td><td>< 20 Min FLR</td><td>≥ 20 Min FLR</td><td colspan="2">≥ 20 Min FLR and Auto Closing</td></tr>
<tr><td colspan="2">-10</td><td>0</td><td>1(0)[d]</td><td colspan="2">2(0)[d]</td></tr>
<tr><td rowspan="3">6. Zone Dimensions</td><td colspan="3">Dead End</td><td colspan="3">No Dead Ends >30m and Zone Area Is</td></tr>
<tr><td>>30 m</td><td>>12m to 30m</td><td><12 m</td><td>>2000m²</td><td>500m² to 2000m²</td><td><500m²</td></tr>
<tr><td>-6(0)[b]</td><td>-4(0)[b]</td><td>-2(0)[b]</td><td>-2(0)[c]</td><td>0</td><td>1</td></tr>
<tr><td rowspan="3">7. Vertical Openings</td><td colspan="2" rowspan="2">Open 4 or More Floors</td><td rowspan="2">Open 2 or 3 Floors</td><td colspan="3">Enclosed with Indicated Fire Resist</td></tr>
<tr><td>≤1hr</td><td>≥1hr to <2hr</td><td>≥ 2 hr</td></tr>
<tr><td colspan="2">-14</td><td>-10</td><td>0</td><td>2(0)[g]</td><td>3(0)[g]</td></tr>
<tr><td rowspan="3">8. Hazardous Areas</td><td colspan="2">Double Deficiency</td><td colspan="2">Single Deficiency</td><td colspan="2" rowspan="2">No Deficiency</td></tr>
<tr><td>In Zone</td><td>Outside Zone</td><td>In Zone</td><td>In Adjacent Zone</td></tr>
<tr><td>-11</td><td>-5</td><td>-6</td><td>-2</td><td colspan="2">0</td></tr>
<tr><td rowspan="2">9. Smoke Control[(e)]</td><td colspan="2">No Control</td><td colspan="2">Smoke Barrier Serves Zone</td><td colspan="2">Mech. Assisted Systems by Zone</td></tr>
<tr><td colspan="2">-5(0)</td><td colspan="2">0</td><td colspan="2">3</td></tr>
<tr><td rowspan="3">10. Emergency Movement Routes</td><td colspan="2">< 2</td><td colspan="4">Multiple Exits</td></tr>
<tr><td colspan="2" rowspan="2">-8</td><td>Deficient</td><td>W/O Horizontal Exits</td><td>Horizontal Exits</td><td>Direct Exits</td></tr>
<tr><td>-2</td><td>0</td><td>1</td><td>5</td></tr>
<tr><td rowspan="3">11. Manual Call Points[(e)]</td><td colspan="2" rowspan="2">No Manual Call Points</td><td colspan="4">Manual Call Points</td></tr>
<tr><td colspan="2">W/O F.B. Conn.</td><td colspan="2">W/F.B. Conn.</td></tr>
<tr><td colspan="2">-4</td><td colspan="2">1</td><td colspan="2">2</td></tr>
<tr><td rowspan="2">12. Smoke Detection and Alarm[(e)]</td><td colspan="2">None</td><td>Corridor Only</td><td>Rooms Only</td><td>Corridor & Habit Spaces</td><td>Total Zone Space</td></tr>
<tr><td colspan="2">0(3)[j]</td><td>2(3)[j]</td><td>4(3)[j]</td><td>6</td><td>8</td></tr>
<tr><td rowspan="2">13. Automatic Sprinklers[(e)]</td><td colspan="2">None</td><td colspan="2">Corridor and Habit Space</td><td colspan="2">Entire Building</td></tr>
<tr><td colspan="2">0</td><td colspan="2">8</td><td colspan="2">10</td></tr>
<tr><td rowspan="2">14. Fire Retardant Materials</td><td colspan="2">No Materials</td><td colspan="2">Some Materials</td><td colspan="2">All Materials</td></tr>
<tr><td colspan="2">0</td><td colspan="2">1</td><td colspan="2">2</td></tr>
<tr><td rowspan="2">15. Brigade Response</td><td colspan="2">No Response</td><td>> 15 Min</td><td>>5 Min and <15 Min</td><td colspan="2">≤ 5 Min</td></tr>
<tr><td colspan="2">0</td><td>1</td><td>2</td><td colspan="2">4</td></tr>
<tr><td rowspan="2">16. Emergency Lighting and Illumination</td><td colspan="2">No Emerg. Lighting or Illum. Exits</td><td>Illuminated Exits</td><td>Emergency Lighting</td><td colspan="2">Emergency Lighting and Illum. Exits</td></tr>
<tr><td colspan="2">-2</td><td>1</td><td>2</td><td colspan="2">3</td></tr>
<tr><td rowspan="2">17. Emergency Procedure and Staff Training</td><td colspan="2">No Procedures or Training</td><td>Procedures and no training</td><td>Training and no procedures</td><td colspan="2">Comprehensive Plan and Training</td></tr>
<tr><td colspan="2">-3</td><td>0</td><td>3</td><td colspan="2">5</td></tr>
</table>

NOTES:

- a Use (0) where Parameter 5 is –10.
- b Use (0) where Parameter 10 is –8.
- c Use (0) on floor with fewer than 31 patients (existing buildings only).
- d Use (0) where Parameter 4 is –10.
- e If no maintenance plan add a –2 to the value. If repairs and maintenance are done when needed, add a – 1 to the value. The value can never be less than 0.
- g Use (0) where Parameter 1 is based on first floor zone or on an unprotected type of construction (columns marked "U").
- h Use ( ) if the area is class B or C interior finish in the corridor and exit or room is protected by automatic sprinklers and Parameter 13 is 0.
- j Use this value in addition to Parameter 13 if the entire zone is protected with quick-response automatic sprinklers.

Safety Parameters	Containment Safety (S_1)	Extinguishment Safety (S_2)	People Movement Safety (S_3)	General Safety (S_4)
1. Construction	2	2	X	2
2. Interior Finish (Corr. And Exit)	3	X	3	3
3. Interior Finish (Rooms)	3	X	X	3
4. Corridors Partitions/Walls	1	X	X	1
5. Doors to Corridors	1	X	1	1
6. Zone Dimensions	X	X	0	0
7. Vertical Openings	0	X	0	0
8. Hazardous Areas	-11	-11	X	-11
9. Smoke Control	X	X	0	0
10. Emergency Movement Routes	X	X	1	1
11. Manual Call Points	X	2	X	2
12. Smoke Detection and Alarms	X	4	4	4
13. Automatic Sprinklers	0	0	÷2= 0	0
14. Fire Retardant Materials	1	X	X	1
15. Fire Brigade Response Time	X	4	4	4
16. Emergency Lighting and Illumination	X	X	1	1
17. Emergency Procedure and Staff Training	X	X	0	0
Total Value	S_1= 0	S_2= 1	S_3= 14	S_4= 12

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Zone Location	Containment (S_a)	Extinguishment (S_b)	People Movement (S_c)
1st Story	9	9	13
2nd Story	13	11	15
3rd Story or Above	15	13	15

			Yes	No
Containment Safety (S_1) minus Mandatory Containment (S_a)	≥ 0	S_1 $\boxed{0}$ - S_a $\boxed{9}$ = C $\boxed{-9}$		✓
Extinguishment Safety (S_2) minus Mandatory Extinguishment (S_b)	≥ 0	S_2 $\boxed{1}$ - S_b $\boxed{9}$ = C $\boxed{-8}$		✓
People Movement Safety (S_3) minus Mandatory People Movement (S_c)	≥ 0	S_3 $\boxed{14}$ - S_c $\boxed{13}$ = C $\boxed{1}$	✓	
General Safety (S_4) minus Occupancy Risk (R)	≥ 0	S_4 $\boxed{12}$ - R $\boxed{15.2}$ = C $\boxed{-3.2}$		✓

Dimboola Trial 3
Admin Building

Australia Evaluation System

Risk Factor Values

1.) Patient Mobility (M)

Mobility Status	~~Mobile~~	Limited Mobility	Not Mobile	Not Movable
Risk Factor	1.0	1.6	3.2	4.5

2.) Patient Density (D)

Floor	1-5	6-10	11-30	>30
Risk Factor	1.0	1.2	1.5	2.0

3.) Zone Location (L)

Floor	1st	2nd or 3rd	4th to 6th	7th and Above	Basements
Risk Factor	1.1	1.2	1.4	1.6	1.6

4.) Ratio of Patients to Attendants (T)

Patients/ Attendants	1-2 / 1	3-5 / 1	6-10 / 1	>10	One or More/None
Risk Factor	1.0	1.1	1.2	1.5	4.0

5.) Patient Average Age (A)

Age	Under 65 Years and Over 1 Year	65 Years and Over, 1 Year and Younger
Risk Factor	1.0	1.2

Occupancy Risk	M		D		L		T		A		F
	1.0	X	1	X	[illegible]	X	1	X	[illegible]	=	1.1

		F		R
10	+	[illegible]	=	[illegible]

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1. Construction	Floor and Zone	Class A	Class B	Class C	Combustible
	First	2	2	0	-2
	Second	4	2	-2	-4
	Third	4	2	-7	-9
	Fourth and Above	4	-7	-9	-13

2. Interior Finish (Corridors and Exits)	Class C	Class B	Class A
	-5(0)[h]	0(3)[h]	3

3. Interior Finish (Rooms)	Class C	Class B	Class A
	-3(1)[h]	1(3)[h]	3

4. Corridors Partitions/Walls	None or Incomplete	< ½ hr	≥ ½ to < 1 hr	≥ 1 hr
	-10(0)[a]	0	1(0)[a]	2(0)[a]

5. Doors to Corridor	No Door	< 20 Min FLR	≥ 20 Min FLR	≥ 20 Min FLR and Auto Closing
	-10	0	1(0)[d]	2(0)[d]

6. Zone Dimensions	Dead End			No Dead Ends >30m and Zone Area Is		
	>30 m	>12m to 30m	<12 m	>2000m²	500m² to 2000m²	<500m²
	-6(0)[b]	-4(0)[b]	-2(0)[b]	-2(0)[c]	0	1

7. Vertical Openings	Open 4 or More Floors	Open 2 or 3 Floors	Enclosed with Indicated Fire Resist		
			< 1hr	≥1hr to <2hr	≥ 2 hr
	-14	-10	0	2(0)[g]	3(0)[g]

8. Hazardous Areas	Double Deficiency		Single Deficiency		No Deficiency
	In Zone	Outside Zone	In Zone	In Adjacent Zone	
	-11	-5	-6	-2	0

9. Smoke Control[c]	No Control	Smoke Barrier Serves Zone	Mech. Assisted Systems by Zone
	-5(0)[c]	0	3

10. Emergency Movement Routes	< 2	Multiple Exits			
		Deficient	W/O Horizontal Exits	Horizontal Exits	Direct Exits
	-8	-2	0	1	5

11. Manual Call Points[e]	No Manual Call Points	Manual Call Points	
		W/O F.B. Conn.	W/F.B. Conn.
	-4	1	2

12. Smoke Detection and Alarm[e]	None	Corridor Only	Rooms Only	Corridor & Habit Spaces	Total Zone Space
	0(3)[j]	2(3)[j]	4(3)[j]	6	8

13. Automatic Sprinklers[e]	None	Corridor and Habit Space	Entire Building
	0	8	10

14. Fire Retardant Materials	No Materials	Some Materials	All Materials
	0	1	2

15. Brigade Response	No Response	> 15 Min	>5 Min and <15 Min	≤ 5 Min
	0	1	2	4

16. Emergency Lighting and Illumination	No Emerg. Lighting or Illum. Exits	Illuminated Exits	Emergency Lighting	Emergency Lighting and Illum. Exits
	-2	1	2	3

17. Emergency Procedure and Staff Training	No Procedures or Training	Procedures and no training	Training and no procedures	Comprehensive Plan and Training
	-3	0	3	5

NOTES:
- a Use (0) where Parameter 5 is –10.
- b Use (0) where Parameter 10 is –8.
- c Use (0) on floor with fewer than 31 patients (existing buildings only).
- d Use (0) where Parameter 4 is –10.
- e If no maintenance plan add a –2 to the value. If repairs and maintenance are done when needed, add a – 1 to the value. The value can never be less than 0.
- g Use (0) where Parameter 1 is based on first floor zone or on an unprotected type of construction (columns marked "U").
- h Use ( ) if the area is class B or C interior finish in the corridor and exit or room is protected by automatic sprinklers and Parameter 13 is 0.
- j Use this value in addition to Parameter 13 if the entire zone is protected with quick-response automatic sprinklers.

Safety Parameters	Containment Safety (S_1)	Extinguishment Safety (S_2)	People Movement Safety (S_3)	General Safety (S_4)
1. Construction	2	2	X	2
2. Interior Finish (Corr. And Exit)	3	X	3	3
3. Interior Finish (Rooms)	3	X	X	3
4. Corridors Partitions/Walls	1	X	X	1
5. Doors to Corridors	0	X	0	0
6. Zone Dimensions	X	X	1	1
7. Vertical Openings	0	X	0	0
8. Hazardous Areas	-11	-11	X	-11
9. Smoke Control	X	X	0	0
10. Emergency Movement Routes	X	X	1	1
11. Manual Call Points	X	2	X	2
12. Smoke Detection and Alarms	X	0	0	0
13. Automatic Sprinklers	0	0	÷2= 0	0
14. Fire Retardant Materials	1	X	X	1
15. Fire Brigade Response Time	X	4	4	4
16. Emergency Lighting and Illumination	X	X	1	1
17. Emergency Procedure and Staff Training	X	X	0	0
Total Value	S_1= -1	S_2= -3	S_3= 10	S_4= 8

Zone Location	Containment (S_a)	Extinguishment (S_b)	People Movement (S_c)
1^{st} Story	9	9	13
2^{nd} Story	13	11	15
3^{rd} Story or Above	15	13	15

				Yes	No
Containment Safety (S_1) minus Mandatory Containment (S_a) ≥ 0	S_1: $\boxed{1}$	- S_a: $\boxed{9}$	= C: $\boxed{-10}$		✓
Extinguishment Safety (S_2) minus Mandatory Extinguishment (S_b) ≥ 0	S_2: $\boxed{-3}$	- S_b: $\boxed{9}$	= C: $\boxed{-12}$		✓
People Movement Safety (S_3) minus Mandatory People Movement (S_c) ≥ 0	S_3: $\boxed{10}$	- S_c: $\boxed{13}$	= C: $\boxed{-3}$		✓
General Safety (S_4) minus Occupancy Risk (R) ≥ 0	S_4: $\boxed{8}$	- R: $\boxed{11.1}$	= C: $\boxed{-3.1}$		✓

C.4 Comparison Chart of Trials

This Appendix compares the three different trials to each other and to the results of NFPA 101A. The discrepancies are clarified in these charts.

Comparison between NFPA 101A and Australia Evaluation System

	NFPA 101A	1st run	2nd run*	3rd run**	Diference NFPA 101A-1st run	Diference NFPA 101A-2nd run	Diference NFPA 101A-3rd run
Monash Hospital							
Students Residence							
S_1-S_a	2	-5	-5	-5	7	7	7
S_2-S_b	-2	-7	-9	-9	5	7	7
S_3-S_c	10	10	8	8	0	2	2
S_4-R	13	27.9	25.9	15.9	-14.9	-12.9	-2.9
Adult Psychiatry							
S_1-S_a	13	10	10	10	3	3	3
S_2-S_b	12	15	13	13	-3	-1	-1
S_3-S_c	12	16	14	14	-4	-2	-2
S_4-R	24	40.4	38.4	28.4	-16.4	-14.4	-4.4
Child Psychiatry W/O Smoke Detectors							
S_1-S_a	-1	-4	-4	-4	3	3	3
S_2-S_b	-6	-5	-7	-7	-1	1	1
S_3-S_c	-5	-3	-5	-5	-2	0	0
S_4-R	-2	12.9	10.4	0.4	-14.9	-12.4	-2.4
Child Psychiatry W/ Smoke Detectors							
S_1-S_a	-1	-4	-4	-4	3	3	3
S_2-S_b	-2	1	-1	-1	-3	-1	-1
S_3-S_c	1	5	3	3	-4	-2	-2
S_4-R	2	17.4	15.4	5.4	-15.4	-13.4	-3.4
Bright Hostel							
S_1-S_a	5	2	2	2	3	3	3
S_2-S_b	1	-4	-4	-4	5	5	5
S_3-S_c	9	4	4	4	5	5	5
S_4-R	12	17.5	17.5	7.5	-5.5	-5.5	4.5

	NFPA 101A	1st run	2nd run	3rd run	Diference NFPA 101A-1st run	Diference NFPA 101A-2nd run	Diference NFPA 101A-3rd run
Mt. Beauty Hospital							
S_1-S_a	-11	-18	-18	-18	7	7	7
S_2-S_b	-13	-12	-14	-14	-1	1	1
S_3-S_c	5	5	3	3	0	2	2
S_4-R	-4	5.3	3.7	-6.3	-9.3	-7.7	2.3
Myrtleford Hospital							
S_1-S_a	2	-1	-1	-1	3	3	3
S_2-S_b	-2	-1	-3	-3	-1	1	1
S_3-S_c	3	3	-1	-1	0	4	4
S_4-R	7	18.8	16.8	6.8	-11.8	-9.8	0.2
James Grimes Aged Care Centre							
No Sprinklers							
S_1-S_a	-20	-21	-21	-21	1	1	1
S_2-S_b	-8	-2	-4	-4	-6	-4	-4
S_3-S_c	6	8	6	6	-2	0	0
S_4-R	-17	-4.7	-6.7	-16.7	-12.3	-10.3	-0.3
Smoke Detectors W/ Separation							
S_1-S_a	-9	-10	-10	-10	1	1	1
S_2-S_b	3	9	7	7	-6	-4	-4
S_3-S_c	6	8	6	6	-2	0	0
S_4-R	-6	6.3	4.3	-5.7	-12.3	-10.3	-0.3
Lorne Hospital							
S_1-S_a	-13	-17	-17	-17	4	4	4
S_2-S_b	-8	-12	-12	-12	4	4	4
S_3-S_c	-1	-14	-14	-14	13	13	13
S_4-R	-5.8	-31	-31	-21	25.2	25.2	15.2

	NFPA 101A	1st run	2nd run	3rd run	Diference NFPA 101A-1st run	Diference NFPA 101A-2nd run	Diference NFPA 101A-3rd run
Lorne Nursing Home							
S_1-S_a	-3	-7	-7	-7	4	4	4
S_2-S_b	-6	-9	-9	-9	3	3	3
S_3-S_c	7	0	0	0	7	7	7
S_4-R	3.3	-15.5	-15.5	-5.5	18.8	18.8	8.8
Dimboola Hospital							
S_1-S_a	-5	-8	-8	-8	3	3	3
S_2-S_b	-11	-10	-12	-12	-1	1	1
S_3-S_c	4	0	-2	-2	4	6	6
S_4-R	1.08	-11.2	-13.2	-3.2	12.28	14.28	4.28
Dimboola Admin Building							
S_1-S_a	-7	-10	-10	-10	3	3	3
S_2-S_b	-11	-10	-12	-12	-1	1	1
S_3-S_c	4	-1	-3	-3	5	7	7
S_4-R	1.33	-11.1	-13.1	-3.1	12.43	14.43	4.43
Dimboola Nursing Home							
S_1-S_a	-6	-9	-9	-9	3	3	3
S_2-S_b	-4	-6	-8	-8	2	4	4
S_3-S_c	-8	3	1	1	-11	-9	-9
S_4-R	-2.88	-11.2	-13.2	-3.2	8.32	10.32	0.32

*For the second run of the Australia Evaluation System the parameter "fire brigade response" was lower to 4 from 6 for a response less than or equal to five minutes.

**For the third run ten points were added to the occupancy risk.

Appendix D

Appendix D consists of the new evaluation system HESA, the manual explaining its use, and the computer tool to ease the use of HESA.

D.1 HESA – Healthcare Evaluation System of Australia

The final form of HESA completed by the Arup IQP group.

HESA – Healthcare Evaluation System of Australia

Worksheet Table 1-1 Occupancy Risk Parameter Factors

1.) Patient Mobility (M)

Mobility Status	Mobile	Limited Mobility	Not Mobile	Not Movable
Risk Factor	1.0	1.6	3.2	4.5

2.) Patient Density (D)

Floor	1-5	6-10	11-30	>30
Risk Factor	1.0	1.2	1.5	2.0

3.) Zone Location (L)

Floor	1^{st}	2^{nd} or 3^{rd}	4^{th} to 6^{th}	7^{th} and Above	Basements
Risk Factor	1.1	1.2	1.4	1.6	1.6

4.) Ratio of Patients to Attendants (T)

Patients/ Attendants	$\frac{1-2}{1}$	$\frac{3-5}{1}$	$\frac{6-10}{1}$	>10	One or More/None
Risk Factor	1.0	1.1	1.2	1.5	4.0

5.) Patient Average Age (A)

Age	Under 65 Years and Over 1 Year	65 Years and Over, 1 Year and Younger
Risk Factor	1.0	1.2

Worksheet Table 1-2 Occupancy Risk Factor Calculation

	M		D		L		T		A		**F**
Occupancy Risk	☐	X	☐	X	☐	X	☐	X	☐	=	☐

		F		**R**
10	+	☐	=	☐

Worksheet Table 1-3 Safety Parameter Values

1. Construction	Floor and Zone	Class A	Class B	Class C	Combustible	
	First	2	2	0	-2	
	Second	4	2	-2	-4	
	Third	4	2	-7	-9	
	Fourth and Above	4	-7	-9	-13	
2. Interior Finish (Corridors and Exits)	Class C	Class B	Class A			
	-5(0)[a]	0(3)[a]	3			
3. Interior Finish (Rooms)	Class C	Class B	Class A			
	-3(1)[a]	1(3)[a]	3			
4. Corridors Partitions/Walls	None or Incomplete	< ½ hr	≥ ½ to < 1 hr	≥ 1 hr		
	-10(0)[b]	0	1(0)[b]	2(0)[b]		
5. Doors to Corridor	No Door	< 20 Min FLR	≥ 20 Min FLR	≥ 20 Min FLR and Auto Closing		
	-10	0	1(0)[c]	2(0)[c]		
6. Zone Dimensions	Dead End			No Dead Ends >30m and Zone Area Is		
	>30 m	>12m to 30m	<12 m	$>2000m^2$	$500m^2$ to $2000m^2$	$<500m^2$
	-6(0)[d]	-4(0)[d]	-2(0)[d]	-2(0)[e]	0	1
7. Vertical Openings	Open 4 or More Floors	Open 2 or 3 Floors	Enclosed with Indicated Fire Resist			
	-14	-10	< 1hr	≥1hr to <2hr	≥ 2 hr	
			0	2(0)[f]	3(0)[f]	
8. Hazardous Areas	Double Deficiency		Single Deficiency		No Deficiency	
	In Zone	Outside Zone	In Zone	In Adjacent Zone		
	-11	-5	-6	-2	0	
9. Smoke Control[h]	No Control	Smoke Barrier Serves Zone	Mech. Assisted Systems by Zone			
	-5(0)[c]	0	3			
10. Emergency Movement Routes	< 2	Multiple Exits				
		Deficient	W/O Horizontal Exits	Horizontal Exits	Direct Exits	
	-8	-2	0	1	5	
11. Manual Call Points[h]	No Manual Call Points	Manual Call Points				
		W/O F.B. Conn.	W/F.B. Conn.			
	-4	1	2			
12. Smoke Detection and Alarm[h]	None	Corridor Only	Rooms Only	Corridor & Habit Spaces	Total Zone Space	
	0(3)[g]	2(3)[g]	4(5)[g]	6	8	
13. Automatic Sprinklers[h]	None	Corridor and Habit Space	Entire Building			
	0	8	10			
14. Fire Retardant Materials	No Materials	Some Materials	All Materials			
	0	1	2			
15. Brigade Response	No Response	> 15 Min	>5 Min and <15 Min	≤ 5 Min		
	0	1	2	4		
16. Emergency Lighting and Illumination	No Emerg. Lighting or Illum. Exits	Illuminated Exits	Emergency Lighting	Emergency Lighting and Illum. Exits		
	-2	1	2	3		
17. Emergency Procedure and Staff Training	No Procedures or Training	Procedures and no training	Training and no procedures	Comprehensive Plan and Training		
	-3	0	3	5		

NOTES:

a. Use ( ) if the area is class B or C interior finish in the corridor and exit or room is protected by automatic sprinklers and Parameter 13 is 0.
b. Use (0) where Parameter 5 is –10.
c. Use (0) where Parameter 4 is –10.
d. Use (0) where Parameter 10 is –8.
e. Use (0) on floor with fewer than 31 patients.
f. Use (0) where Parameter 1 is based on first floor zone or on an unprotected type of construction (columns marked "U").
g. Use this value in addition to Parameter 13 if the entire zone is protected with quick-response automatic sprinklers.
h. If no maintenance plan add a –2 to the value. If repairs and maintenance are done when needed, add a – 1 to the value. The value can never be less than 0.

Worksheet Table 1-4 Individual Safety Evaluations

Safety Parameters	Containment Safety (S_1)	Extinguishment Safety (S_2)	People Movement Safety (S_3)	General Safety (S_4)
1. Construction			X	
2. Interior Finish (Corr. And Exit)		X		
3. Interior Finish (Rooms)		X	X	
4. Corridors Partitions/Walls		X	X	
5. Doors to Corridors		X		
6. Zone Dimensions	X	X		
7. Vertical Openings		X		
8. Hazardous Areas			X	
9. Smoke Control	X	X		
10. Emergency Movement Routes	X	X		
11. Manual Call Points	X		X	
12. Smoke Detection anu Alarms	X			
13. Automatic Sprinklers			÷2=	
14. Fire Retardant Materials		X	X	
15. Fire Brigade Response Time	X			
16. Emergency Lighting and Illumination	X	X		
17. Emergency Procedure and Staff Training	X	X		
Total Value	S_1=	S_2=	S_3=	S_4=

Worksheet Table 1-5 Individual Safety Evaluations

Zone Location	Containment (S_a)	Extinguishment (S_b)	People Movement (S_c)
1st Story	9	9	13
2nd Story	13	11	15
3rd Story or Above	15	13	15

Worksheet Table 1-6 Zone Fire Safety Equivalency Evaluation

Containment Safety (S_1)	minus	Mandatory Containment (S_a)	$\geq$ 0	S_1 - S_a = C
Extinguishment Safety (S_2)	minus	Mandatory Extinguishment (S_b)	$\geq$ 0	S_2 - S_b = C
People Movement Safety (S_3)	minus	Mandatory People Movement (S_c)	$\geq$ 0	S_3 - S_c = C
General Safety (S_4)	minus	Occupancy Risk (R)	$\geq$ 0	S_4 - R = C

Worksheet Table 1-7 Fire Safety Priority Table

				Interim	Priority 1	Priority 2	Priority 3
Containment Safety (S_1)	minus	Mandatory Containment (S_a)	$\geq$ 0				
Extinguishment Safety (S_2)	minus	Mandatory Extinguishment (S_b)	$\geq$ 0				
People Movement Safety (S_3)	minus	Mandatory People Movement (S_c)	$\geq$ 0				
General Safety (S_4)	minus	Occupancy Risk (R)	$\geq$ 0				

-If value is less than –15 check "Interim" box. The priority, "Interim", is defined as critical matters of fire safety, which require attention immediately.
-If value is greater than or equal to –15 but less than –5 check "Priority 1" box. "Priority 1" is for matters which require urgent action within the next 12 month to improve fire safety.
-If value is greater than or equal to –5 but less than 5 check "Priority 2" box. "Priority 2" is for matter which present a medium level of risk to fire safety and improvement works should be programmed for the next 2 to 5 years.
-If value is greater than or equal to 5 check "Priority 3" box. "Priority 3" is for matters of low risk to fire safety, which require further consideration, analysis or review in master planning or further investigations.

D.2 HESA Manual

The manual consists of the descriptions of the parameters and the step by step processes taken to complete an evaluation of a healthcare facility in Australia.

HESA Manual

This is a fire safety evaluation tool modeled after the NFPA's 101A. This manual provides instructions to complete the evaluation of Healthcare Facilities in Australia as well as descriptions of each parameter being evaluated. Much of the description and steps are taken directly from the NFPA 101A and the BCA.
The evaluation is done on each of the Fire/Smoke Zones in the facility. A Fire/Smoke Zone is a space that is separated by floors, horizontal exits, or smoke barriers. If there are no horizontal exits the entire floor is considered a zone.

A floor that is not subdivided by horizontal exits or smoke barriers is considered a single zone. The entire facility shall be divided into zones. In the case of repetition an evaluation of a typical zone may represent the rest. The zones should include:

(a) Each type of patient zone having a different type of mobility, or attendant ratio
(b) Each zone that has different construction, finish, or protection system
(c) Zones with special medical treatment
(d) Zones not involving patients should be evaluated as follows:
  1. Any zone, whether or not used for patient egress, shall be permitted to be evaluated on the same basis as a patient use zone. In such case the value of factor F in the occupancy shall be assigned a value of factor L. In such a case, the parameter 10, Emergency Movement Routes, should be graded as deficient if the exit capacity is less than that prescribed for the actual occupancy of the space and "*<2 routes*" if less than 75 percent of the prescribed exit capacity is present.
  2. If the zone is separated form all patient use zones by a 2-hour fire-rated construction it shall be permitted to be excluded from the evaluation. The space shall conform with the portion of the *BCA* appropriate to its use. In addition, appropriate charges under Safety parameter 8, Hazardous Areas, shall be charged against other zones in the facility.
  3. Evaluation of an unoccupied floor located above the highest floor used for the healthcare occupancy is not required, provided the unoccupied floors meet the construction requirements of Section A in the *BCA* or if the floor is protected by sprinklers.
(e) Patient sleeping rooms or suites exceeding that specified by the BCA, which should be evaluated as follows:
  1. If the room or suited has a single exit access door, it should be evaluated as a single dead-end zone.
  2. A patient sleeping room or suite of sleeping rooms exceeding the BCA specification should be evaluated as a separated zone.
  3. A room other than a patient sleeping room-exceeding the specifications should be evaluated as a separate zone.

The following is the limits set by the BCA for Zone Dimensions.

Maximum Size of Fire Compartments or Atria				
Classification		Type of construction		
		A	B	C
9a	max floor area-	5000m^2	3500m^2	2000m^2
	max volume-	30000m^2	21000m^2	12000m^2

Once the Fire/Smoke zone is determined the evaluation can be completed on that zone. The following are the descriptions of the parameters that are evaluated. Much of the information is directly out of the NFPA 101A and the BCA.
The first five are used to establish a value of the *Occupancy Risk*. The *Occupancy Risk* is evaluated in the first worksheet of the FSES.

1. **Patient Mobility**: The single most important factor in controlling risk in a healthcare facility is the degree to which patients need assistance in taking the actions necessary for their safety. The status of the mobility is the capability of each patient to take actions necessary for self-protection. Below are the four different classifications.

(a) *Mobile.* Capable of readily rising from bed and taking self-protecting actions at approximately the same rate as a healthy adult. In order to be classified as mobile, the patient must not need assistance in getting out of bed and must be able to open a closed or locked door. Persons shall be considered to be mobile if they are not restrained or in any way other than limited in response capabilities so that the type of arousal mechanism that normally would awaken an adult is not effective.
(b) *Limited mobility.* Those patients who have all of the capabilities of a mobile person except that the travel is slower.
(c) *Not Mobile.* Patients incapable of removing themselves from danger by themselves. Examples are persons that are bedridden, restrained, or otherwise prevented from taking complete emergency actions without assistance.
(d) *Not Moveable.* Patients not capable of being moved from the room in which they are housed during the course of a fire. Examples include patients attached to life support machines or surgical procedure that prohibit their immediate relocation.

2. **Patient Density**: The occupancy risk evaluation for occupancy density measures both the inherent increase in the maximum fire death potential that occurs as the number of patients in a zone increases and the problems involved for a limited staff in handling larger numbers of patients during an emergency. The number of patients is essentially the number of beds that can be filled.
3. **Zone Location**: This factor relates the accessibility the fire brigade has to an area/zone.
   (a) *Floor factor.* The measured zone's location shall be considered to be on floor one if the floor has direct access to the exterior at or within less than one-half floor height above or below grade. If a building is on a sloping grade, each floor that has such an exterior access shall be considered to be a first floor.
4. **Ratio of Patients to Attendants**: This risk factor recognizes the importance to patient safety of a staff that is immediately available to respond in an emergency. The staff ratio considered is based on the minimum staffing level immediately available (normally the night shifts).
   (a) *Patient-Attendant Factor.* The ratio calculation is based on those patients in the fire/smoke zone and the immediately available attendant staff. The ratio calculation shall be based on the minimum staffing level (usually occurring during the night).
5. **Patient Average Age**: This risk factor recognizes the increased susceptibility of the elderly and of Infants up to one year old to physical harm by smoke particles, gaseous combustible products, and heated air.

The following seventeen parameters are the *Safety Parameters*. The safety parameters are a measure of those building factors that bear on or contribute to the safety of those persons who might be in the particular zone at the time of a fire. Only one value can be chosen for each of the parameters.

1. **Construction:** The construction types are defined in the BCA. The construction types used by the BCA are A, B, and C. A fourth type of combustible was added to provide values for a building with a hazardous construction. Where the facility includes additions or connected structures of different construction, the rating and classification of the structure shall be based on the following:
   (a) Separate facilities if a 120-minute or greater fire resistance level separation exists.
   (b) The lower safety parameter point score involved if such a separation does not exist
   The story is the distance to the primary level of exit discharge, or ground floor. This works the same for floors above and below the ground level. The FRL ratings are referenced in Appendix B of the HESA report.

2&3 **Interior Finish (Corridors, rooms and exits):** The flame-spread classification shall be based on the most combustible surface after the deletion of the trim.
The three classifications that are used are A, B, and C based on the SFI and SDI as seen below.

	Flame Spread Index	Smoke Development Index
Class A	0	0-2
Class B	1-3	0-5
Class C	>4	>6

4. **Corridors Partitions/Walls:** All elements of the partition, except the door need be included in the determination of its time-rated fire resistance classification. The BCA defines the types of materials that are acceptable in section C1.10. This can be seen in **appendix B.**
   (a) Corridor partitions shall be given the value of none or incomplete if they do not meet the requirements of the BCA.
   (b) Partitions shall be permitted to be graded as " < 1/2 hour," provided the ceiling within the fire/smoke zone is of a design and construction to resist the passage of smoke.
   (c) Corridor partitions shall be graded as "greater than or equal to ½ hours but less than 1 hour" or "greater than or equal to one hour" only where the partitions extend to the underside of the floor or roof construction.
5. **Doors to Corridors:** The classification of doors to corridors shall be based on the minimum quality of any door in the zone. The specifications are defined in section C3.4 of the BCA.
   (a) A room shall be considered not having a door in the opening if there is some other mechanism that prevents closing of the door. Doors that have been blocked by door stops, chocks, tie backs, or other devises that necessitate manual unlatching or releasing action to close the door are also considered "no door".
   (b) Doors are graded as "less than 20 minutes", "greater than 20 minutes", and "greater than or equal to 20 minutes and Auto close" if the FRL correlates.
      (i) If doors are constantly kept closed except when persons are passing through them, they are considered as automatically closing.
      (ii) If self-closing doors are blocked open the are classified as "no door".
6. **Zone Dimensions:** Zone dimensions are determined by the BCA
   (a) The length of a corridor "dead end" shall be measured from the point at which a person egressing from the dead end would have an option of egression in two separate directions.
   (b) For each zone the value of the worst safety level is assessed for the entire zone.
   (c) A value of zero is assigned if the if the risk factor of emergency movements is given a value of negative eight. The reason for this is not to take away points in two areas.
7. **Vertical Openings:** These values apply to vertical openings and penetrations including exits stairways, ramps, other vertical exits, pipe shafts, ventilation shafts, duct penetration, laundry and incinerator chutes.
   (a) Enclosures shall be of construction having a fire resistance level not less than prescribed.
   (b) A vertical opening or penetration shall be considered if it has the following characteristics:
      (i) unenclosed
      (ii) Enclosed but does not have doors
      (iii) Enclosed but has openings other than doorways
      (iv) Enclosed with cloth, paper, or similar materials without any sustained flame-stopping capabilities.
   (c) Where vertical openings are located outside the fire/smoke zone and the separation between the zone and vertical openings are of the prescribed FRL or greater and higher than the FRL of the vertical opening protection, the higher value is used.
   (d) Vertical openings shall be considered open for more than three floors if there is unprotected penetration of four or more floors without a cutoff. If the shaft is enclosed at all floors except one and this results in an unprotected opening between the shaft and one fire/smoke zone, the parameter value assigned for that zone is given a value of zero.
8. **Hazardous Areas:** In assessing the parameter value for hazardous area, only one value should be chosen. It shall be the most severe value according to the deficiencies in that zone. A hazard
   (a) A *"double deficiency"* occurs when a hazard is severe and the area doesn't have sprinklers. Both a fire enclosure and sprinkler system are necessary to have complete protection.
   (b) The maximum deficiency that can be given to a hazard that is not severe is *"single deficiency"*.
   (c) A *"single deficiency"* situation also is considered to exist where a severe hazard is protected by automatic extinguishing system or by fire resistance-rating enclosure, but not both.
9. **Smoke Control:** Smoke Control consists of smoke barriers and or mechanical extinguishing systems.
   (a) *"No Control"* is defined as being no smoke barriers on the floor, and there is no mechanical smoke control.

(b) "*Smoke barrier serves zone*" is defined as a partition extending across the entire width of the zone equipped with doors that either are self-closing or are closed by smoke detectors.

(c) "*Mechanically assisted smoke control*" shall include a smoke control system that obstructs the leakage of smoke between zones.

10. **Emergency Movement Routes:** A movement route is any means of egress meeting section D of the BCA. Horizontal exits may be counted as required exits if the path of travel from a fire compartment leads by one or more horizontals exits directly into another fire compartment that has at least one required exit. This one cannot be a horizontal exit. Horizontal exits must be 2.5 m^2 per patient.
    (a) An emergency movement route is designated as "*fewer than two routes*" is there is not at least two remote movement routes serving the zone. Movement routes shall be permitted to be outside the physical limits of the zone.
    (b) "*Multiple routes*" are assigned when occupants have the choice of two or more distinctly separated movement routes from the zone.
    (c) "*Horizontal exits*" may be counted as required exits if the path of travel from a fire compartment leads by one or more horizontal exits directly into another fire compartment which has at least one required exits which is not a horizontal exit.
    (d) The presence of a "*single horizontal exit*" from the zone being evaluated shall be assigned a value of one, if the space on the opposite side of the exit is capable of handling all of the patients from affected zones.
    (e) "*Direct exits*" need to have a door operable by the room occupants that opens directly to the exterior balcony with direct access to an exterior exit to a smokeproof enclosure. The direct exits shall be ramped or without steps.
11. **Manual Fire Alarm:** Manual call points should be provided so that no point is more than 30m from a call point unless the patient characteristics are such that deliberate false alarms could be raised. In such case manual call points shall be positioned in each staff area. Connection to the fire department shall be considered as being met if the fire alarm system is connected directly to the fire department, through an approved central station, or through other means acceptable to the authority having jurisdiction.
12. **Smoke Detection and Alarm:**
    (a) "*None*" is designated when no detectors are present.
    (b) In the situation where smoke detectors are in the "*corridors only*" the parameter is assigned a value of 2.
    (c) "*Rooms only*" is designated when at least one detector is in each of the patient rooms.
    (d) "*Corridors and habitable spaces*" are designated when systems are installed throughout the corridors of the zone involved and the habitable spaces.
    (e) "*Total spaces*" is when there is a system in all spaces except non-combustible building voids that contain no combustible materials.
13. **Automatic Sprinklers:** A sprinkler system must comply with the AS 2118.1. Where a part of a building is not protected with sprinklers it must be separated by a two-hour firewall. Fast response sprinklers may be installed only if they are suitable for the type of application proposed. Sprinklers are only given half the credit for the people safety movement. Each sprinkler system shall be interconnected electrically with the fire alarm system and the main sprinkler control value.
    (a) No credit is applied if there are no sprinklers of if they are not sufficient in quality.
    (b) If there are sprinklers in the "*Corridors and Habitable space*" the parameter is assigned a value of 8.
    (c) If there are sprinklers in the entire facility then the parameter is given a value of 10.
14. **Fire Retardant Material:** All newly purchased upholstered furnishings, mattresses, curtains and the like shall be flame-retardant or treated with flame-retardants to minimize the risk of ignition. In areas accommodating the mentally ill, intellectually disabled or other patients likely to cause injury to themselves or others, it is recommended that the foam fillings of mattresses and other furnishings be treated with fire retardants.
    (a) For a zone with "*no retardant materials*" the value of 0 is designated.
    (b) For a zone with "*some fire retardant materials*" the value 1 is designated.
    (c) For a zone with "*all materials being retardant*" is awarded a value of 2.
15. **Brigade Response:** The response time of the fire brigade is an essential part of maintaining life safety.
    (a) If there is "*no response*" the value of 0 is assigned.

(b) If the response is "> *15 min*" then a value of 1 is assigned.
(c) If the response is ">*5 min <15min*" then a value of 2 is assigned.
(d) If the response is "<5" the maximum value of 4 is given.

16. Emergency lighting and Illumination: Emergency lighting should be provided in every passageway, corridor, hallway, stairway, rooms with patient access bigger than $120m^2$, at fire control areas, call points, and any other location deemed necessary. Exit signs are required to be above doors and exit directions and to be seen from any point in the corridor.
(a) The value of –2 is given if both criteria are less than satisfactory.
(b) The value of 1 is given if there are only "*illuminated exits*".
(c) The value of 2 is given if there is "*emergency lighting*".
(d) The value of 3 is given if the zone meets both criteria.

17. Emergency Procedure and Staff Training: Procedures covering fire and other building emergencies shall be prepared and documented for each buildings or unit on site. The procedures shall include separate sections covering actions in the event of activation of smoke or heat detector, discovery of fire/smoke incident or suspect conditions by staff, evacuation procedures, fire notices and emergency plans. The procedures shall be developed and documented specifically for staff in each facility, taking into account client characteristics, staff levels, fire protection systems, facility layout etc., and shall be reviewed at least annually. All staff shall be assessed at intervals not exceeding six months and shall receive further training if competency levels are not met.
(a) The value of –3 is given to the parameter if there is "*no existing procedures or training*".
(b) If there are "*procedures and no training*" a value of 0 is assigned.
(c) If there is regular "*training but no procedures*" a value of 3 is assigned.
(d) For having a both a "*comprehensive plan and training*" a value of 5 is assigned.

Healthcare Evaluation System of Australia

The evaluation is composed of four worksheets.
Complete the Occupancy Risk Parameters Worksheet first.
Step 1: Determine the occupancy risk parameter factors by using table 1. For each risk parameter select the appropriate risk factor value. Choose only one for each of the five parameters.

Worksheet Table 1-1 Occupancy Risk Parameter Factors

1.) Patient Mobility (M)

Mobility Status	Mobile	Limited Mobility	Not Mobile	Not Movable
Risk Factor	1.0	1.6	3.2	4.5

2.) Patient Density (D)

Floor	1-5	6-10	11-30	>30
Risk Factor	1.0	1.2	1.5	2.0

3.) Zone Location (L)

Floor	1^{st}	2^{nd} or 3^{rd}	4^{th} to 6^{th}	7^{th} and Above	Basements
Risk Factor	1.1	1.2	1.4	1.6	1.6

4.) Ratio of Patients to Attendants (T)

Patients/ Attendants	$\frac{1\text{-}2}{1}$	$\frac{3\text{-}5}{1}$	$\frac{6\text{-}10}{1}$	>10	One or More/None
Risk Factor	1.0	1.1	1.2	1.5	4.0

5.) Patient Average Age (A)

Age	Under 65 Years and Over 1 Year	65 Years and Over, 1 Year and Younger
Risk Factor	1.0	1.2

Step 2: Compute the occupancy risk factor ***F***

(a) Transfer the risk factor values from table 1 and multiply them together in table 2 to get the value of ***F***.

Worksheet Table 1-2 Occupancy Risk Factor Calculation

	M		D		L		T		A		**F**
Occupancy Risk	☐	X	☐	X	☐	X	☐	X	☐	=	☐

Step 3: Then add a weighting factor of 10 to ***F*** in table 3 to get the occupancy risk ***R***.

		F		**R**
10	+	☐	=	☐

Step 4: Determine the safety parameter values using table 4. Select only one value that best describes the conditions in the zone. If there are two possibilities choose the lower point value. Do this for all seventeen parameters. Make sure to note the discrepancies at the bottom of table 4. For the parameters of 9, 11, 12, and 13 if maintenance doesn't exist subtract two from the choose value. If *maintenance is done when needed* subtract a value of **1** from the chosen value. The value can never be less than **zero**.

Worksheet Table 1-3 Safety Parameter Values

1. Construction	Floor and Zone	Class A	Class B	Class C	Combustible	
	First	2	2	0	-2	
	Second	4	2	-2	-4	
	Third	4	2	-7	-9	
	Fourth and Above	4	-7	-9	-13	
2. Interior Finish (Corridors and Exits)	Class C	Class B	Class A			
	-5(0)[a]	0(3)[a]	3			
3. Interior Finish (Rooms)	Class C	Class B	Class A			
	-3(1)[a]	1(3)[a]	3			
4. Corridors Partitions/Walls	None or Incomplete	< ½ hr	≥ ½ to < 1 hr	≥ 1 hr		
	-10(0)[b]	0	1(0)[b]	2(0)[b]		
5. Doors to Corridor	No Door	< 20 Min FLR	≥ 20 Min FLR	≥ 20 Min FLR and Auto Closing		
	-10	0	1(0)[c]	2(0)[c]		
6. Zone Dimensions	Dead End			No Dead Ends >30m and Zone Area Is		
	>30 m	>12m to 30m	<12 m	>2000m²	500m² to 2000m²	<500m²
	-6(0)[d]	-4(0)[d]	-2(0)[d]	-2(0)[e]	0	1
7. Vertical Openings	Open 4 or More Floors	Open 2 or 3 Floors	Enclosed with Indicated Fire Resist			
	-14	-10	< 1hr	≥1hr to <2hr	≥ 2 hr	
			0	2(0)[f]	3(0)[f]	
8. Hazardous Areas	Double Deficiency		Single Deficiency		No Deficiency	
	In Zone	Outside Zone	In Zone	In Adjacent Zone		
	-11	-5	-6	-2	0	
9. Smoke Control[h]	No Control	Smoke Barrier Serves Zone	Mech. Assisted Systems by Zone			
	-5(0)[e]	0	3			
10. Emergency Movement Routes	< 2	Multiple Exits				
		Deficient	W/O Horizontal Exits	Horizontal Exits	Direct Exits	
	-8	-2	0	1	5	
11. Manual Call Points[h]	No Manual Call Points	Manual Call Points				
		W/O F.B. Conn.	W/F.B. Conn.			
	-4	1	2			
12. Smoke Detection and Alarm[h]	None	Corridor Only	Rooms Only	Corridor & Habit Spaces	Total Zone Space	
	0(3)[g]	2(3)[g]	4(5)[g]	6	8	
13. Automatic Sprinklers[h]	None	Corridor and Habit Space	Entire Building			
	0	8	10			
14. Fire Retardant Materials	No Materials	Some Materials	All Materials			
	0	1	2			
15. Brigade Response	No Response	> 15 Min	>5 Min and <15 Min	≤ 5 Min		
	0	1	2	4		
16. Emergency Lighting and Illumination	No Emerg. Lighting or Illum. Exits	Illuminated Exits	Emergency Lighting	Emergency Lighting and Illum. Exits		
	-2	1	2	3		
17. Emergency Procedure and Staff Training	No Procedures or Training	Procedures and no training	Training and no procedures	Comprehensive Plan and Training		
	-3	0	3	5		

NOTES: a Use ( ) if the area is class B or C interior finish in the corridor And exit or room is protected by automatic sprinklers and Parameter 13 is 0.
b. Use (0) where Parameter 5 is –10.
c. Use (0) where Parameter 4 is –10.
d. Use (0) where Parameter 10 is –8.
e. Use (0) on floor with fewer than 31 patients.
f. Use (0) where Parameter 1 is based on first floor zone or on an unprotected type of construction (columns marked "U").
g. Use this value in addition to Parameter 13 if the entire zone is protected with quick-response automatic sprinklers.
h. If no maintenance plan add a –2 to the value. If repairs and maintenance are done when needed, add a – 1 to the value. The value can never be less than 0.

Step 5: Compute the individual safety evaluation using table 5.

(a) Transfer each of the 17-safety parameter values to every non-blocked out boxes with the corresponding safety parameter in table five.
(b) Sum each of the four columns
(c) Transfer the resulting total values for S_1, S_2, S_3, and S_4 to the corresponding blocks in table 6.

Worksheet Table 1-4 Individual Safety Evaluations

Safety Parameters	Containment Safety (S_1)	Extinguishment Safety (S_2)	People Movement Safety (S_3)	General Safety (S_4)
1. Construction			X	
2. Interior Finish (Corr. And Exit)		X		
3. Interior Finish (Rooms)		X	X	
4. Corridors Partitions/Walls		X	X	
5. Doors to Corridors		X		
6. Zone Dimensions	X	X		
7. Vertical Openings		X		
8. Hazardous Areas			X	
9. Smoke Control	X	X		
10. Emergency Movement Routes	X	X		
11. Manual Call Points	X		X	
12. Smoke Detection and Alarms	X			
13. Automatic Sprinklers			÷2=	
14. Fire Retardant Materials		X	X	
15. Fire Brigade Response Time	X			
16. Emergency Lighting and Illumination	X	X		
17. Emergency Procedure and Staff Training	X	X		
Total Value	S_1=	S_2=	S_3=	S_4=

Step 6: Determine the mandatory safety requirements.

(a) Chose mandatory values from Table 1-5

Worksheet Table 1-5 Individual Safety Evaluations

Zone Location	Containment (S_a)	Extinguishment (S_b)	People Movement (S_c)
1st Story	9	9	13
2nd Story	13	11	15
3rd Story or Above	15	13	15

(b) Transfer the mandatory values S_a, S_b, and S_c as well as the values for S_1, S_2, S_3, and ***R*** into Table 1-6 and determine the zone safety equivalence. Subtract them accordingly. The mandatory values are the basic requirements defined by the BCA for each parameter.

Worksheet Table 1-6 Zone Fire Safety Equivalency Evaluation

Containment (S_1)	minus	Mandatory Containment (S_a)	≥	0 Safety	S_1 ☐ - S_a ☐ = C ☐
Extinguishment Safety (S_2)	minus	Mandatory Extinguishment (S_b)	≥	0	S_2 ☐ - S_b ☐ = C ☐
People Movement Safety (S_3)	minus	Mandatory People Movement (S_c)	≥	0	S_3 ☐ - S_c ☐ = C ☐
General Safety (S_4)	minus	Occupancy Risk (R)	≥	0	S_4 ☐ - R ☐ = C ☐

Step7: Determine what priority each individual safety values are in Table 1-7.

(a) If value is less than –15 check "Interim" box. The priority, "Interim", is defined as critical matters of fire safety, which require attention immediately.

(b) If value is greater than or equal to –15 but less than –5 check "Priority 1" box. "Priority 1" is for matters which require urgent action within the next 12 month to improve fire safety.

(c) If value is greater than or equal to –5 but less than 5 check "Priority 2" box. "Priority 2" is for matter which present a medium level of risk to fire safety and improvement works should be programmed for the next 2 to 5 years.

(d) If value is greater than or equal to 5 check "Priority 3" box. "Priority 3" is for matters of low risk to fire safety, which require further consideration, analysis or review in master planning or further investigations.

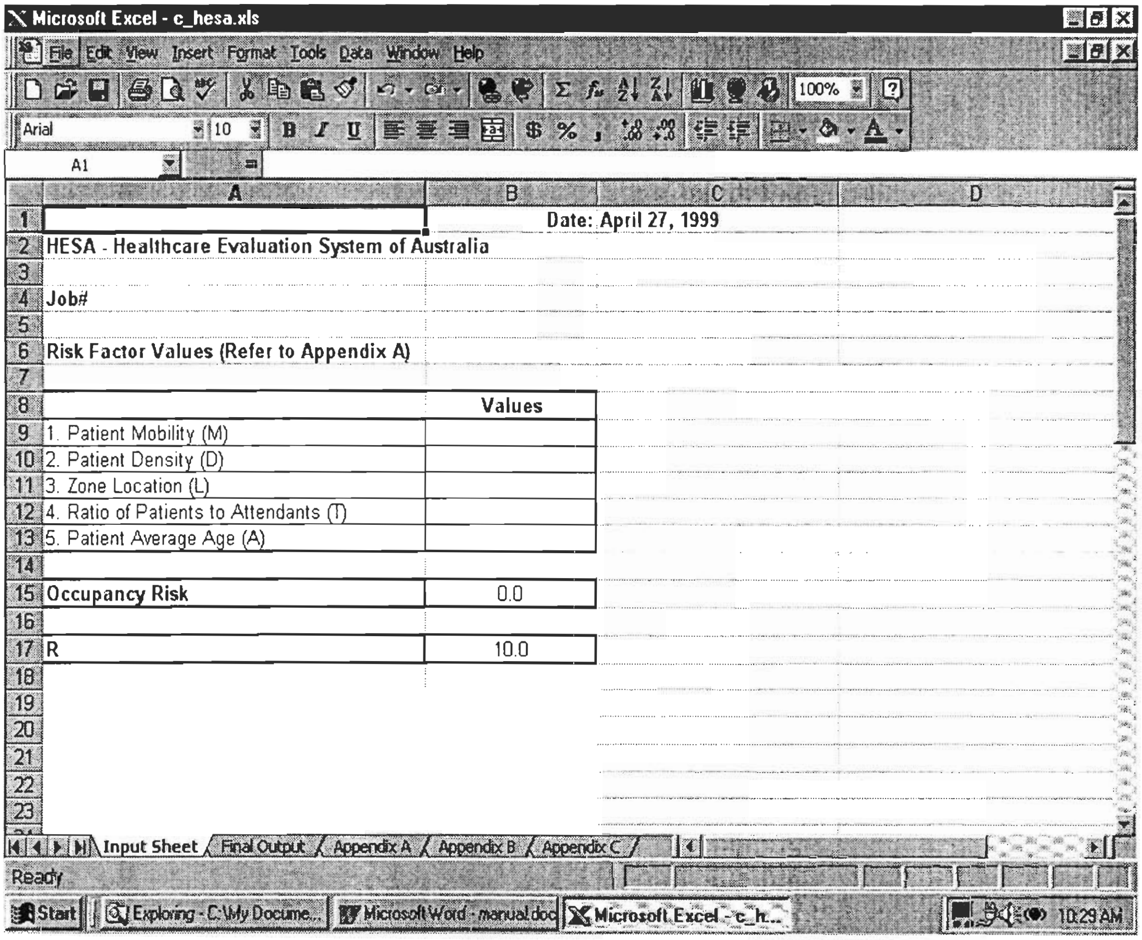
Worksheet Table 1-7 Fire Safety Priority Table

					Interim	Priority 1	Priority 2	Priority 3
Containment Safety (S_1)	minus	Mandatory Containment (S_a)	≥	0				
Extinguishment Safety (S_2)	minus	Mandatory Extinguishment (S_b)	≥	0				
People Movement Safety (S_3)	minus	Mandatory People Movement (S_c)	≥	0				
General Safety (S_4)	minus	Occupancy Risk (R)	≥	0				

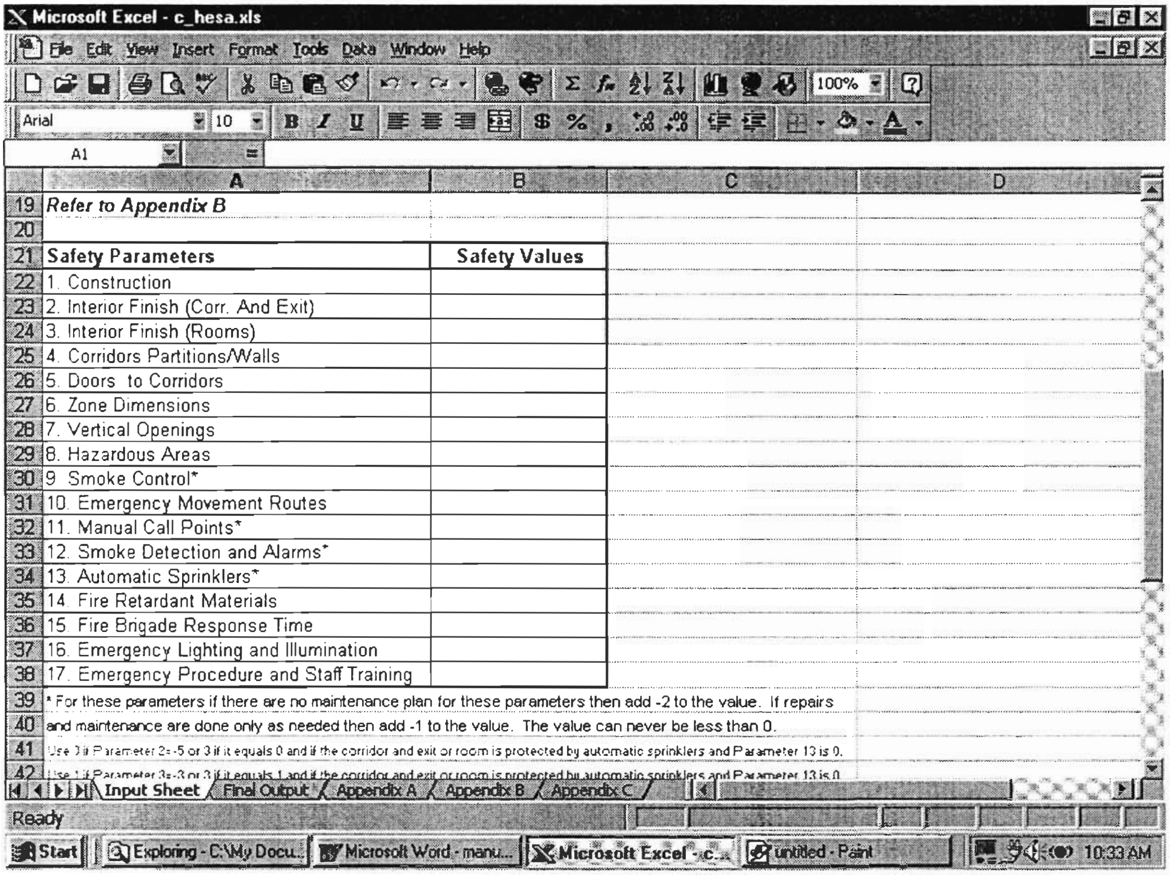
Program Instructions

To input the values into the program (A:/c_hesa.xls) created by the project group, a number of steps have to be follow:

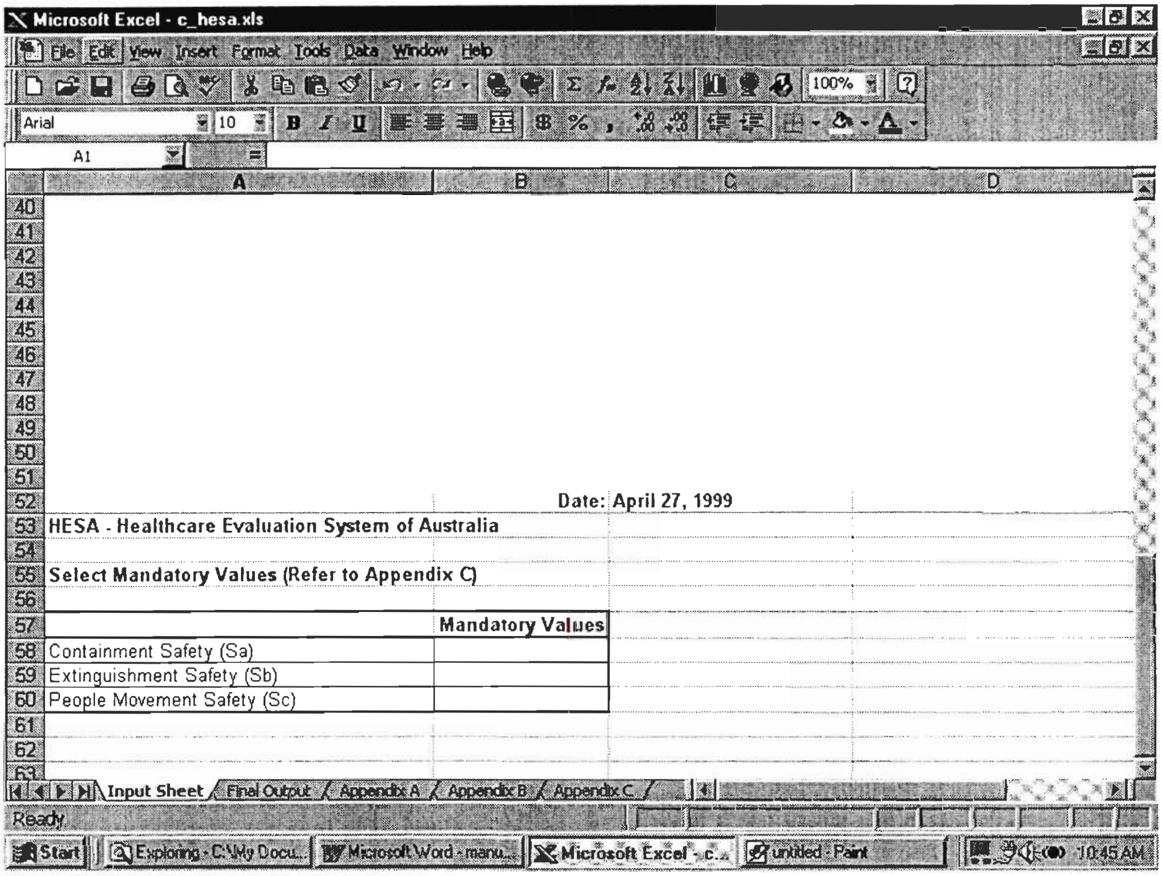
Step 1: Input values into the "occupancy risk chart". These are the values the user chose based on audits and personal opinion. If needed refer to appendix A of the program for possible parameter values.



Step 2: Input values into the "safety parameter chart". If needed refer to appendix B of the program for possible parameter values.



Step 3: Input mandatory values into the "mandatory values chart". If new the needed refer to appendix C of the program for possible mandatory values.

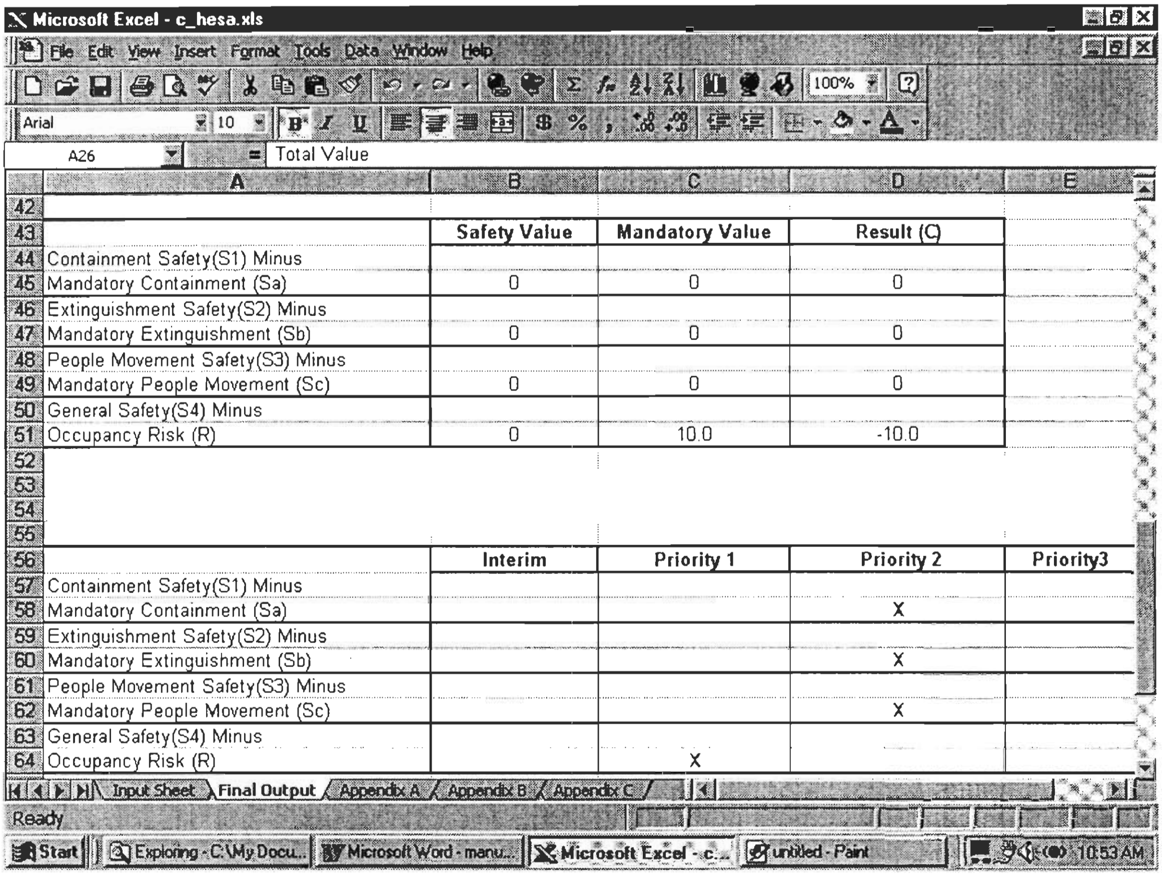


Step 4: Go to final output tab and input project #.

(a) In this sheet all the numbers come up automatically after they have been input into the input sheet.

Job#				
	Safety			
Safety Parameters	**Containment (S1)**	**Extinguishment (S2)**	**People Movement (S3)**	**General (S4)**
1. Construction	0	0	X	0
2. Interior Finish (Corr. And Exit)	0	X	0	0
3. Interior Finish (Rooms)	0	X	X	0
4. Corridors Partitions/Walls	0	X	X	0
5. Doors to Corridors	0	X	0	0
6. Zone Dimensions	X	X	0	0
7. Vertical Openings	0	X	0	0
8. Hazardous Areas	0	0	X	0
9. Smoke Control	X	X	0	0
10. Emergency Movement Routes	X	X	0	0
11. Manual Call Points	X	0	X	0
12. Smoke Detection and Alarms	X	0	0	0
13. Automatic Sprinklers	0	0	0	0
14. Fire Retardant Materials	0	X	X	0
15. Fire Brigade Response Time	X	0	0	0
16. Emergency Lighting and Illumination	X	X	0	0
17. Emergency Procedure and Staff Training	X	X	0	0
Total Value	**0**	**0**	**0**	**0**

(b) The values for this chart come up automatically after they have been inputted in the input sheet. As well, as the priority table.



	Safety Value	Mandatory Value	Result (C)
Containment Safety(S1) Minus Mandatory Containment (Sa)	0	0	0
Extinguishment Safety(S2) Minus Mandatory Extinguishment (Sb)	0	0	0
People Movement Safety(S3) Minus Mandatory People Movement (Sc)	0	0	0
General Safety(S4) Minus Occupancy Risk (R)	0	10.0	-10.0

	Interim	Priority 1	Priority 2	Priority3
Containment Safety(S1) Minus Mandatory Containment (Sa)			X	
Extinguishment Safety(S2) Minus Mandatory Extinguishment (Sb)			X	
People Movement Safety(S3) Minus Mandatory People Movement (Sc)			X	
General Safety(S4) Minus Occupancy Risk (R)		X		

(c) The user can make printouts of both of these worksheets by going to filemenu and choosing the print option.

Note: The "Final Output" worksheet is protected so that the formulas cannot be erased. If these formulas need to be change go to the tools menu and select from the protection tab the unprotect sheet option. Here you will be prompt for your password, which is "arup".

A file (A:/c_hesa_form.doc) with all of the formulas used to create this program can be open for clarification of how the numbers were formulated.