Hot Topics

Fire Engineering Advisory Taskforce

Report and Recommendations

August 2007

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CONTENTS

FOREWORD

I have pleasure in commending *Hot Topics* to all those involved in the fire engineering design of buildings. It has been prepared by an expert taskforce of practising fire engineers, the New Zealand Fire Service, and local and central government regulators brought together by the Institution of Professional Engineers New Zealand (IPENZ). The Fire Engineering Advisory Taskforce also obtained feedback from practitioners and took it into consideration in this final report.

The Taskforce was concerned that there was evidence of a lack of clarity about what fire engineers do and the competencies expected of them. It supports the active implementation of international best practice in New Zealand through training and support for regulators. The Taskforce also wants to give more clarity about the fire design process, to give greater confidence that sound designs will be well implemented.

Hot Topics makes 11 recommendations and calls for support and action from fire engineers, IPENZ, the Department of Building and Housing, the New Zealand Fire Service, building consent authorities and the tertiary education sector. The Society of Fire Protection Engineers is pressing ahead to implement those recommendations where it believes it can make a difference. It will also be supporting other organisations as they make progress on recommendations where they are identified as having a leading role.

New Zealand has been free of serious loss of life in a building fire for many years. Ensuring that fire engineering design is carried out in accordance with best practice is essential to continuing that good record.

Richard Brand
President, Society of Fire Protection Engineers New Zealand Chapter

1. INTRODUCTION

1.1 A New Approach to Improved Fire Engineering Design of Buildings

One of the most significant tragedies that can affect a family is a fatal fire. Fire may also have devastating effects on properties and businesses.

The Taskforce intends that this document will generate significant discussion and response, which will eventually lead to a strengthening of practice in terms of:

a. the standard of fire engineering design

b. the level of assurance for regulatory authorities and building owners that buildings will perform in the unfortunate event of fire, in ways which will comply with the societal expectations of New Zealanders, whether they are legislators, regulators, occupiers or owners of property

1.2 Fire Engineering Taskforce

The various organisations involved in regulating and representing fire engineering in New Zealand – the Department of Building and Housing (the Department), the Institution of Professional Engineers New Zealand (IPENZ) as the Registration Authority for Chartered Professional Engineers (CPEng) and as a professional body, the Society of Fire Protection Engineers (SFPE) New Zealand Chapter, the New Zealand Fire Service, and territorial local authorities – have all been concerned for some time that the standard of fire engineering in New Zealand is variable and that a higher degree of consistency is required.

In particular, the activity of fire engineering design is not well defined and is not always delivered or checked by professionals. There needs to be a generally accepted definition of competency for this area of practice, and greater clarity about minimum levels of training and the standard of documentation supporting designs. There are also concerns about unclear responsibilities for construction and operation in accordance with the fire design. Anecdotal evidence from the building industry indicates a need to strengthen the means by which the intentions of the fire engineer are eventually incorporated into a functional building. There are also concerns about the ongoing performance of fire safety systems throughout the life of the building.

A Taskforce was set up by IPENZ after discussion with senior representatives of these organisations and agreement on a Terms of Reference (see Appendix 1). The Taskforce met to research the issues and develop views on the best way forward, and this work is summarised below. It particularly focuses on fire engineering design of buildings in accordance with the provisions of the Building Act 2004 (the Building Act) and on the necessary role and competencies of fire engineers.

Taskforce members were selected to cover a range of backgrounds and interests and have contributed as individuals rather than directly representing their employing organisations. Each organisation will be asked to adopt this report and its recommendations and will have its own process for making that decision. The views expressed in this report should therefore not be taken to represent those of any of the employing organisations.

Comments and views were invited from IPENZ Members and other interested individuals. All submissions received were reviewed by the Taskforce and a number of changes were made to its draft report. This final report was prepared following a Taskforce meeting on 27 March 2007.

The Taskforce also considered two audit reports on the operation of the New Zealand Fire Service Design Review Unit. The reports were finalised in September 2006 and supplied to IPENZ in December 2006 by the New Zealand Fire Service, the Department, and Local Government New Zealand which jointly asked that the Taskforce consider the reports when making its recommendations. The reports were especially relevant as the reviewers had been asked to comment on the quality and methodology employed in fire engineering reports received by the Unit.

The reviewers found that over 90 per cent of fire engineering reports did not follow a formal fire engineering process and over 90 per cent did not use appropriate engineering methods. Forty-two of the 51 sample projects reviewed were designed by consulting engineering practices and 75 per cent of the authors of the reports were professional engineers (Professional Members or Fellows of IPENZ) practising as fire engineers.

The Taskforce noted that there was some lack of clarity in the two audit reports concerning the requirements for review by the Design Review Unit and the way councils had interpreted them. There could also be instances where the auditors misunderstood the basis for a design. However, these matters did not outweigh the auditors' comments about the generally low standard of fire reports, lack of supporting calculations, inappropriate use or modification of the Acceptable Solution and over-reliance on unsubstantiated opinion purported to be expert judgement. The audit reports reinforce the need for the Taskforce to provide strong recommendations and guidance to address these serious problems.

1.3 Taskforce Objectives

To guide its work the Taskforce developed the following specific objectives:

a. To generate discussion, feedback, comment and ideas on how the "body of knowledge and practice" in fire engineering may be enhanced, and how it should be regulated.

b. To determine how fire engineering should be practised within the context of the *CPEng Code of Ethical Conduct* and *IPENZ Code of Ethics*, as well as within the legal environment required by the Building Act and Building Code regime.

c. To produce recommendations and guidance for fire engineering practitioners, regulators and professional bodies.

d. To ensure uniformity in the practice standards of fire engineering throughout New Zealand and the development of a regime for appropriate design communication processes for fire engineering outcomes.

e. To suggest and develop construction monitoring processes using suitably qualified site personnel which will ensure correct implementation of those outcomes and the successful operation of the fire safety features for the life of the building.

f. To seek response from researchers and academic leaders in the field on "body of knowledge" issues.

2. UNDERSTANDING THE FIRE DESIGN PROCESS

2.1 Statutory Basis for Fire Design

The mandatory provisions for building work are contained in the New Zealand Building Code (the Code) which is the First Schedule to the Building Regulations 1992 and was developed under the Building Act 1991.

The Building Act 2004 set a new framework and this is still being developed. During 2007 there has been consultation on both possible changes to the Act to make it work better and a review of the Code to take performance standards forward so they are compatible with the 2004 Act.

The relevant Code clauses for fire safety in buildings are:

- C1 – Outbreak of Fire which is concerned with the installation and location of fixed appliances using the controlled combustion of solid, liquid or gaseous fuel
- C2 – Means of Escape
- C3 – Spread of Fire
- C4 – Structural Stability During Fire
- D1 – Access Routes
- F6 – Lighting for Emergencies
- F7 – Warning Systems
- F8 – Signs

All work is required to be in compliance with the Code. The Building Act allows for the promulgation by the Department of prescribed Verification Methods and Acceptable Solutions. For most Code clauses, such as those giving structural design requirements, there are well-established Verification Methods referring to New Zealand Standards. However, there are no Verification Methods available for fire safety clauses C2, C3, C4, F7, and F8. The Department has prepared and approved an Acceptable Solution C/AS1. This is a substantial document and provides for some limited calculations to be carried out by users on matters such as smoke control. Where users are not able to comply with the provisions of C/AS1 in all respects, they may show compliance with the Code by specific design, supported by calculations and design reports.

It is apparent from the Taskforce's enquiries, and the recent audit reports on the New Zealand Fire Service, that many users do not currently have the required level of understanding of fire design principles to use the Acceptable Solution, especially for complex buildings. Some of these users, for example, prepare designs for which they rely in part only on the provisions of C/AS1 and justify exceptions by reference to other documents such as Standards from other countries. In these instances a specific fire engineering design should be carried out, following the process set out in the International Fire Engineering Guidelines (IFEG). This is further discussed in section 3.2.

2.2 Role of Fire Engineers in Design and Construction of Buildings

Fire engineers provide professional input to the design of buildings, working to client and Code requirements. They apply the principles of science and engineering in an appropriate manner to minimise the risk of death, injury and disaster due to fire within a building. In this section of the report, recommendations are made on the fire design process. Information on the experience, knowledge and competencies required of a fire engineer is given in following sections.

Fire engineers work with other design professionals and fire safety technicians to develop, document and implement designs that address, amongst other things:

- public safety
- fitness for purpose
- regulatory compliance
- environmental damage
- community requirements

The first of these roles is self-explanatory – the safety of occupants and New Zealand Fire Service personnel is a principal responsibility of the fire engineer. Fitness for purpose means designing or specifying cost-effective fire safety measures which will function effectively in the event of fire but will not significantly inhibit normal day-to-day building functions. Regulatory compliance will be demonstrated by providing the building consent authority (BCA) with clearly documented reports, drawings, calculations and specifications setting out a specifically engineered or prescriptive design. Community requirements and environmental matters are also dealt with by the BCA in the context of its responsibilities under the Building Act.

Fire engineers also assist their clients with:

- property protection – helping ensure that the value of their client's asset is safeguarded
- life cycle cost – developing systems that have lower costs and greater long-term reliability
- business continuity – developing systems that help ensure fire events have a minimal impact on operations for the occupier and building owner
- corporate requirements – addressing the specific needs and values of the client

2.3 Licensed Building Practitioners

The Department proposes to establish 13 classes of licensed building practitioner (LBP) under the provisions of the Building Act. These are Carpentry, Site 1, Site 2, Site 3, Design 1, Design 2, Design 3, Roofing, Brick and Blocklaying, External Plastering, Concrete Structure, Steel Structure, and Building Services. CPEng registrants will be deemed to hold Design 3 licences. IPENZ has advocated that they should automatically be granted Site 3, Concrete Structure, Steel Structure, and Building Services licences for exactly the same reasons they are automatically granted Design 3 licences, but the result of this advocacy is not yet known.

CPEng registrants assessed as competent in fire engineering will be able to practice design in this field while other engineering designers will need to obtain the appropriate LBP Design licences or be supervised by an appropriate LBP. The regulations do not require a designer to be a LBP to carry out fire engineering design (but see section 3).

The Department also proposes to recognise Design Leads and Site Leads who will be required to be LBPs. These people are likely to be responsible for all documentation. The Act requires the LBP regime to be fully operational by 30 November 2009. Thus:

- From December 2009, most projects will have a Design Lead. The Design Lead will be looking for competent fire engineers and will be concerned that the fire engineering design is correctly integrated into the overall design; that finished plans and specifications reflect the fire engineer's design intent; and that the fire engineering design is complete and consistent with other design input such as security, layout, structure and services. This should lead to fire engineers being more involved in the projects that they work on – writing a report based on draft plans and having no further involvement will not be sufficient.
- From the same date, projects will also have a Site Lead. Both of the leads will want the finished building to match the design. This places a greater emphasis on following the design through the construction process, where appropriate. This should mean that fire engineers need to think more about construction observation, commissioning, testing, inspections and maintenance. For complex projects, the need for fire engineers to observe construction is reduced if there are competent people on site – Building Services LBPs will be particularly useful in this respect. However, fire engineers can expect that building services engineers in particular will be asking technical questions to clarify design requirements. Construction of passive fire measures should improve – especially if fire engineers are more actively involved in observation.

As improvements to the building warrant of fitness regime are implemented, fire engineers should be taking more responsibility for ensuring that compliance schedules have appropriate inspection and maintenance requirements – especially for non-standard or interconnected systems. Fire engineers should expect more queries regarding compliance schedules from independent qualified persons (IQPs) or their successors.

3. THE FIRE ENGINEERING DESIGN PROCESS FOR BUILDINGS

3.1 What is Fire Engineering Design?

Fire engineering design is similar to any other engineering discipline, in that it compares design action with design capacity. Fire engineering design includes but is not limited to considering:

- the following design actions:
  - nature and characteristics of fire and associated products of combustion
  - fire origin and spread within and outside buildings
  - number and distribution of occupants within the building
  - human behaviour
  - stakeholder requirements and building function
  - design actions required to meet legislative requirements (societal expectations)
- the following design capacities:
  - predicting the behaviour of materials, structures, machines, apparatus and processes, individually and combined, as related to the protection of life and property in fire
  - how and when people respond and behave in fire situations with respect to the evacuation process and layout of escape routes
  - how and when fires can be detected, controlled and/or extinguished
  - fire fighting capacity

In developing a fire engineering design, the engineer has to apply the same rigorous approach as that applied to any other engineering discipline.

3.2 International Fire Engineering Guidelines (IFEG)

The International Fire Engineering Guidelines (IFEG) have been released under Section 175 of the Building Act. The IFEG are a tool for the designer. They do not prescribe any standard approach but are intended to bring an improved quality and consistency to fire engineered solutions.

The IFEG advocate a consultative approach to the development of a design. They provide a structure to allow input from all those who have an interest in the design, construction and use of the building. This allows the interested parties to provide comment at an early stage in the development of a design. The IFEG set out a detailed process for achieving the interactive development of a fire engineering design.

The IFEG should also result in a smoother route through the consent process. The IFEG do not instruct fire engineers to

perform their duties in certain ways, but are designed to inform the engineer of a process that can be applied in developing a solution. This process is designed to make the development of the design transparent to a reviewer or consent authority and to ensure completeness in the documentation that supports the design. This enables the reader to question the design more fully and gain satisfaction that the building design meets the performance criteria of the Code. The IFEG assume a fire engineer has a level of skill, understanding and competency to use the guidance contained in the document appropriately.

3.3 Contents of the IFEG

The IFEG have been made suitable for use in Australia, Canada, the United States and New Zealand through the development of a separate section (Part 0) for each collaborative country. Each Part 0 links engineering practice with the legal and regulatory system of the country. For New Zealand this is the Building Act.

Parts 1, 2 and 3 of the IFEG contain information on the process, methodologies and data relating to fire engineering, and are equally applicable in each of the member countries.

Part 1 describes the process by which a fire engineering design should be undertaken, in particular the two-step process of a Fire Engineering Brief (FEB) followed by a Fire Engineering Report (FER). This process constitutes a paradigm shift for many fire engineering practitioners in New Zealand. The IFEG advocate that all of those involved in the project and the operation of the final building need to be involved in the development of a FEB. The FEB is a report that provides the designer with the basis for the design, and can become part of the FER. The FER, prepared by the fire engineer, then describes what the design is intended to achieve, lists the assumptions made and other significant information to be communicated to other professionals, and provides information for the consent process.

Part 1 includes information on the content and format of the FEB and FER. It also contains fundamentally important information on methods of analysis and acceptance criteria. In its section on methods of analysis, Part 1 categorises the fire problem into six sub-systems:

- sub-system A: Fire Initiation and Development and Control
- sub-system B: Smoke Development and Spread and Control
- sub-system C: Fire Spread and Impact and Control
- sub-system D: Fire Detection, Warning and Suppression
- sub-system E: Occupant Evacuation and Control
- sub-system F: Fire Services Intervention

Below is a flow chart of the steps a fire engineer should take or consider when preparing the FEB. For further explanation see Part 1 of IFEG.

Part 2 considers the methodology of the FEB/FER concept and analysis approach, although the main contribution of this part is the sub-systems. For the most part, deterministic algorithms are provided for use in calculating properties of interest relevant to the sub-system.

Part 3 includes a selection of data that may be used in applying the methodologies of Part 2 or other chosen methodologies. It is also a good bibliographical source.

The IFEG can be sourced from Victoria University Bookshop in Wellington.

The Taskforce recommends that the IFEG be supported as the basis for all fire engineering design work, with appropriate training.

3.4 Design Documentation

The output of a fire engineering design needs to be documented in a similar manner to outputs of other disciplines involved in the design and construction of buildings. High quality, well co-ordinated plans and specifications also reduce delays and contract variations during the building process.

The Building Act s 45(1) (b) specifies that an application for a building consent must be accompanied by plans and specifications. Section 7 defines plans and specifications as:

plans and specifications —

(a) means the drawings, specifications, and other documents according to which a building is proposed to be constructed, altered, demolished, or removed; and

(b) includes the proposed procedures for inspection during the construction, alteration, demolition, or removal of a building; and

(c) in the case of the construction or alteration of a building, also includes—

> *(i) the intended use of the building; and*
>
> *(ii) the specified systems that the applicant for building consent considers will be required to be included in a compliance schedule required under section 100; and*
>
> *(iii) the proposed procedures for inspection and routine maintenance for the purposes of the compliance schedule for those specified systems*

Currently these requirements are not adequately met. The problem of insufficient or inadequate plans and specifications being submitted for building consent has been noted in a number of determinations made by the Department. For example, determination 2005/109 stated "because of the lack of full plans and specifications, I would not have confirmed the territorial authority's decision to issue the building consent".

In recognition of these problems and concerns about instances of inconsistent or conflicting documentation, in 2005 the Construction Industry Council (CIC) published guidelines on design documentation. These guidelines captured the recommendations of a multi-agency working party. The working party was made up of representatives from:

- ACENZ (Association of Consulting Engineers of New Zealand)
- HERA (Heavy Engineering Research Association)
- IPENZ (Institution of Professional Engineers New Zealand)
- NZBSF (New Zealand Building Subcontractors Federations)
- NZIA (New Zealand Institute of Architects)
- NZIOB (New Zealand Institute of Building
- PCNZ (Property Council of New Zealand)
- RMBF (Registered Master Builders Federation)

The design guidelines were produced to:

- clearly define design responsibilities from the outset and communicate these to all parties involved in the project
- define the scope of design service with the client and communicate this to all parties to the design process
- provide a "level playing field" in achieving appropriate remuneration for the standard of design service required
- provide a quality assurance reference for users

The working party recognised that fire engineering needs to be documented in drawings, specifications, and calculations and co-ordinated in the same manner as other disciplines. Hence, fire engineering is rightfully included in the CIC guidelines.

The guidelines outline the design process that all buildings go through, irrespective of the methodology or programme. They can be used to define the responsibilities of the various parties throughout the design process and identify the inputs and outputs required at each stage. The guidelines also recognise that design is an iterative process and provide a useful tool for identifying and monitoring the design process. By following the process set down in the guidelines fire engineering can provide the appropriate input to other disciplines, add value and produce a solution that results in a project "fit for purpose".

The guidelines can be downloaded from http://www.nzcic.co.nz/Design.cfm

The Taskforce recommends that fire engineers use the CIC *Design Documentation Guidelines* (2005) when documenting their designs.

3.5 Acceptable Solutions and Specific Design

Acceptable Solution C/AS1 for simple buildings and layouts has been developed and published by the Department. Using this document can be cost-effective in many situations. However, use of the Acceptable Solution can lead to problems where it is combined with engineering design for building elements outside the Acceptable Solution standard case.

A common practice has developed where the design methodology incorporates a mixture of an Acceptable Solution with a specific design. Two types of mixed designs can be identified:

- Acceptable Solutions where a specific and limited element of specific design is allowed as part of the Acceptable Solution, such as for smoke control in a car park. Those areas of the Acceptable Solution that require specific fire engineering design will still meet the requirements of an Acceptable Solution provided the specific design does not fall outside of the framework of the Acceptable Solution. The remainder of the design can rely on the Acceptable Solution and does not need to be supported by calculations.
- Designs where the designer has adopted an Acceptable Solution for a situation which is different or **more complex** that that for which the solution has been developed. In this case the design process is required to support the **entire** design proposed. Any deviation from the design requirements specified in the Acceptable Solution will require the design to be produced as a performance-based design, to ensure that the modifications do not adversely affect the rest of the design.

The Taskforce is concerned that the use of mixed designs could lower fire safety standards where they are carried out by persons who are not competent and who do not have the knowledge needed to understand the consequences.

The Taskforce recommends that any specific design or design review, including any calculations required by the Acceptable Solution, be undertaken only by a fire engineer.

3.6 Means of Compliance

A BCA is required to grant a building consent if the building work, properly completed in accordance with the plans and specifications lodged with the application for consent, meets the provisions of the Code. In this regard the Code specifies performance criteria that must be met.

The achievement of these performance criteria can either be by complying with a prescriptive compliance document or by an alternative solution that utilises a first principles approach relying on fire engineering methods.

Compliance documents

Two sorts of compliance documents can be published (see section 2.1). These are either Acceptable Solutions or Verification Methods. The Acceptable Solution is based on following a prescriptive step-by-step set of instructions. No

Verification Methods have been published for the fire safety clauses C2, C3, C4, F7, and F8. The Taskforce is concerned that the suite of Acceptable Solutions as presently allowed are too complex for use as a "cookbook" by designers who are not fire engineers. The Taskforce considers that it is desirable to continue to have an Acceptable Solution option available but that this should not incorporate the need for calculations or specific fire engineering knowledge.

The Taskforce recommends that a simpler version of the Acceptable Solution C/AS1 be produced.

Alternative solutions

Alternative solutions use a fire engineering design that can be derived using one of two approaches. These approaches, described in the IFEG, are either comparative or absolute:

- **comparative**

In assessing compliance, the Department has used a comparative approach in a number of determinations. The Department has established compliance with the Code by comparing the level of safety offered by the design with that of the Acceptable Solution. The Department stated that an accepted method of comparison was to evaluate the individual risk of fatality in each building for realistic ranges of fire scenarios and of probabilities that building elements will fail to perform as intended. However, the Taskforce was advised that the level of safety offered by the Acceptable Solution was unknown. The fire engineer and client were required to agree on the defined level of safety whilst developing the FEB. This process appears to be supported by s21 (2) of the Building Act which states that if regulations are not made, a person may comply with the Building Code by any means.

- **absolute**

Currently no absolute performance data has been published, other than for Code clause F8 – light levels for emergency lighting.

3.7 Design Implementation

It is essential that fire safety systems are constructed and commissioned in ways that ensure the level of performance inherent in the fire design will be achieved.

Relevant considerations to ensure proper implementation include:

- site verification of the proper installation and integration of the fire safety systems
- supplementary analysis as required for any necessary variations during construction
- commissioning and testing of system performance in accordance with the specified standards, including interaction with other sub-systems as required
- certification that the completed fire safety work complies with the building consent
- detailing of appropriate ongoing inspection and maintenance procedures, as appropriate for each specified system listed in the Compliance Schedule for the building
- ensuring that all specifications and technical information for the proper testing and maintenance of the systems are available to the building owner

Many fire systems will include a number of different sub-systems, and there may be a number of specialist designers and contractors involved in the installation. In these instances the Taskforce considers that the accountability for the integration and overall performance of the fire systems must lie with one expert individual – the fire engineer. It is therefore considered essential that the fire engineer takes responsibility for all of these systems before reporting compliant installation to the Site Lead. The Taskforce also considers it important that the fire engineer is involved in the design process from the beginning. This will provide a check on the installation of fire systems by subcontractors and will ensure that other services installation work does not compromise the fire design and safety requirements.

The Taskforce recommends that BCAs formally discuss and agree with consent applicants the explicit responsibilities for inspection and final certification of the fire safety components of construction works. This is likely to include the need for the fire engineer responsible for design (or other suitably qualified professional) to monitor construction work that is relevant to achieving the fire safety levels required by the design.

(Note: Determining which parties will carry out construction review work is a matter for discussion and agreement between the applicant and BCA on a project-specific basis before uplifting the consent. It is not appropriate for the BCA to impose consent conditions which require the involvement of a particular consultant, except with the prior agreement of that consultant and the owner.)

3.8 Life Cycle Performance

It is implicit in the Building Act that the systems and procedures set in place through the building consent will enable the required level of safety to be maintained for the life of the building. The necessary fire safety systems are specified by the fire engineer and the inspection and maintenance procedures are set out in the Compliance Schedule. Through the building warrant of fitness system, the building owner is responsible for ensuring that these inspections are carried out, and that the systems are properly maintained.

It is essential that the independent qualified persons (IQP) employed to carry out the inspection and maintenance of the specified systems have access to all relevant information on the required modes of operation, and the skills and experience to ensure an appropriate operation is maintained.

BCAs have the authority under the Building Act to carry out audit inspections to ensure that the specified procedures are being followed and any non-compliance is properly addressed.

The Taskforce recommends that all BCAs allocate appropriate resources to implementing an auditing regime.

4. WHAT IS A FIRE ENGINEER?

4.1 General

The Taskforce is concerned that the term "fire engineer" is freely used in New Zealand by individuals with a very wide spectrum of experience, knowledge and competencies. It is used by those who have expert knowledge in one area of the fire protection industry (such as sprinkler technology or other proprietary products) as well as by engineers who have achieved a professional qualification. All of these individuals have important and valuable roles but greater clarity is needed.

While recognising that different "fire engineers" will have various areas of specialisation, the Taskforce is particularly concerned with the fire engineering design process and responsibilities.

There is a need to better define the different attributes of fire engineers and fire protection technologists so that building owners and regulatory bodies can be assured that appropriate standards are in place. After considering definitions from Australia, the United Kingdom and the IFEG, which are all very similar, the Taskforce adopted the United Kingdom definitions but modified them for the New Zealand situation.

4.2 Fire Engineer – Description

A fire engineer, by education, training and experience:

- understands the nature and characteristics of fire, the mechanisms of fire spread and the control of fire and the associated products of combustion
- understands how fires originate, spread within and outside buildings/structures, and how fires can be detected, controlled, and/or extinguished
- is able to anticipate the behaviour of materials, structures, machines, apparatus and processes as related to the protection of life, property and the environment from fire
- has an understanding of the interactions and integration of fire safety systems and all other systems in buildings, industrial structures and similar facilities
- is able to design escape routes that facilitate safe evacuation of buildings, taking into account the behaviour of occupants
- is able to make use of all of the above and any other required knowledge to undertake the practice of fire engineering

This description of a fire engineer is by necessity general. For the purpose of assessing competence, it is helpful to further describe some of the required attributes to clarify the appropriate levels of experience, qualifications and skills. The Taskforce decided that a fire engineer should be especially skilled in exercising engineering judgement in assessing the results of quantitative analysis – the process exercised by a professional who is qualified by way of education and experience and has recognised skills to complement, supplement, accept or reject elements of a quantitative analysis.

Fire engineering is an evolving discipline. It has few of the well-proven and well-understood tools and data readily available to other engineering disciplines. Thus, collection of evidence, detailed calculation and sensitivity analysis play a greater role in fire engineering than in most other engineering disciplines.

4.3 Identification of a Fire Engineer

There is a need to communicate to the users of fire engineers' services, such as territorial authorities, how they can identify fire engineers and their specific competencies. Both fire engineers and the users of fire engineers' services need to appreciate the wide range of specialist areas in fire engineering, as well as the range within each specialist area. If this is known then fire engineers can better appreciate and self-regulate their practice within their area of expertise. The Taskforce has developed a pictorial illustration of the skills and knowledge required which it has called the "Wheel of Fire". Further details are given in Appendix 2, together with information on ways in which the Wheel of Fire can assist by providing a snapshot of an individual's areas of expertise and competency.

It has been suggested that IPENZ should prepare lists of CPEng for each specialist area of practice. This has not been done because of the difficulty in dealing with the wide range of possible sub-specialisations; instead the responsibility has been placed on individuals to self-regulate their activities.

The current identifying quality marks, or postnominals, are described below, together with some possible improvements for the future.

4.4 The Postnominals MIPENZ(Fire) and CPEng

The Registration Authority (IPENZ) assesses the competence of engineers for the purposes of gaining registration as a CPEng. Frequently, this assessment is also used to determine entry to Professional Membership of IPENZ and the International Professional Engineers Register (IntPE).

Chartered Professional Engineer

Registration as a CPEng is not qualified in any way by a practice field descriptor. Applicants for CPEng are, however, assessed within their own self-identified practice area, which is confirmed by the assessment panel. In future, this practice area will be confirmed to the registrant when the outcome of the application process is notified. CPEng registrants could use this letter of registration to provide clients or regulators with information on the area of practice in which they were last assessed by the Registration Authority (IPENZ).

It is also important to note that IPENZ Members and CPEng registrants are bound by codes of ethics, which require that they practise only within their area of expertise, and do not misrepresent their competence. This obligation to be aware of and operate within limits of professional competence underpins the professional practice of any Professional Member of IPENZ (MIPENZ or FIPENZ) or CPEng. CPEng do not have to be IPENZ Members to become CPEng.

IPENZ Professional Membership and IPENZ Practice College Membership

Professional Members of IPENZ are automatically given membership of the IPENZ Practice College when they undertake an assessment of current competence – unless they request otherwise. Membership of the IPENZ Practice College is voluntary and provides an indication of the engineering discipline within which the Professional Member was last assessed. A member of the IPENZ Practice College must be a current IPENZ Member and must have undergone a competence assessment within the last five years.

There are currently 17 discipline-based practice fields, including civil, structural, mechanical and fire engineering. Members of the IPENZ Practice College who align their practice area with the fire practice field are entitled to use the postnominal MIPENZ(Fire) or FIPENZ(Fire). The eight specific subject areas identified on the Wheel of Fire (see Appendix 2) could be used by IPENZ to describe the underpinning discipline-specific knowledge and skills required by an engineer seeking to align their area of practice with the fire practice field

4.5 Competency Assessment for Fire Engineers

Fire engineers need to be part of and accountable to a profession. The expected indication of this commitment is achievement of CPEng status and/or Professional Membership of IPENZ. CPEng is a quality mark for professional engineers introduced by legislation in 2002. Practising engineers seeking this recognition are required to be independently assessed as to their skills, knowledge and competence.

Fire engineers should hold an appropriate level of tertiary training in fire engineering principles and this would normally be a recognised degree qualification in fire engineering. Fire engineers need to maintain currency in levels of skill and knowledge in their chosen fields and this would normally be demonstrated by undertaking minimum levels of continuing professional development as part of maintaining their CPEng status.

Applicants for CPEng are currently required to describe or list their practice area (in no more than 20 words) as part of their application and must subsequently be assessed in relation to that practice area. Applicants are also required to align their practice area with one or two practice fields – the practice field can be as broad as "fire".

Applicants are assessed against the 12 elements of the CPEng Competence Standard, which apply to all disciplines, and the evidence presented must demonstrate how they are able to perform complex engineering in their practice area. Guidelines have been produced based on criteria used for entry to the Australian National Engineer Register (see Appendix 3). As part of the assessment process it might be useful to have a subset of fire engineering areas with parameters and guidelines or examples of what the applicant should demonstrate in each to show their level of competency. This subset could be developed from the Wheel of Fire and list of sub-specialisations. Further work is needed to assist assessors and applicants in this regard. Applicants could then assist assessors by using the Wheel of Fire to illustrate their areas of competence as additional information to that required by the CPEng Rules.

A future possibility is for the Wheel of Fire to be generally used as a snapshot of an individual's experience and competency. It would be useful for a user of engineering services to gauge an engineer's field of competence and experience and hence assess suitability for project peer review or where specific expert opinion is required.

The Taskforce recommends that:

- **engineers, when applying for CPEng, define their practice area using the Wheel of Fire and once registered use this to self-regulate their ethical responsibilities**
- **the Wheel of Fire should be used to develop notes for CPEng assessors**

4.6 Ethics

It is the engineer's ethical responsibility to practise only in the areas in which they have been assessed as competent. This responsibility is clearly spelled out in the *IPENZ Code of Ethics* and *CPEng Code of Ethical Conduct*.

To be acknowledged by others as applying the necessary controls on standards of practice, the profession needs to be vigilant and proactive in monitoring the activities of its members and dealing with non-conformances.

There is a formal process set out in the CPEng Rules for hearing complaints against CPEng registrants and there is also a similar process for IPENZ Members. Grounds for a complaint include when work has been carried out in an incompetent or unethical manner, or when a person has misrepresented his or her competence. Possible penalties include removal or suspension of a person's registration, a censure or a fine not exceeding $5,000.

Recent audit reports for the New Zealand Fire Service referred to in 1.2 have raised concerns about the quality of fire engineering design submissions being submitted in support of building consent applications. Practising fire engineers and engineers working for BCAs have also indicated that there is a variable standard. However, very few formal complaints are received by IPENZ and none of a fire engineering nature has been the subject of a disciplinary process.

In addition to this formal process, the Taskforce considers that there needs to be other ways for fire engineers and regulators to provide feedback on design practice standards. This could be some type of "no blame" feedback between professionals, facilitated by their professional organisation. There also need to be ways for councils as BCAs to alert the CPEng Registrar of concerns, short of a formal complaint. It may then be possible, given a sufficient history of concerns being established, for the Registrar to initiate an early review of the competence of a practising CPEng. The Registrar is currently raising this latter topic with BCAs as part of more general discussions and this has been well received by council officers.

The Taskforce supports the development of effective feedback mechanisms on design practice standards and recommends that IPENZ develops processes to alert the CPEng Registrar of industry concerns.

5. EDUCATION AND TRAINING

One of the objectives of the Taskforce was to provide guidance on levels of training for fire engineering design practitioners. The education requirements for fire engineers are embedded in the CPEng assessment process. The situation is unclear for other practitioners.

The development of new and existing qualifications must align with the proposed regime for LBPs currently being developed by the Department.

5.1 Existing Qualifications

The University of Canterbury's Master of Engineering in fire engineering caters for professional-level practitioners and the Taskforce considers that it provides an appropriate benchmark for the discipline-specific knowledge required by fire engineers. This degree equates to national qualification framework (NQF) level 9. Engineers with this qualification should be able to develop unique fire engineering designs from first principles and be able to fully justify and support their designs. Bachelor's degrees from overseas universities specialising in fire engineering may also be acceptable.

Other courses can educate an individual to a level that allows them to work in niche areas of fire engineering, or at a level below that of a fully qualified fire engineer. Firetech Training Ltd runs national certificate courses at NQF level 3 and 4 covering sprinkler and alarm installation and hand-held fire fighting equipment. Victoria University of Wellington's School of Architecture runs a 20-credit paper entitled "Fire Safety Design". This is at second-year university level and NQF level 6, and is an introduction to fire safety in buildings with a focus on the impact on building design. Construction Industry Training Enterprise (CITE), part of BRANZ, runs an eight-day, 10-credit course at NQF level 5 on the Acceptable Solutions for fire safety. (Note that 120 credits is a full-time, one-year course.)

5.2 Fire Technicians and Technologists

It is apparent there is a lack of structured programmes that are suitable to underpin the licensing of fire technicians and technologists. This group includes fire safety technologists with high levels of competence in limited areas. Such qualifications, if developed, could also provide a path for tradespeople within the wider fire protection industry to broaden their knowledge and work towards higher qualifications. They may also be relevant to other building professionals, other designers, building control officers and personnel from the insurance and property management industries.

It is also important that high quality continuing professional development programmes are available to maintain the competence levels required for licensing. Such programmes allow practitioners to broaden their skills and be exposed to new information and techniques. They may also stimulate research and development in specific fire engineering areas. For these programmes, the list of potential providers can be extended to include the Department and IPENZ, through its associated Technical Interest Groups.

We believe that a wider involvement by IPENZ in education and assessment within the fire protection industry, along the lines summarised above, would be instrumental in improving competencies and clarifying accountabilities. This will lead to a better and more consistent end product for building owners and users.

The Taskforce has been advised of some of the potential training opportunities for fire safety technicians as outlined above and, while supporting the need, considers that further development of an IPENZ view is outside its competence. For fire engineers, the Taskforce is confident that the CPEng assessment process will be able to work within its established processes and there is no need for the Taskforce to form a view.

The Taskforce recommends that an appropriate training course for fire safety technicians be developed with pathways progressing to higher qualifications.

5.3 Training Existing Fire Engineers

The Taskforce is concerned that the current standards of practice by fire engineers are variable and below those expected by expert auditors. There is very little understanding of the IFEG and its recommended processes have seldom been adopted by practitioners. There are concerns about low standards of fire reports, lack of supporting calculations, inappropriate use or modification of the Acceptable Solution, and over-reliance on unsubstantiated opinion purporting to be expert judgement.

While many of the recommendations in earlier sections of this report should correct this situation in time, there is a need for existing fire engineers to quickly lift their game. Further best practice training or seminars specifically targeted at fire engineers are needed. The Taskforce sees this as an area where the New Zealand Chapter of the Society of Fire Protection Engineers, a Technical Interest Group of IPENZ, could take the lead.

The Taskforce recommends that a programme of training in the IFEG processes be developed and delivered nationwide during 2007.

6. CONCLUSIONS AND RECOMMENDATIONS FOR ACTION

6.1 Conclusions

The introduction of the IFEG and the new LBP regime provides a real opportunity to strengthen the practice of fire engineering. The Taskforce agrees that change is necessary and urgent. Roles need to be clarified and better systems put in place so that building owners and the general public can be assured that their expectations for the safety and serviceability of buildings will be met.

Changes will need the co-operative effort of all practitioners, regulators and their professional bodies. The Taskforce appreciates the staff time that has been contributed to its activities so far and is confident that the necessary changes and improvements in practice can be successfully implemented. While the regulators have to be supportive, and we believe they will be, it is up to individual fire engineers working with their clients and other industry professionals to make the crucial changes to practice.

We believe that much greater effort is needed to ensure that the processes in the IFEG are used as they give a structure for the design. Also, we believe that they will lead to better briefs being agreed upon by enabling all the professionals involved, working with the client, to uncover real opportunities to add value to a project. A training programme focused on the IFEG processes is needed in 2007 for existing fire engineers practising in fire safety design of buildings and this should be developed by their professional organisation, SFPE, working with IPENZ.

There is confusion at present about the term “fire engineer” and it is used to cover a very wide spectrum of knowledge, experience and competencies. The Taskforce has developed a pictorial method of representing areas of practice and competencies, the Wheel of Fire (Appendix 2), which can be used to clarify the situation. This should be further developed by IPENZ and used for CPEng assessment. BCAs should require that only fire engineers (those who have been accepted for CPEng registration in the building fire safety design area of practice) should carry out specific fire design or design review. Others should still be able to use the Acceptable Solution and it is expected that this will be applicable to the majority of projects. However, the Acceptable Solution C/AS1 should be reviewed by the Department to reduce its scope so that it only applies to simple, low-risk structures, with more complex situations requiring specific design to ensure that they will achieve the necessary safety performance.

Fire engineers with CPEng registration will automatically be accepted as having a LBP licence as a designer of all classes of building (Design 3) and will self-regulate their practice in line with the *CPEng Code of Ethical Conduct*. Their registration is reviewed regularly and may be revoked if they are found to be in breach of the provisions of that Code following consideration of a complaint to the Registration Authority IPENZ. The Registrar can also initiate a review of an individual’s registration. New processes, short of laying a formal complaint, should be developed so that BCAs can advise the Registrar when they have concerns about the performance of a fire engineer who is a CPEng registrant.

Fire safety technicians have a very valuable role in the industry. The Taskforce has concentrated its work on practice issues relating to fire engineers but has noted that there is a need for better recognition, support and training of fire safety technicians and technologists.

Any fire engineering design needs to be documented with plans and specifications and these must be part of an application for building consent. As it appears that this requirement is often neglected, it is important that fire engineers follow the CIC *Design Documentation Guidelines* (2005). It is also important that designers check during construction that the necessary fire engineering devices are correctly installed and that other work has not compromised the fire design in any way. Following construction, councils need to develop auditing schemes for ongoing testing and maintenance.

6.2 Recommendations

The recommendation in the body of the report are summarised in Table 1. Each recommendation is referenced to a specific section in the body of the report and they are in no particular priority order. The organisations primarily responsible for taking action on each item are shown (indicated by ##), as well as those that need to be in support (indicated by #). Individuals active in the fire engineering area are most important in ensuring that better standards and other initiatives are achieved and so they have also been included in the table.

TABLE 1: TASKFORCE RECOMMENDATIONS

RECOMMENDATION	RESPONSIBILITY FOR ACTION (##) AND SUPPORT (#)					
	FIRE ENGINEERS	IPENZ	DEPARTMENT OF BUILDING AND HOUSING	FIRE SERVICE	BCAs	TERTIARY EDUCATION SECTOR
1. Support IFEG as the basis for all fire engineering design work (Ref 3.3).	#	#	##	#	#	#
2. Use the CIC *Design Documentation Guidelines* (2005) when documenting fire engineering designs (Ref 3.4).	##			#	#	
3. Allow any specific design or design review, including any calculations required by the Acceptable Solution, to be undertaken only by a fire engineer (Ref 3.5).	#	#	#		##	
4. Produce a simpler version of the Acceptable Solution C/AS1 (Ref 3.6).	#		##	#	#	
5. Formally discuss and agree with consent applicants the explicit responsibilities for inspection and final certification of the fire safety components of construction works. This is likely to include the need for the fire engineer responsible for design (or other suitably qualified professional) to monitor construction work that is relevant to achieving the fire safety levels required by the design (Ref 3.7).	#		#	#	##	
6. Allocate appropriate resources to an auditing regime for implementation (Ref 3.8).		#	#	#	##	
7. When applying for CPEng, define the practice area using the Wheel of Fire and once registered use this to self-regulate ethical responsibilities (Ref 4.5).	##	#				
8. Use the Wheel of Fire to develop notes for CPEng assessors (Ref 4.5).	#	##				
9. Develop processes to alert the CPEng Registrar of industry concerns on design practice standards (Ref 4.6).	#	##		#	#	
10. Develop an appropriate training course for fire safety technicians with pathways progressing to higher qualifications (separate Taskforce needed) (Ref 5.2).	#	##	#	#	#	#
11. Develop a programme of training in the IFEG processes for practising fire design engineers, for delivery nationwide in 2007 (Ref 5.3).	##	#	#	#		#

APPENDIX 1 FIRE ENGINEERING ADVISORY TASKFORCE – TERMS OF REFERENCE

1. Project description

This project reviews the overall professional state of fire engineering design in New Zealand in the light of concerns expressed and provides recommendations and guidance to practitioners and regulatory and professional bodies.

2. Project background

The various organisations involved in regulating and representing fire engineering in New Zealand – the Department of Building and Housing (the Department), IPENZ (as the Registering Authority for CPEng and as a professional body), the Society of Fire Protection Engineers (New Zealand Chapter), the New Zealand Fire Service, and territorial local authorities – have all been concerned for some time that the standard of fire engineering in New Zealand is variable and may not align well with international best practice.

In particular, the current situation is:

a. Fire engineering design is not well defined and is not always being delivered or checked by professionals.

b. There is no generally accepted definition of competence for this new field of practice; it overlaps and involves more parties and other fields than just about any other area of design.

c. There are no guidelines on minimum levels of training. Education and training organisations are actively developing new courses to meet perceived needs.

d. For some practitioners (outside of professional organisations) there is no formal code of ethics or standard of conduct governing duty of care to clients, other consultants or territorial local authorities.

e. The quality of engineering judgement and the supporting documentation is of variable quality, leading to a lack of confidence in the design solutions offered.

f. It seems to some commentators that “no one is checking the checkers”.

g. Responsibility for construction and operation in accordance with the fire design is often unclear.

h. The Department has recently introduced the International Fire Engineering Guidelines into fire engineering practice. These guidelines detail recommended processes and have been well received.

3. Strategic objectives

Strategic objectives for the project are:

- to provide clear competency requirements for fire engineering design
- to give regulators, designers and end users confidence that appropriate practice standards are in place for fire engineering design in New Zealand
- to provide guidance on standards of conduct and minimum levels of training for fire engineering design practitioners
- to give guidance to councils, as building consent authorities (BCAs), on process, including design review

4. Deliverables

The following deliverables are proposed:

- a communications plan
- a report on how to address the issues identified by parties, for use in inviting submissions
- a final report, including proposals for action in the areas of CPEng competency assessment, education and training, use of best international practice and standards of conduct

5. Target outcomes

Outcomes and measures of success will be:

- acceptance of the recommendations in the final report by stakeholders and professional fire engineering design professionals generally – evidenced by formal adoption of recommendations and positive feedback from industry organisations
- successful implementation of recommendations by regulatory bodies – evidenced by inclusion of recommended changes in their documents within 12 months of acceptance of the final report

6. Project methodology

A meeting of stakeholders (IPENZ, the Department, the New Zealand Fire Service, Society of Fire Protection Engineers – New Zealand Chapter) was held on 17 August 2005 and the business case for the project was agreed. A nine-person taskforce has been established by nomination with an independent chairman. IPENZ will provide secretarial support.

The Taskforce:

a. will conduct a preliminary review of the issues identified by the parties active in this area of practice

b. may invite submissions from the wider IPENZ Membership and gather evidence from other interested or affected parties the Taskforce considers relevant

c. may regulate its procedures as it thinks fit

d. may choose to meet physically or use electronic means of communication such as video conferencing or other appropriate means of communication

e. output will be a report incorporating recommendations and guidelines for adoption by participating organisations – it is expected that this report will be open for key stakeholder and IPENZ Member comment prior to it being finalised and released publicly

f. will report to key stakeholders and the Engineering Practice Board of IPENZ

7. Timetable

The proposed timetable for the project is:

a. agreement on business case and funding – complete

b. arrange membership of Taskforce by nomination – complete

c. first meeting – held 27 September; review issues and programme

d. preliminary review of issues by end November; invite submissions

e. draft final report by end May 2006

f. finalise by end June 2006

APPENDIX 2 WHEEL OF FIRE

The Taskforce has developed the Wheel of Fire, a pictorial description of competencies and practice areas to clarify the situation for all those involved in fire engineering.

While this has been produced principally to assist in assessing an engineer's competence for registration under the Chartered Professional Engineers Act 2002 it should also be useful for describing the role and expertise required by fire engineering technologists and technicians.

The Wheel of Fire comprises eight specific subject areas (1 to 8) and eight general areas of practice (A to H). A fuller description of the specific subject areas follows the first diagram. The second diagram shows how shading in the various segments indicates areas of practice and subject areas.

Areas of practice

An individual's general areas of practice are shown on the left hand side of the Wheel. For any general area of practice (A to H) to be identified as a specialist practice area the person will be expected to be able to demonstrate that they have the ability to solve complex engineering problems in that area. It should be noted that an individual may also be practising at a lower level in other secondary areas. Secondary areas are indicated by partially filled in segments, to a maximum of two additional areas.

Subject areas

The extent of an individual's knowledge is represented on the right hand side of the Wheel. A "core" level of knowledge is indicated by the blue part-segments on the circle. Greater coloured portions of any segments (shown in green and yellow) indicate the knowledge and competence appropriate for "specialist" and "expert" levels respectively. The demarcation between the core standard and higher levels would be determined by consensus amongst peers and through information prepared for the CPEng assessment process, where appropriate. It is expected that individuals will be able to show that "expert" knowledge is recognised internationally, while "specialist" knowledge will be relevant to those who are recognised as such within New Zealand. It is not likely that an individual will be a specialist or expert in more than two areas.

General areas of practice

A. Research and teaching (including fire prevention)

B. Fire safety design and management of cities and communities

C. Fire safety design and management of transport activities

D. Fire safety design and management of industrial processes and facilities

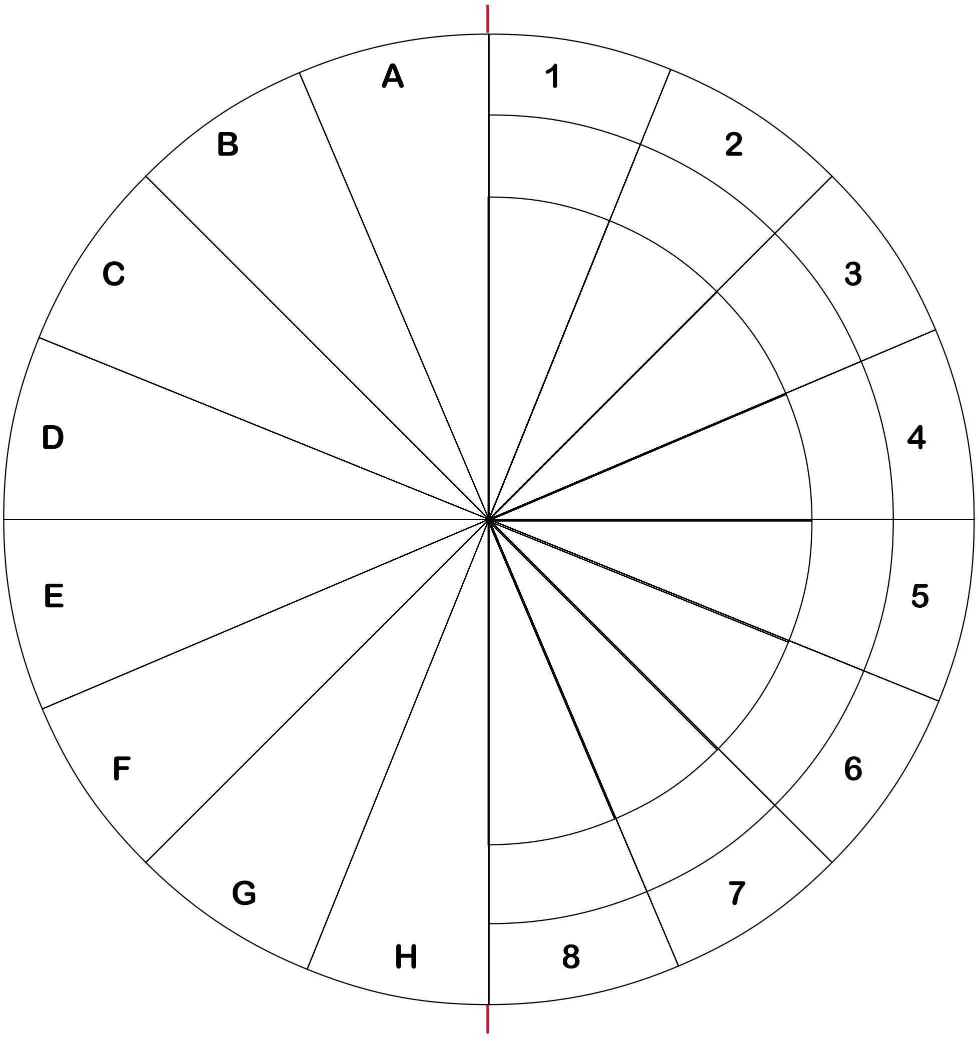
Specific subject areas

1. Fire chemistry

2. Fire dynamics

3. Active fire protection systems

4. Passive fire protection systems



E. Fire safety design and management of buildings

F. Fire safety of infrastructure and energy sources

G. Fire safety of consumer items

H. Fire investigation

5. Smoke control

6. Interaction between fire and people (including means of escape)

7. Fire risk assessment and measurement (including fire insurance)

8. Fireground operations

SPECIFIC SUBJECT AREAS (NOT NECESSARILY A COMPLETE LIST)

1. Fire chemistry

- Fire chemistry
- Toxicity and effective dose
- Smouldering combustion
- Flaming ignition
- Materials behaviour

2. Fire dynamics

- Fire dynamics
- Heat release rates
- Heat transfer
- Fire plumes
- Smoke production
- Flame height, temperatures
- Compartment fire modelling
- Liquid fuel fires
- Surface flame spread
- Estimating temperatures in compartment fires
- Fire severity assessment

3. Active fire protection systems

- Active fire systems
- Automatic detection systems: heat, smoke, flame
- Sprinklers
- Specialist suppression: water deluge, water mist, foam suppression, gas flooding
- Hydrant systems
- Hand-held fire fighting equipment: fire extinguishers, hose reels

4. Passive fire protection systems

- Passive fire protection
- Structure performance and materials behaviour
- Fire separations, doors
- Fire stopping, penetrations, fire seals
- Plasterboard performance
- Insulated sandwich construction
- Fire severity and assessment, fire resistance

5. Smoke control

- Smoke production
- Smoke control
- Natural smoke venting
- Active smoke control, plug holing
- Smoke clearance, purging
- Make up air
- Smoke reservoirs
- Stair pressurisation
- Zone pressurisation
- Smoke curtains, smoke baffles

6. Interaction between fire and people (including means of escape)

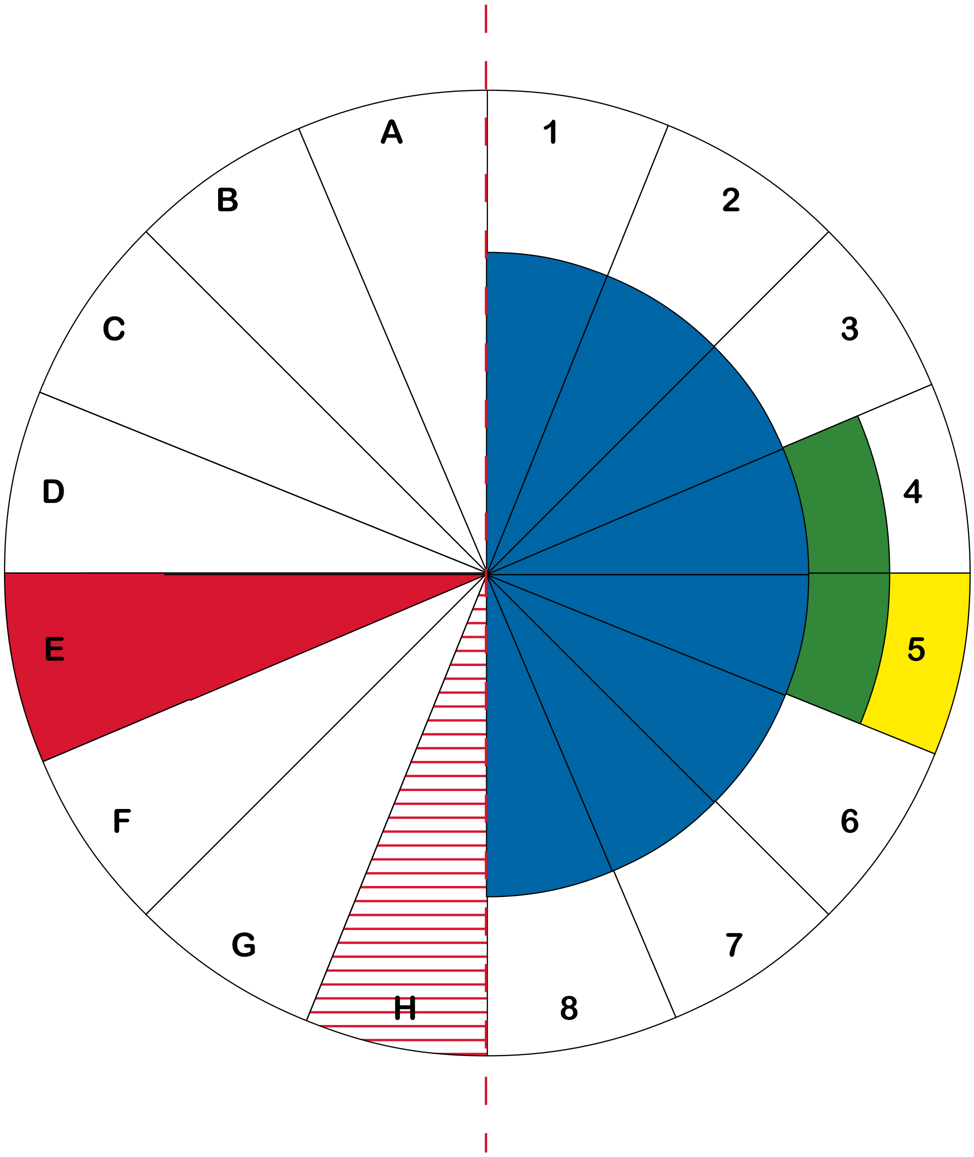
- Interaction between fire and people
- Behavioural response to fire and smoke
- Egress analysis
- Movement of people
- Wayfinding and signage
- Evacuation strategies: stay in place (staged), sequential, uncontrolled
- Locking devices
- Escape route construction details

7. Fire risk assessment and measurement (including fire insurance)

- Quantitative risk analysis and hazard assessment
- Probabilistic methods
- Computer simulations
- Risk data, gathering, collation, reporting
- Economic value of fire protection measures
- Cost benefit analysis
- Balance risk v benefit
- Extreme value theory, infrequent events
- Statistics and probability
- Fire insurance – risk and value of fire losses
- Sensitivity analysis

8. Fireground operations

- Fireground operations
- Building management
- Fire appliance response
- Appliance accessibility
- Equipment location
- Communication systems
- Emergency management
- Automatic interface with alarms and fire service
- Introduced hazards (eg hydrant hose through stair door)
- Public relations
- Evacuation management
- Refuge areas and egress for people with disabilities



General areas of practice

Shaded segments indicate an individual's general areas of practice and profile in terms of knowledge and experience. These will vary from person to person.

Individuals will be competent to solve complex fire engineering problems in any fully shaded segment.

Secondary areas of practice are indicated by partial shading.

Specific subject areas

The shaded area of a subject area segment is in proportion to individual's knowledge and competence in that subject area.

Blue = core professional competency.

Green = specialist knowledge that is nationally recognised.

Yellow = expert knowledge that is internationally recognised.

USING THE WHEEL OF FIRE

The Taskforce is particularly concerned with the competencies required for fire engineers practising in safety design and management of buildings (general area of practice E). Other areas of practice are included in the Wheel for completeness and to allow IPENZ to provide a consistent assessment process for all fire engineering practitioners.

The Taskforce intends that the Wheel of Fire will assist fire engineers to describe their core areas of practice and competencies for CPEng assessment and also indicate to clients and BCAs those subject areas where they have specialist or expert knowledge. The Taskforce has developed several examples of how the Wheel of Fire can be used to describe various fire engineering practitioners.

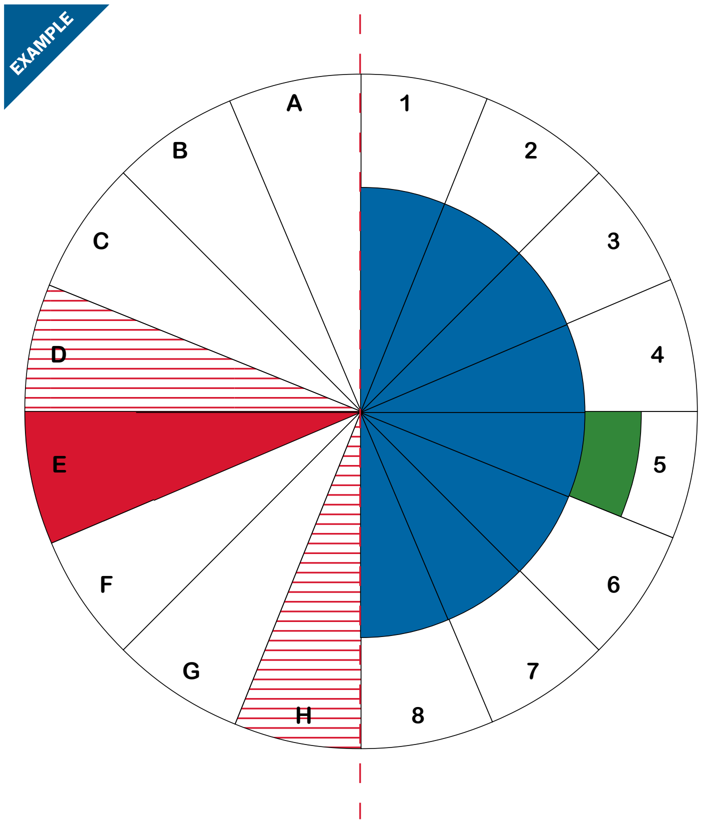
Fire engineer – design and management of buildings (CPEng)
A fire engineer who has met the CPEng standard of competence is expected to have core knowledge of all subject areas 1 to 8. They will also have nominated specialisation in the general area of practice E (fire engineering design and management of buildings) and be able to demonstrate that they can solve complex engineering problems in that specialist area. The specialist area of practice must be a significant area of professional employment or practice and will be the area in which the engineer does most of their work.

In the example below of a fire engineer (CPEng), the individual has nominated the general area of practice E as their main area of practice and shown that they also practice in the general area of practice H – fire investigation. They show core knowledge in all eight specific subject areas and specialist knowledge at an internationally recognised level in subject area five – smoke control.

In categorising fire engineering activities, it is also important to recognise that there are specialisations even within the specific subject areas listed, such as: structural performance during fire; human behaviour and response in emergencies; design of specialised smoke control systems; and quantitative risk assessment. Practitioners must recognise that these fields in themselves require a further level of knowledge and understanding to establish competence. Recognition of this is fundamental if engineers are to avoid practising outside their areas of expertise.

A fire engineer should also be able to demonstrate that they have:

- Acquired a basic understanding of how to deal with a fire emergency.
- Acquired the ability to identify and quantify fire hazard scenarios in fire risk situations.
- An appreciation of the relevant regulations and legislation affecting their areas of specialisation, as well as a working knowledge of codes and standards and the state of the art in their field of operation. This will need to include requirements for installation, maintenance and reliability of appropriate fire protection systems and structures.
- A critical understanding of the assumptions and limitations of computer programmes, in so far as they affect fire safety, where they are used by the fire engineer, or on his or her behalf.



Fire engineer with specialist expertise (CPEng)

As a minimum, needs to demonstrate core knowledge in subject areas 1 to 8.

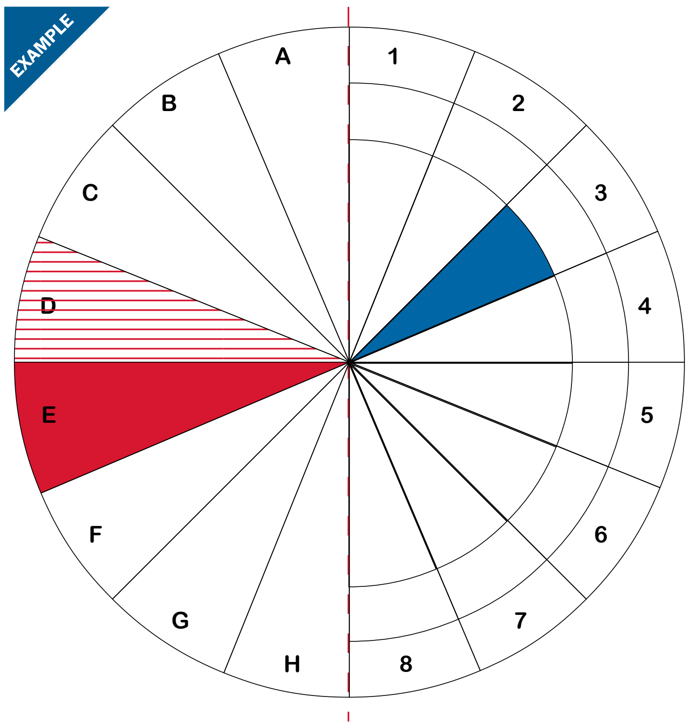
Nominates one or two principle areas of practice for CPEng competence assessment.

May show up to two other areas of practice.

May show additional expertise as a specialist in a certain field (smoke control in this example).

Other fire safety practitioners

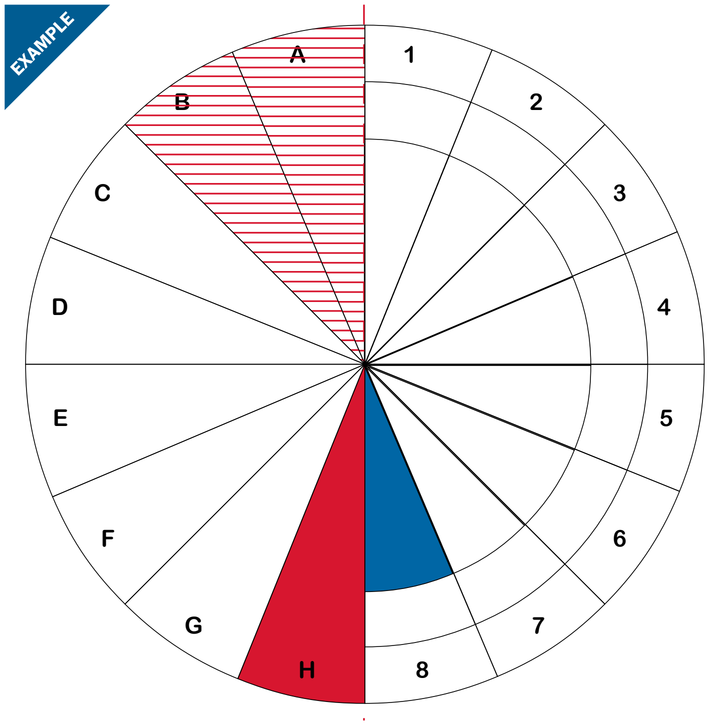
Three descriptions of other fire safety practitioners, using the Wheel of Fire, are shown below. While none of these would be CPEng (at least not on the strength of their fire engineering alone), some may well meet the requirements for fire safety technician registration.



Fire protection systems designer/ contractor

Often highly skilled in the design and installation of active fire protection systems.

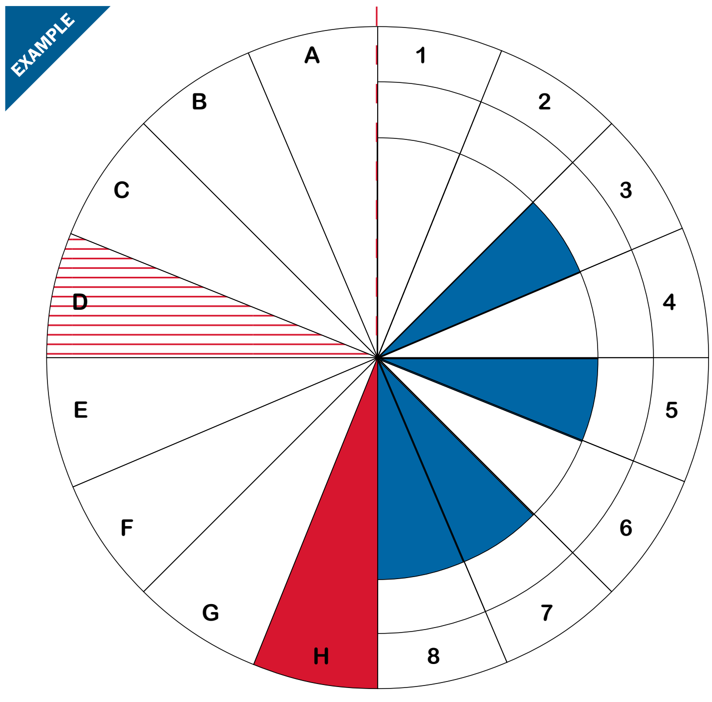
Practises in the area of fire safety design of buildings.



Fire Service fire safety officer
Usually has expertise in evacuation schemes.

May have special expertise in fireground operations.

May practise in the areas of fire investigation, fire safety of cities and communities, or fire prevention.



Insurance underwriter/loss adjuster, risk assessor, fire investigator
Usually has knowledge of active fire systems.

May have specialist expertise in fire risk assessment.

May practise in the areas of fire investigation or fire protection of industrial facilities.

GUIDELINES FOR ASSESSMENT OF CPEng APPLICANTS PRACTISING IN FIRE ENGINEERING

The National Professional Engineers Register (NPER)

3 June 1999 Issue: 1 Revision: 4

Guideline

Eligibility Criteria & Procedures for Recognition in the Specific Area of Practice

Fire Safety Engineering

1. Introduction

This document states the eligibility criteria for applicants seeking recognition on the National Professional Engineers Register (NPER) in the specific area of practice of Fire Safety Engineering.

The Guideline has been prepared by a competency panel comprising representatives of the Society of Fire Safety Australia and the Colleges of Chemical, Civil, Electrical, Mechanical and Structural Engineers. The setting of standards and administration of the registration scheme is the responsibility of the competency panel, but assessment of applications is the responsibility of an assessment panel, established by the Institution and comprising experienced practitioners from the Society and the Colleges.

By arrangement with the Competency Panel responsible for the general area of practice Building Services Engineering, applicants can be registered in the specific area of practice Fire Safety Engineering under NPER – Building Services Engineering if no other general area of practice is appropriate.

2. Background to Fire Safety Engineering

Fire safety engineering is multidisciplinary in nature, having substantial relationships with building services, mechanical, electrical, electronics, chemical, structural and civil engineering and embraces an understanding of human behaviour.

It is the application of engineering principles, rules and expert judgement based on a scientific appreciation of the fire phenomenon, of the effects of fire and of the reaction and behaviour of people in order to:

- save life, protect property and preserve the environment and heritage from destructive fire;
- quantify the hazards and risk of fire and its effects;
- mitigate fire damage by proper design, construction, arrangement and use of buildings, materials, structures, industrial processes and transportation Systems;
- evaluate analytically the optimum protective and Preventive measures, including design, installation and maintenance of active and passive fire and life safety systems, necessary to limit, within prescribed levels, the consequences of fire.

There are currently few structured courses providing training in fire safety engineering. The Society of Fire Safety Australia in conjunction with the Institution intends to facilitate and promote the development of structured programs and will do so in co-operation with the major employers of fire safety engineers.

It is anticipated that most applicants seeking recognition as fire safety engineers will have academic qualifications and professional training in other engineering or related fields. They will need to show that they have received adequate training within the area of fire safety engineering in which they practise and wish to be registered. All applicants are therefore required to submit a Training and Experience Report (TER). In this report they will need to describe the training they have received in specific aspects of their practice.

It is the express intention of the competency assessment embraced by this application process to align with the standards of relevant overseas bodies (such as SFPE and IFS) with a view to assisting NPER registrants to practise overseas and to comply with building legislation in Victoria and other Sates or Territories, implementing registration in the Class of Fire Safety Engineering.

3. Criteria for Fire Safety Engineering

Recognition in the specific area of practice Fire Safety Engineering requires that:

- you have an acceptable qualification and sufficient experience to satisfy the National Competency Standards for Professional Engineer at Stage 2;
- you have registered in a general area of practice on NPER;
- fire safety engineering is a significant area of your professional employment or practice;
- you must be able to demonstrate capability in a satisfactory range of the following fire safety engineering activities:

1. Fire science (fire chemistry) - determining:

- mass conversion from combustion
- heat release rate from combustion
- species products from combustion.

2. Fire science (fire dynamics) - determining:

- heat transfer rates
- smoke movement
- fire spread rates.

3. Fire protection engineering (Active) - using system performance requirements and design verification methods to design:

- automatic suppression systems
- detection systems.

4. Fire protection engineering (Passive) - using system performance requirements and design verification methods to design:

- fire/smoke barrier systems
- structural members under fire conditions.

5. Smoke control - undertaking:

- analysis of smoke production,
- quantitative analysis of smoke spread
- analysis of smoke control measures.

6. Interaction between fire and people - recognising:

- human behaviour during fire emergencies,
- building layouts, occupation rates, means of egress
- methods for estimating occupant response in a
- fire emergency.

7. Fire-ground operations - taking into account:

- fire brigade capabilities
- the role of the fire brigade during a fire emergency
- methods of incorporating fire brigade
- intervention in a fire safety analysis.

8. Fire risk assessment - undertaking quantitative risk assessment to estimate:

- human impact of fire
- financial impact of fire
- environmental impact of fire.

9. Fire prevention - taking into account:

- the causes of fires
- methods of prevention
- selection and management of materials
- control of ignition sources.

10. Codes and Standards - applying:

- appropriate building regulations
- fire related standards and codes of practice.

11. Fire investigation

12. Fire insurance (including QRA)

13. Fire safety of consumer items and energy sources

14. Fire safety design and management of buildings

15. Fire safety design and management of industrial processes

16. Fire safety design and management of transport activities

For more information, contact:

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