Practice Field Guidelines - Fire Engineering

Contents

Purpose of guidelines

The purpose of these guidelines is to provide **applicants** with suggestions on the type of evidence that is considered to demonstrate that they meet the competence standard. These suggestions are not exhaustive nor are they definitive – the assessment panel, which is the only entity with access to all the applicant's evidence, is required to make a judgement on the applicant's competence.

All competence assessments are made in the applicant's practice area (definition below). The applicant is asked to provide a brief description of his or her practice area – which is effectively the professional engineering activities they perform. This description will guide the assessment panel when it assesses the evidence submitted. Assessment panels are instructed to amend the applicant's practice area description if the panel find a mismatch. Hence applicants are asked to consider very carefully their practice area when describing what they do.

Practice area definition

The **practice area** of an engineer is defined as:

> **practice area** means an engineer's area of practice, as determined by—
> (a) the area within which he or she has engineering knowledge and skills; and
> (b) the nature of his or her professional engineering activities.

Fire Engineering Practice Area
The field of engineering that is Fire Engineering is described in detail of Chapter 0.3 of the International Fire Engineering Guidelines* and in particular is defined by the International Standards Organisation (ISO) :-

"The application of engineering principles, rules and expert judgment based on a scientific appreciation of the fire phenomena, of the effects of fire, and the reaction and behaviour of people, in order to:

- *save life, protect property and preserve the environment and heritage*
- *quantify the hazards and risks of fire and its effects*
- *evaluate analytically the optimum protective and preventative measures necessary to limit, within prescribed levels, the consequences of fire"*

(* ICC, NRC-CNRC, DBH and ABCB. "International Fire Engineering Guidelines". 2005 Edition. Australian Building Codes Board. Canberra. 2005).

Engineering problems

Complex engineering problems means engineering problems which cannot be resolved without in-depth engineering knowledge and having some or all of the following characteristics:

- Involve wide-ranging or conflicting technical, engineering and other issues
- Have no obvious solution and require originality in analysis
- Involve infrequently encountered issues
- Are outside problems encompassed by standards and codes of practice for professional engineering
- Involve diverse groups of stakeholders with widely varying needs
- Have significant consequences in a range of contexts

Broadly-defined engineering problems mean engineering problems having some or all of the following characteristics:

- Can be solved by application of well-proven analysis techniques
- Are parts of, or systems within complex engineering problems
- Involve a variety of factors which may impose conflicting constraints
- Belong to families of familiar problems which are solved in well-accepted ways
- May be partially outside those encompassed by standards or codes of practice
- Involve several groups of stakeholders with differing and occasionally conflicting needs
- Have consequences which are important locally, but may extend more widely

Well-defined engineering problems mean engineering problems having some or all of the following characteristics:

- Can be solved in standardised ways
- Are discrete components of engineering systems
- Involve several issues, but with few of these exerting conflicting constraints
- Are frequently encountered and thus familiar to most practitioners in the practice area
- Are encompassed by standards and/or documented codes of practice
- Involve a limited range of stakeholders with differing needs

- Have consequences which are locally important and not far-reaching
- Can be resolved using limited theoretical knowledge but normally requires extensive practical knowledge

Engineering activities

Complex engineering activities means engineering activities or projects that have some or all of the following characteristics:

- Involve the use of diverse resources (and for this purpose resources includes people, money, equipment, materials and technologies)
- Require resolution of significant problems arising from interactions between wide-ranging or conflicting technical, engineering or other issues,
- Involve the use of new materials, techniques or processes, or the use of existing materials techniques or processes in innovative ways

Broadly defined engineering activities means engineering activities or projects that have some or all of the following characteristics:

- Involve a variety of resources (and for this purposes resources includes people, money, equipment, materials and technologies)
- Require resolution of occasional interactions between technical, engineering and other issues, of which few are conflicting
- Have consequences are most important locally, but may extend more widely
- Require a knowledge of normal operating procedures and processes

Well-defined engineering activities mean engineering activities or projects that have some or all of the following characteristics:

- Involve a limited range of resources (and for this purpose resources includes people, money, equipment, materials and technologies)
- Require resolution of interactions between limited technical and engineering issues with little or no impact of wider issues
- Have consequences that are locally important and not far-reaching
- Require a knowledge of practical procedures and practices for widely-applied operations and processes

Guidelines for Fire Engineering

Professional Engineering - Element 1

ELEMENT DESCRIPTION

1 Comprehend, and apply knowledge of, accepted principles underpinning widely applied good practice for professional engineering

PERFORMANCE INDICATORS

- Has a Washington Accord degree or recognised equivalent qualification or has demonstrated equivalent knowledge and is able to:
  - Identify, comprehend and apply appropriate engineering knowledge
  - Work from first principles to make reliable predictions of outcomes
  - Seek advice, where necessary, to supplement own knowledge and experience
  - Read literature, comprehend, evaluate and apply new knowledge

GENERAL PRACTICE FIELD GUIDELINES

- This element is intended to show the candidate currently has the level of knowledge of a Washington Accord degree – as evidenced by an accredited Washington Accord degree (or recognised equivalent qualification) supported by on-going CPD, although applicants can demonstrate they have acquired the same level of knowledge through other learning processes.
- Applicants are able to apply that knowledge through work experience. The competence required by the standard is that of a 4-year Washington Accord degree graduate with typically 4 to 5 years post-graduation work experience.
- Qualifications other than Washington Accord equivalent may require knowledge assessment
- Applicants will be expected to show their ability to work from first principles and to comprehend and apply engineering knowledge – and evidence of this skill will be critical for non-Washington Accord qualified applicants in meeting this element of the standard

PROFESSIONAL ENGINEER

- This element is intended to show the candidate has level of knowledge equivalent to a Washington Accord degree – can demonstrate that he/she has acquired the same level of knowledge through other learning processes, such as ongoing professional development in this field and application of fundamental research and can apply that knowledge through work experience. The competence required by the standard is that of a 4-year Washington Accord degree graduate with typically 4 to 5 years post-graduation work experience.
- A 4-year BE (Civil) / (Mechanical) / (Chemical) / (Electrical) degree is strong evidence of meeting the knowledge level of this element when combined with either a postgraduate degree or diploma in fire engineering or additional specific fire engineering training from a professionally recognised body. Any other relevant formally assessed qualifications is good evidence in demonstrating knowledge equivalent to a Washington Accord degree, however other qualifications must include specialisation in fire engineering.
- Guidance on the curriculum and requirements for a specialised degree in fire engineering is summarised can be found in a paper by Magnusson et al*.

Professional Engineering - Element 1

ELEMENT DESCRIPTION

1 Comprehend, and apply knowledge of, accepted principles underpinning widely applied good practice for professional engineering

*Magnusson, S. E.; Drysdale, D. D.; Fitzgerald, R. W.; Motevalli, V.; Mowrer, F.; Quintiere, J. G.; Williamson, R. B.; Zalosh, R. G. Proposal for a Model Curriculum in Fire Safety Engineering, Fire Safety Journal, Vol. 25, No. Special Issue, 1-88, 1995).

- Formal assessment at a professional level that is fire engineering specific, e.g. United States PE exam. (Note: It is not intended that this would be a substitute for other training and experience, or any sort of mandatory requirement, however it would be regarded as very good evidence the candidate meets element 1).
- Formal assessment at a technologist level that is fire engineering specific, or in a related field such as fire safety or fire investigation, e.g. some IFE Qualifications. (Note: It is not intended that this would be equivalent to a professional qualification, however it would be regarded as good evidence in conjunction with other formal and informal training, experience and CPD).
- An applicant possessing qualifications other than a Washington Accord accredited degree must be able to demonstrate they have 'bridged the gap' from an NZCE (Civil) / (Mechanical) or NZ Diploma or BEngTech (3 year degree). Early advice should be sought from IPENZ before submitting an application as a knowledge assessment will be required to establish Washington Accord equivalence.
- Applicants will be expected to show their ability to work from first principles and to comprehend and apply engineering knowledge – and evidence of this skill will be critical for NZCE (Civil) / (Mechanical), NZ Diploma or BEngTech or other applicants without a Washington Accord degree in meeting this element of the standard.
- The applicant undertakes relevant CPD for continued renewal and upgrading of their knowledge, for example attendance at fire engineering or fire safety science conferences product demonstrations on active and passive fire safety systems, courses on fire and egress modelling programs, live fire demonstrations and general engineering CPD.
- The applicant actively participates with professional bodies such as the NZ Chapter of the Society of Fire Protection Engineers and the Institute of Fire Engineers and Fire Protection Association of NZ and can demonstrate a diversity of engineering activities leading to learning and betterment of engineering skills by a combination of internal to organisation and external CPD.
- The applicant attends industry-based training courses and seminars–as provided by organisations such as IPENZ, Canterbury University's Fire Engineering Department, Firetech Training Limited, Society of Fire Protection Engineers (SFPE), Construction Industry Training Enterprise (CITE) and Victoria University's School of Architecture.
- To gain knowledge the applicant participates in appropriate work place activities, such as investigation, analysis, design, maintenance, risk assessment, construction, supervision, quality assurance, project management, etc. Typically the applicant will demonstrate participation in all or at least most of these activities.
- Prepare and interpret designs and calculations for means of escape, protection of other property, design of smoke management systems and fire rating requirements. These should take the form of alternative solutions, such as an ASET/RSET analysis, calculation of radiation at a boundary, sizing smoke management systems, calculation of required fire resistance ratings. Simple and routine application of the Acceptable Solutions is not sufficient.
- Knowledge and understanding of the theoretical basis of, and practical application of such knowledge of the following
  - Fire initiation and development
  - Smoke Development and Spread and Control
  - Fire Spread and Impact and Control
  - Fire Detection, Warning and Suppression
  - Occupant Evacuation and Control

Professional Engineering - Element 1

ELEMENT DESCRIPTION

1 Comprehend, and apply knowledge of, accepted principles underpinning widely applied good practice for professional engineering

- Fire Services Intervention
- It is expected that candidates would have a broad knowledge over these areas and in many instances have more detailed knowledge in one of these areas of fire engineering
- This knowledge can be demonstrated by candidates showing they are familiar with theoretically and empirically based calculations for various fire phenomena. It is not expected that all candidates would remember these, but should have the knowledge and ability to find reference to them and apply them appropriately within their limits of application. Examples of some of these are:-
  a) Calculation of detection time lag
  b) Calculation detector response time for steady state fires and be able to develop a spreadsheet or similar for quasi-steady state fires.
  c) Estimation of and justification of occupant response times
  d) Calculation of travel speeds for various occupant densities and occupant characteristics
  e) Calculation of travel times, effective widths and queuing times
  f) Assessment of available safe egress times using zone models
  g) Calculation of ventilation controlled burning rate
  h) Calculation of the burning rate required for flashover.
  i) Calculation of compartment temperatures using an energy balance for a steady state fire.
  j) Estimation of an equivalent opening size for multiple vents in a compartment.
  k) Calculation of fire size for a design fire growth rate at a specific time.
  l) Calculation of smoke production rates for a given fire size and smoke layer height.
  m) Calculation of the size of balcony spill plumes.
  n) Calculation of radiation at a point from parallel and orthogonal rectangular radiators to parallel and orthogonal walls.
  o) Calculation of radiation at a point from cylindrical radiators to parallel and orthogonal walls.
  p) Calculation of residual section strengths for fire damaged heavy timber structural elements.
  q) Calculation of 1-dimensional heat transfer through multi-component systems and semi-infinite slabs.
  r) Determine by calculation if fuels and materials are thermally thick or thermally thin
  s) Calculation of Hp/A ratios for 3 and 4 sided, boxed and profiled insulation
  t) Calculation of thickness of insulation required for steel sections using the formula in the FEDG.
  u) Assessment of cover required for reinforcing in pre-stressing steel in structural elements
  v) Assessment of concrete thickness required for insulation of walls and floors.
  w) It is expected that candidates would also be able to carry out more complex calculations and to use and comprehend more complex models at least in one area of fire engineering.

For 'not previously assessed' applicants, the above should be supported by work samples and may be explored further in any interactive assessment.

Professional Engineering - Element 2

ELEMENT DESCRIPTION

2 Comprehend, and apply knowledge of, accepted principles underpinning good practice for professional engineering that is specific to the jurisdiction in which he/she practices (For CPEng assessment this relates to the jurisdiction of NZ)

PERFORMANCE INDICATORS

- Demonstrates an awareness of legal requirements and regulatory issues within the jurisdictions in which he/she practices
- Demonstrates an awareness of and applies appropriately the special engineering requirements operating within the jurisdictions in which he/she practices

GENERAL PRACTICE FIELD GUIDELINES

- Evidence that shows the applicant understands and works in compliance with the relevant regulatory framework - for example, compliance regimes covered by statute or local body by-law, mandatory standards or codes of practice.
- Demonstrate an understanding of situations and responsibilities when/where standards/guidelines/specifications need to be modified or amended to suit specific situations and document the resulting implications

PROFESSIONAL ENGINEER

- Application of knowledge of RMA, Building Act, International Fire Engineering Guidelines, Fire Service Act, Hazardous Substances and New Organisms Act, Building Regulations, Fire Safety and Evacuation of Buildings Regulations, Familiarity with and use of the New Zealand Building Code, NZ Standards; and Specifications, Manuals/Guidelines; Service Authority requirements; local authority standards/guidelines as relating to Fire Engineering. Compliance documents for NZ Building Code Clauses C1, C2, C3, C4, D1, F2, F3, F4, F6, F7 and F8.
- Awareness and understanding of the NZ Fire Service Design Review Unit and their role and processes.
- Involvement in consultation, negotiations with the NZ public that take cognisance of the duty of care to public safety and stakeholders.
- Understand and apply New Zealand (national or local) requirements related to environmental guidelines for resource usage and, design standards (e.g. NZS4541 & NZS4512.
- Health and Safety, awareness of statutory obligations and planning to overcome any issues from the client, consultant and contractor perspective
- Undertake consultation with diverse stakeholders such affected minority parties, Iwi, etc.
- Understand and apply Treaty of Waitangi requirements,
- Be aware of wider fire engineering issues [e.g. promotion of environmentally friendly materials which minimise impact on the community and environment in fire conditions)
- Awareness and understanding of the implications of Determinations issued by the Department of Building and Housing (or Building industry Authority) related to fire safety in Buildings.
- IPENZ Practice Notes, 2, 3, 4, 5, 6, 7, 8, 10 and 13
- Fire Engineering Advisory Taskforce, Report and Recommendations, 2007, *Hot Topics*
- Working Knowledge of the *International Fire Engineering Guidelines*

Note – the above evidence could be approached from different perspectives, such as industry, construction, infrastructural and city planning.

Professional Engineering - Element 3

ELEMENT DESCRIPTION

3 Define, investigate and analyse *complex engineering problems* in accordance with good practice for professional engineering

PERFORMANCE INDICATORS

- Identifies and defines the scope of the problem
- Investigates and analyses relevant information using quantitative and qualitative techniques
- Tests analysis for correctness of results
- Conducts any necessary research and reaches substantiated conclusions

GENERAL PRACTICE FIELD GUIDELINES

- Evidence demonstrates knowledge of technical fundamentals (including initial specification and brief in terms of client perceptions, use of engineering design standards and specifications) to scope a complex engineering problem
- Examples of methodologies used for analysis, prediction and choice outside those encompassed by standard codes (including preparing functional design requirements, addressing design concepts, and determining possible design constraints)
- Evidence of experiments conducted, prototypes built or simulations performed to test analyses
- Evidence of literature searches, use of network of peers to gather information on approaches to problem solving

PROFESSIONAL ENGINEER

- Demonstrate an understanding of, and ability to undertake and plan investigations into complex fire engineering problems and situations, including identifying and breaking-down fire specific issues under the umbrella of wider project issues. A Fire Engineering Brief (FEB) produced in accordance with the international Fire Engineering Guidelines would be good evidence of this.
- Define, investigate and analyse constraints for a given situation or project A Fire Engineering Brief (FEB) produced in accordance with the international Fire Engineering Guidelines would be good evidence of this.
- Undertake fire risk assessment activities and investigations, for example an assessment of an existing building for a change of use, or building work requiring a consent, for understanding the nature of possible fire types, mechanisms for spread and products of combustion.
- Undertake site investigation activities, contributing issues, quality assurance activities and similar activities for example an assessment of an existing building for a change of use, or building work requiring a consent and construction monitoring of fire safety features.
- Analyse interactions between predictable fire situations and building occupants and associated means of escape. Undertake auditing of installed plans and ongoing management supervision of the contractor
- Carry out research into specialist areas to suit individual project requirements for example investigating the properties of unusual fuels or building materials or the use of standard fire safety systems in unusual situations.
- Refer to relevant fire engineering codes, guides and standards for example the international Fire Engineering Guidelines, standards such as NSZ4515, 4517, 4512, 4541, 4232 part 2. BS476, AS/NZS1530, AS/NZS1668

Professional Engineering - Element 3

ELEMENT DESCRIPTION

3 Define, investigate and analyse *complex engineering problems* in accordance with good practice for professional engineering

- Identify strategic issues such as the general suitability and applicability of prescriptive requirements, business continuance for clients for further analysis, where relevant.
- Undertake project specific stakeholder consultation to identify and document stakeholder needs.
- Demonstrate an understanding of issues to study following real fire situations.
- Undertake fire modelling activities, using manual first principle methods and more sophisticated computer analysis, validate results, prepare suitable reports highlighting assumptions, how validated and outcomes derived).
- Investigation of fire causes, development and impacts.
- Undertake quantity and estimating activities
- Apply engineering knowledge and interpretation and application in defining and analysing design requirements for example assessing the output from computer fire modelling with regard to the input values assumed. Undertake engineering activities in consultation or collaboration with relevant stakeholders to minimise risk to the Stakeholders/Client/Project during the approval phase.

Activities can be related to all forms of fire engineering.

Professional Engineering - Element 4
ELEMENT DESCRIPTION 4 Design or develop solutions to *complex engineering problems* in accordance with good practice for professional engineering.
PERFORMANCE INDICATORS • Identifies needs, requirements, constraints and performance criteria • Develops concepts and recommendations that were tested against engineering principles • Consults with stakeholders • Evaluates options and selects solution that best matched needs, requirements and criteria • Plans and implements effective, efficient and practical systems or solutions • Evaluates outcomes
GENERAL PRACTICE FIELD GUIDELINES ▪ Evidence of personal responsibility taken in a project or significant task from the end of an investigation phase showing design solutions developed which resulted in all objectives being met. To indicate the level of complexity, describe involvement in detail. This can be over a range of similar projects/tasks, or one overall project/task with multiple components. ▪ Carry out a Fire Engineering Design process in accordance with the International Fire Engineering Design Guidelines
PROFESSIONAL ENGINEER • Show evidence of first hand responsibility taken for a project or significant task from the end of an investigation phase showing fire engineering design solutions developed which resulted in all objectives being met. To indicate the level of complexity, describe involvement in detail. This can be over a range of similar projects/tasks or one overall project/task with multiple components. • Undertake fire engineering design or activities relevant to the related project for a large project component or numerous smaller (can be similar) components. • Consultation with stakeholders. Will include resolving mitigation measures. • Demonstrate an understanding of the effects of fire engineering solutions as related to the subject building or plant, its occupants, architectural and structural form, building services, construction materials and ongoing maintenance. • Develop generic or project specific fire safety plans for a major project (including staging) or a number of smaller projects integral to a larger development. • Preparation of design solutions quoting principles underpinning good practice application (e.g. consideration of all aspects of fire dynamics such as heat transfer, smoke production, flame height and fire severity;. • Implementing contract specification for fire engineering measures through the construction phase of a project; select, and specify fire safety measures such as active fire systems, specialist suppression, structural performance, smoke control, and evacuation strategy. • Demonstrate awareness of some of the specific areas of fire engineering such as fire chemistry, fire dynamics, active and passive protection, smoke control, people interaction and fire risk. • Considers use of resources structural and fire rated materials (e.g. timber, glass, insulation, steel and concrete); resource planning (materials, labour, plant); preparing, implementing and monitoring risk.

Professional Engineering - Element 4
ELEMENT DESCRIPTION 4 Design or develop solutions to *complex engineering problems* in accordance with good practice for professional engineering.
• Apply and use computer software fire models at a higher level than simple data input (manipulate and understand inputs, outputs and assumptions for models, carry out and interpret sensitivity analysis sensitivity and understand when a sensitivity analysis is not warranted due to the predictability of the effect of varying particular inputs – make judgements on selection of software (and differences and correct selection where there is a choice) and results; prepare report and make recommendations. • Describe the effects of uncertainty in modelling and design. • Undertake validation, assessment and checking of all forms of relevant engineering design and calculation. • Survey and assess levels of fire risk in existing buildings. • Understand relative cost for project specific fire control measures. • Design escape routes that facilitate safe evacuation of buildings taking account the behaviour of the occupants. • Undertake design management. • Demonstrate how a solution meets the relevant performance requirements of legislation and stakeholders. • Quality management activities, from the client, consultant and contractor perspective • Seek and undertake continuous improvement activities to add value for clients and employers • Demonstrate an understanding of situations and responsibilities when/where standards/guidelines/specifications need to be modified or amended to suit specific situations and document the resulting implications. • Determining fire causes, development and impacts, in particular with the aid of numerical and computer models. • Design and specification of commissioning tests and inspection, testing and maintenance requirements. (Typical work includes developing options and proposing solutions for multiple forms of fire engineering problems, such as for industrial plant, in institutional, commercial and residential buildings and on infrastructural projects.)

Professional Engineering - Element 5

ELEMENT DESCRIPTION

5 Be responsible for making decisions on part or all of one or more *complex engineering activities*

PERFORMANCE INDICATORS

- Takes accountability for his/her outputs and for those for whom he/she is responsible
- Accepts responsibility for his/her engineering activities

GENERAL PRACTICE FIELD GUIDELINES

- Demonstrate effective self-management skills (including: undertaking professional development, setting own goals, practising effective time management, and recording professional development activities).
- Undertake and accept responsibility for higher levels of engineering activity, such as preparing and presenting submissions, estimates, project funding requests, annual planning activities and reports to client and senior management. Be responsible for and conduct public and stakeholder consultation and meetings

PROFESSIONAL ENGINEER

- Undertake and accept responsibility for higher levels of engineering activity, such as preparing and presenting submissions, annual planning activities and reports to others.
- Preparation of evidence to present at hearings or preparation and presentation of evidence at hearings or other relevant proceedings such as determinations etc.
- Undertake responsible levels of project management, from the perspective of the client, engineer or contractor.
- Determining and agreeing project scope with clients.
- Checking of plans, designs, and schemes.
- Existing fire engineering criteria and project safety audit participation as a team member.
- Presentation to public/stakeholders as part of the broader project consultation process or lead such a process. Take responsibility for the preparation of project estimating from both client and contractor perspective; be aware of model uncertainty in analysis and also cost estimating.
- Make own decisions that impact significantly on the project with the authority delegated from senior management.
- Actively assists to resolve conflict relating to the design e.g. Fire Service Design Review Unit reviews.
- Decision making taking into account factors that influence fire engineering solutions such as, human behaviour, wider architectural and structural issues, sustainability, client specific needs etc. *(this is more to do with criteria 3 and 4).*
- Include in work examples- economic analysis of project options to arrive at preferred option; assess acceptable levels of risk associated with options such as types of active and passive controls, smoke control measures and means of escape.
- Undertake site supervision of fire system elements or packages or minor projects and subcontractors
- Undertake site management activities such as the Engineer's or Contractor's Representative.
- Managing Fire Investigations.

Consideration of the wider inputs of a multi-disciplinary team and decision making and relationships with other disciplines such as architects, structural and services engineers can be considered under this element.

Professional Engineering - Element 6

ELEMENT DESCRIPTION

6. Manage part or all of one or more *complex engineering activities* in accordance with good engineering management practice

PERFORMANCE INDICATORS

- Plans, schedules and organises projects to deliver specified outcomes
- Applies appropriate quality assurance techniques
- Manages resources, including personnel, finance and physical resources
- Manages conflicting demands and expectations

GENERAL PRACTICE FIELD GUIDELINES

- Project Management responsibility for a group of smaller projects and engineering activities or a significant part of a larger project
- Undertake site management activities such as the Engineer/Client/ or Contractor's Project Manager.

PROFESSIONAL ENGINEER

- Manage projects or a series of tasks or resources (including people, money, equipment, materials and technologies).
- Undertake Elements 3-5 by taking responsibility for inputs and outputs.
- Manage commissioning and post construction monitoring of active fire systems.
- Monitor construction of passive fire control elements in building projects.
- Take responsibility for estimating and tender submission activities, project management and budgets (preparation and monitoring reporting) where related to fire safety systems.
- Programming, allocation of resources, responsibility for personnel.
- Co-ordination/programming and management of staff and other resources to complete tasks and projects. Communication of programme to team members and others.
- Project Management responsibility for a group of smaller projects and engineering activities or a significant part of a larger project.
- Undertake and manage quality assurance activities.
- Undertake site management activities such as the Engineer/Client/ or Contractor's Project Manager (work at higher level than Element 5).
- Supervise commissioning tests.
- Fire system contracts (supervision/management) involving high complexity (such as involved client /authority/ other consultants/contractor/stakeholder/ multiple fire risk/ complex materials/ sophisticated egress control).

Professional Engineering - Element 7

ELEMENT DESCRIPTION

7 Identify, assess and manage engineering risk

PERFORMANCE INDICATORS

- Identifies risks
- Develops risk management policies, procedures and protocols to manage safety and hazards
- Manages risks through 'elimination, minimisation and avoidance' techniques

GENERAL PRACTICE FIELD GUIDELINES

- Evidence of training in risk management
- Knowledge of (not necessarily the use of) specialist software used for risk management
- Consider risks within alternative designs/timings/solutions/options
- Considers financial risk and/or potential liability to company.

PROFESSIONAL ENGINEER

- Document risk at various project phases:
    - at concept/scheme could be building geometry, occupant type, activity, resource consent, building material data;
    - at design stage extent of passive and active fire systems,
    - dealing appropriately with regulatory issues,
    - threat of project benefits falling off; at construction stage,
    - material interfaces,
    - misinterpretation of specialist requirements ,
    - code changes.
- Sensitivity analysis.
- Cost benefit analysis. Balance risks versus benefits.
- Communicate the impact on risk to clients of reducing levels of life safety and/or property protection with alternative solutions.
- Communicating to clients the risk of using designs to the Acceptable Solutions that may be unsafe in particular circumstances.
- Show evidence of training in risk management.
- Quantitative risk analysis and hazard assessment. Probabilistic methods.
- Consider risks within alternative designs/timings/solutions/options.
- Undertake qualitative and quantitative modelling; rank risk;
- Fire Insurance – risk and value of fire losses including loss of business continuity.
- Stakeholder/consultation planning (identifying risks to project from adverse consultation outcomes).
- Develop recommendations from investigations of fire incidents.
- Knowledge and understanding of more advanced risk analysis and mitigation methodologies, such as
    - Extreme value theory, infrequent events, consequences of failure. Statistics and probability
    - Computer simulations, risk data, gathering, collation and reporting.
    - Preparation and implementation of Risk Management Plan
    - Knowledge of (not necessarily the use of) specialist software used for risk management

Professional Engineering - Element 8

ELEMENT DESCRIPTION

8 Conduct engineering activities to an ethical standard at least equivalent to the relevant code of ethical conduct

PERFORMANCE INDICATORS

- Demonstrates understanding of IPENZ and/or CPEng codes of ethics
- Behaves in accordance with the relevant code of ethics even in difficult circumstances (includes demonstrating an awareness of limits of capability; acting with integrity and honesty and demonstrating self management)

GENERAL PRACTICE FIELD GUIDELINES

- Evidence of exercising judgement on own competence – outline actions taken when confronted with work outside own area of competence
- Evidence of managing conflicts of interest – description of actions taken to resolve
- Evidence of quality assurance procedures and risk management methodologies used in professional engineering practise

PROFESSIONAL ENGINEER

- Understand and apply IPENZ Code of Ethics
- Personal day-to-day behaviour – stand up for professional standards (refer to the code of conduct)
- Identify and practice only within your field of competence. Be aware of your limitations and seek assistance from others where necessary.
- Awareness of relationships between commercial pressures and safety of life.
- Ensuring clients are aware of the possible limitations of a building code complying fire design in terms of property protection, business continuance and so on.
- Communication with clients and other stakeholders if there is reason to believe a design complying with prescriptive requirements has a lower than desirable level of safety.
- Understand the respective roles of the Engineer to the Contract and the Contractor's Manager.
- Be aware of personal capabilities and know when to seek input from more competent advisors.
- Understand and apply the concepts of good environmental management and sustainability.
- Understand the role of an engineer in a court.
- Understand the role of an expert (witness, engineer etc).
- Understand relationships with other professionals and management.
- Understand corporate behaviour – client/contractor/ consultant relationship.
- Identify and resolve conflicts of interest.
- Understand compromise – not being trapped by corporate behaviour.
- Open and honest communication with stakeholders.
- Prepare and present evidence and reports to Employer/Client/Court/Council or others – identifying the extent of experience and expertise.
- Understand typical ethical issues in contract bidding/admin, managing contractors etc?
- Contracts – public interface is dealt with honestly, in a timely manner, ensuring closure.
- Dealing with stakeholders/customers (often the client) – listen to issue, take details accurately, investigate, develop an answer, close communication loop.
- Ensure the Stakeholders/Clients are aware of your limitations such that they realise other expertise may be required to complete some projects.

Professional Engineering - Element 8

ELEMENT DESCRIPTION

8 Conduct engineering activities to an ethical standard at least equivalent to the relevant code of ethical conduct

- Design to the Acceptable Solutions that is informed by a fundamental knowledge and understanding of fire safety.
- Ensuring fire safety requirements are implemented in the completed building.
- Undertake constructive and professional peer reviews in accordance with ethical guidelines.

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Professional Engineering - Element 9

ELEMENT DESCRIPTION

9 Recognise the reasonably foreseeable social, cultural and environmental effects of professional engineering activities generally

PERFORMANCE INDICATORS

- Considers and, where needed, takes into account health and safety compliance issues and impact(s) on those affected by engineering activities
- Considers and takes into account possible social, cultural and environmental impacts and consults where appropriate
- Considers Treaty of Waitangi implications and consults accordingly
- Recognises impact and long-term effects of engineering activities on the environment
- Recognises foreseeable effects and where practicable seeks to reduce adverse effects

GENERAL PRACTICE FIELD GUIDELINES

- Evidence of addressing needs of key stakeholders (Iwi, historic places, archaeology, etc - consultation, and possibility for alternative design to reflect needs and aspiration of those affected)
- Evidence of life-cycle considerations in engineering designs – wastage, buildability, materials used, energy consumption and maintenance requirements during operational life, end-of-life issues (disposal and demolition)
- Identify the need for sustainable solutions to engineering and construction activities
- Evidence of actions taken to address health and safety and environmental implications of projects during and after construction/implementation

PROFESSIONAL ENGINEER

- Identify the need for sustainable solutions to engineering and construction activities (could include promotion of sustainable building materials for passive fire control elements. Use of resources.
- Consider the implications of fires and fire-fighting for the environment, for example drainage of contaminated fire-fighting water.
- Understand impact of fire engineering systems on greenhouse gases and global warming scenarios.
- Consider alternatives and options (trade-offs between competing interests etc).
- Undertaking adequate project evaluation and use of correct and justifiable inputs to benefit cost analysis
- Identify community trauma and other social impacts of significant fire events.
- Understanding of needs of key stakeholders (Iwi, historic places, archaeology, etc - consultation, and possibility for alternative design to reflect needs and aspiration of those affected).
- Consider health and safety and environmental implications of projects during and after construction.
- Understand the overall consequences of failure of design in terms of the life safety of occupants.

Professional Engineering - Element 10

ELEMENT DESCRIPTION

10 Communicate clearly with other engineers and others that he or she is likely to deal with in the course of his or her professional engineering activities

PERFORMANCE INDICATORS

- Uses oral and written communication to meet the needs and expectations of his/her audience
- Communicates using a range of media suitable to the audience and context
- Treats people with respect
- Develops empathy and uses active listening skills when communicating with others
- Operates effectively as a team member

GENERAL PRACTICE FIELD GUIDELINES

- Effective communication in the English or other language (sign, Maori etc) language - orally and in writing
- Preparing, interpreting and presenting information, issuing clear and accurate instructions, interpreting instructions, and selecting appropriate methods of communication – for variety of audiences (one-to-one and one-to-many communications; technical and non-technical personnel etc)
- Evidence of acceptance by peers by attendance and active participation in meetings, work place activities, training courses etc where candidate presents points-of-view and debates the topic or issue
- Evidence of leadership - of self and others

PROFESSIONAL ENGINEER

- Preparation, presentation and content of formal reports and evidence and supporting documentation
- Preparation of fire engineering design documentation in accordance with agreed design documentation guidelines.
- Preparation of reports for specific audiences; addressing specific topic/needs – e.g. technical presentations, conference presentations, reports for clients, public; stakeholders; politicians; Court
- Ability to stand up and speak about a subject – supported by presentation material or similar and show evidence of this skill.
- Active participation in IPENZ activities.
- Show evidence of acceptance by your peers by attendance and active participation in meetings, work place activities, training courses etc where you present points-of-view and debate the topic or issue.
- Oral presentations to internal and external groups; public meetings and hearings.
- Team membership and leadership activities and communication to others.
- Interaction with other engineers – wider disciplines and offices to hear other points of view.
- Communicating fire safety requirements to other consultants that document aspects of them including commissioning and on-going maintenance, testing and inspection requirements.
- Communicating compliance schedule requirements to building owners.
- Communicate constructively when undertaking professional peer reviews in accordance with ethical guidelines.

Professional Engineering - Element 11

ELEMENT DESCRIPTION

11 Maintain the currency of his or her professional engineering knowledge and skills

PERFORMANCE INDICATORS

- Demonstrates a commitment to extending and developing knowledge and skills
- Participates in education, training, mentoring or other programmes contributing to his/her professional development
- Adapts and updates knowledge base in the course of professional practice
- Demonstrates collaborative involvement with professional engineers (NZ engineers for CPEng assessments)

GENERAL PRACTICE FIELD GUIDELINES

- Maintains Continued Professional Development (CPD) records
- Identifies future needs and plans competence development accordingly
- Actively participates with professional bodies
- Participates in diverse engineering activities leading to learning and betterment of engineering skills by a combination of training internal to organisation and external CPD, and self directed learning
- Maintains a network of professional engineers – peer reviews, collaborative activities
- Evidence of reflecting and learning from mistakes with the benefit of hindsight

PROFESSIONAL ENGINEER

- Continued Professional Development (CPD) records.
- Attendance and/or presentation to conferences and workshops in Fire Engineering or fire safety science.
- Membership of IPENZ, SFPE and other fire engineering groups or societies.
- Participation in professional and regulatory bodies and standards organisations
- Demonstrate ability to understand and adapt to changes within the profession and industry.
- Sharing achievements with others – development of best practice, demonstration of understanding of new policy, documents, current affairs etc.
- Undertake advanced or supplemental training (can include engineering, management or similar activity).
- Undertake relevant reading, such as peer reviewed journals and magazines in fire science and engineering, (e.g. J. Fire Protection Engineering), and/or research as a supplementary reference or source of knowledge to support your engineering and management activities and role (can be to establish a first principles approach).
- Reading fire investigation reports and recommendations.

Professional Engineering - Element 12

ELEMENT DESCRIPTION

12 Exercise sound professional engineering judgement

PERFORMANCE INDICATORS

- Demonstrates the ability to identify alternative options
- Demonstrates the ability to choose between options and justify decisions
- Peers recognise his/her ability to exercise sound professional engineering judgement

GENERAL PRACTICE FIELD GUIDELINES

- Undertake complex and multi-criteria analysis as a part of exercising engineering judgement
- Takes a holistic approach in the development and implementation of engineering solutions, respecting other professional and individual inputs and demonstrating a balanced process to achieve desired outcomes.
- Undertakes decision making - uses technical, economic, social, environmental etc criteria when where there is a choice of options (e.g., what factors were taken into account in making the decision? What impact did those factors have? What were the benefits/compromises in making the decision?)
- Feedback and learning from one's peers (e.g. positive peer review of work)

PROFESSIONAL ENGINEER

- Taking a holistic approach in the development and implementation of engineering solutions, respecting other professional and individual inputs and demonstrating a balanced process to achieve desired outcomes.
- Undertake decision making - where there is a choice of options (e.g. using economic, social and environmental criteria), including justification (e.g., what factors were taken into account in making the decision? What impact did those factors have? What were the benefits/compromises in making the decision?), learning from mistakes and the benefit of hindsight.
- Respect other's points of view and decisions of peers reviewing your work.
- Undertake peer review and recognise responsibilities.
- Responding (in professional manner) to and resolving issues arising from a peer review/audit/consultation, constructive criticism.
- Undertake complex and multi-criteria analysis as a part of exercising engineering judgement.
- Feedback and learning from one's peers (e.g. good positive peer review of work).
- Demonstrate the knowledge of compromises required in achieving social/economic/technical balance in fire engineering solutions.
- Evidence of learning from project experience ("school of hard knocks")
- Evidence of learning from investigations of fire cause and development and consequences.
- Organisation/management/leadership awareness and activity.
- Be aware of own limits of capability.