

Practice Field Guidelines – Design Verifiers

Pressure Equipment

1. Pressure Vessels (guidelines not yet done)
2. Pressure piping
3. Boilers (guidelines not yet done)
4. Steam Turbines (guidelines not yet done)

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1. PURPOSE OF GUIDELINES

These guidelines are intended to provide **applicants** with an indication of the type of evidence that demonstrates they meet the competence standard. They are neither exhaustive nor definitive – they are a guide and the assessment panel, which has access to all the applicant’s evidence, will make the judgement on the applicant’s competence. If the panel requires more information, it will ask the applicant for evidence related to the appropriate element(s).

All competence assessments are made in the applicant’s practice area (definition below) and so the applicant’s brief description of his or her practice area – which is combination of

his/her knowledge and skills and nature of his/her professional engineering activities - will guide the assessment panel when it assesses the evidence submitted. Assessment panels are instructed to amend the applicant's practice area description if it finds a mismatch between the practice area description and the evidence supplied. Hence applicants should consider very carefully their practice area when describing what they do.

2. 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.

Design verifier applicants should include design verification in one or more types of pressure equipment (i.e., pressure vessels, pressure piping or boilers) in their practice area descriptions.

3. ENGINEERING PROBLEMS AND ACTIVITIES

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

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

4. DESIGN VERIFICATION

IPENZ is the only qualification issuing agency recognised by the Department of Labour to certify Design Verifiers as defined by Regulation 29 of the Health and Safety in Employment (Pressure Equipment, Cranes, and Passenger Ropeways) Regulations 1999 – referred to as 'the regulations' in this document.

As a qualification issuing agency for Design Verifiers, IPENZ must ensure that it issues certificates of competence “only after a determination (by way of examination, assessment or otherwise)” to engineers who have demonstrated that they have the “knowledge, training, skills and experience” to “perform competently every activity that a holder of the certificate would be expected to perform competently”.

Guidelines for Design Verifiers – Pressure Piping

Certificates of competence are required to identify:

- a. The specified activity being undertaken by the holder of the certificate – namely, ‘Design Verification’; and
- b. The equipment for which the holder is able to conduct the specified activity. There are three types of equipment:
 - (i) Pressure equipment, which includes the following 4 categories:
 - Boilers
 - Pressure vessels
 - Pressure Piping
 - Steam Turbines
 - (ii) Cranes; and
 - (iii) Passenger ropeways.

An Inspection Body is responsible for the design verification of equipment and must be accredited with a recognised body approved by Department of Labour, such as International Accreditation New Zealand (IANZ). In performing design verification, an Inspection Body must only engage Design Verifiers who hold a current certificate of competence to carry out design verification.

It is also possible for a company to be given an exemption by Department of Labour under the PECPR Regulations (1999) to undertake in-house design verification of pressure equipment subject to it maintaining a quality management system certified to AS/NZS ISO 9001.

Note that a Design Verifier cannot issue a Design Verification certificate unless engaged by an accredited Inspection Body or a company with a Department of Labour exemption as noted above.

Refer to Appendix 1 for details on the meaning of ‘design verification’ and ‘equipment’ as prescribed in the PECPR regulations.

Guidelines for Design Verifier assessment

Professional Engineering - Element 1	
ELEMENT DESCRIPTION	
1	Comprehend, and apply knowledge of, accepted principles underpinning widely applied good practice for professional engineering
PERFORMANCE INDICATORS	
	<ul style="list-style-type: none">• Has a Washington Accord degree or recognised equivalent qualification or has demonstrated equivalent knowledge and is able to:<ul style="list-style-type: none">○ 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
ALL DESIGN VERIFIERS – PRESSURE EQUIPMENT	
	<p>A Washington Accord (New Zealand 4-year BE degree) or recognised Washington Accord-equivalent qualification in mechanical engineering, especially if gained recently, along with work samples that demonstrate your application of this knowledge is good evidence.</p> <p>Other good evidence includes:</p> <ul style="list-style-type: none">• Work samples involving design and/or design verification or construction of pressure equipment to demonstrate how this level of knowledge has been applied.• Clear, logical hand written calculations laid out in a manner that another engineer can readily follow (in preference to calculations produced using products such as Excel or MathCAD) that show your understanding and application of pressure equipment stresses.• Evidence of how the you have worked within the limits of your knowledge and have sought advice from other engineers (“knowing what you don’t know”). For example, if skills do not cover safety valves for pressure equipment.
DESIGN VERIFIER – PRESSURE PIPING	
	<ul style="list-style-type: none">• Knowledge of materials appropriate for use in manufacture of pressure vessels including:<ul style="list-style-type: none">▪ Selection of materials for given conditions of Load, Temperature, Environment and manufacturing methods▪ Use of materials listed in standards.▪ Understanding of material properties and how they are tested, material properties listed in relevant codes or in manufacturer’s data, analysis of results of material tests required by relevant standards and codes, design of tests to simulate the working environment of a component (where required).▪ Corrosion and Metal Loss - common causes of types of corrosion and metal loss including chemical, electrochemical, abrasion, erosion, high temperature – oxidation, stress corrosion – cracking▪ Understanding of methods for treating and preventing the above types of corrosion▪ Design of extra thickness tolerance in the equipment to allow for corrosion.

Professional Engineering - Element 1

ELEMENT DESCRIPTION

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

- Sample calculations such as:
 - Materials used at low temperature and required impact tests (or calculations showing why impact tests are not required for design temperatures below 0 deg C).
 - Calculations of pipe thickness, conical end thickness, torispherical or semi-ellipsoidal end thickness under internal and external pressures, including any stiffeners for external pressure.
 - Calculations of flat ends with and without compensation
 - Calculations of nozzle compensation with/without reinforcing pads
 - Calculations for bolted flanges
 - Choice of materials
 - Hot and low temperature application, including knowledge of impact temperatures required for various pressure/temperature conditions (eg ammonia piping at minus 40 deg C)
 - Calculations of hydrostatic or pneumatic tests
 - Calculations of localised loadings on nozzles on larger diameter pipe due to external loads.
 - Calculations of localised loadings on pipe supports due to external or seismic loads
 - Finite Element Analysis (FEA) calculations or FEA reports, with comments to show an understanding of stresses and how to interpret. The intention is not so much to be an “expert”, but to show your ability to judge applicability of results to a certain problem.
 - Fatigue calculations
 - Calculations for weld sizing
 - Vessel and/or piping hazard level calculations and relevance to design verification and inspections
- Computer printouts that show your understanding of the models used by the program, the assumptions made for the models used and how these assumptions are satisfied. Supporting hand calculations as a check of estimates is always useful.

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

DESIGN VERIFIER - PRESSURE EQUIPMENT

Design Verifiers need to demonstrate compliance with the following regulations, standards and codes:

- Health and Safety in Employment (Pressure Equipment, Cranes, and Passenger Ropeways) Regulations 1999
- Approved codes of practice relating to specified equipment as issued by the Secretary of Labour
- You should demonstrate how they apply or are compliant with the requirements of AS/NZS 4481:1997 Pressure equipment – Competencies of inspectors

DESIGN VERIFIER – PRESSURE PIPING

Evidence that you are able to comprehend and apply knowledge of:

- Seismic and wind loading standards such as NZS 4203 and AS/NZS 1170 in respect to
 - Fabrication/welding and inspection standards
 - Critical detailing for design of pipe branches
 - Critical detailing for design of supports directly attached to the piping
 - Technical specifications of various steels used in pressure piping
- Sample calculations (especially if done as hand calculations) for:
 - In-service wind loads and out-of-service storm wind loads and calculations of the out-of-service wind speed using appropriate NZ standards.
 - Summary printouts of pipe stress analysis software such as AutoPIPE with 3D model showing the piping system
 - Local load stress analysis of pipe brackets
 - Seismic load calculations
 - Wind load calculations
 - Materials used at low temperature and required impact tests (or calculations/procedure showing if impact tests are not required for design temperatures below 0 deg C).
 - Fatigue calculations
 - Hydrostatic test pressure
 - Computer based calculations where you show you have a good understanding all modelling assumptions made by the programme and how the output satisfies these assumptions (supporting hand calculations as check estimates will be useful).

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

DESIGN VERIFIER - PRESSURE EQUIPMENT

Evidence that demonstrates ability to solve complex engineering problems includes:

- Examples of methodologies used for analysis, prediction and choice outside those encompassed by standard codes
- Simulations performed to test analyses outside standard procedures/calculations.
- Literature searches, use of network of peers to gather information on approaches to problem solving

DESIGN VERIFIER – PRESSURE PIPING

Examples of complex engineering problems to demonstrate your ability to apply established design and construction principles for design verification of pressure piping include:

- Modifications/upgrading of existing pressure piping, taking into account material uncertainty, and past loading uncertainty
- Use of pipe stress analysis software such as AutoPIPE or CAESAR (such tools are considered essential for a design verifier). As noted in element 1, you should be able to show you have an understanding of the models used by the program, the assumptions made for the models used and how these assumptions are satisfied - supporting hand calculations as check estimates are always useful.
- Establishing remaining design life
- Review of modifications/repairs to prevent further cracking in components
- Suitability of materials for high cyclic fatigue, and choice of suitable material
- Finite Element Analysis (FEA) calculations for critical members of unusual shape where hand or standard calculations are unsuitable.
- Evaluating complex FEA reports that were carried out as evidence of structural integrity on complex parts that were unable to be analysed by traditional calculations.
- Where computer frame or FEA models are used, you could include calculations or basic checks e.g. sum of reactions approximately equals what is expected, or the deflected shapes been checked to see that they 'look' right.
- Identification of faults on drawings for items that can't be built as drawn.
- Identification of inadequate weld detailing and strength on drawings
- Highlight critical high stress areas overlooked by a designer e.g. localised stresses on large diameter pipe.
- Application of relevant design standards, such as
 - Pressure piping design standards listed in the approved code of practice such as ASME B31.1, ASME B31.3, ASME B31.5, AS 4041
 - Both American and Australian pressure piping design standards

Professional Engineering - Element 3

ELEMENT DESCRIPTION

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

- List of piping systems designed and/or design verified during the last 5 years, supported by short comments on special features of the piping, the year designed and/or verified, the piping design standards (e.g. ASME B31.1 etc), the design pressure, design temperature, contents (e.g. steam), and hazard level (to AS 4343).
- Details of experience with different types of design codes and system contents (e.g. steam and ammonia)
- Note that design of items related to pressure piping such as design or verification of pressure vessels may also be useful – significant design of pressure piping systems earlier than 5 years may also be taken into account.
- First time applicants: you are encouraged to submit a synopsis of the specialised training you have had, with regards to pressure piping. If the work was done under the supervision of an existing design verifier, this person would be a good referee.

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

DESIGN VERIFIER - PRESSURE EQUIPMENT

- Assessors will be looking for your personal contribution to at least one project or significant task where designs or solutions that met all objectives were developed from the investigation phase. You should describe factors contributing to the level of complexity of the activity. You can draw on evidence from a range of projects/tasks or from one project/task with multiple components.
- A list the pressure equipment you have designed or design verified during the past 5 years is helpful - listing the year designed, design code, pressures and temperatures, maximum pipe diameters, hazard level (to AS 4343), the level of NDT you specified for the welds and commenting on any special features/complexity of the pressure equipment. Design of significant pressure equipment systems earlier than 5 years may also be included.
- Your use of pipe stress analysis package such as Bentley AutoPIPE or CAESAR II for (at least) static analysis of piping systems. Give an example of pipe stress analysis you have done, with comments on how the system was modelled, and any assumptions made (eg assumptions/modelling of anchors, assumptions about vessels connected to the piping, other supports and support gaps). Show how various load cases were analysed eg different pressure/temperature or parts of system closed down by isolating valves etc, seismic/wind loads, hydrostatic test pressure etc.

DESIGN VERIFIER – PRESSURE PIPING

Examples of your ability to apply established design and construction principles for complex piping for new and/or existing plant (or parts of), including:

- Modifications to existing piping where little or limited information is available from the original manufacturer.
- Special conditions were added to a design verification certificate to ensure optimum safety
- Reasons for a specific design being deficient
- Identification of non-compliant piping that has already been built and how these compliance matters were handled
- The diverse range of piping systems you have been involved with.

While design verifiers are generally not involved in analysing various options and making decisions on how to construct/manufacture an item, the scope of complexity will be in how the verifier carries out the process, the choices made about the degree of analysis required for a design and its parts, and recording of decisions (e.g., on how complex piping systems or parts of piping were dealt with, the assumptions made, and the level of analysis required

Professional Engineering - Element 4

ELEMENT DESCRIPTION

4 Design or develop solutions to *complex engineering problems* in accordance with good practice for professional engineering.

etc). A Design Verifier is expected to look for problems that the designer has overlooked by methodical checking (e.g. welds that cannot be inspected after fabrication).

Various problems listed in Element 3 may also be applicable to this element so long as there is an outcome - a solution or design.

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

DESIGN VERIFIER - PRESSURE EQUIPMENT

- Examples where you made decisions and took responsibility for complex engineering activities – that is, took responsibility for decisions in relation to quality outcomes, managing the engineering activities - and were accountable of the results.
- Examples of your involvement when ‘things went wrong’ – who had to act to remedy the problem? What actions did you take to remedy the problem(s)?
- A summary of the design verifications you have undertaken (as suggested in earlier elements) – either directly or under supervision - would be useful evidence of responsibility for such work.

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

DESIGN VERIFIER - PRESSURE EQUIPMENT

- Examples where you managed (or project managed) complex engineering activities – where you negotiated resources (funding, equipment, staff etc), set standards of work and/or timelines, planned and organised work using resources available, monitored progress (to ensure work was within restraints – budget, deadlines and required standards of quality). What were the factors contributing to the complexity of these activities?
- How did you handle conflict between 'demands and expectations' - such as trying to deal with an unreasonable deadline (what compromises had to be made to get enough done in time to keep 'everyone happy' whilst still being able to complete the outstanding items before it is too late?)
- If you are responsible for other engineering staff: how do you ensure good practice and/or good designs (for example, training, mentoring, coaching etc.) by staff doing design verification or design work?

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

DESIGN VERIFIER - PRESSURE EQUIPMENT

- Examples of where you identified risk and then developed ways to eliminate or mitigate risk in relation to design or verification of pressure equipment/piping design
- What steps did you take as a Design Verifier to ensure the design meets the required codes and standards in New Zealand? For example, what are the risks inherent in the design (such as materials, overseas pressure components fitted to a piping system designed without consideration of New Zealand's seismic environment or regulatory system etc)?
- What risk management system(s) do you have in place to ensure that inspections are carried out on critical components and that no critical components are overlooked?
- What QA procedures do you have in place and what steps have you taken to identify and address risk in relation to:
 - Health and safety
 - Handling uncertain design data – doing 'what if' analyses
 - Adequacy of resources to do a good job
 - Working in areas where you are on the limits of your competence/knowledge base? How do you recognise what you 'do not know'?
 - Confusion over documentation, misuse of documentation
 - Document/drawing approvals process.
 - Financial risk versus liability associated with your engineering work
 - Setting project costs taking account of risks
 - Identifying who shares risks and how this is incorporated into project documentation - cost estimation and contingency
 - Engineering and use of new materials
 - Existing piping that was previously not design verified
 - Hazard level identification to AS 4343 and required level of design verification and inspection.
 - Compliance with Department of Labour 'Codes of Practice' and PECPR Regulations
 - Risks from compromises made to meet 'real world' constraints – client wishes, resource availability, operational requirements etc

It is essential that engineers appreciate the effect on their client and other affected parties of their failure to perform. This often necessitates the engineer 'speaking up', especially in the early stages of work, when others want things that may not be achievable with regard to programme time, fees, cost and budget.

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)

DESIGN VERIFIER - PRESSURE EQUIPMENT

Provide evidence of your ability to act ethically – you are encouraged to refer to the code of ethical conduct when preparing your competence self-review (CPEng code of ethical conduct is at http://www.ipenz.org.nz/ipenz/forms/pdfs/CPEng_Code_of_Ethical_Conduct.pdf). In your competence self-review, you should describe a situation in which you encountered an ethical dilemma, and outline the actions you took in response to the situation. Circumstances where an engineer might be presented with an ethical dilemma might be:

- Identification of errors in a design verification certificate;
- What happens when the budget is 'blown' on a project you are working on? Have you been subjected to pressure to 'take short cuts', or pressured to work fewer hours than are required to complete the work (i.e. 'book' less hours than the work actually required)? Have you had to stand up for professional standards in the presence of pressure to 'take short cuts'?
- How have you handled client pressure to complete work for the Design Verification certificates - especially if design issues have not been resolved, due to, for example, liquidated damages for the project?
- Have you had clients decline to accept your recommendations (due to say cost considerations)? What steps did you take to sure they were aware of the consequences of not following your advice?
- How have you handled requests or pressure to perform work outside your area of competence?
- How have you dealt with conflicts of interest?
- What actions have you taken to safeguard health and safety of people, or avoid adverse effects on the environment etc.?
- Occasions where you have had to act with honesty and integrity – such as when you have had to 'speak up' or act when your client or another party has tried to take 'short cuts'.

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

DESIGN VERIFIER - PRESSURE EQUIPMENT

- Evidence of life-cycle considerations in engineering designs – wastage, buildability, materials used during operational life
- Evidence of actions taken to address health and safety implications of projects
- Consequence assessments (effects of failure)
- End of life issues relevant to old/existing pressure equipment
- Inputs made in the design of pressure equipment that reduces adverse impacts of systems on the environment – either in its construction or operation or end-of-life cycle.

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

DESIGN VERIFIER - PRESSURE EQUIPMENT

Evidence of your competence in communications may include:

- Reports to clients or inspection bodies that demonstrate clear thought process and conveyance of appropriate unambiguous information;
- communications of a technical nature (or as a communication to non-technical persons who may be involved with having equipment design verified)
- Communications with regulators, other engineers, etc
- Participation as a member of a safety committee – what contributions have you made? How have you helped build a consensus?
- Presentations to clients – what was the purpose and how did you achieve successful outcomes?
- Technical presentations to other engineers – what was the purpose and how did you achieve successful outcomes?
- Written papers published in relevant technical journals (e.g. e.nz magazine, Department of Labour Safety Lines, IRHACE Magazine)
- Member of relevant IPENZ or Department of Labour safety committee or standards member
- Correspondence – especially where the content of the correspondence had (potentially) significant consequences, such as design improvements, contract related matters, issues involving regulators on related requirements, etc.
- Leadership roles at meetings – leading technical discussion, presenting documents to influence decision makers (management, regulators, clients or other stakeholders);
- Consider your portfolio of evidence as evidence of your written communication skills.
- If you practise in a management role, what forms of communications have you used in managing complex engineering activities? Such as negotiating resources, communicating with staff, contractors, owners and others in regard to organising work, monitoring progress and meeting timeframes and budgets?

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)

DESIGN VERIFIER - PRESSURE EQUIPMENT

- IPENZ on-line CPD records
- Documentation of your actively taking responsibility for your own professional development, with an appropriate balance between technical and “soft skills” learning
- Evidence of your actively seeking out information on engineering failures, ‘near misses,’ contractual issues and the like – learning from own and others’ mistakes and avoiding repeating them.
- Networking with other professional engineers – especially important for sole practitioners and those in small practices or where few professional engineers are employed by company;
- Mentoring, coaching or taking a leadership role in sharing new knowledge with peers;
- Maintaining currency with New Zealand regulatory environment – PECPR regulations, Department of Labour approved codes of practice for pressure equipment
- Maintaining currency with current good practice for Design Verifiers in New Zealand – and the relevant standards for piping design
- Reading and understanding of required codes and standards e.g. Department of Labour Codes of Practice, ASME/AS/BS standards for pressure piping
- Reading/reviewing the latest codes and standards as and when they are updated

Good evidence may include:

- Books on pressure equipment/background information on code/pipe stress analysis
- Training courses available from ASME (some web based courses are available) on ASME CODES e.g. ASME B31.1 –Pressure Piping, ASME B31.3 -Process Piping
- Finite Element Analysis training for basic or advanced levels e.g. Matrix Computing Ltd
- Webinars and other web based courses on FEA from organisations such as NAFEMS e.g. “Non-Linear Analysis”, and “Dynamic FE Analysis” - e-learning course from NAFEMS Webinars and other web based short courses on pressure equipment
- Pressure equipment inspection courses (such as those available from HERA)
- Active member of discussion groups for pressure piping Design Verifiers.
- Attending pressure equipment seminars and conferences – what were the learning outcomes?
- Relevant seminars on pressure equipment/welding/fatigue (as offered by HERA periodically)

Professional Engineering - Element 11

ELEMENT DESCRIPTION

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

- Seismic seminars for New Zealand conditions available from HERA/SESOC/NZSEE
- Reading relevant magazines and periodicals
- Reading and writing articles for the Department of Labour “Safety Lines” publication.
- Meetings (whether formal or informal) with other design verifiers discussing relevant topical issues (maybe items such as ambiguities in codes/standards) and other issues causing inconsistency or some confusion by designers and design verifiers.
- Carrying out tutorials and learning to use software that is specific, essential or useful for carrying out design verification e.g.
 1. Pipe stress analysis software such as AutoPIPE.
 2. Frame analysis software such as Microstran
 3. FEA software such as Femap
- Self training on software upgrades and updates
- Site visits to manufacturers of pressure equipment
- Check website of software used such as AutoPIPE and review information available to users such as FAQ’s, modelling tips, case studies etc.

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

DESIGN VERIFIER - PRESSURE PIPING

Examples of sound engineering judgment can be shown by how you:

- Selected the 'best' design (or design analysis) option, or
- Determined the best modelling approach for stress analysis of a piping system
- Determined the criteria for selecting the final option assessed
- Used information to make your decision and who you consulted in making the decision
- How you managed risks
- How to you responded to ethical dilemmas

Evidence demonstrating your ability to evaluate options and exercise engineering judgement can be provided in your:

- Competence self-review form – cite examples and highlight instances where personal input to decision-making process. Reference other elements where evidence may also demonstrate engineering judgement – such as ethical behaviour, analysis and investigation of complex engineering problems, taking responsibility for decisions in complex engineering activities etc.
- Work history summary – reference calculations and/or reports (with further expansion as required – or include as work samples);
- Design review of pressure equipment – how you addressed equipment where code compliance was “hazy” or unclear and where professional judgement was required to convince regulators or the client (such as in related correspondence);
- Reports which include discussions/concerns of affected parties, and recommendations with options on solving problems (bearing in mind that a design verifier should not be advising a client on how to design equipment).
- Demonstrate that technical judgements are in accordance with the intent of the relevant standard or code where not specifically covered within the said document.

APPENDIX 1 –EXTRACTS FROM PECPR REGULATIONS

1. DESIGN VERIFICATION

Schedule 1 of the PECPR regulations contains the following information:

Design verification means verification that the following comply, in every respect related to safety, with the requirements of the appropriate design standards and contain every safety feature that is relevant, whether or not referred to in those standards

- a. Designs of equipment, and
- b. Alterations to designs, affecting the structural strength or safety of equipment, made in the course of manufacture; and
- c. Designs of a repair or alteration affecting the operational safety of the equipment repaired or altered or any other equipment; and
- d. The fabrication inspection requirements specified by the designer:

2. EXPLANATION OF 'EQUIPMENT' – PRESSURE EQUIPMENT

Extracts from Schedule 1 of the PECPR regulations provide the following information:

1. **Pressure equipment** means a boiler, boiler piping, compressor, fired heater, gas turbine, hot water boiler, piping component, pressure fittings, pressure piping, pressure vessel, pump, steam engine, or steam turbine.
2. **Boiler**—
 - (a) Means a device—
 - (i) Most of which is an arrangement of pressure containment parts; and
 - (ii) The purpose of which is to generate steam—
 - (A) By the use of a directly applied combustion process; or
 - (B) By the application of heated gases; and
 - (b) Includes any of the following:
 - (i) Boiler piping:
 - (ii) Combustion equipment:
 - (iii) Combustion management systems:
 - (iv) Controls:
 - (v) Economisers:
 - (vi) Fans:
 - (vii) Feed and circulating pumps:
 - (viii) Pressure fittings:
 - (ix) Reheaters:
 - (x) Superheaters:
 - (xi) Supports:
 - (xii) Water level management systems; but
 - (c) Does not include a hot water boiler:
3. **Boiler piping**—

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- (a) Means piping forming part of a boiler and extending to the isolating device for the boiler; and
 - (b) Includes blowdown piping, feed water piping, fuel supply piping, safety device discharge piping, steam piping, and the supports of boiler piping:
4. **Fired heater**—
- (a) Means a device, not including a boiler or hot water boiler,—
 - (i) Most of which is an arrangement of pressure containment parts; and
 - (ii) Which heats gases or liquids at pressures exceeding 50 kPag—
 - (a) By the use of a directly applied combustion process; or
 - (b) By the application of heated gases; and
 - (b) Includes any of the following that is necessary to ensure the pressure integrity of the device or its safe operation:
 - (i) Circulation pumps:
 - (ii) Combustion equipment:
 - (iii) Combustion management systems:
 - (iv) Controls:
 - (v) Fans:
 - (vi) Piping:
 - (vii) Pressure fittings:
 - (viii) Supports:
5. **Hot water boiler**—
- (a) Means a device—
 - (i) Most of which is an arrangement of pressure containment parts; and
 - (ii) That does not produce or contain steam; and
 - (iii) The purpose of which is to heat water at pressures exceeding 200 kPag and temperatures exceeding 100°C—
 - (A) By the use of a directly applied combustion process; or
 - (B) By the application of heated gases; and
 - (b) Includes any of the following that is necessary to ensure the pressure integrity of the device or its safe operation:
 - (i) Boiler piping:
 - (ii) Combustion equipment:
 - (iii) Combustion management systems:
 - (iv) Controls:
 - (v) Controls for water temperature and flow:
 - (vi) Fans:
 - (vii) Pressure fittings:
 - (viii) Pumps:
 - (ix) Supports; but
 - (c) Does not include a device of a kind that could reasonably be expected to be used only for domestic water heating:
6. **Piping components** means—
- (a) Bolting, fittings, flanges, gaskets, pipes, supports, tubing, and valves:
 - (b) Mechanical elements that are or could be assembled or joined to form pressure piping systems:
 - (c) Dryers, expansion joints, flexible joints, pressure hoses, strainers, traps, or similar devices—

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(i) That are associated with a kind of pressure equipment the purpose of which is to contain all or any of the following:

- (A) Gases at pressures exceeding 50 kPag; or
- (B) Liquids at pressures exceeding 50 kPag; or
- (C) Steam; and

(ii) Including all items and safety devices that are necessary to maintain the safety of the kind of pressure equipment, whether the kind of pressure equipment stands alone or is part of an operating system:

7. **Pressure fittings—**

(a) Means fittings that are associated with a kind of pressure equipment the purpose of which is to contain all or any of the following:

- (i) Gases at pressures exceeding 50 kPag; or
- (ii) Liquids at pressures exceeding 50 kPag; or
- (iii) Steam; and

(b) Includes all mountings, pressure gauges, safety devices, valves, and other articles necessary to maintain the safety of the pressure equipment, whether the pressure equipment stands alone or is part of an operating system:

8. **Pressure piping—**

(a) Means an assembly of piping components the purpose of which is to convey fluid, or transmit a fluid pressure, for any of the following or any combination of them:

- (i) Gases at pressures exceeding 50 kPag; or
- (ii) Liquids at pressures exceeding 50 kPag; or
- (iii) Steam; and

(b) Includes all pressure relief discharge piping up to the point of release; and

(c) Includes all supports for pressure piping necessary to maintain the safety of the pressure equipment, whether the pressure equipment stands alone or is part of an operating system:

9. **Pressure vessel—**

(a) Means an unfired vessel the purpose of which is to hold, process store, transport, or use all or any of the following:

- (i) Gases at pressures exceeding 50 kPag;
- (ii) Liquids at pressures exceeding 50 kPag;
- (iii) Steam; and

(b) Includes all fittings, mountings, piping, and supports necessary to maintain the safety of the pressure vessel, whether the pressure vessel stands alone or is part of an operating system; and

(c) Includes vessels heated by electricity or heated by a hot gas or liquid; but

(d) Does not include fixed roofed or floating roofed storage tanks: