REGISTRATION AUTHORITY
FOR CHARTERED PROFESSIONAL ENGINEERS

Recognised Engineer Competency Framework (Dam Safety)

Knowledge Base

April 2023

Contents

Purpose

RECOGNISED ENGINEER COMPETENCY FRAMEWORK (DAM SAFETY)

Engineering New Zealand Te Ao Rangahau has developed and implemented a Recognised Engineer Competency Framework (Dam Safety) to support the implementation and operation of the Building (Dam Safety) Regulations 2022.

A Register of Recognised Engineers has been established within Engineering New Zealand as the Registration Authority. This is conducted through the Recognised Engineer Competency Framework (Dam Safety) as the system that:

» assesses the prescribed qualifications and competencies for Recognised Engineers
» certifies that named individuals have been assessed as demonstrating the ability to practice competently in the dam safety area of practice (with regard to the certification of Potential Impact Classifications (PIC) and Dam Safety Assurance Programmes (DSAP))
» maintains a publicly accessible register of certified Recognised Engineers.

The assessment and certification of Recognised Engineers through this framework is similar to the assessment and registration of Chartered Professional Engineers.

RECOGNISED ENGINEER KNOWLEDGE BASE

The Knowledge Base provides the background information and documentation for the Recognised Engineer Competency Framework (Dam Safety), including guidance for applicants, and for assessors.

It highlights relevant parts of regulations and other guidance documents and provides specific considerations for the conduct of the Recognised Engineer role. Applicants to be assessed and certified as Recognised Engineers should be familiar with and be able to apply this information.

The Knowledge Base should be read together with the Recognised Engineer Competency Framework (Dam safety) Guide to Assessment.

Building (Dam Safety) Regulations 2022

The Building (Dam Safety) Regulations 2022 provide a succinct, regulatory framework for the dam safety regulations. Recognised Engineers need to be familiar with these regulations. They state the qualifications for PIC and DSAP Recognised Engineers, which are explicitly reproduced in Section 3.0 of this document. They also reference other related regulatory information related to Dam Safety.

The Building (Dam Safety) Regulations 2022 are complete on their own and no attempt to interpret them further for Recognised Engineer purposes is made in this document.

Regulatory Recognised Engineer qualifications

The Building (Dam Safety) Regulations 2022 prescribe qualifications and competencies for Recognised Engineers. These sections of the regulations are presented in the subsections below and are reproduced verbatim.

The Institution of Professional Engineers New Zealand (IPENZ) is the legal name of Engineering New Zealand.

PIC qualifications
(section 22 of the regulations)

(1) This regulation applies in relation to sections 134B, 135, 136, 138, and 139 of the Act (which provide for a recognised engineer to audit and certify the classification of a dam).

(2) The prescribed qualification is a qualification given by IPENZ that meets the following requirements:
- (a) IPENZ must have given the qualification only if it is satisfied that the engineer—
  - (i) is able to practise competently in the area of practice referred to in sections 134B, 135, 136, 138, and 139 of the Act (the area) to the reasonable standard of a professional engineer practising in the area; and
  - (ii) has at least 4 years' experience in the field of dam safety engineering within the previous 10 years; and
  - (iii) has relevant experience in and knowledge of dam safety engineering, including relevant experience in and knowledge of 1 or more of the fields referred to in subclause (3); and
- (b) IPENZ must have given the qualification to the engineer within the 6-year period before the engineer acts in the area.

(3) For the purposes of subclause (2)(a)(iii), the fields are as follows:
- (a) water and natural resources engineering
- (b) civil engineering
- (c) hydrological and hydraulic engineering
- (d) any other field of engineering that IPENZ considers is relevant to 1 or more of the following:
  - (i) identifying dam potential failure modes
  - (ii) analysing dam breaks
  - (iii) assessing dam hazards
  - (iv) applying other principles of dam safety engineering.

(4) The prescribed competency is that the engineer has demonstrated to IPENZ that the engineer has the experience in and knowledge of the following things that would be reasonably expected of a professional engineer practising in the area:
- (a) the classification of dams under section 134B of the Act (including regulation 9)
- (b) the identification of appurtenant structures
- (c) the assessment of the hazard of potential dam-break floods to downstream people and property and the environment (for example, assessing the extent of inundation, depth of inundation, velocity, flow, time to peak flow, and duration of inundation).

DSAP qualifications
(section 23 of the regulations)

(1) This regulation applies in relation to sections 140 to 148B and 150 of the Act (which provide for a recognised engineer to audit, certify, and review dam safety assurance programmes).

(2) The prescribed qualification is a qualification given by IPENZ that meets the following requirements:
  - (a) IPENZ must have given the qualification only if it is satisfied that the engineer—
    - (i) is able to practise competently in the area of practice referred to in sections 140 to 148B and 150 of the Act (the area) to the reasonable standard of a professional engineer practising in the area; and
    - (ii) has at least 4 years' experience in the field of dam safety engineering within the previous 10 years; and
    - (iii) has relevant experience in and knowledge of 1 or more of the fields referred to in subclause (3); and
  - (b) IPENZ must have given the qualification to the engineer within the 6-year period before the engineer acts in the area.

(3) For the purposes of subclause (2)(a)(iii), the fields are as follows:
  - (a) dam safety assurance programmes and management systems engineering
  - (b) water and natural resources engineering
  - (c) civil engineering
  - (d) gate and valve systems and other dam and reservoir safety systems engineering
  - (e) any other field of engineering that IPENZ considers is relevant to 1 or more of the following:
    - (i) designing and operating dam systems
    - (ii) managing dam safety risk
    - (iii) applying other principles of dam safety engineering.

(4) The prescribed competency is that the engineer has demonstrated to IPENZ that the engineer has the experience in and knowledge of the following things that would be reasonably expected of a professional engineer practising in those areas:
  - (a) the general requirements for dam safety assurance programmes (see regulation 11)
  - (b) procedures for the operation and maintenance of dams and reservoirs (see regulation 12)
  - (c) surveillance procedures (see regulation 13)
  - (d) procedures for the identification, inspection, and maintenance of appurtenant structures (see regulation 14)
  - (e) procedures for the inspection, maintenance, and testing of gate and valve systems with dam or reservoir safety functions (see regulation 14)
  - (f) procedures for intermediate dam safety reviews (see regulation 15)
  - (g) procedures for comprehensive dam safety reviews (see regulation 16)
  - (h) procedures for emergency planning and response (see regulation 17)
  - (i) procedures for identifying and managing dam safety issues (see regulation 18).

MBIE guidance

The Ministry of Business, Innovation and Employment (MBIE) has published Dam Safety guidance, which aims to “support understanding of the Building (Dam Safety) Regulations 2022 (the regulations) for dam owners, technical practitioners and regional authorities, and to provide guidance to assist preparing for and fulfilling the requirements of the regulations.” The document provides a wide range of information about the form and implementation of the regulations, and specific information for the role and responsibilities of Recognised Engineers. Recognised Engineers should be familiar with the whole document. Specific extracts related to Recognised Engineers are reproduced verbatim below.

STEP 3 – DETERMINE THE POTENTIAL IMPACT CLASSIFICATION OF YOUR DAM

A dam owner may choose to classify the dam themselves or they may instead decide that a technical practitioner is best placed to determine the dam’s PIC. Regardless of who does the classification, the PIC must be audited by a recognised engineer against the classification criteria in the regulations and, if they agree, they must provide the dam owner with a certificate confirming the dam’s PIC. All duties of non-compliance will be attached to the dam owner.

MBIE Dam Safety Guidance, p22

STEP 4A – HAVE THE DSAP CERTIFIED BY A RECOGNISED ENGINEER

In some cases, a dam owner may arrange for a technical practitioner to prepare the DSAP in collaboration with the dam owner’s staff, but only a recognised engineer can certify the DSAP. The recognised engineer will work with the dam owner to prepare and certify their DSAP form. The form contains:

- the DSAP, attached documents, and any other referenced documents
- information about the dam
- the PIC given to the dam
- information about the dam owner
- a summary of compliance with criteria and standards
- documentation of the DSAP
- a list of appurtenant structures, and
- certificate of the recognised engineer.

MBIE Dam Safety Guidance, p37

IMPLEMENT THE DAM SAFETY ASSURANCE PROGRAMME

Dam owners should ensure that the procedures outlined in the DSAP are followed to ensure the dam is operated, maintained, and managed safely.

A dam owner must make sure that except for any identified, minor items of non-compliance, all procedures in the DSAP are fully complied with. An example of a minor non-compliance is if a DSAP stated that 12 visual inspections of the dam would be conducted throughout the course of a year, but there was a significant event or circumstance (eg site construction work, equipment breakdown, loss of access, pandemic, staff shortage) that prevented one of the inspections from occurring, so only 11 took place that year. Another example may be that the DSAP stated four spillway gate system backup power tests would be completed in one year but due to a significant event or circumstance, only three were completed.

MBIE Dam Safety Guidance, p37

New Zealand Dam Safety Guidelines

The New Zealand Dam Safety Guidelines (NZDSG) provide comprehensive guidance on design, construction and safety of dams in New Zealand. They contain seven modules; the modules most relevant to Recognised Engineers are:

- Module 1 – Legal Requirements
- Module 2 – Consequence Assessment and Dam Potential Impact Classification
- Module 5 – Dam Safety Management
- Module 6 – Emergency Preparedness
- Module 7 – Lifecycle Management

The NZDSG focuses on recommended dam practices – they're not a prescriptive how-to manual. The following sections provide guidance on how to perform PIC and DSAP certification, and annual DSAP audits.

Certifying a PIC

This guidance has been developed from consideration of the Building (Dam Safety) Regulations 2022, the MBIE Dam Safety Guidance, the NZDSG and the experience of dam safety engineers.

1. Review the materials submitted supporting the PIC assessment.
2. Have the inputs and assumptions been clearly stated and justified?
3. Has the Consequence Assessment been performed at a level appropriate for the anticipated consequences?
   - ◯ Refer to Module 2 of the NZDSG regarding Consequence Assessment levels; initial, intermediate and comprehensive.
   - ◯ Consider the hypothetical dam failure scenario(s) including sunny and rainy day dambreak discharge magnitudes, time for failure modes to develop, downstream channel profile, flood depth and velocity, distance downstream to population at risk (PAR), potential for adequate versus no warning.
   - ◯ Have Table 1 (Determination of assessed damage level) and Table 2 (Determination of dam's potential impact classification) of the Building (Dam Safety) Regulations 2022 been used appropriately?
     - ✓ Has determination of assessed damage level to buildings, historical or cultural sites, infrastructure and the environment been done adequately?
     - ✓ Has good practice been used to estimate PAR and Potential Loss of Life (PLL)? For example, has PAR been estimated considering no warning to the downstream population? Has good judgment been used to estimate PLL?
   - ◯ Are there sensitive parameters? Are there any key assumptions or inputs that could readily be interpreted differently that would result in a different PIC?
   - ◯ If classified as Low PIC, does the situation clearly suggest the consequences are low? If not, are there inputs/items that need further work?
4. Regulatory requirements:
   - ◯ Has the PIC been determined according to Section 134B of the Building Act 2004 and Regulation 9 of the Building (Dam Safety) Regulation 2022?
   - ◯ During the course of the PIC certification process have you come across any information that suggests the dam may be prone to failure or dangerous? If the dam may be dangerous or prone to failure, inform the dam owner and the regional authority.
5. Complete the PIC review:
   - ◯ The PIC submission meets requirements. Certify the PIC by filling out Form 1; or
   - ◯ The PIC submission is incomplete. Respond to request additional information and/or clarification; or
   - ◯ Reject the PIC application with clearly stated reasons why it is rejected.
6. Form 1: dam classification certificate:
   - ◯ The dam owner, or their representative submitting Form 1, fills out the form down to "Certificate of the recognised engineer".
   - ◯ The "Flood performance" and Earthquake performance" on Page 1 is provided by the Owner on Form 1 prior to submittal. It is intended this information be taken from existing studies of the dam. If the flood performance or earthquake performance (expressed as Annual Exceedance Probability) is not known, state "unknown".
   - ◯ The Recognised Engineer completes the "Certificate of recognised engineer" section, signs the form and attached evidence of being a recognised engineer (ie, Engineering New Zealand Te Ao Rangahau Registration Certificate).

Certifying a DSAP

This guidance has been developed from consideration of the Building (Dam Safety) Regulations 2022, the MBIE Dam Safety Guidance, and the NZDSG, and the experience of dam safety engineers.

1. Is a DSAP required? Check PIC; DSAP required for Medium and High PIC dams.
2. Review the materials submitted supporting the DSAP assessment.
3. Check the DSAP meets regulatory requirements, summarised below. Refer to the Building (Dam Safety) Regulations 2022 for more information.
   - ○ General requirements of the DSAP:
     - ✓ The DSAP is appropriate to the nature of the dam, including design, construction, potential failure modes, potential dam safety deficiencies and confirmed dam safety deficiencies.
     - ✓ The DSAP is appropriate to the dam's classification.
     - ✓ The DSAP must provide for who should carry out the activity, and when, where, and how it should be done.
   - ○ Dam and reservoir operation and maintenance procedures.
   - ○ Surveillance procedures.
   - ○ Inspection, maintenance and testing of appurtenant structures and gate and valve systems with dam safety functions.
   - ○ Intermediate dam safety reviews.
   - ○ Comprehensive dam safety reviews.
   - ○ Emergency planning and response.
   - ○ System for identifying and managing dam safety issues.
   - ○ List the location of all documentation, manuals and publications referred to in the DSAP.
   - ○ The location of the DSAP.
   - ○ List of documents that form the DSAP.
4. Assess each DSAP component against requirements:
   - ○ Use Table 3 of the MBIE guidance document.
   - ○ Use the NZDSG – modules 5, 6 and 7 in particular relate to DSAP components.
   - ○ Apply the reasonable level of practice to judge whether each component meets requirements.
5. Review the documentation provided with the application to see if the appurtenant structures have previously been identified. If so, review and, if warranted, amend, the list of appurtenant structures. If not, review the dam system at a high level to identify the main appurtenant structures, including gate and valve systems (and other equipment or systems) with dam safety or reservoir safety functions.
6. During the course of the DSAP certification process have you come across any information that suggests the dam may be prone to failure or dangerous? If the dam may be dangerous or prone to failure, inform the dam owner and the regional authority.
7. Make a judgment whether the submitted DSAP can be certified. Respond by one of the following options:
   - ○ The submission meets requirements. Certify the DSAP by filling out Form 2; or
   - ○ The submission is incomplete. Request additional information and/or clarification; or
   - ○ Reject the DSAP certification application with clearly stated reasons why it is rejected.
8. Form 2: Dam safety assurance programme
   - ○ The dam owner, or their representative submitting Form 2, down to the "Appurtenant Structures" section.
   - ○ The Recognised Engineer lists the dam's appurtenant structures, including gates, valves, communications equipment and other mechanical and electrical equipment with a dam safety or reservoir safety function. Refer to the Building Act definition of appurtenant structure and the NZDSG for guidance regarding identifying appurtenant structures.
   - ○ The Recognised Engineer completes the "Certificate of recognised engineer" section, signs the form and attached evidence of being a recognised engineer (ie Engineering New Zealand Registration Certificate).

Auditing annual dam compliance

This guidance has been developed from consideration of the Building (Dam Safety) Regulations 2022, the MBIE Dam Safety Guidance, and the NZDSG, and the experience of dam safety engineers.

1. Has the DSAP previously been certified by a Recognised Engineer? If not, a DSAP audit cannot be completed.
2. Review the materials submitted supporting the DSAP audit.
3. Has building work requiring a building consent been carried out? Has the DSAP been reviewed and updated considering such building elements?
4. Has the dam been advised to be dangerous, earthquake prone or flood prone? Has the DSAP been reviewed and updated considering the dangerous, earthquake prone or flood prone status?
5. Review the list of appurtenant structures, including gate and valve systems with dam safety or reservoir safety functions, for the dam.
6. Have the procedures in the DSAP been fulfilled during the audit period:
   - ◯ Dam and reservoir operation and maintenance procedures are current.
   - ◯ Surveillance procedures completed.
   - ◯ Any enhanced or intensive surveillance completed.
   - ◯ Inspection and maintenance of appurtenant structures and inspections, maintenance and testing of gate and valve systems with dam safety functions completed.
   - ◯ Intermediate dam safety review up to date and compliant.
   - ◯ Comprehensive dam safety review up to date and compliant.
   - ◯ Emergency planning and response up to date and compliant.
   - ◯ Dam safety issues are being managed and resolved effectively.
7. Non-compliances.
   - ◯ Are there non-compliances?
   - ◯ If so, segregate and list into minor and major non-compliances.

> A dam owner must make sure that except for any identified, minor items of non-compliance, all procedures in the DSAP are fully complied with. An example of a minor non-compliance is if a DSAP stated that 12 visual inspections of the dam would be conducted throughout the course of a year, but there was a significant event or circumstance (eg site construction work, equipment breakdown, loss of access, pandemic, staff shortage) that prevented one of the inspections from occurring, so only 11 took place that year. Another example may be that the DSAP stated four spillway gate system backup power tests would be completed in one year but due to a significant event or circumstance, only three were completed.
>
> MBIE Dam Safety Guidance, p37

8. During the course of the PIC certification process have you come across any information that suggests the dam may be prone to failure or dangerous? If the dam may be dangerous or prone to failure, inform the dam owner and the regional authority.
9. Make a judgment whether the annual dam compliance submission can be certified. Respond by one of the following options:
   - ◯ The annual compliance submission is complete, with no more than minor noncompliance(s). Certify the DSAP by filling out Form 3; or
   - ◯ The annual dam compliance submission is incomplete. Request additional information and/or clarification; or
   - ◯ Reject the annual dam compliance application with clearly stated reasons why it is rejected.

10 Form 3: Annual dam compliance certificate:

- ◯ The dam owner, or their representative submitting Form 3, down to the “Certificate of recognised engineer” section.
- ◯ The Recognised Engineer lists any minor items of non-compliance in the DSAP in the review period.
- ◯ The Recognised Engineer completes the “Certificate of recognised engineer” section, signs the form and attached evidence of being a recognised engineer (ie Engineering New Zealand Registration Certificate).

Dangerous and prone-to-failure dams

Recognised Engineers have specific responsibilities if they become aware that a dam may be dangerous or prone to failure in the course of their PIC and DSAP Recognised Engineer duties (they are not required to depart from those duties to look for or identify dangerous or prone dams). This is outlined in the MBIE Dam Safety Guidance (p43) as:

"All recognised engineers must be Chartered Professional Engineers who are subject to a code of ethical conduct. They must, in the course of their engineering activities, take reasonable steps to safeguard the health and safety of people and report adverse consequences. If, during the recognised engineer’s completion of PIC certification or DSAP certification or audit they become aware that a dam may be dangerous, then they have an ethical obligation as well as a legal obligation to inform the dam owner and the relevant regional authority."

The relevant provision in the Building Act 2004 is shown below.

135A CERTIFYING ENGINEER MUST NOTIFY REGIONAL AUTHORITY AND OWNER IF DAM DANGEROUS

(1) An engineer engaged to provide a certificate for the purposes of section 135(1)(b), 142(1)(b), or 150(2)(f) must notify the regional authority and the owner of the dam if he or she believes that the dam is dangerous.

(2) The notice must be—

(a) in writing; and

(b) given within 5 working days after the engineer forms the belief in question.

(3) Nothing in subsection (1) requires an engineer to act outside the terms of his or her engagement by investigating whether the dam is dangerous or not and a breach of the duty in subsection (1) does not give rise to any civil liability in damages.

Building Act 2004

The Recognised Engineer, in the course of their duties, has an obligation to inform the dam owner and regulatory Regional Authority if they become aware the dam in question may be dangerous. Referring to Section 153 of the Building Act 2004, dams with earthquake-prone and flood-prone dam categories (Section 153A) are defined in addition to the dangerous dam category (Section 153) under ‘Dangerous dams’. This is taken as dams meeting either the category of:

» dangerous dam
» earthquake-prone dam
» flood-prone dam.

Dangerous, earthquake prone and flood-prone dam definitions are explicitly provided in the Building (Dam Safety) Regulations 2022. These definitions are reproduced on the following page.

DANGEROUS DAMS, EARTHQUAKE-PRONE DAMS, AND FLOOD-PRONE DAMS

19 Certain terms defined in relation to dangerous dams, earthquake-prone dams, and flood-prone dams

(1) For the purpose of section 153 of the Act (meaning of dangerous dam)

moderate earthquake,—

(a) in relation to a high potential impact dam, means an earthquake that would result in ground shaking, at the site of the dam, at an intensity with an AEP of 1 in 100 (determined by normal measures of acceleration, velocity, and displacement) but not less than the 1 in 100 AEP shaking determined using a seismic hazard factor (Z factor) of 0.10; and

(b) in relation to a medium potential impact dam, means an earthquake that would result in ground shaking, at the site of the dam, at an intensity with an AEP of 1 in 50 (determined by normal measures of acceleration, velocity, and displacement) but not less than the 1 in 50 AEP shaking determined using a seismic hazard factor (Z factor) of 0.10.

moderate flood,—

(a) in relation to a high potential impact dam, means a flood that would result in water or other fluid flowing into the reservoir formed by the dam at a flow rate with an AEP of 1 in 100; and

(b) in relation to a medium potential impact dam, means a flood that would result in water or other fluid flowing into the reservoir formed by the dam at a flow rate with an AEP of 1 in 50.

(2) For the purpose of section 153A of the Act (meaning of earthquake-prone dam and flood-prone dam),—

earthquake threshold event means,—

(a) in relation to a high potential impact dam, an earthquake that would result in ground shaking, at the site of the dam, at an intensity with an AEP of 1 in 500 (determined by normal measures of acceleration, velocity, and displacement) but not less than the 1 in 500 AEP shaking determined using a seismic hazard factor (Z factor) of 0.10; and

(b) in relation to a medium potential impact dam, an earthquake that would result in ground shaking, at the site of the dam, at an intensity with an AEP of 1 in 250 (determined by normal measures of acceleration, velocity, and displacement) but not less than the 1 in 250 AEP shaking determined using a seismic hazard factor (Z factor) of 0.10.

flood threshold event means,—

(a) in relation to a high potential impact dam, a flood that would result in water or other fluid flowing, into the reservoir formed by the dam, at a flow rate with an AEP of 1 in 500; and

(b) in relation to a medium potential impact dam, a flood that would result in water or other fluid flowing, into the reservoir formed by the dam, at a flow rate with an AEP of 1 in 250.

(3) In this regulation, AEP (which stands for annual exceedance probability), in relation to an earthquake or a flood of a particular intensity or flow rate, means the probability that an earthquake or a flood of that intensity or flow rate or a greater intensity or flow rate will occur in any year.

20 Seismic hazard factor (Z factor)

In these regulations, the seismic hazard factor (Z factor) must be calculated in accordance with New Zealand Standard NZS 1170.5:2004 (Structural design actions—Part 5: Earthquake actions—New Zealand), whether or not that standard would otherwise apply.

References

(1) Building Act 2004: www.legislation.govt.nz/act/public/2004/0072/latest/DLM306036.html

(2) Building (Dam Safety) Regulations 2022: www.legislation.govt.nz/regulation/public/2022/0133/latest/whole.html

(3) MBIE Dam Safety Guidance: www.building.govt.nz/assets/Uploads/managing-buildings/building-safety/dam-safety-guidance.pdf

(4) New Zealand Dam Safety Guidelines: nzsold.org.nz/wp-content/uploads/2019/10/nzsold_dam_safety_guidelines-may-2015-1.pdf

(5) Form: 1 Dam Classification Certificate: www.building.govt.nz/assets/Uploads/managing-buildings/building-safety/dam-classification-certificate.pdf

(6) Form 2: Dam Safety Assurance Programme: www.building.govt.nz/assets/Uploads/managing-buildings/building-safety/dam-safety-assurance-programme.pdf

(7) Form 3: Annual Dam Compliance Certificate: www.building.govt.nz/assets/Uploads/managing-buildings/building-safety/annual-dam-compliance-certificate.pdf

Glossary

Abbreviation	Description
CDSR	Comprehensive Dam Safety Review
CPEng	Chartered Professional Engineer
DSAP	Dam Safety Assurance Programme
EAP	Emergency Action Plan
IDSR	Intermediate Dam Safety Review
IPENZ	Institution of Professional Engineers New Zealand (legal name of Engineering New Zealand Te Ao Rangahau)
MBIE	New Zealand Ministry of Business, Innovation and Employment
NZDSG	New Zealand Dam Safety Guidelines
OMS	Operations, Maintenance and Surveillance
PAR	Population at Risk
PIC	Potential Impact Classification
PLL	Potential Loss of Life

REGISTRATION AUTHORITY
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The Registration Authority under the Chartered Professional Engineers of New Zealand Act 2002 is the Institution of Professional Engineers New Zealand (trading as Engineering New Zealand).