

National Transport Commission Rail Safety National Law Consultation Regulatory Impact Analysis

Richard Stephens Responses

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1 Introduction

This document is Richard Stephens' responses to the National Transport Commission (NTC) Rail Safety National Law (RSNL) Consultation Regulatory Impact Analysis.

1.1 Terms and Abbreviations

The terms and abbreviations used in this document are defined in the table below:

Term / Abbreviation	Definition
AQF	Australian Qualifications Framework
ARISO	Australian Rail Industry Standards Organisation
IRSE	Institution of Railway Signal Engineers
NTC	National Transport Commission
RSNL	Rail Safety National Law

2 Competence

In order to provide a considered response regarding RSNL Review recommendation 20, it is necessary to consider how we should develop and assess competence.

The below considers railway control systems engineering, where:

- ‘railway control systems’ includes signalling, communications and train control systems; and
- ‘engineering’ includes professional and paraprofessional roles, but excludes trade roles.

This section considers:

- What is engineering?
- How to develop professionals and paraprofessionals?
- How to develop railway control systems professional engineers?
- How to develop railway control systems engineering technologists?
- How to develop railway control systems engineering associates?

2.1 What is engineering?

The International Engineering Alliance¹ defines ‘engineering’ as:

Engineering: (n) an activity that seeks to meet identified needs of people and societies by the purposeful application of engineering sciences, technology and techniques to achieve predicted solutions that use available resources efficiently, are economical, that manage risks; engineering is carried out by practitioners performing roles differentiated by the level of problem analysis and solution, the activity to be managed, risk and responsibility.

The International Engineering Alliance² also defines three types of engineering problems:

- Well-defined
- Broadly-defined
- Complex.

How can an engineering problem be ‘well-defined’ or ‘broadly-defined’?

Standards Australia³ defines performance-based and prescriptive standards as follows:

¹ <https://www.internationalengineeringalliance.org/assets/Uploads/Documents/IEA-Extended-Glossary.pdf>

² <https://www.internationalengineeringalliance.org/assets/Uploads/IEA-Graduate-Attributes-and-Professional-Competencies-2021.1-Sept-2021.pdf>

³ <https://www.standards.org.au/documents/sg-003-standards-and-other-publications>

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Performance Based Standards—have their requirements expressed in terms of performance, i.e. outcomes to be achieved. This approach leaves freedom for the development of innovative technical methods to meet the requirements of the Standard.

Performance Based Standards include the criteria, testing or other approved form of verification required to assess performance and to ensure consistency across the solutions developed to meet requirements.

For example, a requirement for a hypothetical wall plug suitable for hanging a mirror might state ‘The wall fixing shall support a weight of 40kg when tested in accordance with the test method in Appendix A.’ This leaves the manufacturer(s) the option of how they design the wall plug – nylon, brass, chemical and so on, as long as it supports the weight.

Prescriptive Standards—express requirements in precise, often quantitative, terms. This leaves little opportunity to depart from the specifications in the Standard.

Using the hypothetical wall plug example again, a Prescriptive Standard might state ‘The 40kg wall fixing shall consist of a 2cm expansion case in accordance with Figure 1, together with a ¼in. Whitworth mild steel zinc plated nut and matching 3cm threaded hook in accordance with Figure 2’.

A prescriptive standard can well-define an engineering problem. The solution is defined. Little or no engineering judgement is required. Within railway control systems engineering, examples are:

- Application design using templates
- Function testing.

A performance-based standard can broadly-define an engineering problem. The outcomes are defined, but there are multiple (usually well-trodden) ways to achieve those outcomes. Some engineering judgement is required. Within railway control systems engineering, examples are:

- Application design beyond templates but within existing principles
- Principles testing.

Complex engineering problems are beyond what can be defined in a standard (prescriptive or performance-based). Significant engineering judgement is required. Within railway control systems engineering, examples are:

- Writing standards
- Standards waivers
- Novel application design

- Equipment design
- Tester in Charge work.

I note that a lot of signalling design falls into the ‘broadly-defined engineering problem’ category.

The International Engineering Alliance⁴ defines the occupational categories for work with the different types of engineering problems as:

- Engineering technicians (aka engineering associates) work with well-defined engineering problems
- Engineering technologists work with broadly-defined engineering problems
- Professional engineers work with complex engineering problems.

This is summarised in Table 1.

Occupational category...	Professional engineer	Engineering technologist	Engineering associate
Works with...	complex engineering problems	broadly-defined engineering problems	well-defined engineering problems
Which can be legally defined as...	beyond standards	only in accordance with a standard	only in accordance with a prescriptive standard
Requires...	significant engineering judgement	some engineering judgement	little or no engineering judgement

Table 1: Engineering occupational categories

Professional engineers are professionals.

Engineering technologists and engineering associates are paraprofessionals.

2.2 How to develop professionals and paraprofessionals?

Professional development can be divided into:

- Initial professional development – developing competence to a level appropriate for independent practice; and
- Continuing professional development – maintaining, deepening and broadening competence.

Our principal concern in RSNL is whether someone can demonstrate that their competence is suitable for independent practice – i.e. initial professional development.

⁴ <https://www.internationalengineeringalliance.org/assets/Uploads/IEA-Graduate-Attributes-and-Professional-Competencies-2021.1-Sept-2021.pdf>

Initial professional development typically consists of two stages:

- Stage 1 – education, resulting in a qualification
- Stage 2 – training and experience, resulting in competence.

Colloquially, ‘education’ and ‘training’ are often used interchangeably. However, these are actually distinct concepts, as contrasted in Table 2.

Education	Training
Knowing (knowledge)	Doing (skills)
Theory	Practice
Understanding, reasoning, judgement and intellect	Performance, productivity and competence
Concepts	Tasks
Broad	Narrow

Table 2: Education and training contrasted

Of note:

- Education is the theory
- Training is the practical application of the theory
- You need to know the theory (education) before you can apply it (training).

Where there are specialisations, it is usual for there to be multiple rounds of education, training and experience. For instance, the typical progression in medicine is shown in Table 3.

Stage Name	Stage Type	Description
Medical degree	Generalist education	4-6 years at university
Internship	Generalist training and experience	1 year of working under supervision, rotating around various specialities
Residency	Generalist training and experience	1-2 years of working under lesser supervision, rotating around various specialities
Registrarship	Specialist education, training and experience	3-7 years of education, training and working under supervision in the speciality

Table 3: Initial professional development in medicine

Of interest, registrarship starts with registration with the relevant medical college (professional body) for the speciality (e.g. surgery, emergency medicine, rheumatology).

After the completion of registrarship is independent practice in the speciality.

Where there are specialisations, I suggest that initial professional development consists of the following stages:

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- Stage 1 – generalist education, resulting in a generalist qualification
- Stage 2A – generalist training and experience, resulting in generalist competence
- Stage 2B – specialist education, training and experience, resulting in specialist competence.

Note that there are different levels of education and training. The Australian Qualifications Framework (AQF)⁵ levels...

...define the relative complexity and depth of achievement and the autonomy required of graduates to demonstrate that achievement. In the AQF there are 10 levels with level 1 having the lowest complexity and AQF level 10 the highest complexity.

It is important to match the education and training level with the work. Consider the following case study⁶. A large pharmaceutical company had a quality control problem. When investigated, they found that it was caused by the lab technicians (equivalent to engineering associates). They decided to stop the lab technicians' apprenticeship program and, instead, recruit technicians with associate's degrees (a 2 year degree, equivalent to what the International Engineering Alliance would expect for an engineering associate) from a community college:

As management had hoped, the community college-trained lab technicians did improve quality control. These lab technicians understood the importance of precisely followed procedures and detailed documentation. Encouraged by their success, management decided to recruit people with more advanced degrees to be technicians. If an associate's degree was good, then logically, a bachelor's degree would be better; a master's better still; and a doctorate would be best. Because of the company's reputation as a good employer and the union pay scale, management was able to implement its upgrading plan. The company even recruited Ph.D.'s, mainly foreign-born scientists, into the bargaining unit. This plan proved disastrous. In Quality Control these more advanced degree-holders found their work boring, routine, and even demeaning. Once they realised that it would take at least three to five years to get a promotion, many of them expressed their intense displeasure with everyone, and many quit.

The case study also describes the pharmaceutical company removing the apprenticeship program for skilled tradesworkers and using the community college programs instead. Again a disaster.

⁵ <https://www.aqf.edu.au/framework/australian-qualifications-framework>

⁶ J. Keefe and D. Potosky, "Technical Dissonance: Conflicting Portraits of Technicians," in *Between Craft and Science: Technical Work in U.S. Settings*, S. R. Barley and J. E. Orr, Eds., Ithaca, New York, USA: Cornell University Press, 1997, pp. 53-81.

It is important to match the education and training level with the work. Too low is a problem – e.g. the apprenticeship system for lab technicians. Too high is a problem – e.g. Ph.D.'s for lab technicians and community college for skilled tradesworkers.

In summary:

- Where there are specialisations, initial professional development consists of the following stages:
 - Stage 1 – generalist education, resulting in a generalist qualification
 - Stage 2A – generalist training and experience, resulting in generalist competence
 - Stage 2B – specialist education, training and experience, resulting in specialist competence
- It is important to match the education and training level with the work.

2.3 How to develop railway control systems professional engineers?

The professional engineer works with complex engineering problems – beyond what is defined in a standard and hence significant engineering judgement is required.

Almost by definition, it is difficult to define all of the possible roles or tasks that a professional engineer might undertake. However:

- It might be very broad – consider a project engineer:
 - Other than progress tracking, the project engineer isn't going to be interested in the nitty-gritty of the individual deliverables (e.g. control tables, bonding plans, circuits) – that is the role of the engineering technologists
 - What the project engineer will be interested in is ensuring that all of the individual deliverables integrate together to form a coherent whole, and that the railway control systems work integrates with the rest of the railway – the level of focus needs to be of the railway control system as a system within the railway system-of-systems.
- It might be very deep – consider someone designing equipment:
 - The designer needs to be able to design electrical equipment from first principles
 - The designer needs to understand the railway context, both within the railway control system and the railway system that it lives within.

This is often referred to as the T-shaped engineer – broad across many disciplines and deep in their own discipline⁷.

⁷ <https://eric.ed.gov/?id=EJ1246395>

Of interest, two of the abstracts submitted for the ASPECT 2023 conference mention this scope. Woodbridge⁸ states:

In essence what we seem to be at the point of losing is that “jack of all trades” Signal Engineer who actually understands, at some level, the whole picture; this includes other railway disciplines and above all the operator (driver, signaller, train timetable, possession planner...).

Schmid et al⁹ state:

The design, construction and operation of modern railways require inputs from operators and civil, electrical, electronic, mechanical and software engineers to deliver economically sound, efficient and safe railways that satisfy stakeholder needs. Today, systems engineers are employed to act as guiding minds who ensure that the contributions of all disciplines work as a whole. However, systems engineering input and oversight often stops once contracts have been let and physical work has started. The role of the signalling engineer tends to be limited to the implementation of standard solutions against already fixed rigid requirements.

The authors suggest that the industry needs a new kind of practical engineer who understands how the whole system works and who is involved in its conceptual development from the start. The railway integration engineer (and manager) ensures that the operational requirements of a scheme are discussed, respected and implemented correctly, throughout, across all disciplines. The authors view this as the ‘new’ role of the signalling engineer!

How to develop such a person?

I suggest the following...

2.3.1 Stage 1 – Electrical engineering education

What is needed is the generalist education appropriate to work with complex electrical engineering problems. This includes engineering knowledge, problem analysis, design/development of solutions, investigation, tool usage, sustainability, ethics, teamwork, communication, project management / finance and lifelong learning.

These outcomes are defined in the Washington Accord. These outcomes do not specify the manner in which they are achieved – via university education or otherwise. Many people have, in good faith, worked their way up through the ranks to achieve substantially the same outcomes as the Washington Accord. As professional engineers

⁸ P. Woodbridge, “Are we forgetting the Signal Engineer?,” ASPECT 2023 abstract.

⁹ F. Schmid, H. Kim and T. Moore, “Railway Integration Engineer and Manager: reflections on the changing role, perception, education and training of signalling engineers,” ASPECT 2023 abstract.

registration legislation comes into effect throughout Australia, grandfathering pathways need to be (and are, at least on paper) provided to recognise this prior learning. However, the legislation (mostly¹⁰) requires that the registered professional engineer is the one making the engineering judgements. It is the level of engineering judgement that really distinguishes the various occupational categories. Therefore, in the future, it will be very hard to demonstrate that the Washington Accord outcomes have been achieved through experience, and a Washington Accord degree will become the norm.

Therefore, going forward, this stage will be satisfied by a Washington Accord degree (or equivalent qualification) in electrical engineering (or related – e.g. mechatronics).

2.3.2 Stage 2A – Electrical engineering experience

I suggest that what is needed is about two years of experience rotating around as many electrical engineering areas as possible – e.g.:

- Various disciplines – e.g. railway control systems, traction, telecommunications
- Various asset lifecycle stages – e.g. design, construction, testing and commissioning, maintenance
- Various non-technical – e.g. project management, human factors.

2.3.3 Stage 2A – Railway control systems engineering fundamentals education

I suggest that, during the railway control systems part of the two-year graduate rotation, there should be a short course that gives the fundamentals (i.e. breadth, not depth) of railway control systems engineering. This allows the graduate to see ‘the big picture’ during their railway control systems rotation.

2.3.4 Stage 2A – Railway control systems engineering training

During the railway control systems part of the two-year graduate rotation, many of the tasks undertaken will be at the engineering associate level (e.g. design from templates, test assistant). There should be prescriptive standards for these tasks. There should be a short course (including assessment) for each of these prescriptive standards. The duration of the course should be proportionate to the subject and could range from an hour (e.g. fuse and terminal analysis) through to, say, a week (e.g. control tables). These could be grouped into skill sets¹¹, akin to the British Basic Signalling Technology course.

Australian prescriptive standards need to be developed. This task belongs to the Australian Rail Industry Standards Organisation.

¹⁰ <https://www.richardstephens.id.au/competence/professional-engineers-registration-in-victoria/the-direct-supervision-guideline-and-who-may-make-engineering-judgements/>

¹¹ https://www.education.vic.gov.au/Documents/training/providers/rto/Skill_sets.pdf

Australian short courses to match the prescriptive standards need to be developed. The development of the units of competency should belong to the Institution of Railway Signal Engineers (IRSE), as the professional body. The delivery of the short courses belongs to registered training organisations.

2.3.5 Stage 2B – Railway control systems engineering experience

At the end of the two-year graduate rotation, some will select railway control systems as their speciality. I suggest that there should then be about three years of working under supervision.

2.3.6 Stage 2B – Railway control systems professional engineer education

I suggest that there should be an education program that covers railway control systems engineering in depth and also interfacing systems in breadth at the professional engineer level.

It is usual that the professional body sets the outcomes for this education – e.g. CPA exam for accountants, medical college exams for medical doctors. It is also usual that, once the outcomes have been established, it can be delivered by the professional body (e.g. via self-learning with an exam at the end) or by education and assessment by higher education providers.

For railway control systems engineering, the outcomes have already been established (although, as always, they can be refined) – the IRSE Professional Exam outcomes.

This can be assessed via:

- The IRSE Professional Exam itself; or
- Courses accredited to meet the same outcomes as the IRSE Professional Exam – e.g.
 - University of Birmingham MSc in Railway Safety and Control Systems
 - IRSE Graduate Diploma in Railway Signalling

2.3.7 Stage 2B – Railway control systems engineering training

This is as per Stage 2A – Railway control systems engineering training.

2.3.8 Stage 3 – Independent practice

Independent practice actually comes after the end of initial professional development. However, I include it here to discuss how readiness for independent practice can be demonstrated.

I suggest that, within the professional engineer registration schemes, a ‘railway control systems engineering’ area of engineering could be created. Completion of the above allows for independent practice at the level of professional engineer.

This allows demonstration of competence for complex engineering problems.

2.3.9 Summary

The recommended initial professional development for a railway control systems professional engineer is summarised in Table 4.

Occupational category	Professional engineer (complex engineering problems) (beyond standards) (significant engineering judgement)		
Stage 1 - Generalist education	Washington Accord degree (or 4-year engineering degree)		
Stage 2A - Generalist training and experience	Graduate rotation program	RCSE fundamentals education	RCSE training
Stage 2B - Specialist education, training and experience	RCSE supervised practice	RCS professional engineer education	RCSE training
Stage 3 - Independent practice	Independent practice		

Table 4: Railway control systems professional engineer initial professional development

2.4 How to develop railway control systems engineering technologists?

The engineering technologist works with broadly-defined engineering problems – i.e. what is defined in a performance-based standard and hence some engineering judgement is required.

Much of signalling design fits into this category – there are existing principles (performance-based standards), and there are multiple well-trodden ways to achieve those principles.

How to develop such a person?

I suggest the following...

2.4.1 Stage 1 – Electrical engineering education

For the same rationale as with professional engineers, going forward this stage will be satisfied by a Sydney Accord degree (or equivalent qualification) in electrical engineering (or related – e.g. mechatronics).

Note that the engineering registration legislation in Queensland, New South Wales and Victoria does not properly recognise engineering technologists¹². Fixing this is a separate issue.

2.4.2 Stage 2A – Railway control systems engineering experience

I suggest that what is needed is about two years of experience rotating around as many railway control systems engineering areas as possible.

This is as per professional engineers, but within railway control systems engineering only (e.g. not traction and not general telecommunications).

2.4.3 Stage 2A – Railway control systems engineering fundamentals education

During the two-year graduate rotation, there should be a short course that gives the fundamentals (i.e. breadth, not depth) of railway control systems engineering.

2.4.4 Stage 2A – Railway control systems engineering training

The same as for professional engineers (Section 2.3.4).

2.4.5 Stage 2B – Railway control systems engineering experience

At the end of the two-year graduate rotation, there should be about three years of working under supervision.

2.4.6 Stage 2B – Railway control systems engineering technologist education

There should be an education program that covers railway control systems engineering in depth at the engineering technologist level.

This is much the same as for a professional engineer, but omits the breadth of interfacing systems (although study of the interface itself should be retained) and omits the higher level of judgement (e.g. omit a research project).

2.4.7 Stage 2B – Railway control systems engineering training

The same as for professional engineers (Section 2.3.7).

2.4.8 Stage 3 – Independent practice

Independent practice is actually after the end of initial professional development. However, I include it here to discuss how readiness for independent practice can be demonstrated.

¹² <https://www.richardstephens.id.au/competence/professional-engineers-registration-in-victoria/the-act-does-not-recognise-engineering-technologists/>

Within the (altered) engineering registration schemes, a ‘railway control systems engineering’ area of engineering could be created. Completion of the above allows for independent practice at the level of engineering technologist. This would be independent practice within an engineering technologist’s scope of practice – i.e. only in accordance with a standard (performance-based or prescriptive).

This allows demonstration of competence for broadly-defined engineering problems.

2.4.9 Summary

The recommended initial professional development for an engineering technologist is summarised in Table 5.

Occupational category	Engineering technologist (broadly-defined engineering problems) (within standards) (some engineering judgement)		
Stage 1 - Generalist education	Sydney Accord degree (or 3-year engineering degree)		
Stage 2A - Generalist training and experience	Graduate rotation program	RCSE fundamentals education	RCSE training
Stage 2B - Specialist education, training and experience	RCSE supervised practice	RCS engineering technologist education	RCSE training
Stage 3 - Independent practice	Independent practice		

Table 5: Railway control systems engineering technologist initial professional development

2.5 How to develop railway control systems engineering associates?

The engineering associate works with well-defined engineering problems – i.e. what is defined in a prescriptive standard and hence little to no engineering judgement is required.

How to develop such a person?

I suggest the following...

2.5.1 Stage 1 – Electrical engineering education

I suggest that a Dublin Accord degree (or equivalent qualification) in electrical engineering (or related – e.g. mechatronics) is recommended for entry to practice.

2.5.2 Stage 2B – Railway control systems engineering experience

I suggest that there should be a period of working under supervision.

2.5.3 Stage 2B – Railway control systems engineering training

This is the same as for professional engineers (Section 2.3.7).

2.5.4 Stage 3 – Independent practice

Independent practice is actually after the end of initial professional development. However, I include it here to discuss how readiness for independent practice can be demonstrated.

I suggest that completion of the above allows for independent practice at the level of engineering associate. This would be independent practice within an engineering associate’s scope of practice – i.e. only in accordance with a prescriptive standard.

This allows demonstration of competence for well-defined engineering problems.

2.5.5 Summary

The recommended initial professional development for an engineering associate is summarised in Table 6.

Occupational category	Engineering associate (well-defined engineering problems) (within prescriptive standards) (no engineering judgement)	
Stage 1 - Generalist education	Dublin Accord degree (or 2-year engineering degree)	
Stage 2A - Generalist training and experience	N/A	
Stage 2B - Specialist education, training and experience	RCSE supervised practice	RCSE training
Stage 3 - Independent practice	Independent practice	

Table 6: Railway control systems engineering associate initial professional development

2.6 Key point

From the perspective of RSNL Review recommendation 20, the key point in this section is that the development and assessment of competence requires:

- Generalist education
- Specialist education
- Training
- Experience.

3 Standards

In order to provide a considered response regarding ‘national standards development and adoption’, it is necessary to consider the standards required and how they will be used.

As per Section 2, the below considers railway control systems engineering, where:

- ‘railway control systems’ includes signalling, communications and train control systems; and
- ‘engineering’ includes professional and paraprofessional roles, but excludes trade roles.

This section considers:

- What are the engineering occupational categories?
- What standards do professional engineers need?
- What standards do engineering technologists need?
- What standards do engineering associates need?

3.1 What are the engineering occupational categories?

To recap from Section 2, the engineering occupational categories are summarised in Table 7.

Occupational category...	Professional engineer	Engineering technologist	Engineering associate
Works with...	complex engineering problems	broadly-defined engineering problems	well-defined engineering problems
Which can be legally defined as...	beyond standards	only in accordance with a standard	only in accordance with a prescriptive standard
Requires...	significant engineering judgement	some engineering judgement	little or no engineering judgement

Table 7: Engineering occupational categories

3.2 What standards do professional engineers need?

Professional engineers, when the situation requires, are able to design from first principles.

Professional engineers require a standard that defines the railway control systems engineering first principles.

The IRSE has developed the *Fundamental Requirements for Train Control Systems*¹³. This can be adopted as a standard.

3.3 What standards do engineering technologists need?

Engineering technologists work with broadly defined engineering problems – i.e. only in accordance with a standard (performance-based or prescriptive).

Consider how AS 3000 (the *Wiring Rules*) is structured:

- Part 1 is the ‘high level safety performance outcomes/conditions’ (performance-based requirements)
- Part 2 is the ‘installation practices that achieve certainty of compliance with the essential safety requirements of Part 1’ (prescriptive requirements)
- If someone is undertaking a routine task (e.g. wiring a house), they can follow-the-bouncing-ball in Part 2 and little justification is required
- If someone is undertaking a novel task (e.g. wiring a nuclear reactor), they are able to comply with Part 1 but it will require justification.

Likewise, consider how the *National Construction Code*¹⁴ is structured:

- Each section has a set of performance requirements
- The performance requirements can be satisfied by:
 - A performance solution; or
 - A deemed-to-satisfy solution.
- If someone is undertaking a routine task (e.g. building a typical pool in a typical backyard), they can follow-the-bouncing-ball with a deemed-to-satisfy solution and little justification is required
- If someone is undertaking a novel task (e.g. building a glass-sided pool on the top floor of a high-rise building), they can develop a performance solution, but it will require justification.

I suggest that we want a similar structure to AS 3000 and the *National Construction Code* – i.e.:

- A suite of national (Australian Rail Industry Standards Organisation – ARISO) standards
- A suite of performance-based standards:

¹³ [https://www.webinfo.uk/webdocssl/irse-kbase/PDFreader.aspx?RefNo=365852309&document=IRSE%20Fundamental%20Requirements%20for%20Train%20Control%20Systems%20\(v8.3%20July%202024\).pdf&id=87&PDFC=DP&App=Knowledge%20Base&Title=](https://www.webinfo.uk/webdocssl/irse-kbase/PDFreader.aspx?RefNo=365852309&document=IRSE%20Fundamental%20Requirements%20for%20Train%20Control%20Systems%20(v8.3%20July%202024).pdf&id=87&PDFC=DP&App=Knowledge%20Base&Title=)

¹⁴

https://www.abcb.gov.au/sites/default/files/resources/2026/NCC%202025%20Volume%20One.pdf?_gl=1*69cbks*_ga*NzM4Nzc5NTlwLjE3Nzg1NTcxNDY.*_ga_DE8H8SFX8R*czE3Nzg1NTcxNDUkbzEkZzEkdDE3Nzg1NTcxNDgkajU3JGwwJGgw

- Technical, for each subsystem – e.g. train detection, points, signals, etc
- Process, for each asset lifecycle phase – e.g. design, construction, etc.
- A suite of (where possible) prescriptive standards that are ‘deemed to comply’ with the performance-based standards for each discipline and asset lifecycle phase – e.g.:
 - AS 1234 Signalling design
 - AS 1235 Signalling installation
 - AS 1236 Signalling testing
 - AS 1237 Signalling maintenance
 - AS 1238 Systems design
 - etc.
- Each prescriptive standard will have a part for each task – e.g. AS 1234 Signalling design will have:
 - Part 1: Gather requirements
 - Part 2: Design scheme plan
 - Part 3: Design control tables
 - etc.

Once a prescriptive standard is in place, an AQF unit of competency can be created aligned with that standard.

Recognition of prior learning can be handled using the standard AQF recognition of prior learning processes.

3.4 What standards do engineering associates need?

Engineering associates work with well-defined engineering problems – i.e. only in accordance with a prescriptive standard.

Engineering associates would use the prescriptive standards (as per Section 3.3) and templates.

3.5 Key point

From the perspective of ‘national standards development and adoption’, the key point in this section is that a hierarchy of standards is required:

- Prescriptive standards that can be used by all engineers
- Performance-based standards that can be used by:
 - Professional engineers and engineering technologists independently
 - Engineering associates under supervision
- First principles that can be used by:
 - Professional engineers independently
 - Engineering technologists and engineering associates under supervision.

4 Responses to Consultation Questions

4.1 Preferred option for RSNL Review recommendation 20

4.1.1 Question

The question is:

Question 1: Which is your preferred option for each recommendation?

RSNL Review recommendation 20.

20. Establish a national set of competencies that would be recognised by all RTOs and includes the following elements:

- a. The mandating and awarding of qualifications and units of competency for nationally recognised training (NRT);
- b. Nationally recognised qualifications and units of competency where emerging gaps are identified;
- c. The validation of localised training and competency assurance processes;
- d. Mandating a national competency management system to support mutual recognition;
- e. Established national safeworking rules, and ensuring changes are made at a national level; and
- f. Defining and implementing national rail roles.

4.1.2 Options

Option 1:

Rec 20 (a-f)

An MOU between operators to recognise each other's competencies or mutually recognise national competencies

Introduction of an industry code outlining that RIMs and RSOs will deliver or utilise standard qualifications and issue accreditation for training provided.

Rec 20 (b-c)

The NRAP program will support delivery of a mutual recognition framework, including national competencies and courseware

Option 2:

Rec 20 (a-d) Pursue regulatory amendment to ensure transferrable skillsets are recognised and reduce existing potential for variance across jurisdictions by: strengthening the requirement to issue qualifications and units of competency where they exist, requiring the use of a national competency management register (containing competency information including inputs from competency management systems where they currently exist)

Rec 20(e) Include mechanism for driving adoption of harmonised national safe working rules as part of tier 2 standards, rules and processes

Rec 20(f) Include national rail roles in the RSNL (eg encompassing roles such as train driver, train controller, signalling engineer as well as a range of maintenance roles)

Option 3:

Amend the RSNL to require the use of a national competency management system (rather than RTOs or industry bodies maintaining their own) in order to recognise transferrable skillsets and reduce existing potential for variance across jurisdictions

Impose mandatory standards for national safe working rules. Note that recommendation 20(e) did not originally foreshadow the mandating of safeworking rules

4.1.3 Response

As discussed in Section 2, the development and assessment of competence requires:

- Generalist education
- Specialist education
- Training
- Experience.

4.1.3.1 *Generalist education*

In the context of railway control systems engineering, the national competency management system should recognise AQF qualifications:

- AQF8 or AQF9 (e.g. Bachelor of Engineering (Honours)) for professional engineers
- AQF7 (e.g. Bachelor of Engineering Technology) for engineering technologists
- AQF6 (e.g. Associate Degree in Engineering Technology) for engineering associates.

However, the national competency management system should also recognise:

- Australian qualifications issued before the AQF was introduced in 1995

- Overseas qualifications that are substantially equivalent to an AQF qualification
- Any mix of education, training and experience that is assessed as substantially equivalent to an AQF qualification.

The mechanism for assessing these is readily available – a ‘Stage 1’ or ‘Graduate Attributes’ assessment by a signatory (e.g. Engineers Australia) or a licensee of a signatory (e.g. IRSE) to the relevant accord (Washington Accord, Sydney Accord or Dublin Accord).

4.1.3.2 Specialist education

In the context of railway control systems engineering, the national competency management system should recognise AQF qualifications – e.g.:

- AQF8 IRSE Australasia Graduate Diploma in Railway Signalling
- AQF8 IRSE Australasia Graduate Certificate in Railway Signalling
- AQF8 Victorian Graduate Diploma of Railway Signalling Systems
- AQF8 Victorian Graduate Certificate of Railway Signalling Systems.

However, the national competency management system should also recognise other qualifications that are substantially equivalent to an AQF qualification – e.g.:

- The IRSE Professional Exam
- Master of Science in Railway Safety and Control systems through the University of Birmingham.

4.1.3.3 Training

In the context of railway control systems engineering, the national competency management system should recognise AQF units of competence. The scope of each training course should be developed as described in Section 2.3.4.

Non-AQF training courses can be recognised using the standard AQF recognition of prior learning processes. For instance, the standard UK training courses:

- Basic Signalling Technology
- Intermediate Signalling Technology
- Advanced Signalling Technology
- Mod 1 Tester in Charge
- Mod 2 Principles Tester
- Mod 3 Verification Tester
- Mod 4 Functional Tester
- Mod 5 Test Assistant.

4.1.3.4 Experience

Knowledge can be categorised in many ways. Of relevance to this discussion is explicit knowledge and tacit knowledge.

Explicit knowledge is knowledge that is able to be communicated to others¹⁵ – e.g. by writing it down or verbalising it.

Tacit knowledge is knowledge that is unable to be communicated to others¹⁶. It was first described by Polanyi, who stated ‘we can know more than we can tell’.

Consider learning to ride a bicycle. You can draw a diagram of a bicycle (explicit knowledge) – these are the pedals, push down on them to make the bicycle move, and so on. However, can you explain the difference between being slightly off balance because you are going around a corner versus being slightly off balance because you are about to fall over (tacit knowledge)?

The ‘ability to do’ (competence)¹⁷ requires both explicit knowledge and tacit knowledge.

Of relevance to this discussion:

- Explicit knowledge is typically developed through education and training
- Tacit knowledge is typically developed through experience.

In the context of railway control systems engineering, the national competency management system should recognise AQF units of competence, where these include sufficient experience to develop the tacit knowledge required for competence.

However, educational qualifications and training courses usually require a period of working under supervision to develop the tacit knowledge required for competence. The national competency management system should also recognise other means of assessing this tacit knowledge – e.g.:

- Engineering registration (currently in Queensland and Victoria, but being progressively implemented in all states)
- Engineers Australia chartered credential (for all three occupational categories)
- Engineers Australia National Engineering Register (for all three occupational categories)
- IRSE professional registration (for all three occupational categories)

¹⁵ <https://www.oxfordreference.com/display/10.1093/acref/9780191843273.001.0001/acref-9780191843273-e-97>

¹⁶ <https://www.oxfordreference.com/display/10.1093/oi/authority.20110803101844995>

¹⁷

https://www.researchgate.net/profile/Stan_Lester/publication/317066799_Professional_competence_standards_guide_to_concepts_and_development/links/592422b4458515e3d4107660/Professional-competence-standards-guide-to-concepts-and-development.pdf?_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6InB1YmxpY2F0aW9uIiwicGFnZSI6InB1YmxpY2F0aW9uIn19

- IRSE licensing.

As discussed in Sections 2.3.8 and 2.4.8, within the professional engineer registration schemes, a ‘railway control systems engineering’ area of engineering could be created.

The IRSE licensing is useful as an alternative pathway. However, it is of little benefit in Queensland and Victoria, where engineering registration is already mandatory for professional engineer and engineering technologist work (unless working under direct supervision, which is double work). As engineering registration is rolled out Australia-wide, an IRSE licensing alternative pathway would become redundant. Also, it is desirable to align with internationally recognised qualifications (which includes the Washington Accord, Sydney accord and Dublin Accord, as well as the IRSE licensing) – therefore creating Australia-specific roles in the IRSE licensing scheme should be avoided.

4.1.4 Preferred option

The Australian experience has been that Rail Infrastructure Managers are reluctant to acknowledge competence assessments by other Rail Infrastructure Managers. Therefore Option 1 can be ruled out as having insufficient force to meet the objectives.

This leaves Option 2 and Option 3. I have no preference between the two, so long as:

- The national competency management system has the flexibility to include the alternative pathways discussed in Section 4.1.3 (not just AQF qualifications and units of competence); and
- The national competency management system permits an orderly introduction of the national competencies as the underlying standards are developed.

I note that Option 3 ‘require[s] the use of a national competency management system (rather than RTOs or industry bodies maintaining their own)’. In most professions, the professional body is responsible for (directly or indirectly) educating, training, assessing and ensuring the conduct of those in the profession. Consider if someone raises a complaint against an engineer. Engineers Australia¹⁸ has:

- A code of ethics
- A procedure for making complaints against members and handling the complaint
- A Professional Conduct Committee
- A procedure for the Professional Conduct Committee to investigate the complaint
- Requirements for findings, sanctions and notifying the various parties

¹⁸ <https://www.engineersaustralia.org.au/sites/default/files/2025-07/general-regulations-2019.pdf>

- An appeals process.

If Option 3 is chosen, NTC would need to ensure that the body responsible for the national competency management system has the people and process required to handle the functions that are normally performed by professional bodies.

4.2 Preferred option for national standards development and adoption

4.2.1 Question

The question is:

Question 1: Which is your preferred option for each recommendation?

National standards development and adoption

4.2.2 Options

Option 1:

Introduction of a ministerial statement directing the Regulator to consider safety across the whole network - include harmonisation as a consideration to reduce differences and thereby improve productivity

This could be achieved by ministers issuing a Statement of Expectations to the Regulator, requiring the Regulator to consider nationally harmonised tier 2 standards and refer to them in regulatory activities and guidance

Option 2:

Provision included in the RSNL to better facilitate national harmonised standards and network rules

Provision included in the RSNL to give more legal weight to nationally harmonised tier 2 standards, for example, by conferring on tier 2 standards a similar legal status to that already given to Codes of Practice in the RSNL. This would have the effect of making tier 2 standards admissible evidence in relation to what is known about risks and what is reasonably practicable in addressing them

Duty holders would still be required to consider whether there are, as a question of fact, any safety hazards beyond those covered in the standard. Membership of ARISO to be included as a condition of rail safety accreditation

4.2.3 Response

As discussed in Section 3:

- Professional engineers, when the situation requires, are able to design from first principles (i.e. beyond standards)
- Engineering technologists work with broadly defined engineering problems – i.e. only in accordance with a standard (performance-based or prescriptive)
- Engineering associates work with well-defined engineering problems – i.e. only in accordance with a prescriptive standard.

Therefore, a hierarchy of standards is required:

- Prescriptive standards that can be used by all engineers
- Performance-based standards that can be used by:
 - Professional engineers and engineering technologists independently
 - Engineering associates under supervision
- First principles that can be used by:
 - Professional engineers independently
 - Engineering technologists and engineering associates under supervision.

4.2.4 Preferred option

The Australian experience has been that Rail Infrastructure Managers are reluctant to adopt national standards. Therefore Option 1 can be ruled out as having insufficient force to meet the objectives.

Therefore I recommend Option 2, so long as the standards structure has the flexibility to support the hierarchy discussed in Section 4.2.3.

4.3 Other consultation questions

I have no comment on the other consultation questions.