



TAO Authorisation Requirements

Issue date: 09 December 2024

Effective date: 09 December 2024

SUPERSEDED

Disclaimer

This document has been prepared by Transport for NSW (TfNSW) specifically for its own use and is also available for use by NSW public transport agencies for transport assets.

Any third parties considering use of this document should obtain their own independent professional advice about the appropriateness of using this document and the accuracy of its contents. TfNSW disclaims all responsibility and liability arising whether directly or indirectly out of or in connection with the contents or use of this document.

TfNSW makes no warranty or representation in relation to the accuracy, currency or adequacy of this document or that the document is fit for purpose.

The inclusion of any third party material in this document, does not represent an endorsement by TfNSW of any third party product or service.

SUPERSEDED

For queries regarding this document, please email Transport for NSW Asset Management Branch at standards@transport.nsw.gov.au or visit www.transport.nsw.gov.au

Document information

Owner: Director Supplier Assurance and Engagement
 Asset Management
 Planning, Integration and Passenger

Mode: Multimodal

Discipline: TAO

Document history

Revision	Effective date	Summary of changes
1.0	6 June 2013	First issued as TS 10502: 2013 <i>AEO Authorisation Requirements</i> .
2.0	5 January 2015	Issued as T MU MD 00009 ST <i>AEO Authorisation Requirements</i> 1 December 2014.
3.0	8 May 2017	Third issue – changes to previous content include: restructuring of the requirements and guiding information to remove overlaps in requirements causing duplications in answers, to add clarity and to provide more information on the expected evidence; new grouping of requirements to make some important requirements more prominent and to better align the requirements structure with the engineering assurance and contract performance evaluation frameworks.
1.0	30 March 2022	First issue as TS 06197.1:1.0 <i>TAO Authorisation Requirements</i> – changes to previous issue include: change of name, streamlining of the competency management requirements, removal of the performance measurement and continual improvement requirements, updates to guidance for requirements to enhance clarity, updates to the structure of the document to clearly align to EMCAs.
1.1	30 March 2022	This is a minor revision issued to include reference to TS 06197.5 <i>TAO Engineering Services Matrix – Maritime</i> .
2.0	19 December 2022	Second issue. Changes from the previous content include: expansion of sustainability management to broader environmental and sustainability management context; updates to configuration management, systems engineering and system safety assurance requirement to enhance clarity; general updates to guidance information for better clarity.
3.0	8 December 2023	Third issue. Changes from the previous issue include: updated all sections to comply with Asset Standards Style Manual and to enhance readability; updated system safety assurance requirements to provide clearer guidance; updated references to standards and various definitions.
4.0	9 December 2024	Fourth issue. Changes from the previous issue include: updated ENM18 requirement and expected evidence, and updated references to standards and various definitions.

Preface

This is a fourth issue.

This standard forms part of a series of documents that describe the management of the TAO Scheme.

This standard specifies the system assessment criteria against which TAO applicants are assessed and audited. This standard provides guidance to applicants and authorised TAOs related to those requirements.

Changes from the previous version include the following:

- updated ENM18 requirement and expected evidence to keep expectation current
- updated references to standards and various definitions.

SUPERSEDED

Table of contents

1	Scope	6
2	Application	6
3	Referenced documents	6
4	Terms, definitions and abbreviations	8
5	Authorisation	10
6	TAO authorisation requirements	10
6.1	Engineering management process and planning – EMCA1	11
6.2	Requirements management – EMCA2	16
6.3	Service or solution engineering – EMCA3	19
6.4	Assurance, verification and validation – EMCA4	36
6.5	Configuration management – EMCA5	49
6.6	Competence management – EMCA6	50
6.7	Stakeholder management – EMCA7	56
6.8	Resources management – EMCA8	56
6.9	Supplier management – EMCA9	58

1 Scope

This document is part of a suite that governs the TAO Scheme. This standard outlines the authorisation requirements against which an applicant's management system is evaluated, in order to attain and maintain TAO status.

2 Application

This document applies to organisations applying for authorisation to provide self-assured technical services and products to TfNSW. This standard applies to all phases of the asset life cycle. It also applies to all self-assured technical supplier assurance arrangements that TfNSW is accountable for.

TAO engineering services are defined in TS 06197.3, TS 06197.4 and TS 06197.5 in relation to the TfNSW asset life cycle.

The primary audiences for this standard are applicants for TAO status, existing TAOs, individuals across TfNSW and industry working under the *Technical Supplier Assurance Framework*.

The requirements in this standard may be used by a TAO to inform and improve its own engineering assurance system and competence management to self-assure technical outputs and to manage staff competence.

3 Referenced documents

The following documents are cited in the text. For dated references, only the cited edition applies. For undated references, the latest edition of the referenced document applies.

International standards

I.S. EN 50121 (all parts) *Railway applications – Electromagnetic compatibility*

ISO 14090 *Adaptation to climate change – Principles, requirements and guidelines*

ISO/IEC/IEEE 15288 *Systems and software engineering – System life cycle processes*

ISO/IEC/IEEE 24748-4 *Systems and software engineering – Life cycle management – Part 4: Systems engineering planning*

ISO/IEC/IEEE 29148 *Systems and software engineering – Life cycle processes – Requirements engineering*

Australian standards

AS ISO 10007 *Quality management – Guidelines for configuration management*

AS ISO 20400 *Sustainable procurement – Guidance*

AS ISO 55000 *Asset management – Overview, principles and terminology*

AS ISO 55001 *Asset management – Asset management system – Requirements*

AS/NZS ISO 9001 *Quality management systems – Requirements*

AS/RISSB 7470 *Human Factors Integration in Engineering Design – General Requirements*

AS/RISSB 7722 *EMC Management*

Transport for NSW standards

TS 00038 (T MU EN 00003 GU) *AEO Guide to Sustainability in Design*

TS 00041.1 *Sustainability Assurance Requirements*

TS 00161 *Requirements for Software Tools used for Engineering Simulation and Modelling*

TS 01454 *Configuration Management Guide for TAOs*

TS 01460 (T MU AM 06001 GU) *AEO Guide to Systems Architectural Design*

TS 01461 (T MU AM 06002 GU) *AEO Guide to Reliability, Availability and Maintainability*

TS 01462 (T MU AM 06006 GU) *Systems Engineering (Guide)*

TS 01464 (T MU AM 06010 GU) *Business Requirements Specification*

TS 01465 (T MU AM 06014 GU) *Guide to Systems Integration*

TS 01467 (T MU MD 00014 GU) *Multi-Discipline Rail Infrastructure Design Management*

TS 01470 (T MU AM 06004 ST) *Requirements Schema*

TS 01471 (T MU AM 06006 ST) *Systems Engineering (Standard)*

TS 01498 *Guide to Requirements Definition and Analysis*

TS 04976 (T MU HF 00001 GU) *Guide to Human Factors Integration*

TS 04978 (T MU HF 00001 ST) *Human Factors Integration – General Requirements*

TS 04981 (T MU MD 20001 ST) *System Safety Standard for New or Altered Assets*

TS 04986 (T MU MD 00003 GU) *Guide to Independent Safety Assessment*

TS 04987 (T MU MD 00004 TI) *Independent Safety Assessor Requirements*

TS 06196 *TAO Guide to Engineering Competency Management*

TS 06197.2 *TAO Authorisation Scheme*

TS 06197.3 *TAO Engineering Services*

TS 06197.4 *TAO Engineering Services Matrix – Rail*

TS 06197.5 *TAO Engineering Services Matrix – Maritime*

TS 10504 *AEO Guide to Engineering Management*

Other referenced documents

RISSB 2018, *Guideline – Integration of Human Factors in engineering design*, version 1.0

TfNSW, *Sustainable Design Guidelines*, version 4.0

TfNSW 2020, CP20009.1 *Transport Procurement Policy*

TfNSW 2020, *Future Energy Strategy*

TfNSW 2020, *Transport Environment and Sustainability Policy*

TfNSW 2021, DMS-SD-081/4.1 *TfNSW Climate Risk Assessment Guidelines*

TfNSW 2021, *Transport Sustainability Plan*

TfNSW 2022, *Future Transport Strategy 2056*

TfNSW 2023, *Technical Supplier Assurance Framework*

4 Terms, definitions and abbreviations

The following terms, definitions and abbreviations apply in this document.

AMB Asset Management Branch

asset item, thing or entity that has potential or actual value to an organisation (Source: ISO 55000:2014)

asset life cycle stages for an asset from recognition of need through to disposal and any residual risks or liability period

assurance a set of structured and planned activities conducted through the asset life cycle providing progressive justified confidence that objectives are being achieved and that the asset is or will be fit for purpose

authorisation the conferring of authority, by means of an official instruction, and supported by assessment and audit, to a technical supplier, to self-perform assurance of the competence of its staff and the outputs of engineering processes

compliance the state or fact of according with, or meeting, rules, requirements or standards

ECR engineering change request

EMC electromagnetic compatibility

EMCA engineering management capability area

EMI electromagnetic interference

engineering assurance a sum of technical assurance activities along the life cycle; includes design assurance, construction assurance, maintenance assurance

HF human factors

HV high voltage

ISA independent safety assessment

JOS judgement of significance; an assessment of the technical risk introduced by the implementation of the design and considers both the probability and consequence of partial performance or failure of a design

RAM reliability, availability and maintainability

responsible a duty or obligation to satisfactorily perform or complete a task (assigned by someone, or created by one's own promise or circumstances) that one shall fulfil, and which has a consequent penalty for failure. Responsibility can be delegated

RFI requests for information

SEMP system engineering management plan

service provider a party providing a service to an accountable party or responsible party either directly or indirectly

SFAIRP so far as is reasonably practicable

SME subject matter expert

SMS safety management system

staff all of the following employment categories: permanent or fulltime or fixed-term employees, part-time or casual employees, shift workers, daily hire and weekly hire employees, probationary employees, apprentices or trainees, employment agency staff or labour hire, contractors or sub-contractors

TAO Technically Assured Organisation; a legal entity to whom TfNSW has issued a TAO Authorisation

technical supplier a party, external or internal to TfNSW, providing a technical service related to TfNSW assets and services

TfNSW Transport for NSW

TfNSW transport assets for the purpose of this document transport assets vested in or owned, managed, controlled, commissioned or funded by TfNSW or a subsidiary NSW Government Transport Agency

Transport Network the transport system owned and operated by TfNSW or its operating agencies upon which TfNSW has power to exercise its functions as conferred by the *Transport Administration Act* or any other Act

validation confirmation, through the provision of objective evidence, that the requirements for a specific intended use or application have been fulfilled

verification confirmation, through the provision of objective evidence, that specified requirements have been fulfilled

5 Authorisation

Organisations in the TfNSW supply chain range from constructors and large design houses to small, specialised companies. All organisations in the TfNSW supply chain, including entities internal to TfNSW, that make technical decisions related to transport assets and services shall be authorised.

The TAO authorisation process, as detailed in TS 06197.2, includes an assessment of demonstrated and proven technical and systems (including competency systems) capability. It qualifies organisations to deliver self-assured engineering and technical services to TfNSW.

A supplier of engineering and technical services and products wishing to engage in work for TfNSW shall be assessed and audited against TAO requirements irrespective of contractual status. Contract delivery evidence produced by the TAO or TAO applicant, shall be used to demonstrate compliance with TAO requirements.

Compliance with the requirements of this standard is verified during the initial TAO authorisation assessment. TAOs shall continually demonstrate compliance as part of the TfNSW tendering and contracting arrangements, and through participation in the TAO surveillance program.

Users of this standard are bound by all relevant requirements of state and federal law, regardless of whether or not there is any specific reference to them in this standard.

All work delivered to TfNSW by a TAO as a self-assuring entity shall be delivered using the authorised management system. The TAO surveillance program assures that a TAO is operating within its scope and that its technical and systems capability including competency systems still meet the TAO authorisation requirements. TfNSW also carries out risk-based surveillance on TAOs to ensure they are working within their scope of authorisation.

Issuing of TAO status does not detract from TfNSW's role in appropriately managing and assuring any contracts it enters into, its contractors and their activities.

6 TAO authorisation requirements

Sections 6.1 to 6.9 specify the requirements that an entity shall meet to attain and maintain its status as a TAO.

The requirements are accompanied by the following:

- elaboration – supplementary mandatory information regarding the requirement
- evidence – elaboration on documentation and proof of deployment that TAOs are expected to provide, which shall be relevant and cover the proposed scope of authorisation
- documents – reference to standards or documents that provide additional information.

6.1 Engineering management process and planning – EMCA1

These requirements cover engineering management activities and arrangements for the systematic execution of those activities. They are to ensure TAO's delivery of services within the scope of authorisation is compliant with relevant standards whilst satisfying TfNSW needs.

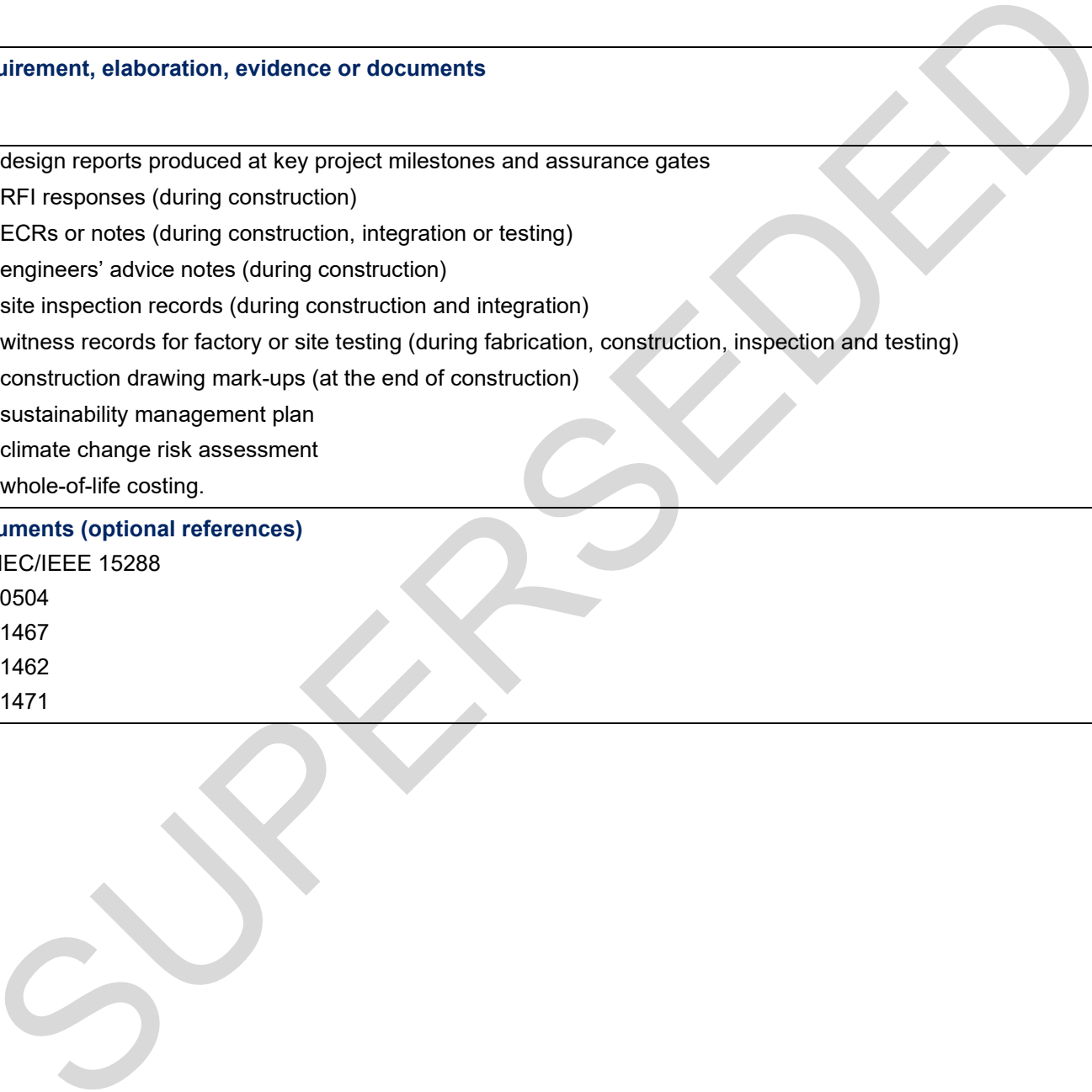
Mandatory, as applicable or guidance	Requirement, elaboration, evidence or documents
Mandatory	<p>Requirement – ENM1</p> <p>A TAO shall have documented engineering and technical management processes, tools, resources, and methodologies appropriate to deliver and assure the engineering services or products offered and suitably aligned with AS ISO 55000, AS ISO 55001 and AS/NZS ISO 9001.</p>
	<p>Elaboration</p> <p>Where applicable, a TAO shall perform systems engineering activities in accordance with the requirements of ISO/IEC/IEEE 15288 or ISO/IEC/IEEE 24748-4 or equivalent.</p> <p>The level of application of systems engineering is scalable and tailored as relevant to the level of complexity, novelty and risk associated with the TAO services.</p> <p>A TAO should ensure that the technical processes covered in its documentation include all required processes as specified in this document as applicable.</p>
	<p>Evidence</p> <p>A TAO should have suitable plans, processes, procedures, guides or manuals (or a combination thereof) that demonstrate how it consistently carry out their services in the absence of, or in conjunction with, the contractually prescribed relevant processes.</p> <p>A TAO that provides multi-disciplinary engineering services should document its engineering approach in a SEMP or manual or equivalent document or system.</p> <p>A TAO may choose to establish an enterprise level SEMP, which is scaled, tailored and applied to each project, rather than developing project-specific SEMPs without reference to an overarching standard SEMP.</p> <p>A TAO may choose to embed systems engineering principles and processes within an engineering management plan, technical services management plan or similar, rather than writing a dedicated SEMP. This choice will depend on the complexity and range of services offered by the TAO. Specialised engineering service providers that have limited scope of authorisation, typically within the same life cycle phase, and only for few disciplines, may choose this approach. TAOs engaged in standard, single-discipline engineering projects may prepare a relatively simple engineering management plan, whereas TAOs engaged in complex, multi-discipline, multi-phase projects with significant levels of systems integration, novelty</p>

Mandatory, as applicable or guidance	Requirement, elaboration, evidence or documents
	<p>and risk will likely need to prepare a SEMP that covers all systems engineering areas, or have separate plans or manuals, including, but not limited to, the following:</p> <ul style="list-style-type: none"> • requirements management plan or procedure or guide or manual • technical system interface management plan or procedure or guide or manual • systems architecture management plan or procedure or guide or manual • systems assurance management plan or procedure or guide or manual • HF integration plan • RAM management plan or procedure or guide or manual • verification and validation management plan or procedure or guide or manual • testing and commissioning management plan or procedure or guide or manual • EMC management plan or procedure or guide or manual • maintenance management plan or procedure or guide or manual. <p>The relevant organisational procedures or project plans should meet the following:</p> <ul style="list-style-type: none"> • reflect all the requirements for the discipline or capability • be documented as suitable (standalone document or part of another document, hardcopy or softcopy organisational procedure or project plan) • define the process (activities, applicable standards and rules) • provide evidence of its review. <p>These demonstrated artefacts may be part of the organisation's integrated management system or similar, and should be aligned with the AS/NZS ISO 9001 or AS ISO 55000 requirements as suitable.</p> <p>Depending on the scope and complexity of engineering services, a TAO may incorporate some or all sub-plans within a single engineering management plan. For example, a specialist technical supplier of geotechnical or potholing services will have a relatively simple engineering (or technical services) management plan compared to a technical supplier of multi-discipline, multi-phase services covering systems integration.</p> <p>Possible evidence for various engineering disciplines and life cycle services or activities may include the following:</p> <ul style="list-style-type: none"> • integrated management system (IMS) or similar business management systems home page • design management plan, procedure, guide or manual

Mandatory, as applicable or guidance	Requirement, elaboration, evidence or documents
	<ul style="list-style-type: none"> • procurement management plan (including assurance of procured commercial off-the-shelf (COTS) products from original equipment manufacturers (OEMs)) • fabrication or manufacturing management plan, procedure, guide or manual • construction or installation management plan, procedure, guide or manual • sustainability management plan • climate change risk assessment • whole-of-life costing • inspection, testing and commissioning management plan, procedure, guide or manual • maintenance management plan, procedure, guide or manual • plan, procedure, guide or manual associated with any other specialist services that are not specific to an asset life cycle phase (design, manufacture, install, test and maintain, BIM management). <p>Evidence of documentation and deployment shall be relevant and cover the proposed scope of authorisation. Evidence should be provided as follows:</p> <ul style="list-style-type: none"> • Design consultants should document how they manage designs from start to finish, including design assurance (see Section 6.4) and design support of post approved for construction (AFC) life cycle phases. This may include multi-criteria options analysis associated with early concept designs and feasibility studies to select the preferred design option. • Manufacturers of products and systems should document how they manage, deliver and assure the manufacturing process and products. This includes mass public transport asset manufacturers. • Constructors, often principal contractors, should document how they plan, execute, coordinate and assure (see Section 6.4) construction phase activities, including management of design sub-consultants, material suppliers, other construction sub-contractors and testers. • Testing and commissioning organisations, often the constructor TAO on large public transport programs, but sometimes a test specialist service provider, should document how they plan, coordinate and assure all inspection, testing and commissioning activities. • Maintenance organisations should document how they plan, execute, coordinate and assure all asset maintenance activities. <p>The evidence in the preceding bullet list should be directly relevant to the asset group (or multiple asset groups) for which the TAO is applying for. TAOs applying for non-asset specific services, who provide specialist service directly to TfNSW or in relation to other service providers in the interest of and/or on behalf of TfNSW, should also document how they plan, execute and assure those services.</p>

Mandatory, as applicable or guidance	Requirement, elaboration, evidence or documents
	<p>Documents (optional references)</p> <p>TS 10504 TS 01471 TS 01462 TS 01467</p>
Mandatory, as applicable or guidance	Requirement, elaboration, evidence or documents
As applicable	<p>Requirement – ENM2</p> <p>Design TAOs shall have capability to provide design support during procurement, manufacturing, construction, integration, test and commissioning stages.</p>
	<p>Elaboration</p> <p>This requirement is limited to design TAOs, who are expected to demonstrate that they have capability to provide post-AFC design support and advice. The capability includes:</p> <ul style="list-style-type: none"> • responding to and clarifying RFI raised by the constructor • reviewing and approving ECRs proposed by the constructor by assuring that the changes continue to meet the original design intent and comply with relevant system requirements and standards • inspecting the site • witnessing tests performed by others to ensure that the design intent is met. <p>The design TAO shall also assure and mark up all changes made during construction, integration and testing, and prepare final as-built designs for handover to the client.</p>
	<p>Evidence</p> <p>Evidence may include the following:</p> <ul style="list-style-type: none"> • design management procedure • design management plan and supporting project schedule

Mandatory, as applicable or guidance	Requirement, elaboration, evidence or documents
	<ul style="list-style-type: none"> • design reports produced at key project milestones and assurance gates • RFI responses (during construction) • ECRs or notes (during construction, integration or testing) • engineers' advice notes (during construction) • site inspection records (during construction and integration) • witness records for factory or site testing (during fabrication, construction, inspection and testing) • construction drawing mark-ups (at the end of construction) • sustainability management plan • climate change risk assessment • whole-of-life costing.
	<p>Documents (optional references)</p> <p>ISO/IEC/IEEE 15288 TS 10504 TS 01467 TS 01462 TS 01471</p>

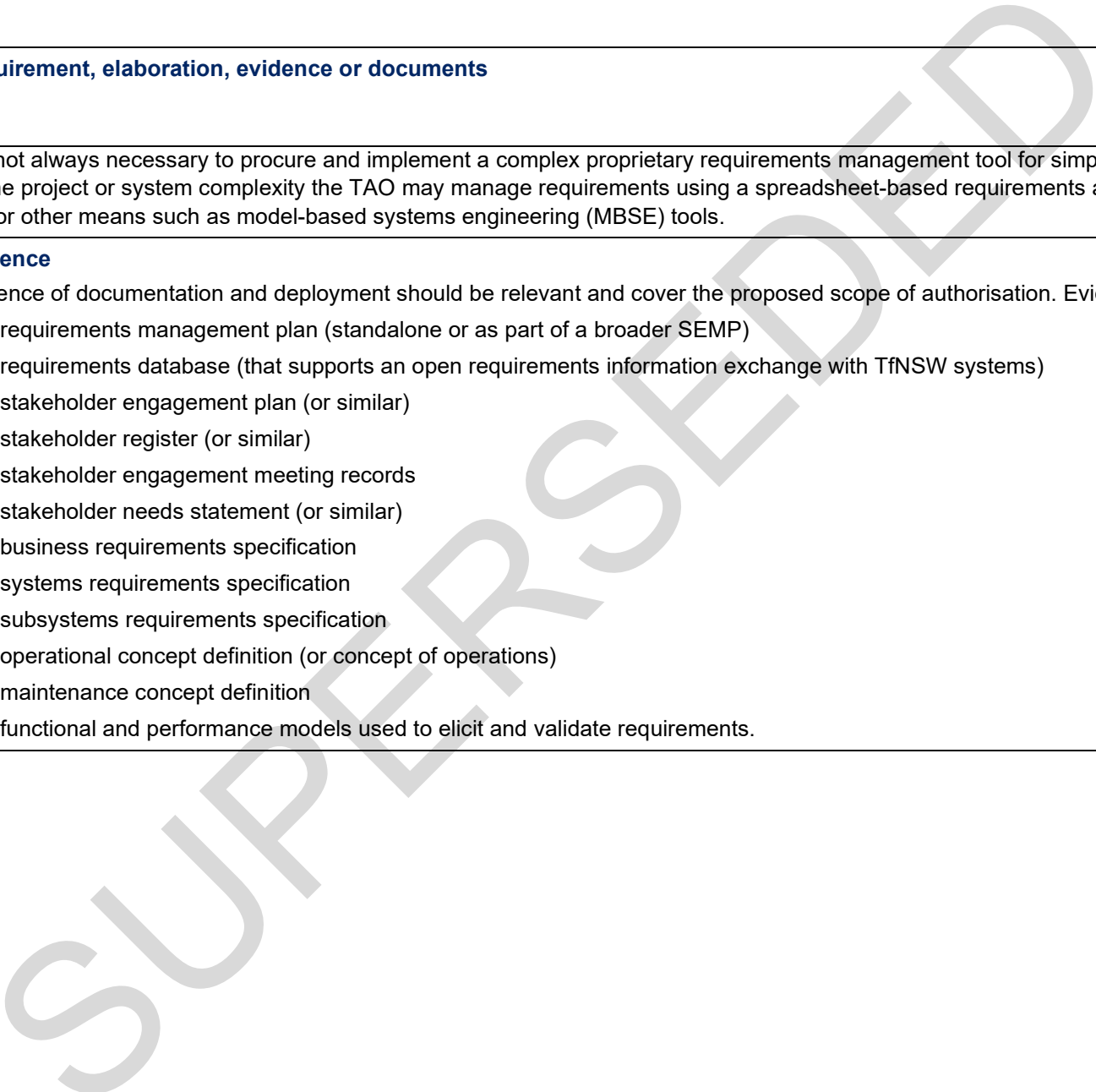


6.2 Requirements management – EMCA2

This requirement demonstrates engineering management activities and arrangements for systematic eliciting, defining, analysing and allocating service or solution requirements as well as managing traceability and fulfilment of those requirements through the service delivery cycle.

Mandatory, as applicable or guidance	Requirement, elaboration, evidence or documents
Mandatory	<p>Requirement – ENM3</p> <p>A TAO shall have requirements management arrangements in place that set out appropriate process, responsibilities, structure, tools and deliverables for identification, analysis and management of stakeholder requirements, applicable to the scope of engineering or technical services provided across the system life cycle.</p>
	<p>Elaboration</p> <p>A TAO should ensure that the technical process or tool for service requirements management is covered in its documentation (as appropriate), including:</p> <ul style="list-style-type: none"> • identification • categorisation • allocation • analysis • traceability • prioritisation • agreement • documentation • change management • communication • compliance demonstration. <p>The requirements management process or tool should enable requirements information exchange in an open format. This may be addressed by using some common agreed requirements interchange formats in accordance with relevant industry best practices.</p>

Mandatory, as applicable or guidance	Requirement, elaboration, evidence or documents
	<p>It is not always necessary to procure and implement a complex proprietary requirements management tool for simple services or projects. Depending on the project or system complexity the TAO may manage requirements using a spreadsheet-based requirements allocation and traceability (RATM) tool or other means such as model-based systems engineering (MBSE) tools.</p>
	<p>Evidence</p> <p>Evidence of documentation and deployment should be relevant and cover the proposed scope of authorisation. Evidence may include the following:</p> <ul style="list-style-type: none"> • requirements management plan (standalone or as part of a broader SEMP) • requirements database (that supports an open requirements information exchange with TfNSW systems) • stakeholder engagement plan (or similar) • stakeholder register (or similar) • stakeholder engagement meeting records • stakeholder needs statement (or similar) • business requirements specification • systems requirements specification • subsystems requirements specification • operational concept definition (or concept of operations) • maintenance concept definition • functional and performance models used to elicit and validate requirements.



Mandatory, as applicable or guidance	Requirement, elaboration, evidence or documents
Guidance	Documents (optional references) ISO/IEC/IEEE 15288 ISO/IEC/IEEE 29148 TS 01498 TS 01470 TS 01462 TS 01471 TS 01464 TS 10504

SUPERSEDED

6.3 Service or solution engineering – EMCA3

These requirements demonstrate engineering management activities and arrangements that support application of the relevant engineering principles and practices in developing engineering products, services or solutions as appropriate to the scope of authorisation.

6.3.1 Technical system interface management

The objective of technical system interface management requirement is to ensure that an organisation has a systematic process for:

- identifying all technical system interfaces
- defining and analysing safety, functional and performance requirements of relevant products or service interfaces within the scope of authorisation
- agreeing on primary and secondary owners of such technical system interfaces
- managing those interfaces over the full system life cycle.

Mandatory, as applicable or guidance	Requirement, elaboration, evidence or documents
Mandatory	<p>Requirement – ENM4</p> <p>A TAO shall have technical system interface management arrangements that set out the processes, responsibilities, structures, tools and deliverables for the identification, definition, design, analysis and development coordination of technical system interfaces, relevant to the engineering services, systems or products offered.</p>
	<p>Elaboration</p> <p>A TAO shall ensure that all technical system interface requirements under the control of its engineering services are identified, captured and managed.</p> <p>A TAO shall ensure that technical system interface design reviews and checks are conducted at appropriate stages of the engineering design process by competent SMEs.</p> <p>A TAO shall identify and manage technical system interface risks and outcomes that may have a safety or other undesired impact.</p> <p>The technical systems interface management applies to system solution. The project, commercial, contract, or organisational interface management that deals with communications and contractual interactions between parties is separate to the system solution.</p>

Mandatory, as applicable or guidance	Requirement, elaboration, evidence or documents
	<p>Evidence</p> <p>A TAO should ensure that the technical system interface management processes covered in its documentation include the following for internal and external technical system interfaces:</p> <ul style="list-style-type: none"> • identifying technical interfaces (functional, logical or physical) • recording technical interfaces (for example in a technical interface register) • tracking specification, design, and implementation of technical interfaces • interface requirement specifications (IRS) • interface control documents (ICD) • inter-disciplinary checks (IDC) if applicable (for designers) • identification, analysis and control of interface risks and outcomes that may have a safety, security or other undesired impact • arrangements to plan and carry out the integration of these technical interfaces if systems integration capability is offered. <p>Evidence for various engineering disciplines and life cycle services or activities may include the following:</p> <ul style="list-style-type: none"> • technical system interface management plan or process (system) or section in an overall SEMP or engineering management plan • technical interface stakeholder meetings, interface design reviews and check records • technical interface matrix (system) • technical interface control documents (system) • interface requirement specifications • interface requirements included with system functional and performance requirements in a requirements database • managing safety hazards and risks at technical interfaces. <p>Evidence of documentation and deployment shall be relevant and cover the proposed scope of authorisation.</p>

Mandatory, as applicable or guidance	Requirement, elaboration, evidence or documents
	<p>Documents (optional references)</p> <p>ISO/IEC/IEEE 15288 ISO/IEC/IEEE 29148 TS 01462 TS 01471 TS 10504 TS 01465</p>

6.3.2 Technical systems integration management

The objective of technical systems integration management requirement is to demonstrate the process that ensures implemented sub-system elements are integrated into the final system in a controlled manner that is consistent with the system architectural design and function as a coherent system.

Mandatory, as applicable or guidance	Requirement, elaboration, evidence or documents
As applicable	<p>Requirement – ENM5</p> <p>A TAO shall demonstrate that it has suitable management arrangements in place, relevant to the scope of services offered, to plan and carry out the integration of all the declared products or systems as appropriate to the scope of authorisation.</p>
	<p>Elaboration</p> <p>Systems integration is bringing together component elements of the product or service into one integrated system, ensuring that elements function together as a complete system, and the resultant system integrates within the existing broader transport system or systems.</p>
	<p>Evidence</p> <p>Evidence of documentation and deployment shall be relevant and cover the proposed scope of authorisation.</p> <p>A TAO should ensure that the systems integration processes covered in its documentation include the following activities:</p> <ul style="list-style-type: none"> • planning

Mandatory, as applicable or guidance	Requirement, elaboration, evidence or documents
	<ul style="list-style-type: none"> • assembly (which includes both hardware and software) • verification and validation • documenting • analysing results. <p>Evidence may include the following:</p> <ul style="list-style-type: none"> • systems integration plan (standalone or as part of a broader SEMP) • systems integration requirements • interface control documents • inter-disciplinary design review records • systems integration (including software integration) test records • systems integration report.
	<p>Documents (optional references)</p> <p>ISO/IEC/IEEE 15288 ISO/IEC/IEEE 29148 TS 01471 TS 10504 TS 01465</p>

6.3.3 System architecture management

The objective of system architecture management requirement is to demonstrate the capability to synthesise or translate system level functional and performance requirements into a framework architecture that provides a range of perspectives, which are then used for design decision making and detailed system design development.

<p>Mandatory, as applicable or guidance</p>	<p>Requirement, elaboration, evidence or documents</p>
<p>As applicable</p>	<p>Requirement – ENM6 A design TAO shall demonstrate that it has arrangements to manage the synthesis and development of system level requirements into a credible system architecture design.</p>
	<p>Elaboration System architecture development and management is typically done by TAOs during the concept and development stages of the system or asset life cycle in conjunction with system modelling and analysis. For complex software programmable communications and control systems, evolving best practice is to use industry-standard modelling languages and architecture frameworks and conventions to define the functionality and behaviour of these systems, using a range of standard architectural viewpoints and models. This requirement applies equally to traditional building architecture design companies that produce the initial design models and frameworks for buildings and precincts that form the basis for detailed design by asset-specific disciplines including civil, structural, electrical, mechanical, communication and control systems. A TAO may choose to procure established, validated, commercial system architecture development and modelling tools to support its service. Generally, this approach is used for modelling complex digital software-defined systems. It is expected that the TAO's processes would have triggers for this approach to occur and have suitable mechanism in place to ensure procurement.</p>
	<p>Evidence System architecture management arrangements are typically documented in a system architecture management plan but may be included as a section within an overall SEMP or engineering management plan depending on the scope and complexity of engineering services provided. Depending on the nature of the systems, the asset types involved and the level of detail abstraction system architecture may be defined in standards and general arrangement drawings. Depending on the scope and nature of systems and elements involved, typical architectural viewpoints may include the following:</p> <ul style="list-style-type: none"> • functional architecture, a representation of each function and its embedding or relationship to other functions within and outside the system • logical architecture, representing logical relationships between functional elements of the system • physical architecture, representing the physical hardware that actually contains the functions defined in the functional architecture • geographic architecture, representing the allocation of physical hardware assets to geographic locations • operational architecture, operational processes and interactions with internal and external users.

Mandatory, as applicable or guidance	Requirement, elaboration, evidence or documents
	<p>A TAO should ensure that the systems architecture processes covered in its documentation include some or all of the following:</p> <ul style="list-style-type: none"> • defining the system architecture • defining different architectural viewpoints • analysing the architecture • evaluating system design options based on architectural models and viewpoints • documenting the architecture and decisions (documentation may be recorded in a model-based engineering tool) • maintaining the architecture through design, procurement, manufacture/fabrication, construction/installation, integration and testing. <p>Evidence may include the following:</p> <ul style="list-style-type: none"> • system architecture management plan • architectural framework • constructor viewpoint (for example, constructability, site access, site logistics issues with the proposed physical and geographic architecture) • operator viewpoint • maintainer viewpoint • external stakeholder viewpoint (for example, emergency services, external service providers) • logical or functional architecture (including software and data architecture for software-defined operational systems) • physical architecture (including equipment layouts) • geographical architecture.
	<p>Documents (optional references)</p> <p>ISO/IEC/IEEE 15288 TS 00161 TS 01460 TS 01462 TS 01471 TS 10504</p>

6.3.4 Environment and sustainability

The objective of the environment and sustainability criteria is to demonstrate organisational capability to ensure that all relevant aspects of environmental management and sustainability are considered in the engineering activities applied across the full asset life cycle as relevant. Appropriate and timely consideration of environmental and sustainability risk and opportunities should aim to optimise the environmental, social and economic sustainability of the asset.

Mandatory, as applicable or guidance	Requirement, elaboration, evidence or documents
As applicable	Requirement – ENM7 A TAO shall provide effective environmental management and incorporate sustainability principles to the scope of the authorised engineering services.



Mandatory, as applicable or guidance	Requirement, elaboration, evidence or documents
	<p>Elaboration</p> <p>For specific projects or issues, a TAO will often require specialist environment and sustainability advice. This expertise may be in-house or contracted. Environmental management should be planned and implemented to effectively manage environmental risks during relevant stages of the asset life cycle.</p> <p>Key considerations for environmental management are as follows:</p> <ul style="list-style-type: none"> • processes are in place to identify environmental risks and appropriate control measures across the asset life cycle • activities are planned with effective environmental protection measures to minimise environmental risks and to comply with environmental protection requirements (for example, regulatory or contractual requirements) • assurance processes are in place for monitoring, review and continuous improvement of environmental management • a positive reporting culture is practised for identified environmental incidents and noncompliances, and appropriate corrective actions are identified and implemented • leaders model best-practice environmental management and all workers take responsibility for environmental management. <p>Sustainability in design considerations should aim to provide the optimal design solution for the whole-of-life of the asset, by improving environmental, social and economic sustainability.</p> <p>Key considerations for sustainability are as follows:</p> <ul style="list-style-type: none"> • inclusion of sustainability early in the planning and design process • inclusion of sustainability in engineering analyses. For example, in requirements definition, life cycle analysis, operational concepts or risk assessment, multi criteria analysis • identification and documentation of sustainability outcomes • analysis, management and control of sustainability risks and opportunities across the asset life cycle • identification and assessment of sustainable innovation and initiatives • provision of a mechanism for transferring sustainability requirements to subsequent life cycle stages, closing out issues, and capture and recording of lessons learnt at the conclusion of projects • consideration of key sustainability areas outlined in the documents, including but not limited to climate change mitigation, risk assessment and adaptation, resource efficiency – water, energy and waste, sustainable procurement and social sustainability.

Mandatory, as applicable or guidance	Requirement, elaboration, evidence or documents
	<p>Evidence</p> <p>TAOs should demonstrate company commitment to environment, sustainability, or both. Evidence may include the following:</p> <ul style="list-style-type: none"> • company environment or sustainability policies • environmental or sustainability management systems, plans or both • organisational structure showing environment, sustainability leadership and resources, or both • evidence based environment, sustainability targets or both • procedures for environmental incident reporting, investigations and corrective actions • evidence of environmental assurance activities, such as environmental inspections, audits or both • environment, sustainability performance reporting, or both • where regulatory action has been received from an environmental regulator, corrective actions have been identified and implemented to prevent a recurrence • processes to integrate sustainability into designs of the project, such as in a design management plan including reference to relevant TfNSW standards • evidence of deployment such as sustainability integration plans, sustainability workshops • evidence of completion of sustainability tools including <i>Sustainable Design Guidelines</i>, the Infrastructure Sustainability Council Infrastructure Sustainability rating or Green Building Council of Australia Green Star rating. <p>The application of environmental management should typically be described in an environmental management plan and/or environmental work method statement, which may include sub-plans such as erosion and sediment control plans.</p> <p>The application of sustainability consideration should typically be described in a sustainability management plan (SMP) or relevant sections of the other planning documents, for example within the design management plan and design reports.</p>
	<p>Documents (optional references)</p> <p><i>Transport Environment and Sustainability Policy</i> <i>CP20009</i> <i>Future Transport Strategy 2056</i> <i>Future Energy Strategy</i> <i>Transport Sustainability Plan</i></p>

Mandatory, as applicable or guidance	Requirement, elaboration, evidence or documents
	<i>Sustainable Design Guidelines</i> TS 00038 TS 00041.1 DMS-SD-081/4.1 ISO 14090 AS ISO 20400

SUPERSEDED

6.3.5 RAM management

The objective of this requirement is to demonstrate organisational capability to ensure that RAM properties of the impacted target system or asset can be achieved by the evolving system architecture and design.

Mandatory, as applicable or guidance	Requirement, elaboration, evidence or documents
As applicable	<p>Requirement – ENM8</p> <p>A TAO shall demonstrate that it has management arrangements in place, relevant to the engineering services or products provided, to assure the delivery of assets and systems that are durable, reliable, available and maintainable to support relevant transport outcomes.</p>
	<p>Elaboration</p> <p>A TAO providing fabrication, construction or installation and system integration services may need to demonstrate RAM management, particularly in terms of inspection and testing. A TAO offering system design services should have RAM management arrangements in terms of modelling and analysis. Maintenance TAOs may need to ensure that the delivered asset or system continues to meet its original designed RAM targets over its operational lifetime by means of regular inspections and testing.</p> <p>If a TAO intends to engage in design or systems integration services involving specification, development and delivery of novel systems in configurations that are not covered by existing TfNSW standard configuration drawings, then the TAO will be expected to demonstrate that it has sufficient and appropriate RAM management arrangements relevant to the engineering services, asset types or products offered, including modelling, calculation and analysis.</p> <p>Validating RAM models may be done by the TAO, and also by the TfNSW accepting organisation during system acceptance and handback.</p> <p>A TAO may choose to develop in-house RAM assurance tools, but their outputs shall be demonstrated to have been validated against recognised established benchmarks.</p> <p>A TAO may choose to procure established and validated commercial RAM modelling tools to support this service.</p>

Mandatory, as applicable or guidance	Requirement, elaboration, evidence or documents
	<p>Evidence</p> <p>RAM management arrangements should be documented in a RAM plan or manual, however they may be included as a section within an overall SEMP or engineering management plan, depending on the scope and complexity of engineering services provided.</p> <p>A TAO should cover the following RAM management processes in its documentation:</p> <ul style="list-style-type: none"> • RAM activity planning • capturing and analysing RAM requirements • RAM modelling and analysis • documenting RAM modelling, analysis, testing and demonstration • system or asset defects and failure recording. <p>Evidence may include the following:</p> <ul style="list-style-type: none"> • RAM management plan • RAM requirements (including service availability, which may be a sub-set of wider system requirements) • RAM models • RAM reports • redundancy strategies.
	<p>Documents (optional references)</p> <p>ISO/IEC/IEEE 15288 TS 01461 TS 01462 TS 01471 TS 10504</p>

6.3.6 Human factors integration

The objective of this requirement is to demonstrate organisational capability to ensure that all relevant aspects of the human interaction within the system are considered in the engineering activities applied across the full asset life cycle as relevant or impacted by the services within the scope of authorisation. The practical application of HF knowledge contributes to enhanced design solutions and improved operational and safety performance. This requirement is only applicable to TAOs that perform feasibility, concept, reference design, detailed design, design management or design assurance activities.

Mandatory, as applicable or guidance	Requirement, elaboration, evidence or documents
As applicable	<p>Requirement – ENM9 A TAO shall manage all HF relevant to the scope of the authorised engineering services.</p>
	<p>Elaboration HF considerations form an integral part of the specification, design and development process ensuring that an asset is designed and delivered such that it can be operated and maintained safely and efficiently.</p> <p>A TAO should ensure that engineering design decisions are properly informed by adequate information about human related issues and that decisions relating to design alternatives or assessments consider HF data, to provide the optimal design solution for the whole asset life cycle.</p> <p>Application of the HF integration processes should identify HF issues such as physical, cognitive and organisational including the opportunities for human error and their consequences, as well as ways of improving the efficiency and effectiveness of the use of the asset.</p> <p>HF integration is the process by which the application of HF is managed. A TAO is expected to have such a process, either standalone or integrated into the other product or service delivery processes. A TAO that delivers assets that require simple human interactions for operations and maintenance (for example, railway structures, buildings and so on) is able to satisfy this requirement through the incorporation of appropriate HF considerations within its safety in design process. Information on incorporating HF into safety in design processes is provided in Appendix F of <i>Guideline – Integration of Human Factors in engineering design</i>. For TAOs that are not members of RISSB, guidance or assistance on this may be provided upon request.</p> <p>A TAO that delivers assets with complex human interactions such as rolling stock or control systems interfaces shall have a standalone process that meets the requirements of AS/RISSB 7470.</p> <p>Although not a requirement, there are benefits that an organisation can gain through the application of HF principles when conducting post-design asset life cycle activities from manufacturing and installation through to decommissioning and disposal.</p>

Mandatory, as applicable or guidance	Requirement, elaboration, evidence or documents
	<p>Evidence</p> <p>The application of the HF integration process for a project involving numerous and complex human interactions would typically be described in a standalone HF integration plan (HFIP), although for some projects it may be sufficient to include the relevant details within the engineering management plan.</p> <p>The scale of the HF input required will vary from project to project. A TAO should identify an appropriate scale of HF relevant to the project or the services they are providing. This would typically range from significant for novel and complex projects to minimal for 'like for like' substitution of a piece of equipment.</p> <p>For specific projects or issues a TAO often requires specialist HF services. This expertise may be in-house or contracted. The TAO shall have a process in place that would identify the need for specialist services on a project. The TAO shall also have a process in place to ensure the use of competent resources, in line with its procurement or competency management system.</p> <p>TAOs shall demonstrate that their HF integration practice contains the following as a minimum:</p> <ul style="list-style-type: none"> • identifies the various user groups, their attributes and requirements • identifies and records HF issues relevant to specific projects • determines and justifies the level of HF work in line with the risk and complexity of specific projects • analyses, manages and controls identified issues • includes HF consideration in engineering analyses (for example in requirements definition, operational concepts, hazard identification, risk assessment, failure mode, effects, and criticality analysis (FMECA), fault tree analysis (FTA) and so forth) • provides a mechanism for closing out issues (such as within multi-disciplinary design reviews) • captures and records lessons learnt at the conclusion of projects.
	<p>Documents (optional references)</p> <p>TS 04976 TS 04978 TS 04981 AS/RISSB 7470 <i>Guideline – Integration of Human Factors in engineering design</i></p>

6.3.7 Electromagnetic compatibility

The TfNSW operational transport environment consists of a large number of critical, electromagnetically emissive and sensitive systems co-located in close proximity, which include systems used by other transport operators and external organisations.

Any electrical or electronic systems that are not correctly designed, manufactured or installed can cause EMI to other equipment or services susceptible to EMI from a range of sources in the operational environment.

It is essential to manage EMC throughout the system life cycle, from concept to commissioning and ongoing maintenance, to achieve and maintain total system functionality, performance and safety.

Mandatory, as applicable or guidance	Requirement, elaboration, evidence or documents
As applicable	<p>Requirement – ENM10</p> <p>A TAO engaged by TfNSW to undertake engineering activities involving the specification, design, integration, testing and maintenance of electrical or electronic systems or products involving EMI emitters (threats) or receivers (victims) shall have arrangements for managing EMC.</p> <p>A TAO engaged by TfNSW to undertake engineering activities involving the specification, design, build, integration or modification of electrically conductive or magnetically permeative structures shall ensure that arrangements are in place for managing EMI and EMC.</p>
	<p>Elaboration</p> <p>EMI can typically occur via four coupling mechanisms:</p> <ul style="list-style-type: none"> • conductive interference, for example, stray earth currents from the traction earth return circuit • inductive, for example, currents induced by near-field alternating current power circuits in proximity to sensitive electronic circuits • capacitive, for example, static discharge from HV circuits and coupling to lineside fences and electronic systems • radiative, for example, radiated electromagnetic waves (typically wireless transmitters). <p>Any electrically conductive or magnetically permeative structure near electrical or electronic equipment can excessively couple (transfer) EMI if it is not correctly designed, manufactured, modified, configured or installed. These structures typically include buried metal pipes, fences, towers and steel reinforced concrete structures of appreciable length such as viaducts, bridges, tunnels, platforms and concourses.</p> <p>A TAO responsible for design and construction of these electrically conductive or magnetically permeative structures, usually civil engineers, should consult with the designers and installers of the electrical or electronic systems that may transfer EMI via these structures.</p>

EMC is typically achieved on most TfNSW transport projects through the following:

- compliance to established standards and standard drawings for the configuration and relative positioning of electrical HV power feeders, overhead wiring (OHW) systems, low voltage (LV) power circuits and various signalling, telecommunication and control systems
- use of type-approved electrical and electronic systems and products such as radar, navigation, global positioning and radio communications systems
- compliance with established earthing, bonding, screening, segregation, immunisation and electrolysis standards and codes of practice.

Engineering design and specification activities associated with EMC on TfNSW transport assets include the following:

- earthing and bonding design for protection of both equipment and people
- electromagnetic radiation analysis and design
- electrolysis effects and their mitigation
- lightning and other surge protection.

A TAO engaged by TfNSW to undertake engineering activities involving the specification, design, integration or testing of electrical or electronic systems involving EMI emitters (threats) or receivers (victims) shall have arrangements for managing EMC.

A TAO engaged by TfNSW to undertake engineering activities involving the specification, design, build, integration or modification of electrically conductive or magnetically permeative structures shall ensure that arrangements are in place for managing EMI and EMC.

A TAO offering system design or systems integration services, either as a technical advisor during the development of reference designs or as part of a design and construct contract during project implementation, should have EMC management arrangements.

A TAO that intends to engage in design or systems integration services on projects involving development and delivery of novel electrical and electronic systems in novel configurations that are not covered by existing standards, should demonstrate EMC management including systematic analyses of the electromagnetic impact of any deviation from standard practice.

These arrangements should enable the planning, analysis, execution, assurance and reporting of all EMC-related activities on a project or system. They should be documented in an EMC management plan.

The level of EMC management is expected to be negligible where it can be demonstrated that a new system will be designed and implemented using type-approved products in standard configurations.

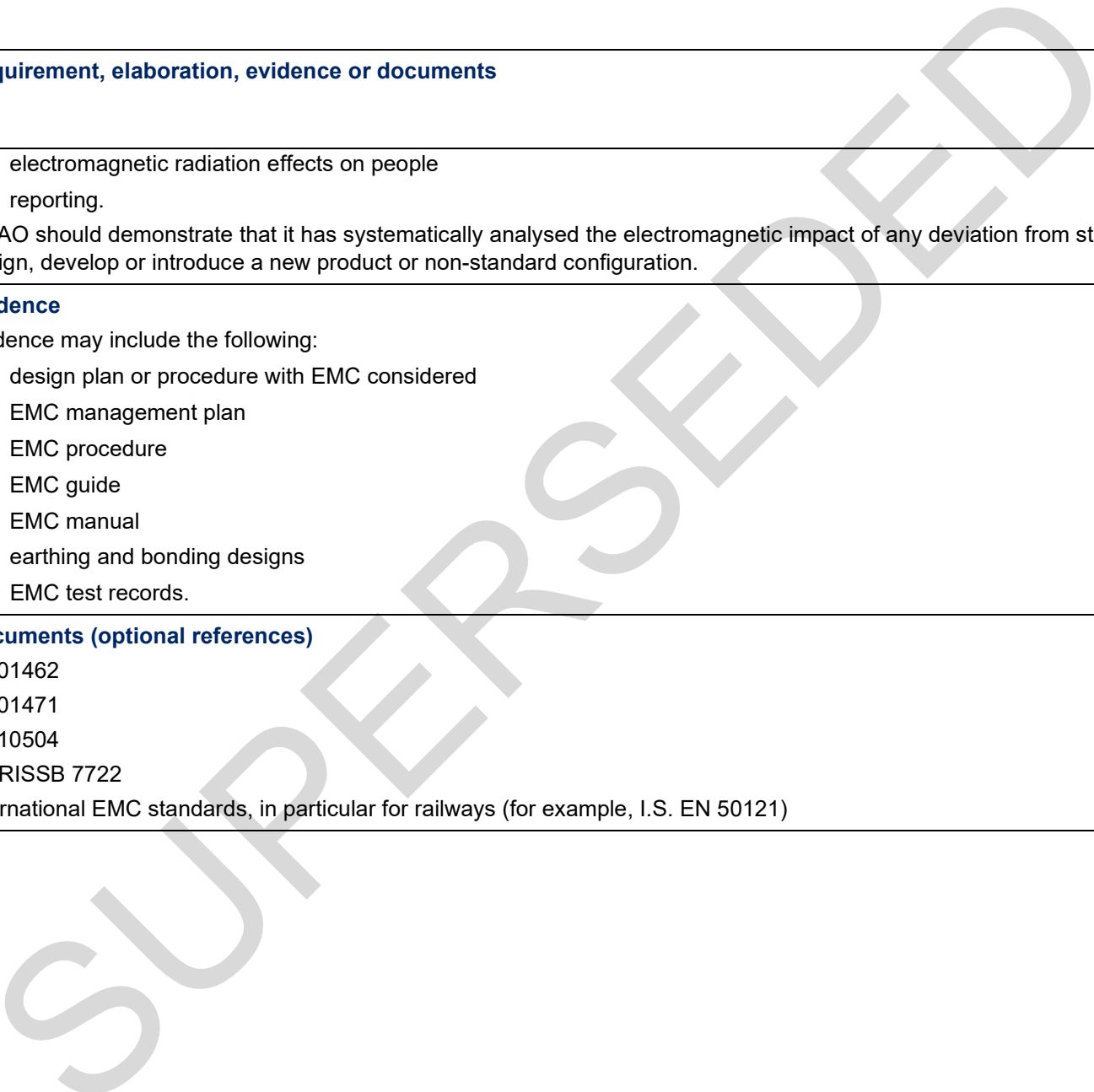
A TAO providing fabrication, construction or installation services for non-electrical or electronic systems will not need to demonstrate full EMC management arrangements.

The system design or systems integrator TAO may choose to sub-contract a specialist EMC consultant to support its EMC management arrangements. A TAO's process should have required triggers for this to occur and suitable process in place to ensure procurement.

A TAO should ensure, if applicable to its services, that the EMC management processes covered in its documentation includes the following:

- planning of EMC or related electrical immunisation activities
- EMC hazard identification

<p>Mandatory, as applicable or guidance</p>	<p>Requirement, elaboration, evidence or documents</p>
	<ul style="list-style-type: none"> • electromagnetic radiation effects on people • reporting. <p>A TAO should demonstrate that it has systematically analysed the electromagnetic impact of any deviation from standard practice if it is engaged to design, develop or introduce a new product or non-standard configuration.</p>
	<p>Evidence</p> <p>Evidence may include the following:</p> <ul style="list-style-type: none"> • design plan or procedure with EMC considered • EMC management plan • EMC procedure • EMC guide • EMC manual • earthing and bonding designs • EMC test records.
	<p>Documents (optional references)</p> <p>TS 01462 TS 01471 TS 10504 AS/RISSB 7722 International EMC standards, in particular for railways (for example, I.S. EN 50121)</p>



6.4 Assurance, verification and validation – EMCA4

These requirements demonstrate engineering management activities and arrangements that support the delivery of a quality engineering product, system or service by providing confidence that relevant processes are followed, requirements are met and the final product or service meets its intended purpose.

Mandatory, as applicable or guidance	Requirement, elaboration, evidence or documents
Mandatory	Requirement – ENM11 A TAO shall have arrangements for verification and validation management relevant to the engineering services or products provided.

SUPERSEDED

<p>Mandatory, as applicable or guidance</p>	<p>Requirement, elaboration, evidence or documents</p>
	<p>Elaboration</p> <p>Verification and validation are processes that are often used together for assuring that a product, service or system fulfils its intended purpose. The two processes are seen as essential and complementary in the life cycle of any complex system. The development of any system is not complete without ensuring that the implementation is consistent with the specifications. Implementing verification and validation provides assurance that a product, service or system meets its required specifications, including any safety requirements.</p>
	<p>Evidence</p> <p>Verification and validation management arrangements should typically be supported by the following evidence artefacts:</p> <ul style="list-style-type: none"> • organisation level verification and validation arrangements • project level verification and validation arrangements • verification and validation plans • verification and validation processes and procedures • verification and validation guides • verification and validation checklists or tools • verification and validation reports • other artefacts documenting or demonstrating how the organisation will carry out verification and validation of systems on a repeatable basis. <p>These artefacts should form part of an integrated management system or similar system at an organisational or project level that is compliant with AS/NZS ISO 9001 or AS ISO 55000 as appropriate.</p> <p>Verification and validation management arrangements are typically documented in a verification and validation plan. However, they may form a section of a SEMP or overall engineering management plan, depending on the scope and complexity of engineering services provided.</p> <p>A TAO may choose to develop in-house systems verification and validation tools.</p> <p>A TAO may choose to procure established and validated commercial verification and validation management tools to support this service.</p> <p>A TAO's processes should have the required triggers for this to occur and also suitable processes in place to ensure procurement.</p> <p>A TAO should ensure that the verification and validation management processes covered in its documentation includes the following:</p> <ul style="list-style-type: none"> • design reviews • design or systems analysis

Mandatory, as applicable or guidance	Requirement, elaboration, evidence or documents
	<ul style="list-style-type: none"> • demonstration • certification • inspection and testing • commissioning • acceptance testing • maintenance. <p>Evidence may include the following:</p> <ul style="list-style-type: none"> • verification management plan, procedure, guide or manual • validation management plan, procedure, guide or manual • testing and commissioning management plan, procedure, guide or manual • maintenance management plan, procedure, guide or manual.

SUPERSEDED

<p>Mandatory, as applicable or guidance</p>	<p>Requirement, elaboration, evidence or documents</p>
	<p>Documents (optional references) ISO/IEC/IEEE 15288 TS 01454 TS 01462 TS 01471 TS 10504</p>
<p>Mandatory, as applicable or guidance</p>	<p>Requirement, elaboration, evidence or documents</p>
<p>Mandatory</p>	<p>Requirement – ENM12 A TAO shall demonstrate engineering assurance based on progressive stage gateway reviews.</p>
	<p>Elaboration This requirement is applicable to design, manufacturing, construction and testing, and maintenance TAOs and shall be fulfilled. The baseline stage gateways to apply will depend on the scope of engineering services offered over the asset life cycle by the TAO. The engineering methodologies and processes that a TAO applies will also depend on the scope of engineering services offered over the asset life cycle. Systems assurance brings together the elements of the following:</p> <ul style="list-style-type: none"> • quality assurance • verification and validation results • RAM assurance • system safety assurance (also see requirement ENM16) • compliance to procedures • compliance to standards • compliance to appropriate legislation.

Mandatory, as applicable or guidance	Requirement, elaboration, evidence or documents
	<p>Evidence</p> <p>For design consultants, the design assurance process should identify key stages where the design is reviewed prior to progressing to the next level of detail. This may take the form of 30%, 70% or 100% gates or system definition review (SDR), preliminary definition review (PDR) or critical design review (CDR) gates or something similar.</p> <p>For construction contractors, the use of witness and hold points represents application of stage gates in the progressive assurance of the built asset or system.</p> <p>Possible evidence includes the following:</p> <ul style="list-style-type: none"> • design management plan, procedure, guide or manual • fabrication or manufacturing management plan, procedure, guide or manual • construction or installation management plan, procedure, guide or manual • testing management plan, procedure, guide or manual.
	<p>Documents (optional references)</p> <p>TS 10504</p>

Mandatory, as applicable or guidance	Requirement, elaboration, evidence or documents
Mandatory	<p>Requirement – ENM13</p> <p>TAOs shall apply a risk-based approach to engineering assurance.</p>
	<p>Elaboration</p> <p>This requirement refers to assurance of all engineering-related risks and while they include safety risk, they are not limited to safety. Management of engineering risks across the Transport Network is a joint responsibility of all parties, including the TAO and TfNSW. The level of risk associated with an engineering activity is related to technology, novelty, system size and complexity, amount of stage work and quantity and type of system interfaces.</p>

Mandatory, as applicable or guidance	Requirement, elaboration, evidence or documents
	<p>Evidence</p> <p>Design consultants should demonstrate how they assure risks introduced by their designs.</p> <p>Constructors should demonstrate how they assure risks introduced by their construction methods, tools and equipment.</p> <p>Maintainers should demonstrate how they assure risks introduced by their maintenance actions, methods, tools and equipment.</p> <p>This requirement is applicable to all TAOs and shall include demonstrated arrangements for acceptance of risks transferred from preceding life cycle stages.</p> <p>Evidence may include the following:</p> <ul style="list-style-type: none"> • risk management plan, procedure, guide or manual • risk registers • risk matrix • risk assessment forms • risk workshops • risk reports • hazard logs.
	<p>Documents (optional references)</p> <p>TS 10504</p>

6.4.1 Judgement of significance

All designs shall be subject to a JOS. The JOS is an assessment of the technical risk introduced by the implementation of a design and shall consider both the probability and consequence of partial performance or design failure. Subsequent to a JOS, all designs shall be classed as either significant or non-significant. Designs judged as significant shall be subject to a more rigorous design review and approval process.

Mandatory, as applicable or guidance	Requirements
As applicable	<p>Requirement – ENM14</p> <p>A TAO shall establish arrangements for assessing the significance of proposed engineering changes arising from the delivery of its engineering services.</p>
	<p>Elaboration</p> <p>The JOS should assess complexity and effects, including safety risk, of the change.</p> <p>In the absence of hands-on JOS decision making by the client, a TAO shall demonstrate that it has a systematic and robust process for assessing the impact of engineering changes.</p> <p>These changes may arise during the design, procurement, fabrication or manufacturing, construction or installation, integration, testing and commissioning phases.</p> <p>The TAO responsible for assuring the engineering service in these phases shall demonstrate how it will assess an engineering change against a set of criteria, to assure that the change is safe, reliable, sustainable and value for money. Assessment of the change should be demonstrated on a risk basis.</p> <p>The attributes of a suitable JOS related to a proposed engineering change include the following:</p> <ul style="list-style-type: none"> • assessment of the need for the change • risk level including safety risk • RAM impacts • updates to the configuration and technical data.
	<p>Evidence</p> <p>Evidence may include the following:</p> <ul style="list-style-type: none"> • engineering change request or note • risk assessment evidence • configuration change note.

6.4.2 System safety assurance

The objective of these requirements is to demonstrate organisational capability to ensure that the operational safety risks associated with the impact of the TAO service system or asset are identified, managed and reduced SFAIRP in all engineering activities and disciplines over the full asset life cycle. Safety shall be integrated into the design of assets and demonstrated to be safe SFAIRP in accordance with TS 04981.

To support proportionate due diligence and exercise appropriate levels of oversight, the scale and applicability of the system safety assurance requirements are determined based on a TAO's scope of service and life cycle stages the services are delivered across.

Mandatory, as applicable or guidance	Requirement, elaboration, evidence or documents
Mandatory	<p>Requirement – ENM15</p> <p>The TAO shall have system safety assurance arrangements in place relevant to the engineering services or products provided. These arrangements shall include suitable planning activities and deliverables. They shall also demonstrate suitable and sufficient integration into the engineering services.</p>
	<p>Elaboration</p> <p>The key objective of system safety is to ensure the integration of safety in operation into the design, construction, implementation and commissioning of a change.</p> <p>System safety activities shall be planned so that they support the development of a suitably safe system and provide the assurance needed to demonstrate the safety of the system, asset, product or service.</p> <p>A TAO planning to undertake the leading role in integrating and delivering change (product or service) directly to or on behalf of TfNSW, including system safety integration, shall be capable of ensuring alignment of its own systems safety assurance and management systems with the TfNSW configuration management framework.</p> <p>The scope and depth of safety assurance arrangements should be scaled according to the range of engineering services being provided and the associated risk. For example, a large multi-disciplinary engineering organisation that performs significant safety critical functions or engages other TAOs to deliver services, including construction, testing and maintenance, affecting the Transport Network will require a more comprehensive set of system safety assurance arrangements than a small niche consultancy providing single-discipline design services.</p> <p>TfNSW undertakes an assessment of the safety significance of the change prior to awarding contracts and informs the TAO of the outcome.</p>

<p>Mandatory, as applicable or guidance</p>	<p>Requirement, elaboration, evidence or documents</p>
	<p>Evidence</p> <p>System safety assurance arrangements may be documented in a SMS. The scope and depth of a SMS will depend on the scope and depth of a TAO's engineering services. A small single-disciplinary consultancy may have a less complex SMS, whereas a large, multi-disciplinary engineering services or construction company shall demonstrate a robust, comprehensive organisational system.</p> <p>The TAO shall have a process to plan all safety assurance activities in an auditable manner.</p> <p>Where appropriate, the system safety activities should be aligned with the engineering life cycle.</p> <p>Typically, a plan is documented demonstrating how the TAO manages the safety risks associated with the changes that it introduces to the Transport Network. The plan should also demonstrate how the TAO integrates safety into the design of an asset to ensure it is safe SFAIRP to construct, operate, maintain and dispose of at the end of its life. This plan is referred to as a safety assurance plan, safety management plan or similar.</p> <p>Plans shall not be standalone documents; plans shall be documented and integrated as suitable to the organisations process. Engineering management and safety processes shall be cross referenced appropriately.</p> <p>Evidence includes, but not limited to, the following:</p> <ul style="list-style-type: none"> • safety assurance plan • design management plan • engineering management plan • project management plan.
<p>Mandatory, as applicable or guidance</p>	<p>Requirement, elaboration, evidence or documents</p>
<p>Mandatory</p>	<p>Requirement – ENM16</p> <p>The TAO's safety assurance arrangements shall provide progressive assurance through the project or system life cycle.</p>

<p>Mandatory, as applicable or guidance</p>	<p>Requirement, elaboration, evidence or documents</p>
	<p>Elaboration</p> <p>The planned safety assurance arrangements shall be progressive across the project life cycle stages. As safety assurance is integrated with engineering assurance, this requirement means that TAOs shall continually demonstrate safety assurance for each staged gateway review. The assurance level shall be in line with the level of details of the design.</p> <p>The approach to progressive safety assurance should be scaled to the scope and nature of services being provided and consider the overarching integral systems safety needs for the impacted TfNSW assets and services.</p> <p>At each gateway an agreement shall be reached with all stakeholders that at that point in the system development all reasonably practicable activities and actions have been conducted to ensure safety SFAIRP.</p>
	<p>Evidence</p> <p>The safety assurance arrangements include development or continual update of safety assurance documents at key project milestones including concept design, detailed design and testing. These interim assurance documents representing a progressive assurance approach help manage the risks associated with the asset and its delivery.</p> <p>Evidence includes, but not limited to, the following:</p> <ul style="list-style-type: none"> • A hazard identification process that identifies all reasonably foreseeable hazards throughout the project life cycle. • A hazard log used as the central repository for all identified hazards, which is updated and maintained throughout the asset life cycle. Hazard logs should cover the safety of assets through design and installation as well as operation and maintenance (not just work, health and safety and site hazards). • Stakeholder identification, engagement and management, including operators or maintainers, in hazard management activities. For example, hazard workshops where the end users i.e. operators, maintainers, were involved (evidenced by record of minutes and attendees). • Staged design reviews (for example, 30%, 60%, 90% reviews). • Design verification (including independent verification) and validation. • Safety representation in the design review process (check at each design review that the design ensures safety SFAIRP). • Scheduled gateway reviews in place aligned with TfNSW configuration management process. • Change control management process , including for changes after the design stage is completed; for example, recording or approving design changes; identifying change associated impact on safety in design and the design handover; and assessing and recording any introduced hazards in the hazards log.

<p>Mandatory, as applicable or guidance</p>	<p>Requirement, elaboration, evidence or documents</p>
<p>Mandatory</p>	<p>Requirement – ENM17 The TAO shall have arrangements for the identification and management of safety risks associated with the changes to be introduced. The process should follow a life cycle approach such that the granularity of risks and the level of analysis aligns with the progression through the engineering life cycle. It shall also support risk-based decision-making with records to show traceability of all decisions made.</p>
	<p>Elaboration TAOs shall implement a level of safety risk management appropriate to the risks associated with the change. The safety risk management process implemented by TAOs shall address the full intended operational life of the new or altered asset or system. It shall include an assessment of safety risk for each identified hazard against the appropriate risk criteria and provide a high degree of confidence that the risk has been reduced to tolerable and SFAIRP.</p>
	<p>Evidence TAOs shall deploy suitable and sufficient hazard identification, hazard analysis and hazard management techniques and demonstrate this in the safety argument, risk summary report or other safety assurance documentation. All analysis results shall be documented and referred to as deployed evidence. Hazard identification and analysis techniques may include hazard identification (HazID), hazard and operability studies (HazOp), preliminary hazard analysis (PHA), system hazard analysis (SHA), sub-system hazard analysis (SSHA) and operational support hazard analysis (OSHA). The hazard log is the primary artefact for providing traceability within the safety risk management process and assurance of the effective management of safety including demonstrating that the identified safety requirements have been incorporated into the system design. The hazard log at the system level may be managed by a system integrator entity, however, it is still the responsibility of all TAOs to identify and manage the hazards and risks for which they are responsible. Evidence includes, but not limited to, the following:</p> <ul style="list-style-type: none"> • organisational process of how and when hazards are identified and managed across the life cycle • scheduled workshops where operators, maintainers and end users were involved in risk management activities • evidence of hazard log that gets continually updated throughout the asset life cycle (superseded hazard logs to be sighted) • demonstration of traceability of identified risk controls becoming safety requirements that are incorporated into design.

Mandatory, as applicable or guidance	Requirement, elaboration, evidence or documents
Mandatory	<p>Requirement – ENM18</p> <p>The TAO shall have arrangements for delivering safety assurance arguments and supporting evidence (or input to such documentation) that describes how it ensures safety risks are managed SFAIRP. The content of such documents shall be aligned with the requirements of TS 04981.</p>
	<p>Elaboration</p> <p>As defined in TS 04981, a TAO shall demonstrate organisational process and capability to develop a safety argument, risk summary report or similar. The safety argument or risk summary report should effectively cover the following:</p> <ul style="list-style-type: none"> • a statement that all risks identified have been managed to a tolerable level and SFAIRP • justification demonstrating that all reasonably foreseeable safety risks in the operational environment have been identified and managed SFAIRP including evidence that the hierarchy of controls has been applied • explicit descriptions of all residual safety risks for operation and maintenance, identifying ownership of those residual risks • demonstration of sound safety management and quality management principles application throughout the design, development, implementation and commissioning of the new or altered assets.
	<p>Evidence</p> <p>The safety argument should be structured using goal structuring notation or a similar approach, and is documented in a safety assurance report, safety case or similar. An operational risk register shall be included in the safety argument to document risks that have been identified but not eliminated during the development and implementation phase and are thus carried over to the operate and maintain phase.</p> <p>The argument should be scaled to the level of risks and follow the expected industry practice.</p> <p>Evidence includes, but is not limited to, the following:</p> <ul style="list-style-type: none"> • operational safety argument • ISA (may be required by TfNSW) • final hazard logs that use SFAIRP justifications • progressive safety assurance report or risk summary report showing the transfer and acceptance of risk.
	<p>Documents (optional references)</p> <p>TS 04981</p>

Mandatory, as applicable or guidance	Requirement, elaboration, evidence or documents
As applicable	<p>Requirement – ENM19</p> <p>TAO safety engineering and assurance arrangements shall be subject to ISA, where it is responsible for the introduction of new or novel systems that affect the operational safety of the network or where the general scope and complexity of the project has been determined as safety significant change. Arrangements shall be in place to support the appointment of an ISA organisation and to engage with an ISA organisation at all stages of the engineering activities being undertaken when required and in accordance with the relevant standards and best practice for the scope of works.</p>
	<p>Elaboration</p> <p>For changes determined to be safety significant by TfNSW an authorised ISA organisation shall be appointed. The ISA organisation may be appointed by the TAO or by TfNSW.</p>
	<p>Evidence</p> <p>A TAO should have a process for the engagement of an independent safety assessor covering the following:</p> <ul style="list-style-type: none"> • scenario or circumstances when an ISA is to be conducted • function of an ISA • details and use of the expected outcome of the ISA • suitable process in place to ensure appropriate procurement • deployed evidence of an ISA engagement (if available). <p>For TAOs which may not be required to engage an independent safety assessor directly (for example, due to limited scope of services), the following shall be demonstrated:</p> <ul style="list-style-type: none"> • understanding of what an ISA's function is • what the TAO's involvement with an ISA would be • a trigger of the initiation of that engagement in their organisational document • what their responsibility is when required to provide input to an ISA conducted by a primary contractor.
	<p>Documents (optional references)</p> <p>TS 04981 TS 04986 TS 04987</p>

6.5 Configuration management – EMCA5

This requirement demonstrates engineering management activities and arrangements that ensure the integrity of network product or service being delivered and that all changes to assets over the system life cycle are managed across a defined set of baselines, including all related information and records.

Mandatory, as applicable or guidance	Requirement, elaboration, evidence or documents
Mandatory	<p>Requirement – CFM1</p> <p>A TAO shall have a documented system that describes the management of the configuration of all proposed or existing configuration items under its control as relevant to the scope of the authorised engineering service.</p>
	<p>Elaboration</p> <p>A TAO shall have and apply arrangements that demonstrate a systematic and comprehensive approach to the management of configuration items by their organisation irrespective of any requirements expected by the client.</p> <p>The intent is that the TAO have its own arrangements to plan, identify and control configuration items, typically its deliverables or the assets it is managing. This is to provide confidence that the approved state of the assets or deliverables is known at any point in time, and that appropriate evaluation and approval processes are in place to support any change. Having arrangements of configuration management is also to provide client with confidence that the deliverables provided by a TAO are as expected, understood and properly documented through the TAO's own configuration management processes before it reaches the client.</p> <p>A TAO's configuration management arrangements should be consistent with international or other industry standards for configuration management.</p>
	<p>Evidence</p> <p>Some evidence provided can overlap with that provided to meet other TAO requirements. Evidence provided may include the following:</p> <ul style="list-style-type: none"> • documented processes, typically as part of routine activities that show ongoing control of configuration items • records that demonstrate traceability of change decisions and the state of configuration items • registers or other records of the configuration items that are being controlled • records of change control including the evaluation of changes prior to approval and implementation • processes and records of audits or other activities that assure deliverables are as expected and properly documented.

Mandatory, as applicable or guidance	Requirement, elaboration, evidence or documents
	Documents (optional references) AS ISO 10007 TS 01454

6.6 Competence management – EMCA6

These requirements demonstrate engineering management activities and arrangements that ensure that only engineering staff with the appropriate knowledge, skills and behaviours are engaged to perform activities defined for a specific job role or function, within a specific engineering service area or discipline.

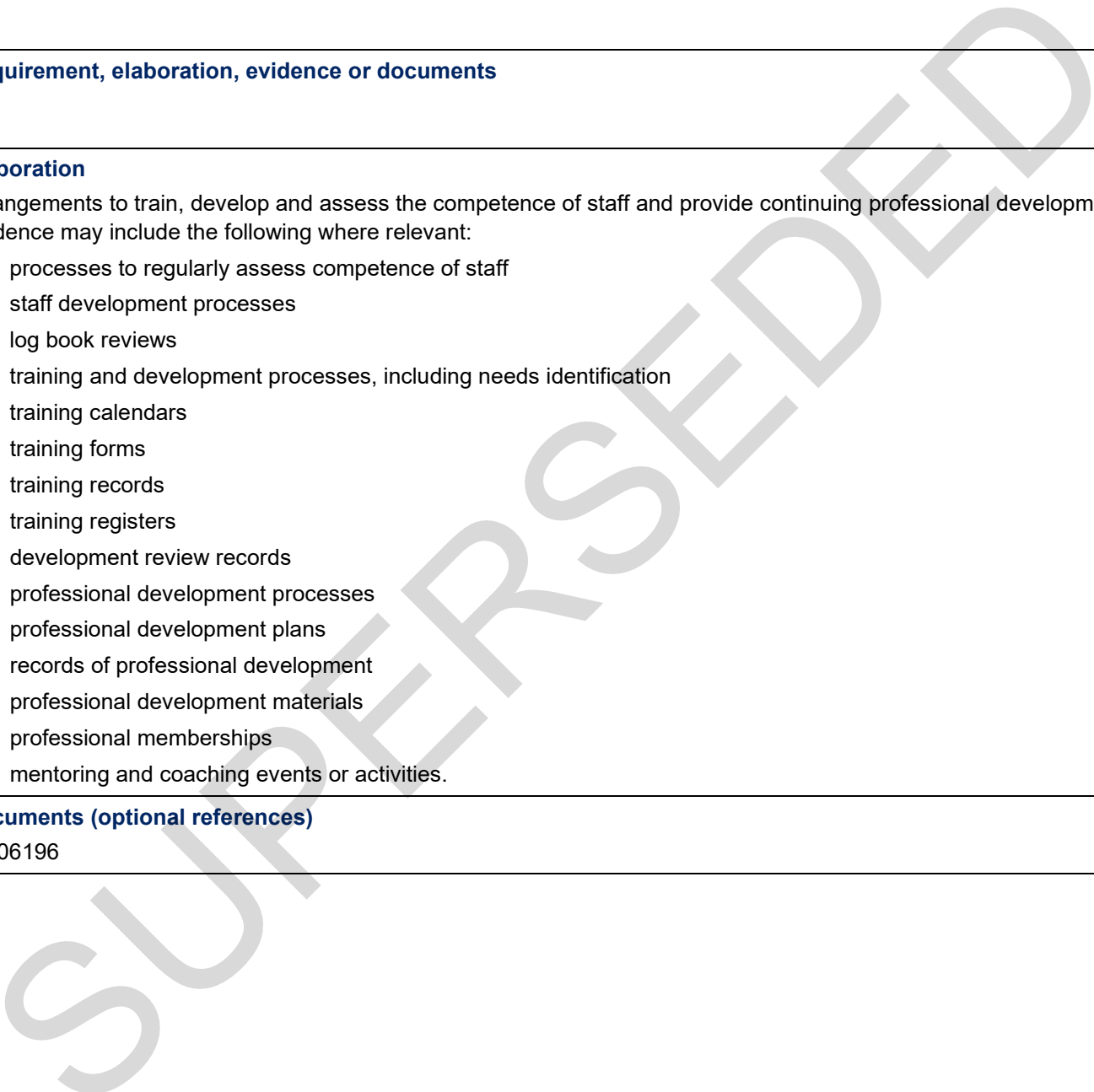
Mandatory, as applicable or guidance	Requirement, elaboration, evidence or documents
Mandatory	Requirement – CPM1 A TAO shall have comprehensive arrangements and systems for managing the competence of its staff, contractors, sub-contractors and other third party suppliers, relevant to the engineering services provided.

Mandatory, as applicable or guidance	Requirement, elaboration, evidence or documents
	<p>Elaboration</p> <p>A system for managing competence may consist of the following:</p> <ul style="list-style-type: none"> • an unambiguous series of documented arrangements of the organisation’s roles, plans, processes, tools and records in relation to managing competence • a recruitment process that clearly outlines how the organisation employs people that have the necessary knowledge, skills and attitudes to competently and safely discharge their duties in providing engineering services • recruitment records • existing job descriptions containing roles, functions and capabilities • a process for assuring competence of individuals from all external parties delivering engineering services, including contractors, sub-contractors and suppliers including any due diligence for assuring the competence of individuals from engaged TAOs • defined skills and proficiency levels relevant to the tasks and activities used in the provision of engineering services to TfNSW • minimum acceptable competence requirements for positions carrying out key roles identified in the organisation • processes for the maintenance and storage of records • competence assessment records • management of expiry of competences and assessments • periodical review or audit of competency management records.
	<p>Documents (optional references)</p> <p>TS 06196</p>



Mandatory, as applicable or guidance	Requirement, elaboration, evidence or documents
Mandatory	<p>Requirement – CPM2</p> <p>A TAO shall define the competence requirements that are relevant to the tasks and activities used in the provision of engineering services to TfNSW. These competence requirements shall include TAO relevant external qualification standards to benchmark the skills to be assessed. The TAO shall maintain evidence that relevant industry competence requirements, including TfNSW Standards, have been analysed and interpreted for the appropriate engineering services offered.</p>
	<p>Elaboration</p> <p>Defining of competence requirements and benchmarking of skills should consist of the following where relevant:</p> <ul style="list-style-type: none"> • defined skills and proficiency levels relevant to the tasks and activities used in the provision of engineering services to TfNSW • minimum acceptable competence requirements for positions carrying out key roles identified in the organisation • evidence of how technical assessments align with the industry and other standards • qualification or Australian Quality Training Framework (AQTF) reference in position descriptions • benchmark plans • references to international or Australian standards • references to TfNSW standards • professional memberships.
	<p>Documents (optional references)</p> <p>TS 06196</p>
Mandatory, as applicable or guidance	Requirement, elaboration, evidence or documents
Mandatory	<p>Requirement – CPM3</p> <p>A TAO shall have arrangements in place to train, develop and assess the competence of staff using established methods and competence standards, including establishing training and development needs for staff delivering engineering services. Continuing professional development activities shall be provided by the TAO to enhance the knowledge and skills of staff and the organisation as a whole.</p>

Mandatory, as applicable or guidance	Requirement, elaboration, evidence or documents
	<p>Elaboration</p> <p>Arrangements to train, develop and assess the competence of staff and provide continuing professional development should be demonstrated. Evidence may include the following where relevant:</p> <ul style="list-style-type: none"> • processes to regularly assess competence of staff • staff development processes • log book reviews • training and development processes, including needs identification • training calendars • training forms • training records • training registers • development review records • professional development processes • professional development plans • records of professional development • professional development materials • professional memberships • mentoring and coaching events or activities.
	<p>Documents (optional references)</p> <p>TS 06196</p>



Mandatory, as applicable or guidance	Requirement, elaboration, evidence or documents
Mandatory	<p>Requirement – CPM4</p> <p>A TAO shall establish and maintain a register of all engineering and other engineering-related services provided by staff and their competences.</p>
	<p>Elaboration</p> <p>The register shall document details of staff members who have been assessed as competent to carry out required functions or roles within the scope of engineering services.</p> <p>The register should contain the following information:</p> <ul style="list-style-type: none"> • names, roles and functions • proficiency levels and controls • assessment dates/expiry points.
	<p>Documents (optional references)</p> <p>TS 06196</p>

Mandatory, as applicable or guidance	Requirement, elaboration, evidence or documents
Mandatory	<p>Requirement – CPM5</p> <p>A TAO shall maintain the competence of those managers and assessors implementing the competence management system and ensure that the managers and assessors understand their responsibilities.</p>
	<p>Elaboration</p> <p>Arrangements for managing competence for those involved in the management and implementation of the competence management system shall be demonstrated. Evidence may include the following where relevant:</p> <ul style="list-style-type: none"> • defining competence management roles and responsibilities • assigning accountability to suitably qualified and experienced individuals • processes to outline the procedures for conducting competence assessments • qualification or proficiency levels required for SME's competence requirements for assessors and technical SME.

Mandatory, as applicable or guidance	Requirement, elaboration, evidence or documents
	Documents (optional references) TS 06196

Mandatory, as applicable or guidance	Requirement, elaboration, evidence or documents
Mandatory	Requirement – CPM6 A TAO shall demonstrate its knowledge management capability as suitable to the scope of services and the sharing of industry relevant lessons learnt within the organisation and with TfNSW.
	Elaboration The purpose of knowledge management practice is to enable the organisation to use and re-apply existing internal and external knowledge. This requirement also aligns with one of the AMB objectives to engage with industry to share lessons learnt and emerging best practice.
	Evidence A TAO should demonstrate its ability and arrangements for knowledge capture, storage and redeployment as appropriate for the scope of authorisation and organisational business model. Evidence may include the following: <ul style="list-style-type: none"> • plans to identify, obtain, retain and deploy knowledge, skills and knowledge assets • arrangements of quality management and control of relevant information and records • evidence of the knowledge sharing to have been occurring within the organisation and with TfNSW • capturing, storing, sharing and using lessons learnt.
	Documents (optional references) TS 06196

6.7 Stakeholder management – EMCA7

This requirement demonstrates engineering management activities and arrangements to establish and maintain stakeholder involvement for the work within the scope of authorisation.

Mandatory, as applicable or guidance	Requirement, elaboration, evidence or documents
Mandatory	<p>Requirement – ENM20 A TAO shall have arrangements in place to identify and manage internal and external stakeholders as appropriate to the scale and scope of engineering services being provided.</p>
	<p>Elaboration It is expected that TAOs be able to identify relevant internal and external stakeholders, establish appropriate levels of engagement and manage stakeholder involvement, communication and consultation as suitable for the engineering service being provided.</p>
	<p>Evidence Evidence of documentation and deployment shall be relevant and cover the proposed scope of authorisation. Stakeholder management regarding the impacted assets and the solution for whole-of-life considerations should be demonstrated. Evidence could include various organisational processes, plans that support stakeholder management, records of relevant activities such as meetings minutes, communications, stakeholder registers, stakeholder engagement tracking tools and records.</p>
	<p>Documents (optional references) TS 10504</p>

6.8 Resources management – EMCA8

This requirement demonstrates engineering management activities and arrangements that ensure that all tangible and non-tangible resources are in place to support the engineering service provision within the scope of authorisation.

<p>Mandatory, as applicable or guidance</p>	<p>Requirement, elaboration, evidence or documents</p>
<p>Mandatory</p>	<p>Requirement – ENM21 A TAO shall have arrangements in place to ensure the required tangible and non-tangible resources are available as necessary for the provision of the authorised scope of engineering services.</p>
	<p>Elaboration There may be a need for special facilities and resources for the service delivery, solution or product design, implementation, installation or maintenance. This may include the following:</p> <ul style="list-style-type: none"> • tools (for example, computer-aided design system or other specific tools) • methodologies (adequate life cycles or relevant engineering methodologies) • infrastructure (work site or equipment) • materials • standards. <p>Standards management ensures that TAOs are working to the latest approved versions of engineering standards relevant to engineering services provided. Human resources requirements are not included here, see Section 6.6.</p>
	<p>Evidence A TAO should demonstrate understanding of what kind of resources are required for the service it provides and demonstrate that those resources are available when necessary. TAOs shall demonstrate that they:</p> <ul style="list-style-type: none"> • have ready access to all relevant engineering standards • are notified of changes to those standards • brief their engineering staff on the changes to the standards and perform an impact assessment of the changes to determine whether to comply or seek a concession to the changes made to the standard. <p>Evidence may include the following:</p> <ul style="list-style-type: none"> • engineering intranet home page with links to standards • links to TfNSW standards • standards change briefing notes or emails

Mandatory, as applicable or guidance	Requirement, elaboration, evidence or documents
	<ul style="list-style-type: none"> standards change impact assessments.
	Documents (optional references) TS 10504

6.9 Supplier management – EMCA9

This requirement demonstrates engineering management activities and arrangements that enable management of acquisitions from internal and external suppliers as necessary for the scope of authorisation.

Mandatory, as applicable or guidance	Requirement, elaboration, evidence or documents
Mandatory	Requirement – ENM22 A TAO shall have arrangements in place, appropriate to the scope of services, to manage selection, evaluation and monitoring of internal or external suppliers and to assure selection and acquisition of required products and services.
	Elaboration Certain work products or services may be acquired to be used during the delivery of the authorised engineering services. These could be various sub-systems, intermediate work products, elements of the solution that are used in the final product or service delivery. Suppliers may also be used by a TAO for provision of some parts of the service. A TAO should be able to demonstrate its approach to the use of acquired products and services in its authorised engineering product creation or service delivery. This includes demonstrating its relevant acceptance and assurance arrangements and transitioning of the acquired products into its own product or service. A TAO shall be able to demonstrate its approach to sustainable and social procurement.

Mandatory, as applicable or guidance	Requirement, elaboration, evidence or documents
	Evidence A TAO shall demonstrate that it has a process for managing suppliers and associated risks including selection, evaluation and monitoring of supplier performance. Evidence of process execution covering the scope of authorisation (disciplines and life cycle phases) as suitable is also required.
	Documents (optional references) TS 10504

SUPERSEDED